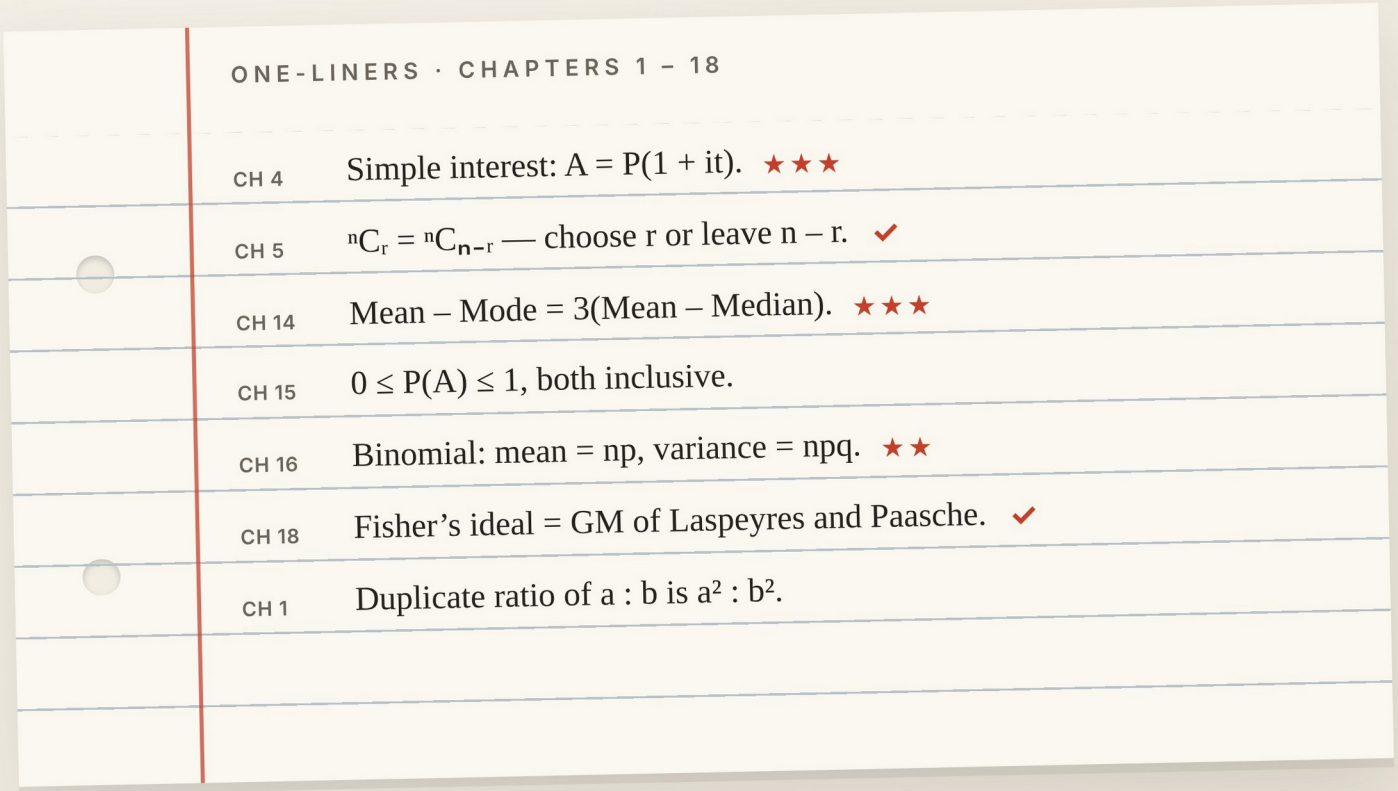
CA FOUNDATION · PAPER 3

Quantitative Aptitude

Scanner Revision Pointers

Every Scanner question connected to the **ICAI Study Material (July 2026)** — and the one line that answers it.



18 CHAPTERS

2,351 SCANNER QUESTIONS

936 ONE-LINERS

Shuchita Prakashan PVT. LTD.

Introductory Note

Quantitative Aptitude is examined entirely through multiple-choice questions, and nearly every question turns on one formula, one rule or one standard technique — the compound-interest formula, ${}^{n}C_{r}$ against ${}^{n}P_{r}$, the empirical relation between mean, median and mode, the turn rules of a direction test. ICAI sets the same formulas again and again, in past papers, RTPs and MTPs, with fresh numbers each time. This booklet is built on that observation. Every question in the Shuchita Scanner for CA Foundation Paper 3 has been traced to the passage, formula or illustration of the ICAI Study Material that answers it, and the formula or technique it turns on has been written down as a single line.

The result: **2351 Scanner questions** — past examination papers (including relevant old-course papers), RTPs and MTPs — reduced to **936 one-liners**, and those condensed further into **464 revision pointers**. Every one-liner follows the wording of the ICAI Study Material (July 2026). Where a Scanner key and the Study Material differ, the one-liner teaches the Study Material position.

How each chapter is arranged

Part A — One-liners mapped to Scanner questions and Study Material. Topic by topic, in Scanner order. Each row gives:

- **Ref** — the row's address: Topic.Row in single-unit chapters (5.2 is the second row of Topic 5) and Unit.Topic.Row where a chapter has several units (2.5.2 is Unit 2, Topic 5, second row);
- **One-liner** — the formula, rule or technique the question turns on, written as the Study Material states it;
- **Scanner Q** — the Scanner questions it answers (the paper and question number as printed in the Scanner — PYQ May 18 Q1 is question 1 of the May 2018 paper; '+' marks a question filed under another topic);
- **Asked in** — every examination, RTP and MTP in which ICAI set those questions;
- **SM source** — the Study Material section, illustration and page.

Part B — Revision Sheet. The same chapter compressed to short pointers, in Study Material order, each weighted by how often ICAI has asked it and linked back to its Part A row.

How to use this booklet

1. Work the chapter from the Study Material and the Scanner first; this booklet is for revision, not first learning.
2. Before a practice set, read the one-liners for its topic — most MCQs can be solved in under a minute once the right formula is in mind.
3. Revise from Part B. Where a pointer is not instantly clear, go to its Part A ref and re-attempt one of the Scanner questions listed against it.
4. In the final week, read only the ★★★ and ★★ lines of every chapter; for Logical Reasoning, re-solve one question from each technique row.

Conventions

PYQ May 18 Q1	The Scanner question by paper and number: question 1 of the May 2018 examination
T4 …	In '+' references, the topic under which that question is filed
PYQ	Previous-year question from an ICAI examination (month and year shown)
RTP / MTP	ICAI Revision Test Paper / Mock Test Paper (S1, S2 = series)
★★★ ★★ ★	Asked by ICAI 6 or more times · 3 – 5 times · once or twice
Not in SM	Examined but not covered in the Study Material unit; the one-liner follows the ICAI answer

The chapters at a glance

Ch	Chapter	Questions	One-liners	Pointers	★★★ share
1	Ratio and Proportion, Indices, Logarithms	126	47	29	42%
2	Equations	90	43	26	47%
3	Linear Inequalities	42	15	10	60%
4	Mathematics of Finance	302	89	46	74%
5	Permutations and Combinations	112	63	26	46%
6	Sequence and Series	88	39	20	60%
7	Sets, Relations and Functions, Limits and Continuity	89	40	19	72%
8	Differential and Integral Calculus	102	73	22	33%
9	Number Series, Coding and Decoding, Odd Man Out	126	42	26	52%
10	Direction Tests	110	22	17	71%
11	Seating Arrangements	102	26	19	69%
12	Blood Relations	118	26	18	87%
13	Statistical Description of Data and Sampling	156	70	33	51%
14	Measures of Central Tendency and Dispersion	269	119	48	68%
15	Probability	157	76	25	71%
16	Theoretical Distributions	121	40	23	74%
17	Correlation and Regression	124	59	30	59%
18	Index Numbers	117	47	27	56%
	Total	**2351**	**936**	**464**	

Prof. Arun Kumar
Editor-in-Chief, Shuchita Prakashan Pvt. Ltd.
October 2026

Index

Introductory Note 1

PART A — BUSINESS MATHEMATICS

Chapter 1 Ratio and Proportion, Indices, Logarithms 6
Topic 1 Ratio 6
Topic 2 Proportion 8
Topic 3 Indices 9
Topic 4 Logarithm 10
Part B — Revision Sheet 12

Chapter 2 Equations 14
Topic 1 Simple Equation 14
Topic 2 Simultaneous Linear Equations in Two Variables 15
Topic 3 Quadratic Equations 16
Topic 4 Cubic Equations 18
Part B — Revision Sheet 19

Chapter 3 Linear Inequalities 21
Topic 1 Linear Inequalities in one variable and the Solution space 21
Part B — Revision Sheet 23

Chapter 4 Mathematics of Finance 24
Topic 1 Simple Interest 24
Topic 2 Compound Interest 26
Topic 3 Depreciation 28
Topic 4 Difference Between Compound Interest and Simple Interest 29
Topic 5 Effective Rate of Interest 30
Topic 6 Future Value of Annuity 31
Topic 7 Present Value of Annuity 32
Topic 8 Perpetuity; Nominal Rate of Interest; Compounded Annual Growth Rate 33
Part B — Revision Sheet 36

Chapter 5 Permutations and Combinations 38
Topic 1 The Factorial 38
Topic 2 Permutation 38
Topic 3 Circular Permutations 40
Topic 4 Permutation with Restrictions 40
Topic 5 Combinations 41
Topic 6 Standard Results 43
Part B — Revision Sheet 45

Chapter 6 Sequence and Series 47
Topic 1 Arithmetic Progression 47
Topic 2 Geometric Progression 49
Topic 3 Special Series 51
Part B — Revision Sheet 52

Chapter 7 Sets, Relations and Functions, Limits and Continuity 53
Topic 1 Sets 53
Topic 2 Venn Diagrams 54
Topic 3 Product Sets 55
Topic 4 Relations and Functions 55
Topic 5 Domain & Range of a Function 56
Topic 6 Various Types of Functions 56
Topic 7 Concept of Limit 57
Topic 8 Useful Rules of Limits 57
Topic 9 Continuity 57
Part B — Revision Sheet 58

Chapter 8 Differential and Integral Calculus....59
Topic 1 Derivative or Differential Coefficient....59
Topic 2 Some Standard Results (Formulas)....59
Topic 3 Derivative of a Function of Function....60
Topic 4 Implicit Functions....60
Topic 5 Parametric Equation....61
Topic 6 Logarithmic Differentiation....61
Topic 7 Some More Examples....62
Topic 8 Geometric Interpretation of the Differentiation....62
Topic 9 Applications of Differential calculus in Economics....62
Topic 10 Integration Calculus....63
Topic 11 Basic Formulas....64
Topic 12 Method of Substitution (change of variable)....64
Topic 13 Method of Partial Fraction....65
Topic 14 Definite Integration....65
Topic 15 Important Properties....65
Part B — Revision Sheet....67

PART B — LOGICAL REASONING

Chapter 9 Number Series, Coding and Decoding, Odd Man Out....69
Topic 1 Number Series....69
Topic 2 Coding and Decoding....71
Topic 3 Odd man out....73
Part B — Revision Sheet....75

Chapter 10 Direction Tests....77
Topic 1 Introduction....77
Part B — Revision Sheet....81

Chapter 11 Seating Arrangements....82
Topic 1 Introduction....82
Part B — Revision Sheet....87

Chapter 12 Blood Relations....88
Topic 1 Introduction....88
Part B — Revision Sheet....93

PART C — STATISTICS

Chapter 13 Statistical Description of Data and Sampling....94
Unit 1: Statistical Description of Data....94
Topic 1 Introduction of Statistics....94
Topic 2 Collection of Data....94
Topic 3 Presentation of Data....96
Topic 4 Frequency Distribution....97
Topic 5 Graphical Representation of Frequency Distribution....99
Unit 2: Sampling....100
Topic 2 Basic Principles of Survey....100
Topic 3 Errors in Sampling....100
Topic 4 Some important terms associated with sampling....101
Topic 5 Types of Sampling....101
Part B — Revision Sheet....103

Chapter 14 Measures of Central Tendency and Dispersion....105
Topic 1 Arithmetic Mean....105
Topic 2 Geometric Mean....107
Topic 3 Harmonic Mean....108
Topic 4 Median, Quartile, Decile, Percentile....109
Topic 5 Mode....110
Topic 6 Range....112
Topic 7 Mean Deviation....112

Topic 8 Standard Deviation....114
Topic 9 Quartile Deviation....116
Part B — Revision Sheet....119

Chapter 15 Probability....122
Topic 1 Introduction....122
Topic 2 Random Experiment....122
Topic 3 Classical Definition of Probability....124
Topic 4 Statistical Definition of Probability....126
Topic 5 Operations on Events: Set Theoretic Approach to Probability....126
Topic 6 Axiomatic or Modern Definition of Probability....127
Topic 7 Addition Theorems....127
Topic 8 Conditional Probability and Compound Theorem of Probability....128
Topic 9 Random Variable-Probability Distribution....129
Topic 10 Expected Value of a Random Variable....130
Part B — Revision Sheet....131

Chapter 16 Theoretical Distributions....133
Topic 1 Introduction....133
Topic 2 Binomial Distribution....133
Topic 3 Poisson Distribution....135
Topic 4 Normal Distribution or Gaussian Distribution....136
Part B — Revision Sheet....139

Chapter 17 Correlation and Regression....141
Topic 1 Correlation Analysis....141
Topic 2 Measures of Correlation....142
Topic 3 Regression Analysis....144
Topic 4 Properties of Regression Lines....146
Topic 5 Review of Correlation and Regression Analysis....147
Part B — Revision Sheet....148

Chapter 18 Index Numbers....150
Topic 1 Introduction....150
Topic 2 Issues Involved....150
Topic 3 Construction of Index Number....151
Topic 4 Usefulness of Index Numbers....153
Topic 5 Deflating Times Series using Index Numbers....154
Topic 6 Shifting and Splicing of Index Numbers....154
Topic 7 Test of Adequacy....154
Part B — Revision Sheet....156

CHAPTER 1

Ratio and Proportion, Indices, Logarithms

126 Scanner questions · 47 one-liners · 29 revision pointers

Part A — One-liners mapped to Scanner questions and Study Material

Ratio and Proportion, Indices, Logarithms

SM Chapter 1, pages 1.1 – 1.45

Topic 1 Ratio

41 Scanner questions · ICAI appearances PYQ 31 · RTP 1 · MTP 9

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.1	Duplicate ratio of a : b = a^2 : b^2; sub-duplicate = √a : √b. Equate the given ratio to the squared (or square-rooted) one and cross-multiply: p : q sub-duplicate of $(p - x^2) : (q - x^2)$ ⇒ $p^2/q^2 = (p - x^2)/(q - x^2)$ ⇒ $x^2 = pq/(p + q)$; (3x − 2)/(5x + 6) duplicate of 2/3 ⇒ = 4/9 ⇒ x = 6. Trap: square the ratio, not the terms separately.	PYQ May 18 Q1, PYQ Nov 18 Q1	PYQ 2018-May, 2018-Nov	1.1.3 (properties 3–4), p. 1.4; Exercise 1(A) Q20–21, p. 1.7
1.2	Inverse ratio of a : b is b : a (their product is 1). Ratio 15 : 17 → inverse 17 : 15, so if its consequent is 15 the antecedent is 17.	PYQ Jan 21 Q4	PYQ 2021-Jan	1.1.3, p. 1.4; Exercise 1(A) Q3, p. 1.5
1.3	k-method: if a : b (: c) is given, put a = 3k, b = 7k … and substitute — k cancels in any expression of equal degree: a : b = 3 : 7 ⇒ (3a + 2b) : (4a + 5b) = 23k : 47k = 23 : 47; x : y : z = 7 : 4 : 11 ⇒ (x + y + z)/z = 22k/11k = 2; a : b = 9 : 4 ⇒ √(a/b) + √(b/a) = 3/2 + 2/3 = 13/6.	PYQ Nov 18 Q3, PYQ Nov 20 Q1, PYQ Nov 20 Q4	PYQ 2018-Nov, 2020-Nov (×2)	Exercise 1(A) Q12, Q19, Q22, pp. 1.6 – 1.7; Exercise 1(B) Q14, Q29, pp. 1.13 – 1.14
1.4	Two quantities in a : b are ak and bk; one extra fact fixes k: difference 9k − 7k = 1,600 ⇒ moped = 9k = ₹7,200; $16k^2 - 9k^2 = 28$ ⇒ k = 2, greater = 8; 12k × 13k = 7,644 ⇒ k = 7, smaller = 84; ages 7k − 5k = 8 ⇒ 20 and 28, after 4 years 32 : 24 = 4 : 3 (elder first).	PYQ Nov 19 Q1, PYQ Nov 19 Q2, PYQ Jan 25 Q26, PYQ May 26 Q56	PYQ 2019-Nov (×2), 2025-Jan, 2026-May	1.1, p. 1.2; Exercise 1(A) Q17, p. 1.6
1.5	Same number added to (or subtracted from) each term: (a + x)/(b + x) = new ratio, cross-multiply. (7k + 7)/(11k + 7) = 2/3 ⇒ k = 7 → 49, 77; (15 + x)/(32 + x) = 2/3 ⇒ x = 19; (49 + x)/(68 + x) = 3/4 ⇒ x = 8; (3k + 2)/(2k + 5) = 1 ⇒ k = 3, females 6; (2k + 4,000)/(3k + 4,000) = 40/57 ⇒ k = 11,333.33, Suneet 3k = ₹34,000; incentives (3k + 4,000)/(4k + 4,000) = 5/6 ⇒ k = 2,000, B's variable 4k = ₹8,000. Trap: adding equal amounts changes the ratio.	PYQ Jun 19 Q1, PYQ Nov 20 Q5, PYQ Dec 21 Q7, PYQ Jan 25 Q34, MTP Apr 26 S1 Q12, MTP Apr 26 S2 Q1	PYQ 2019-Jun, 2020-Nov, 2021-Dec, 2025-Jan; MTP 2026-Apr S1, 2026-Apr S2	1.1, Example 2, p. 1.3; Exercise 1(A) Q13, Q23, pp. 1.6 – 1.7
1.6	Ages at two different times: (A − 1)/(B − 1) = 5/4 and (A + 4)/(B + 4) = 6/5 ⇒ A = 26, B = 21. Trap: the question asks for A's age 10 years from now = 36, not the present age.	PYQ Jan 26 Q52	PYQ 2026-Jan	1.2, p. 1.8 (ages in a given ratio); Exercise 1(B) Q17, p. 1.13

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.7	Income − Expenditure = Savings. Incomes ak, bk; if each saves S then (ak − S) : (bk − S) = expenditure ratio: 5 : 4, 3 : 2, S = ₹1,600 ⇒ k = 800, A = ₹4,000; 7 : 9, 3 : 4, S = ₹2,000 ⇒ k = 2,000, incomes ₹14,000 and ₹18,000. With expenditures 4y, 5y and 9y = 7x (total expenditure = R's income), savings (7x − 4y) : (9x − 5y) = 35 : 46.	PYQ Dec 21 Q2, PYQ Sep 24 Q32, PYQ Sep 26 Q75	PYQ 2021-Dec, 2024-Sep, 2026-Sep	1.1.3, Example 1, p. 1.4; Exercise 1(A) Q24, p. 1.7
1.8	Change each term by its own factor: salaries 2 : 3 : 5 raised 15%, 10%, 20% → 2 × 1.15 : 3 × 1.10 : 5 × 1.20 = 23 : 33 : 60; prices 16k, 23k → (1.1 × 16k)/(23k + 477) = 11/20 ⇒ 352k = 253k + 5,247 ⇒ k = 53, prices ₹848, ₹1,219.	PYQ Jul 21 Q1, MTP Jan 25 S2 Q1, RTP Jan 25 Q1	PYQ 2021-Jul; RTP 2025-Jan; MTP 2025-Jan S2	1.1.3, Example 2 (houses 16 : 23), p. 1.5; 1.1 (factor multiplying ratio), p. 1.3
1.9	Combining ratios into a continued ratio: make the common term equal by its LCM. A : B = 5 : 3, B : C = 6 : 7, C : D = 14 : 9 ⇒ 20 : 12 : 14 : 9; P : Q = 11 : 12 and P : R = 9 : 8 ⇒ P = 99 gives Q : R = 108 : 88 = 27 : 22; x : y = 4 : 6, z : x = 4 : 16 ⇒ y : x : z = 6 : 4 : 1.	PYQ Jul 21 Q2, PYQ Jun 22 Q4, MTP Jun 24 S3 Q1	PYQ 2021-Jul, 2022-Jun; MTP 2024-Jun S3	1.1.3 (property 6, continued ratio), p. 1.4; Exercise 1(A) Q18, p. 1.6; Exercise 1(B) Q13, Q15, p. 1.13
1.10	*See Topic 2: 'A : B in the same ratio as B : C' means B is the mean proportional, $B^2 = AC \Rightarrow B = \sqrt{(1,600 \times 2,500)} = ₹2,000$.*	PYQ Jan 21 Q3	PYQ 2021-Jan	1.2, p. 1.9
1.11	Equal multiples: 3A = 6S = 8N ⇒ A : S : N = 1/3 : 1/6 : 1/8 = 8 : 4 : 3 (× LCM 24); Anil = 3,600 × 8/15 = ₹1,920. Trap: shares are in the inverse ratio of the multipliers.	PYQ Jan 25 Q25	PYQ 2025-Jan	1.1.3 (inverse ratio), p. 1.4; Example 1 (1/3 : 1/8 : 1/6 = 8 : 3 : 4), p. 1.3
1.12	Coins: the ratio is of the NUMBER of coins; value = Σ number × face value. 50 p : 25 p = 4 : 3 of 105 coins → 60 and 45 → ₹30 + ₹11.25 = ₹41.25; 25 p, 10 p, 5 p in 3 : 2 : 1 → 0.75x + 0.2x + 0.05x = 40 ⇒ 40 five-paise coins; ₹1 : ₹2 = 3 : 2 in 23 coins worth ₹43 → 3k + 4k + 5(23 − 5k) = 43 ⇒ k = 4, twelve ₹1 coins.	PYQ Dec 21 Q3, PYQ Jun 22 Q3, MTP Aug 24 S2 Q1	PYQ 2021-Dec, 2022-Jun; MTP 2024-Aug S2	1.1, p. 1.1 (division in a given ratio; coin case not worked in SM)
1.13	Partnership: profit-sharing ratio = capital × months invested. 1,40,000 × 36 : 2,10,000 × 30 : 2,80,000 × 24 = 12 : 15 : 16; 1,68,000 × 12 : 1,12,000 × (12 − m) = 2 : 1 ⇒ m = 3 months. Trap: count months from the date of joining to the end of the period.	PYQ May 25 Q1, PYQ Sep 25 Q2	PYQ 2025-May, 2025-Sep	Additional Question Bank Q98, Q105 – 106, p. 1.44
1.14	Mixture with replacement: removing some solution takes out each component in its existing ratio; then only water is added. Acid = 0.36(V − 4) and 0.36(V − 4)/V = 0.30 ⇒ V = 24 litres.	PYQ Jul 21 Q3	PYQ 2021-Jul	Not in SM (PYQ-only)
1.15	Provisions = men × days (inverse proportion): food left = 400 × (31 − 28) = 1,200 man-days; 120 men remain ⇒ 1,200/120 = 10 days.	PYQ Dec 22 Q5	PYQ 2022-Dec	Not in SM (PYQ-only)

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.16	Not ratio questions — linear equations: 4T + 3C = 2,250 and 3T + 4C = 1,950 ⇒ T + C = 600, T − C = 300 ⇒ T + 2C = ₹750; Roy x, Paul x − 4, Singh x − 5, 3x − 9 = 51 ⇒ ₹20, ₹16, ₹15; 1/a + 1/b = (a + b)/ab = 62/960 = 31/480; d/s − d/(s + ½) = 1 and d/(s − 1) − d/s = 3 ⇒ 36 km at 4 km/h (check the options).	MTP Aug 24 S2 Q8, MTP Aug 24 S2 Q10, MTP Jan 25 S2 Q6, MTP Jan 25 S2 Q7	MTP 2024-Aug S2 (×2), 2025-Jan S2 (×2)	Not in SM (MTP-only) — linear equations, SM Chapter 2
1.17	*See Topic 3: $(x^b/x^c)^{(b+c-a)} \times (x^c/x^a)^{(c+a-b)} \times (x^a/x^b)^{(a+b-c)}$ — the exponents add to zero, so the value is $x^0 = 1$.*	PYQ Jan 26 Q53	PYQ 2026-Jan	Exercise 1(C) Q26, p. 1.22; Additional Question Bank Q14, p. 1.36
1.18	*See Topic 4: $\sqrt{(a\sqrt{(a\sqrt{(a\sqrt{a})})}} = a^{(15/16)}$; $\log_{\sqrt{a}} a^{(15/16)} = (15/16) \div (1/2) = 15/8$.*	PYQ Sep 25 Q3	PYQ 2025-Sep	1.4.1 (law 3), p. 1.25; 1.4.2, p. 1.26

Topic 2 Proportion

11 Scanner questions · ICAI appearances PYQ 7 · RTP 1 · MTP 3

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.1	Mean proportional between a and c: $b^2 = ac$, $b = \sqrt{(ac)}$. $\sqrt{(24 \times 54)} = \sqrt{1,296} = 36$; $\sqrt{(12x^2 \times 27y^2)} = \sqrt{(324x^2y^2)} = 18xy$.	PYQ May 18 Q3, PYQ Sep 24 Q33	PYQ 2018-May, 2024-Sep	1.2, p. 1.9; Example 5, p. 1.10; Exercise 1(B) Q3, Q7, p. 1.12
2.2	Third proportional to a and b: $a : b = b : c \Rightarrow c = b^2/a$. $21^2/49 = 9$; $(a + b)^4/(a^2 - b^2) = (a + b)^3/(a - b)$.	MTP Jun 24 S3 Q2, MTP Jan 25 S2 Q3	MTP 2024-Jun S3, 2025-Jan S2	1.2, Example 4, p. 1.9; Exercise 1(B) Q2, p. 1.12
2.3	Four numbers in proportion $a : b = c : d \Rightarrow ad = bc$ (product of extremes = product of means): $(1/4)(1/x) = (1/6)(1/10) \Rightarrow x = 15$; $(1/2)(1/x) = (1/3)(1/5) \Rightarrow x = 15/2$. Trap: the extremes are the 1st and 4th terms.	PYQ Jun 24 Q3, RTP Sep 24 Q1	PYQ 2024-Jun; RTP 2024-Sep	1.2 (cross product rule), pp. 1.8 – 1.9; Exercise 1(B) Q6, p. 1.12
2.4	Division in a continued ratio: A : B : C : D = 5 : 2 : 4 : 3, C − D = k = ₹1,000 ⇒ B = 2k = ₹2,000; A : B = 2 : 3 and B : C = 5 : 8 ⇒ 10 : 15 : 24, B = 98 × 15/49 = 30.	PYQ Dec 22 Q3, PYQ May 25 Q2	PYQ 2022-Dec, 2025-May	1.1.3 (continued ratio), p. 1.4; Exercise 1(B) Q13, Q16, p. 1.13
2.5	k-method with a : b = 3 : 4 (a = 3k, b = 4k): (2a + 3b) : (3a + 4b) = 18k : 25k = 18 : 25; (2a + 3b)/(3a + 2b) = 18k/17k = 18/17.	MTP Jan 25 S2 Q2, PYQ May 26 Q55	PYQ 2026-May; MTP 2025-Jan S2	Exercise 1(A) Q12, p. 1.6
2.6	Componendo and dividendo: $a/b = c/d \Rightarrow (a + b)/(a - b) = (c + d)/(c - d)$. With $x/2 = y/3 = z/4 = k$: $(y + 3)/(y - 3) = (k + 1)/(k - 1) = (z + 4)/(z - 4)$, so option (b) holds; (a) and (c) give reciprocals.	PYQ Sep 26 Q77	PYQ 2026-Sep	1.2.1 (property 6), p. 1.10; Exercise 1(B) Q28, p. 1.14

Topic 3 Indices

36 Scanner questions · ICAI appearances PYQ 29 · RTP – · MTP 7

Ref	One-liner for the student	Scanner Q	Asked in	SM source
3.1	Laws of indices on monomials: $a^m \times a^n = a^{m+n}$, $a^m \div a^n = a^{m-n}$, $(a^m)^n = a^{mn}$, $(ab)^n = a^n b^n$. $(2a^3b^4)^6 \div [(4a^3b)^2 \times a^2b^2] = 64a^{18}b^{24} \div 16a^8b^4 = 4a^{10}b^{20}$; $5a^5b^2 \times 3(ab^3)^2 \div 15a^2b = a^5b^7$; $3t^{-1} \div t^{(-1/3)} = 3/t^{(2/3)}$; $\sqrt[4]{(a^{(6b)}x^4)} \cdot \sqrt{((a^3x^{-4})^{(-b)})} = a^{(3b/2)}x \cdot a^{(-3b/2)}x^{(2b)} = x^{(1+2b)}$.	PYQ Jan 21 Q1, PYQ Dec 22 Q4, PYQ Jan 25 Q33, PYQ May 26 Q54	PYQ 2021-Jan, 2022-Dec, 2025-Jan, 2026-May	1.3, Laws 1–4, pp. 1.16 – 1.19; Example 6, p. 1.19
3.2	Take the lowest power out as a common factor: $(2^n + 2^{n-1})/(2^{n+1} - 2^n) = 2^n(1 + ½)/2^n(2 - 1) = 3/2$; $(6^{n+4} + 3^{n+3} \cdot 2^{n+3})/(5 \cdot 6^n + 6^n) = 6^n(1{,}296 + 216)/(6 \cdot 6^n) = 252$ (n cancels — putting n = 1 gives the same answer).	PYQ May 18 Q5, PYQ Dec 21 Q6	PYQ 2018-May, 2021-Dec	1.3, Laws 1–2, pp. 1.16 – 1.17
3.3	Break every base into primes and compare the index of each prime: $2^{(m+1)}3^{(2m-n+3)}5^{(n+m+4)}6^{(2n+m)} \div 6^{(2m+n)}10^{(n+1)}15^{(m+3)} = 1$; $6^{12} \cdot 35^{28} \cdot 15^{16} \div 14^{12} \cdot 21^{11} = 3^{17} \cdot 5^{44} \cdot 7^5 \rightarrow 17 + 44 + 5 = 66$ prime factors; $[9^{(n+¼)} \cdot \sqrt{(3 \cdot 3^n)/(3 \cdot \sqrt{3^{-n}})}]^{(1/n)} = (3^{3n})^{(1/n)} = 27$; $243^{0.2} \div 7^{(0.25+0.15+0.6)} = 3/7$; $(18/27)^{3.5} \times 6^{3.5} = 4^{3.5} = 2^7 \Rightarrow x = 7$; $720 = 2^4 \cdot 3^2 \cdot 5 \Rightarrow 4, 2, 1$.	PYQ Nov 18 Q2, PYQ Nov 19 Q4, MTP Aug 24 S2 Q3, MTP Aug 24 S2 Q4, MTP Aug 24 S2 Q5, MTP Apr 26 S1 Q8	PYQ 2018-Nov, 2019-Nov; MTP 2024-Aug S2 (×3), 2026-Apr S1	1.3, Laws 3–4, pp. 1.18 – 1.19; Additional Question Bank Q1, Q3, p. 1.35
3.4	If $a^x = a^y$ then x = y: bring both sides to one base and equate powers. $(\sqrt{9})^{-5}(\sqrt{3})^{-7} = (\sqrt{3})^{-10-7} \Rightarrow a = 17$; $(\sqrt{3})^{18} = (\sqrt{9})^x \Rightarrow 3^9 = 3^x \Rightarrow x = 9$; $9^n \cdot 3^5 \cdot 27^5 \div 3 \cdot 81^4 = 3^{(2n+3)} = 27 \Rightarrow n = 0$; $4^3 \cdot \sqrt{(2^n)} = 2^n \Rightarrow 6 + n/2 = n \Rightarrow n = 12$; $(x/y)^{(a^2+4)} = (x^{-1}y)^{(-5a)} = (x/y)^{(5a)} \Rightarrow a^2 - 5a + 4 = 0 \Rightarrow 4, 1$. Trap: $(3a/2b)^{(2x-4)} = (2b/3a)^{(2x-4)}$ needs a zero index (reciprocal bases), so x = 2.	PYQ Nov 20 Q6, PYQ Dec 21 Q8, PYQ Jun 22 Q5, PYQ Dec 23 Q1, PYQ Jan 25 Q27, MTP Apr 26 S1 Q1	PYQ 2020-Nov, 2021-Dec, 2022-Jun, 2023-Dec, 2025-Jan; MTP 2026-Apr S1	1.3, Summary (if $a^x = a^y$ then x = y), p. 1.20; Example 8, p. 1.20
3.5	Cyclic indices collapse to $x^0 = 1$: $(x^b/x^c)^{(b+c-a)} \times (x^c/x^a)^{(c+a-b)} \times (x^a/x^b)^{(a+b-c)}$ has total index $\Sigma(b - c)(b + c - a) = 0$; $1/(1 + z^{(a-b)} + z^{(a-c)}) + 1/(1 + z^{(b-c)} + z^{(b-a)}) + 1/(1 + z^{(c-a)} + z^{(c-b)}) = 1$ (multiply each term by $z^{(-a)}$, $z^{(-b)}$, $z^{(-c)}$).	MTP Aug 24 S2 Q2, PYQ Sep 24 Q29	PYQ 2024-Sep; MTP 2024-Aug S2	Exercise 1(C) Q25 – 26, p. 1.22; Additional Question Bank Q14, Q19, pp. 1.36 – 1.37
3.6	$a^x = b^y = c^z = k$: write $a = k^{(1/x)}$, $b = k^{(1/y)}$, $c = k^{(1/z)}$ and use the relation between the bases. $4^x = 5^y = 20^z$, $20 = 4 \times 5 \Rightarrow 1/z = 1/x + 1/y \Rightarrow z = xy/(x + y)$; $2^{(x^2)} = 3^{(y^2)} = 12^{(z^2)}$, $12 = 2^2 \times 3 \Rightarrow 1/z^2 = 2/x^2 + 1/y^2$; $3^X = (10/3)^Y = 10^Z$, $10 = 3 \times 10/3 \Rightarrow 1/X + 1/Y - 1/Z = 0$; $2^x = 4^y = 8^z \Rightarrow x = 2y = 3z$, so $1/2x + 1/4y + 1/6z = 3/6z = 24/7 \Rightarrow z = 7/48$; $x = y^a$, $y = z^b$, $z = x^c \Rightarrow x = x^{(abc)} \Rightarrow abc = 1$.	PYQ Jun 19 Q2, PYQ Jun 23 Q4, PYQ Jun 24 Q2, PYQ May 25 Q4, PYQ Sep 26 Q78	PYQ 2019-Jun, 2023-Jun, 2024-Jun, 2025-May, 2026-Sep	Exercise 1(C) Q28, Q30, p. 1.23; Additional Question Bank Q33, Q35 – 36, p. 1.38
3.7	Cube identity: $P = x^{(1/3)} + x^{(-1/3)} \Rightarrow P^3 = x + x^{-1} + 3P \Rightarrow P^3 - 3P = x + 1/x$; if $\sqrt[3]{a} + \sqrt[3]{b} + \sqrt[3]{c} = 0$ then $(\sqrt[3]{a})^3 + (\sqrt[3]{b})^3 + (\sqrt[3]{c})^3 = 3\sqrt[3]{(abc)}$, so $a + b + c = 3\sqrt[3]{(abc)}$ and $((a + b + c)/3)^3 = abc$.	PYQ Jun 19 Q5, PYQ Jun 23 Q1	PYQ 2019-Jun, 2023-Jun	Exercise 1(C) Q24, Q27, p. 1.22; Additional Question Bank Q23, Q43, pp. 1.37, 1.39

Ref	One-liner for the student	Scanner Q	Asked in	SM source
3.8	Surds: rationalise with the conjugate. $(\sqrt{5}+\sqrt{3})/(\sqrt{5}-\sqrt{3}) = 4+\sqrt{15}$ and its reciprocal $4-\sqrt{15}$ — sum 8, product 1 ⇒ $a^2+b^2 = 8^2-2 = 62$, and $1/x^2+1/y^2 = x^2+y^2 = 62$; $x = 3+\sqrt{8} \Rightarrow 1/x = 3-\sqrt{8} \Rightarrow x+1/x = 6$; $x = \sqrt{2}+1/\sqrt{2}$, $y = \sqrt{2}-1/\sqrt{2} \Rightarrow x^2+y^2 = 4.5+0.5 = 5$; $x = \sqrt{3}+1/\sqrt{3}$: $x-\sqrt{126}/\sqrt{42} = 1/\sqrt{3}$ and $x-1/(x-2\sqrt{3}/3) = 5/(2\sqrt{3}) \Rightarrow$ product 5/6.	PYQ Nov 19 Q5, PYQ Dec 21 Q1, PYQ Dec 23 Q2, PYQ Jan 25 Q24, PYQ May 26 Q58	PYQ 2019-Nov, 2021-Dec, 2023-Dec, 2025-Jan, 2026-May	Additional Question Bank Q45, Q48, Q56 – 58, pp. 1.39 – 1.40
3.9	Fractional index: a^(1/m) = $\sqrt[m]{a}$. $1-\sqrt[3]{0.027}\times(5/6)\times(1/2)^2 = 1-0.3\times5/24 = 1-1/16 = 15/16$.	PYQ Dec 21 Q9	PYQ 2021-Dec	1.3, Summary ($\sqrt[m]{a} = a^{(1/m)}$), p. 1.20; Exercise 1(C) Q5, p. 1.21
3.10	Conditional sum: $xy+yz+zx = -1 \Rightarrow 1+xy = -z(x+y)$, so $(x+y)/(1+xy) = -1/z$; the sum $= -(1/x+1/y+1/z) = -(xy+yz+zx)/xyz = 1/xyz$.	PYQ Jul 21 Q4	PYQ 2021-Jul	Not in SM (PYQ-only)
3.11	*See Topic 4: a^(log^{a}x) = x, so b^(5 log_b x) = x^5; $3x\times x^5 = 192 \Rightarrow x^6 = 64 \Rightarrow x = 2$.*	PYQ Jan 26 Q49	PYQ 2026-Jan	1.4, Summary ($a^{\log_a x} = x$), p. 1.32
3.12	Perfect square (algebra, not indices): $4x^2+4x+1 = (2x+1)^2$, so add 1.	MTP Jan 25 S2 Q5	MTP 2025-Jan S2	Not in SM (MTP-only)

Topic 4 Logarithm

38 Scanner questions · ICAI appearances PYQ 27 · RTP 1 · MTP 10

Ref	One-liner for the student	Scanner Q	Asked in	SM source
4.1	Definition: $\log_a n = x \Leftrightarrow a^x = n$ ($a>0$, $a\neq1$, $n>0$) — convert to index form. $\log_a\sqrt{3} = 1/6 \Rightarrow a = (\sqrt{3})^6 = 27$; log_√3 a = 6 ⇒ a = $(\sqrt{3})^6 = 27$; $\log_4 x = -3/2 \Rightarrow x = 4^{(-3/2)} = 1/8$; $\log_{0.1}0.001 = 3$; $\log_{0.01}10{,}000 = 4/(-2) = -2$; $\log_x4+\log_x16+\log_x64 = \log_x4{,}096 = 12 \Rightarrow x = 2$.	PYQ Nov 19 Q3, PYQ Nov 20 Q2, PYQ Jun 22 Q2, MTP Jun 24 S3 Q23, MTP Jun 24 S3 Q24, PYQ Sep 25 Q1	PYQ 2019-Nov, 2020-Nov, 2022-Jun, 2025-Sep; MTP 2024-Jun S3 (×2)	1.4, pp. 1.23 – 1.24 (Illustration 1, $\log_a\sqrt{2} = 1/6$), p. 1.24; Exercise 1(D) Q5, p. 1.33
4.2	Nested logs: evaluate from the innermost bracket outwards, using $\log_a a = 1$. $\log_2\log_2\log_2 16 = \log_2\log_2 4 = \log_2 2 = 1$; $\log_6(3\log_{10}100) = \log_6 6 = 1$; $\log_2\log_2\log_4256 + 2$ log_√2 $2 = \log_2 2+2\times2 = 5$.	PYQ Nov 18 Q4, PYQ Jun 23 Q3, PYQ Sep 24 Q34	PYQ 2018-Nov, 2023-Jun, 2024-Sep	1.4, Remarks 2–3, p. 1.24; Exercise 1(D) Q12, p. 1.33
4.3	Laws: $\log_a mn = \log_a m+\log_a n$; $\log_a(m/n) = \log_a m-\log_a n$; $\log_a m^n = n\log_a m$. log 9 + log 5 = log 45; $\log(p^2/qr)+\log(q^2/pr)+\log(r^2/pq) = \log1 = 0$; $\log(a^2/bc)-\log(ca/b^2)+\log(c^2/ab) = \log1 = 0$; ½ log 25 − 2 log 3 + log 18 = log(5 × 18/9) = 1; $\log_5(6/5\times7/6\times\ldots\times625/624) = \log_5125 = 3$; log x + 2 log x^2 + 3 log x^3 = 14 log x = 14 ⇒ log x^6 = 6.	PYQ Jun 19 Q3, PYQ Nov 20 Q3, PYQ Dec 21 Q5, PYQ Jun 22 Q1, MTP Aug 24 S2 Q6, MTP Apr 26 S2 Q3	PYQ 2019-Jun, 2020-Nov, 2021-Dec, 2022-Jun; MTP 2024-Aug S2, 2026-Apr S2	1.4.1 (laws 1–3), pp. 1.24 – 1.25; Illustration II 1(b), p. 1.26
4.4	Write the number as a product of 2, 3 and 10, with $\log_{10}10 = 1$: log 120 = log 3 + log 4 + 1 = x + y + 1; log 60 = log 2 + log 3 + 1 = x + y + 1; log 15 = log 3 + log 10 − log 2 = x − y + 1 (trap: here log 2 = y); $\log(100x/y^2) = 2+(m+n-1)-2(m-n) = 1-m+3n$.	PYQ Dec 21 Q4, PYQ Dec 22 Q1, PYQ Jun 23 Q2, MTP Jan 25 S2 Q4	PYQ 2021-Dec, 2022-Dec, 2023-Jun; MTP 2025-Jan S2	1.4.1, pp. 1.24 – 1.25; Example 1 (log 5 = 1 − log 2), p. 1.29; Exercise 1(D) Q17, Q19, p. 1.33

Ref	One-liner for the student	Scanner Q	Asked in	SM source
4.5	Change of base: $\log_b m = \log_a m/\log_a b$, so chains collapse: $\log_b a \times \log_c b = \log_c a$. $\log_3 4 \cdot \log_4 5 \cdot \ldots \cdot \log_8 9 = \log_3 9 = 2$; $\log_a b = 3$, $\log_b c = 2 \Rightarrow \log_a c = 6$; $\log_4 9 \cdot \log_3 2 = (2 \log 3/2 \log 2)(\log 2/\log 3) = 1$; a^($\log_a b \cdot \log_{bc} \cdot \log_{cd} \cdot \log_{dt}$) = a^($\log_a t$) = t; $(\log_3 16 \times \log_{\sqrt{2}} 3) \div (\log_8 3 \times \log_9 4) = 8 \div (1/3) = 24$.	PYQ May 18 Q2, PYQ May 18 Q4, PYQ Dec 22 Q2, PYQ Jun 24 Q1, PYQ May 26 Q57	PYQ 2018-May (×2), 2022-Dec, 2024-Jun, 2026-May	1.4.2, p. 1.26; Summary, p. 1.32; Additional Question Bank Q86, p. 1.42
4.6	Base or number as a power: $\log_{(a^n)} b^m = (m/n) \log_a b$. $\log_4 x + \log_{16} x + \log_{64} x + \log_{256} x = \log_2 x(½ + ¼ + ⅛ + 1/8) = (25/24) \log_2 x = 25/6 \Rightarrow \log_2 x = 4$, $x = 16$; $\log_{\sqrt{2}} 64 = 6 \div ½ = 12$; $\log_{(2\sqrt{2})} 512 : \log_{(3\sqrt{2})} 324 = 9/(3/2) : 2/(1/2) = 6 : 4 = 3 : 2$.	PYQ Jun 19 Q4, PYQ Jul 21 Q5, PYQ Jun 22 Q6	PYQ 2019-Jun, 2021-Jul, 2022-Jun	1.4.2, p. 1.26; Example 1 (log of 64 to base 2√2), p. 1.31; Exercise 1(D) Q16, Q24, pp. 1.33 – 1.34
4.7	Reciprocal rule: $1/\log_b a = \log_a b$. $1/\log_{xy} xyz + 1/\log_{yz} xyz + 1/\log_{zx} xyz = \log_{xyz}(x^2y^2z^2) = 2$; $\Sigma 1/\log_k n$ for $k = 2 \ldots m = \log_n(2 \times 3 \times \ldots \times m) = \log_n m! = \log_n n = 1$; $\log_a(ab) = x \Rightarrow \log_a b = x - 1 \Rightarrow \log_b(ab) = 1 + 1/(x - 1) = x/(x - 1)$.	PYQ Jan 21 Q2, MTP Aug 24 S2 Q7, MTP Aug 24 S2 Q9, MTP Apr 26 S2 Q4	PYQ 2021-Jan; MTP 2024-Aug S2 (×2), 2026-Apr S2	1.4.2 ($\log_b a \times \log_a b = 1$), p. 1.26; Summary, p. 1.32; Additional Question Bank Q65, p. 1.41
4.8	$x = \log_{24} 12$, $y = \log_{36} 24$, $z = \log_{48} 36 \Rightarrow xyz = \log_{48} 12$, so $xyz + 1 = \log_{48}(12 \times 48) = \log_{48} 24^2 = 2 \log_{48} 24 = 2yz$.	MTP Dec 24 S1 Q2	MTP 2024-Dec S1	Example 3, p. 1.31
4.9	Log equations: combine into one log, convert to index form, then check the domain (every argument > 0). $\log_4(x^2 + x) - \log_4(x + 1) = \log_4 x = 2 \Rightarrow x = 16$; $\log_3(x - 2) + \log_3(x + 2) = 2 \Rightarrow x^2 - 4 = 9 \Rightarrow x = \sqrt{13}$ (reject $-\sqrt{13}$); $\log((a + b)/4) = ½(\log a + \log b) \Rightarrow (a + b)/4 = \sqrt{(ab)} \Rightarrow a^2 + b^2 = 14ab \Rightarrow a/b + b/a = 14$.	MTP Dec 24 S1 Q1, PYQ May 25 Q3, RTP Jan 25 Q2, PYQ Sep 26 Q76	PYQ 2025-May, 2026-Sep; RTP 2025-Jan; MTP 2024-Dec S1	1.4.1, pp. 1.24 – 1.25; Additional Question Bank Q88, Q92, p. 1.43
4.10	*See Topic 1: 455 students in 8 : 5 → 280 boys, 175 girls; girls become 225, and girls : boys = 3 : 4 ⇒ 225/(280 + x) = 3/4 ⇒ x = 20. Trap: the new ratio is stated girls to boys.*	PYQ Jan 26 Q50	PYQ 2026-Jan	1.1, Example 2, p. 1.3
4.11	*See Topic 1: simplify surds before comparing — $\sqrt{140} = 2\sqrt{35}$, so $½\sqrt{35} : ⅓\sqrt{140} = ½ : ⅔ = 3 : 4$.*	PYQ Sep 25 Q4	PYQ 2025-Sep	1.3, Law 4 ($(ab)^n = a^n b^n$), p. 1.19

Part B — Chapter 1 One-liner Revision Sheet

Deduplicated and in Study Material order. Click a 'Part A ref' to jump to the Part A row(s) carrying the full wording, the Scanner questions and the SM page. Refs read Unit.Topic.Row in chapters with several units and Topic.Row otherwise. Weight: ★★★ asked by ICAI 6 or more times · ★★ 3 – 5 times · ★ once or twice. The ★★★ lines alone cover about 42% of ICAI appearances in this chapter.

Ratio and Proportion, Indices, Logarithms

#	One-liner	Weight	Part A ref
1	Ratio a : b = a/b; terms ak and bk — a difference, sum or product of terms fixes k	★★	1.4
2	k-method: put a = ak, b = bk; k cancels in expressions of equal degree	★★	1.3, 2.5
3	Inverse b : a · duplicate $a^2 : b^2$ · sub-duplicate $\sqrt{a} : \sqrt{b}$ · triplicate $a^3 : b^3$	★★	1.1, 1.2
4	Equal multiples 3A = 6S = 8N ⇒ shares in ratio 1/3 : 1/6 : 1/8	★	1.11
5	**Same number added to each term: (a + x)/(b + x) = new ratio, cross-multiply**	★★★	1.5, 4.10
6	Ages at two dates → two equations; answer the date asked	★	1.6
7	Savings = Income − Expenditure; (ak − S) : (bk − S) = expenditure ratio	★★	1.7
8	% increase on each term: multiply each by its own (1 + r)	★★	1.8
9	Continued ratio: equalise the common term by LCM	★★	1.9, 2.4
10	Coins: ratio of numbers; value = Σ number × face value	★★	1.12
11	Partnership: capital × months, from date of joining	★	1.13
12	Mixture: removal keeps proportions; men × days constant for provisions	★	1.14, 1.15
13	Proportion a : b = c : d ⇔ ad = bc (extremes × means)	★	2.3
14	Mean proportional b = $\sqrt{(ac)}$; third proportional c = b^2/a	★★	2.1, 2.2, 1.10
15	Componendo–dividendo: (a + b)/(a − b) = (c + d)/(c − d)	★	2.6
16	**$a^m a^n = a^{m+n} \cdot a^m/a^n = a^{m-n} \cdot (a^m)^n = a^{mn} \cdot (ab)^n = a^n b^n \cdot a^0 = 1$**	★★★	3.1, 3.2
17	**Reduce all bases to primes; compare index of each prime**	★★★	3.3
18	**$a^x = a^y$ ⇒ x = y; reciprocal bases equal ⇒ index 0**	★★★	3.4
19	Cyclic indices / 1/(1 + z^(a−b) + z^(a−c)) sums → 1	★★	3.5, 1.17
20	$a^x = b^y = c^z = k$ ⇒ a = k^(1/x); relation of bases → relation of reciprocals	★★	3.6
21	x^(1/3) + x^(−1/3) = P ⇒ $P^3 - 3P = x + 1/x$; $\sqrt[3]{a} + \sqrt[3]{b} + \sqrt[3]{c} = 0 \Rightarrow a + b + c = 3\sqrt[3]{(abc)}$	★	3.7
22	**Conjugate surds: $(\sqrt{a} + \sqrt{b})/(\sqrt{a} - \sqrt{b})$ and its reciprocal — product 1, use $(x + y)^2 - 2xy$**	★★★	3.8, 3.9
23	**$\log_a n = x \Leftrightarrow a^x = n$; $\log_a 1 = 0$, $\log_a a = 1$; work nested logs inside out**	★★★	4.1, 4.2
24	**log mn = log m + log n · log m/n = log m − log n · log m^n = n log m**	★★★	4.3, 1.18

#	One-liner	Weight	Part A ref
25	Express in log 2, log 3 with log 10 = 1 (log 5 = 1 − log 2)	★★	4.4
26	**Change of base log_b m = $\log_a m/\log_a b$; chain log_b a × log_c b = log_c a**	★★★	4.5, 4.8
27	log_(a^n) b^m = (m/n) $\log_a b$	★★	4.6
28	1/log_b a = $\log_a b$; a^($\log_a x$) = x	★★	4.7, 3.11
29	Log equations: combine, take antilog, reject roots making an argument ≤ 0	★★	4.9

CHAPTER 2

Equations

90 Scanner questions · 43 one-liners · 26 revision pointers

Part A — One-liners mapped to Scanner questions and Study Material

Equations

SM Chapter 2, pages 2.1 – 2.34

Topic 1 Simple Equation

12 Scanner questions · ICAI appearances PYQ 9 · RTP – · MTP 3

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.1	Simple equation ax + b = 0 (a ≠ 0) has only one root: clear fractions by multiplying through by the LCM, then transpose variables to one side. (2x + 5)/10 + (3x + 10)/15 = 5 → ×30: 3(2x + 5) + 2(3x + 10) = 150 … i.e. 60x + 175 = 750 → x = 575/60 ≈ 9.58.	PYQ Nov 19 Q7	PYQ 2019-Nov	2.2, p. 2.2
1.2	Dividing a whole into parts: call one part x and write every other part in terms of x. Cloth 91 cm: x + 2x + (x + 3) = 91 → x = 22; divide 27 so that 5 × first + 11 × second = 195: 5x + 11(27 − x) = 195 → x = 17, parts 17 : 10.	PYQ Jun 22 Q10, PYQ Dec 23 Q4	PYQ 2022-Jun, 2023-Dec	2.2, p. 2.2; Exercise (B) Q3, p. 2.5
1.3	Negative marking: right = x, wrong = (total − x); marks = x − 0.25(100 − x) = 60 → 1.25x = 85 → x = 68, wrong = 32. The question asks the DIFFERENCE 68 − 32 = 36 (68 and 32 are the trap options).	PYQ Dec 21 Q11	PYQ 2021-Dec	2.2, p. 2.2
1.4	Equating two linear expressions: equal wages 600 + 50n = 170n → n = 5; meeting point of two lifts 11 + 57t = 51 − 63t → t = 1/3 min, floor = 11 + 57/3 = 30 (find t first, then the position).	PYQ Jun 22 Q9, PYQ May 25 Q6	PYQ 2022-Jun, 2025-May	2.2, p. 2.2
1.5	Two-digit number = 10 × (ten's digit) + (unit's digit); reversed = 10 × unit + ten's. Ten's = 2x, unit = x: 21x − 18 = 12x → x = 2 → 42.	MTP Dec 24 S1 Q3	MTP 2024-Dec S1	Illustration 3, p. 2.4
1.6	Market (equilibrium) price: demand = supply. 100(10 − p) = 75(p − 3) → 175p = 1225 → p = ₹7; quantity = 100(10 − 7) = 300 units.	MTP Dec 24 S1 Q4	MTP 2024-Dec S1	Illustration 4, p. 2.4
1.7	Age problems: add the elapsed years to EACH person. Grandfather x = 3y + 8 (y = twins' combined age); after 8 years the twins' sum rises by 16: x + 8 = 2(y + 16) + 10 → y = 26, x = 86, each twin 13 → age when twins were born = 86 − 13 = 73 (86 is the trap).	MTP Dec 24 S1 Q5	MTP 2024-Dec S1	Illustration 2, p. 2.4
1.8	*See Topic 3: Pythagoras gives a quadratic — the side shortened least (x − 3) is the hypotenuse: $(x-3)^2 = (x-4)^2 + (x-5)^2 \rightarrow x^2 - 12x + 32 = 0 \rightarrow x = 8$ ($x = 4$ rejected, it makes a side ≤ 0).*	PYQ May 18 Q9	PYQ 2018-May	Exercise (H) Q10, p. 2.25

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.9	See Chapter 3: 'at least' → ≥. Sides x, 3x, 3x − 4: x + 3x + 3x − 4 ≥ 59 → 7x ≥ 63 → x ≥ 9 cm.	PYQ Jun 23 Q6	PYQ 2023-Jun	3.2, p. 3.2
1.10	Remainder pattern: N leaves 3 on ÷5 and 5 on ÷7 — the shortfall is 2 in both, so N = 35k − 2; smallest = 33 (68 also fits but is not the smallest).	PYQ Sep 26 Q55	PYQ 2026-Sep	Not in SM (PYQ-only)

Topic 2 Simultaneous Linear Equations in Two Variables

23 Scanner questions · ICAI appearances PYQ 18 · RTP – · MTP 5

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.1	Elimination method: multiply to make the coefficients of one unknown equal, then add/subtract. 2x − y = 4, 3x + 4y = 17 → x = 3, y = 2; 2x + y = 10, 4x + 6y = 36 → y = 10 − 2x → x = 3. (Cross-multiplication: $x = (b_1c_2 - b_2c_1)/(a_1b_2 - a_2b_1)$, $y = (c_1a_2 - c_2a_1)/(a_1b_2 - a_2b_1)$.)	PYQ Dec 23 Q5, PYQ May 26 Q4	PYQ 2023-Dec, 2026-May	2.4, pp. 2.6 – 2.7
2.2	Cost/amount problems — one equation per condition: 3x + 4y = 257, 4x + 3y = 324 → bag x = 75 (pen = 8 is the trap option); 2x + 3y = 28, 3x + 5(2y) = 75 → (5, 6), 7x + 4y = 59; 2x + 5y = 90, 50 + y = 3x → (20, 10); G + B = 150, 25G + 50B = 5800 (convert ₹ to paise) → B = 82, G = 68.	PYQ Jul 21 Q8, PYQ Dec 22 Q8, PYQ Sep 24 Q31, PYQ May 25 Q5	PYQ 2021-Jul, 2022-Dec, 2024-Sep, 2025-May	2.4, p. 2.6; Exercise (E) Q5, p. 2.13
2.3	Reciprocal unknowns: put u = 1/(x + y), v = 1/(x − y) to get linear equations. 3u + 2v = 3, 2u + 3v = 11/3 → x + y = 3, x − y = 1 → (2, 1); 3u + 2v = −1, u − v = 4/3 → x + y = 3, x − y = −1 → (1, 2). In the exam, testing the options is quickest.	PYQ May 18 Q8, PYQ Jun 22 Q7	PYQ 2018-May, 2022-Jun	Exercise (C) Q10, p. 2.11; 2.5 Example 2, pp. 2.8 – 2.9
2.4	Exponential equations: write both sides to the same base and equate indices. 2^(x+y) = 2^(2x−y) = √8 = 2^(3/2) → x + y = 3/2, 2x − y = 3/2 → x = 1, y = 1/2.	PYQ May 18 Q7	PYQ 2018-May	2.4, p. 2.6
2.5	Ratio-type conditions reduce to a linear equation: (x + y)/y = 13/8 → 8x = 5y; with 2x + 3y = 34 → (5, 8), so 7x + 5y = 75. x/2 − y/5 = y − x and (x − 5)/(y − 10) = 1 → test options in BOTH equations → (20, 25).	PYQ Jan 25 Q31, PYQ Jan 26 Q1	PYQ 2025-Jan, 2026-Jan	2.4, p. 2.6; Exercise (C) Q6, p. 2.10
2.6	Fraction problems: let the fraction be x/y and turn each condition into a linear equation. (x + 3)/(y + 1) = 1, (x − 2)/(y − 1) = 1/2 → x = 5, y = 7 (denominator 7). Denominator = numerator + 7: x/(x + 9) = 3/4 → x = 27, fraction 27/34 — see editorial note on the options.	PYQ Jun 24 Q8, MTP Apr 26 S1 Q4	PYQ 2024-Jun; MTP 2026-Apr S1	2.6 Illustration 1, p. 2.12; Illustration 1, pp. 2.3 – 2.4
2.7	Two-digit number with reversal: (10t + u) − (10u + t) = 9(t − u). Unit = 3 × ten's, +36 reverses → 9(x − 3x) = −36 → x = 2 → 26; ten's = 3 × unit, −54 reverses → 18x = 54 → x = 3 → 93.	PYQ Jun 19 Q6, PYQ Sep 24 Q30	PYQ 2019-Jun, 2024-Sep	Exercise (B) Q10, p. 2.5
2.8	Age with sum of sons' ages: x = 4y; after 10 years EACH son gains 10, so the sum gains 20: x + 10 = 2(y + 20) → y = 15, x = 60. Father + son = 60, five years ago F − 5 = 4(S − 5) → S = 15, F = 45.	PYQ Jun 23 Q8, PYQ Sep 26 Q30	PYQ 2023-Jun, 2026-Sep	2.6 Illustration 2, pp. 2.12 – 2.13

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.9	Linear relation from a table: slope = Δy/Δx = 2/1, then y = 2x + c with (5, 11) → c = 1: y = 2x + 1.	MTP Jun 24 S3 Q27	MTP 2024-Jun S3	2.3, p. 2.6
2.10	Three equations, three unknowns: eliminate one variable from two pairs, or substitute each option in ALL three equations. (I) (1, 2, 3); (II) (2, 1, 3); (III) (2, 3, 1); (IV) (3, 2, 1) → I-(b), II-(a), III-(d), IV-(c).	PYQ Sep 26 Q54	PYQ 2026-Sep	2.5, pp. 2.7 – 2.8
2.11	xy/(x + y) = k ⇔ 1/x + 1/y = 1/k: add the three equations, halve, then subtract each. 1/m + 1/n = 1/14, 1/n + 1/p = 1/21, 1/m + 1/p = 1/6 → 1/m + 1/n + 1/p = 1/7 → m = 21/2, n = −42, p = 14 (watch the sign of n).	PYQ Sep 26 Q53	PYQ 2026-Sep	2.5 Example 3, pp. 2.9 – 2.10
2.12	Laws of indices (Chapter 1 work): take out the lowest power. $(3^{n+1} + 3^n)/(3^{n+3} - 3^{n+1}) = 3^n(3 + 1)/3^n(27 - 3) = 1/6$; $[1 - \{1 - (1 - x^2)^{-1}\}^{-1}]^{(-1/2)} = (1/x^2)^{(-1/2)} = x$.	MTP Dec 24 S1 Q8, MTP Dec 24 S1 Q9	MTP 2024-Dec S1 (×2)	Not in SM (MTP-only)
2.13	Equal powers: u^(5x) = v^(5y) = w^(5z) = k → u = k^(1/5x) etc.; $u^2 = vw$ gives 2/x = 1/y + 1/z → xy + zx − 2yz = 0.	MTP Dec 24 S1 Q10	MTP 2024-Dec S1	Not in SM (MTP-only)

Topic 3 Quadratic Equations

45 Scanner questions · ICAI appearances PYQ 33 · RTP 3 · MTP 9

Ref	One-liner for the student	Scanner Q	Asked in	SM source
3.1	Roots of $ax^2 + bx + c = 0$: $x = [-b \pm \sqrt{(b^2 - 4ac)}]/2a$, or factorise. Bring all terms to one side first: $x^2 + 9x + 18 = 6 - 4x \rightarrow x^2 + 13x + 12 = 0 \rightarrow -1, -12$; $x^2 - 7x + 10 = 0 \rightarrow 2, 5$; $2x^2 - 2(a + 6)x + 12a = 0 \rightarrow (x - a)(2x - 12) = 0 \rightarrow 6$ and a.	PYQ Nov 20 Q8, PYQ Jun 24 Q7, MTP Apr 26 S1 Q2	PYQ 2020-Nov, 2024-Jun; MTP 2026-Apr S1	2.7, pp. 2.14 – 2.15; Example 1, p. 2.16; Exercise (G) Q6, p. 2.22
3.2	A root satisfies the equation — substitute it: $3(2)^2 - 2k(2) + 5 = 0 \rightarrow k = 17/4$; $x^2 - 3x + k$ with root 1 → k = 2; $x^2 - 2x = 15 \rightarrow x = 5$ (the other root −3 is not offered; −5 is the trap).	PYQ Nov 19 Q9, PYQ Dec 21 Q12, PYQ Sep 24 Q36	PYQ 2019-Nov, 2021-Dec, 2024-Sep	2.7, p. 2.14
3.3	Sum and product of roots: $\alpha + \beta = -b/a$, $\alpha\beta = c/a$. $1/\alpha + 1/\beta = (\alpha + \beta)/\alpha\beta = 8/12 = 2/3$; harmonic mean of roots = $2\alpha\beta/(\alpha + \beta) = -2c/b = 2(8 + 2\sqrt{5})/(4 + \sqrt{5}) = 4$.	PYQ Jan 21 Q7, PYQ Jun 24 Q6	PYQ 2021-Jan, 2024-Jun	2.7, p. 2.15
3.4	Symmetric functions: $\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta$; $(\alpha - \beta)^2 = (\alpha + \beta)^2 - 4\alpha\beta$; $\alpha^3 + \beta^3 = (\alpha + \beta)^3 - 3\alpha\beta(\alpha + \beta)$. $x^2 - 4x + 1$: $\alpha^3 + \beta^3 = 64 - 12 = 52$; $x^2 - x - 6$: 19 + 13 + 1 = 33; $x^2 - (n^2 + 1)x + \frac{1}{2}(n^4 + n^2 + 1)$: $\alpha^2 + \beta^2 = n^2$; $x^2 + x + r$: $-1 + 3r = -6 \rightarrow r = -5/3$; $4[(\alpha + \beta)^2 - \alpha\beta] = 23 \rightarrow k = 1$; $x^2 - 2x - 35$: $(\alpha - \beta)^2/(\alpha + \beta)^2 = 144/4 = 36$.	PYQ Jul 21 Q6, PYQ Jun 23 Q7, PYQ Dec 23 Q7, MTP Dec 24 S1 Q7, PYQ Sep 25 Q5, PYQ May 26 Q1	PYQ 2021-Jul, 2023-Jun, 2023-Dec, 2025-Sep, 2026-May; MTP 2024-Dec S1	2.7, p. 2.15; 2.9 Illustration 2, pp. 2.17 – 2.18
3.5	$\alpha^2/\beta + \beta^2/\alpha = (\alpha^3 + \beta^3)/\alpha\beta$: $x^2 + x + 5 \rightarrow (-1 + 15)/5 = 14/5$; $x^2 + 7x + 12 \rightarrow (-343 + 252)/12 = -91/12$.	PYQ May 18 Q10, PYQ Nov 18 Q5	PYQ 2018-May, 2018-Nov	2.9 Illustration 2, pp. 2.17 – 2.18

Ref	One-liner for the student	Scanner Q	Asked in	SM source
3.6	Constructing the equation: x^2 − (sum of roots)x + product of roots = 0. Sum −2, product −3 → $x^2 + 2x - 3 = 0$; roots α, 1/α → $\alpha x^2 - (\alpha^2 + 1)x + \alpha = 0$; one root half the other with difference a → roots 2a, a → $x^2 - 3ax + 2a^2 = 0$; roots α + β = 2 and α − β = 4 (α = 3, β = −1) → $x^2 - 6x + 8 = 0$.	PYQ May 18 Q6, PYQ Nov 18 Q6, PYQ Dec 21 Q10, PYQ Jun 23 Q5	PYQ 2018-May, 2018-Nov, 2021-Dec, 2023-Jun	2.8, p. 2.15
3.7	Transformed roots — find the new sum and product: 1/α, 1/β of $ax^2 + bx + c$ → $cx^2 + bx + a = 0$ (swap a and c; $2x^2 - 3x + 1$ → $x^2 - 3x + 2$); $(\alpha + \beta)^2$, $(\alpha - \beta)^2$ of $x^2 + 7x + 12$ → sum 49 + 1 = 50, product 49 → $x^2 - 50x + 49$; α/β, β/α → product 1, sum $(\alpha^2 + \beta^2)/\alpha\beta = 4$ → $x^2 - 4x + 1$; α^2/β, β^2/α → sum $(\alpha^3 + \beta^3)/\alpha\beta$, product αβ → $9x^2 - 28x + 3$ (from $3x^2 - 4x + 1$) and $3x^2 + 10x + 9$ (from $2x^2 - 4x + 6$).	PYQ Jun 24 Q5, MTP Aug 24 S2 Q11, RTP Sep 24 Q3, PYQ Jan 25 Q29, PYQ Sep 25 Q7, PYQ Jan 26 Q51	PYQ 2024-Jun, 2025-Jan, 2025-Sep, 2026-Jan; RTP 2024-Sep; MTP 2024-Aug S2	2.9 Illustrations 1 and 7, pp. 2.17 – 2.20
3.8	Nature of roots — discriminant $b^2 - 4ac$: = 0 real and equal (coincident); > 0 real and distinct; < 0 imaginary; 'real' means ≥ 0. Equal: $4k^2 - 4(k - 4)(k + 5) = 0$ → k = 20; $(P + 4)^2 - 4(2P + 5) = P^2 - 4 = 0$ → P = ±2; 16 − 4k = 0 → k = 4. Real: $(2p - 1)^2 - 4p^2 \geq 0$ → p ≤ 1/4; $2x^2 - \sqrt{5}x + 1$: D = 5 − 8 < 0 → no real roots; $x^2 + kx + 64$ needs k ≥ 16 and $x^2 - 8x + k$ needs k ≤ 16 → k = 16.	PYQ Dec 22 Q7, MTP Jun 24 S3 Q26, MTP Jan 25 S2 Q8, MTP Jan 25 S2 Q12, PYQ May 25 Q7, RTP May 26 Q15	PYQ 2022-Dec, 2025-May; RTP 2026-May; MTP 2024-Jun S3, 2025-Jan S2 (×2)	2.9, pp. 2.15 – 2.16; Exercise (F) Q6 – Q7, p. 2.21
3.9	Roots reciprocal of each other → product = 1 → c = a: $5x^2 - 13x + k$ → k = 5; $3x^2 - 14x - k$ → −k = 3 → k = −3 (sign trap — see editorial); $x^2 - 2(5 + m)x + 3(7 + m)$ → 3(7 + m) = 1 → m = −20/3.	PYQ Jun 22 Q8, MTP Dec 24 S1 Q6, RTP May 26 Q2	PYQ 2022-Jun; RTP 2026-May; MTP 2024-Dec S1	2.9 Note (b), p. 2.16; Exercise (F) Q13, p. 2.21
3.10	Roots in ratio p : q ⇔ $(p + q)^2 \cdot ac = pq \cdot b^2$: one root double the other (1 : 2) → $2b^2 = 9ac$; ratio 2 : 3 in $x^2 - px + q$ → $6p^2 = 25q$. Difference of roots given: $(\alpha - \beta)^2 = (\alpha + \beta)^2 - 4\alpha\beta$ → $x^2 + px + 8$ with α − β = 2: $p^2 = 4 + 32$ → p = ±6.	PYQ Jun 19 Q7, PYQ Jan 21 Q5, PYQ Dec 22 Q6	PYQ 2019-Jun, 2021-Jan, 2022-Dec	Additional Question Bank Q31 and Q33, p. 2.32
3.11	Common root: subtract $x^2 + qx + p = 0$ from $x^2 + px + q = 0$ → $(p - q)(\alpha - 1) = 0$ → α = 1 (p ≠ q) → 1 + p + q = 0 → p + q = −1.	PYQ Jan 21 Q6	PYQ 2021-Jan	Not in SM (PYQ-only)
3.12	Surds: irrational roots occur in conjugate pairs. $x = 1/(5 - 2\sqrt{6}) = 5 + 2\sqrt{6}$ → $x + 1/x = 10$ → $x^2 - 10x + 1 = 0$; $m + \sqrt{m} = 6/25$ → put $\sqrt{m} = y$: $25y^2 + 25y - 6 = 0$ → y = 1/5 → m = 1/25.	PYQ Nov 19 Q8, PYQ Nov 20 Q9	PYQ 2019-Nov, 2020-Nov	2.9 Note (a), p. 2.16; Additional Question Bank Q15, p. 2.30
3.13	Equations reducible to quadratics: substitute y = x/(x − 1): $y^2 - 5y + 6 = 0$ → y = 2 or 3 → x = 2 or 3/2.	PYQ Sep 25 Q6	PYQ 2025-Sep	2.9 Illustrations 3 – 5, pp. 2.18 – 2.19
3.14	Infinite nested radical: $x = \sqrt{(a + x)}$ → $x^2 - x - a = 0$, keep the positive root. a = 5 → $(1 + \sqrt{21})/2$; a = 6 → $x^2 - x - 6 = 0$ → 3 (−2 rejected).	PYQ Jan 26 Q3, MTP Apr 26 S1 Q5	PYQ 2026-Jan; MTP 2026-Apr S1	Exercise (F) Q3, p. 2.20
3.15	*See Topic 1: the p^2 terms cancel, so it is a simple equation — $(p + 2)(p - 3) + (p + 3)(p - 4) = p(2p - 5)$ → $2p^2 - 2p - 18 = 2p^2 - 5p$ → p = 6.*	MTP Apr 26 S1 Q3	MTP 2026-Apr S1	Exercise (A) Q7, p. 2.3

Topic 4 Cubic Equations

10 Scanner questions · ICAI appearances PYQ 9 · RTP 1 · MTP –

Ref	One-liner for the student	Scanner Q	Asked in	SM source
4.1	Cubic by grouping: $x^3 + 9x^2 - x - 9 = (x + 9)(x^2 - 1) \rightarrow 1, -1, -9$; $x^3 + x^2 - x - 1 = (x + 1)^2(x - 1) \rightarrow 1, -1, -1$; $x^3 - 3x^2 - 4x + 12 = (x - 3)(x^2 - 4) \rightarrow -2, 2, 3$; $2p^3 - p^2 - 4p + 2 = (2p - 1)(p^2 - 2) \rightarrow$ rational root 1/2 ($\pm\sqrt{2}$ are irrational).	PYQ Nov 19 Q6, PYQ Nov 20 Q7, PYQ Dec 23 Q6, PYQ Jun 24 Q4	PYQ 2019-Nov, 2020-Nov, 2023-Dec, 2024-Jun	2.11, p. 2.25; Exercise (I) Q6 and Q10, p. 2.26
4.2	Trial factor: if x = a makes the LHS zero, (x − a) is a factor; divide out and solve the quadratic. $x^3 - 7x + 6$: $x = 1 \rightarrow (x - 1)(x - 2)(x + 3) \rightarrow 1, 2, -3$; $x^3 - 23x^2 + 142x - 120 \rightarrow$ test options → (1, 10, 12).	PYQ Dec 21 Q13, PYQ Dec 23 Q3	PYQ 2021-Dec, 2023-Dec	2.11 Illustration 1, p. 2.25
4.3	Given a root, substitute it: $x = 2$ in $x^3 - (k + 1)x + k = 0 \rightarrow 8 - 2k - 2 + k = 0 \rightarrow k = 6$.	PYQ Jul 21 Q7	PYQ 2021-Jul	2.11, p. 2.25
4.4	Cubic $ax^3 + bx^2 + cx + d = 0$: $\alpha + \beta + \gamma = -b/a$, $\alpha\beta\gamma = -d/a$ (use with the given condition, or test options): $3x^3 - 5x^2 - 11x - 3$ with root $-1/3 \rightarrow$ other two sum 2, product $-3 \rightarrow 3$ and -1; $x^3 - 6x^2 + 5x + 12$ with two roots' product $12 \rightarrow -1, 3, 4$ (options containing 1 fail since 1 is not a root).	PYQ Sep 24 Q37, PYQ May 25 Q8	PYQ 2024-Sep, 2025-May	Additional Question Bank Q49, p. 2.34
4.5	Not a cubic-equation question: p = x^(1/3) + x^(−1/3) → $p^3 = x + 1/x + 3p$ (since $(a + b)^3 = a^3 + b^3 + 3ab(a + b)$, $ab = 1$) → $3p^3 - 9p = 3(x + 1/x)$.	RTP Sep 24 Q2	RTP 2024-Sep	Not in SM (RTP-only)

Part B — Chapter 2 One-liner Revision Sheet

Deduplicated and in Study Material order. Click a 'Part A ref' to jump to the Part A row(s) carrying the full wording, the Scanner questions and the SM page. Refs read Unit.Topic.Row in chapters with several units and Topic.Row otherwise. Weight: ★★★ asked by ICAI 6 or more times · ★★ 3 – 5 times · ★ once or twice. The ★★★ lines alone cover about 47% of ICAI appearances in this chapter.

Equations

#	One-liner	Weight	Part A ref
1	Simple equation ax + b = 0: one root; clear fractions by LCM; negative marking x − 0.25(N − x) = marks	★	1.1, 1.3
2	Word problems: let one part be x; equate two expressions (wages, meeting point)	★★	1.2, 1.4
3	Two-digit number 10t + u; reversed 10u + t; difference = 9(t − u)	★★	1.5, 2.7
4	Equilibrium price: demand = supply	★	1.6
5	Ages: add elapsed years to EACH person (two sons → sum + 2n)	★★	1.7, 2.8
6	**Elimination: equalise one coefficient; cross-multiplication $x = (b_1c_2 - b_2c_1)/(a_1b_2 - a_2b_1)$**	★★★	2.1, 2.2
7	Reciprocal unknowns: u = 1/(x + y), v = 1/(x − y); or test options	★	2.3
8	Same base → equate indices; take out the lowest power	★★	2.4, 2.12, 2.13
9	Fraction x/y and ratio conditions → linear equations	★★	2.5, 2.6
10	Table → y = mx + c with m = Δy/Δx	★	2.9
11	Three unknowns: eliminate twice or test options in all equations	★	2.10
12	xy/(x + y) = k ⇔ 1/x + 1/y = 1/k: add all, halve, subtract each	★	2.11
13	**$x = [-b \pm \sqrt{(b^2 - 4ac)}]/2a$; bring all terms to one side; a root satisfies the equation**	★★★	3.1, 3.2, 3.15
14	α + β = −b/a · αβ = c/a · 1/α + 1/β = −b/c · HM of roots = 2αβ/(α + β)	★	3.3
15	**$\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta \cdot (\alpha - \beta)^2 = (\alpha + \beta)^2 - 4\alpha\beta \cdot \alpha^3 + \beta^3 = (\alpha + \beta)^3 - 3\alpha\beta(\alpha + \beta)$**	★★★	3.4, 3.5
16	New equation: x^2 − (sum)x + product = 0	★★	3.6
17	**Reciprocal roots → swap a and c; α/β, β/α → product 1; α^2/β, β^2/α → sum $(\alpha^3 + \beta^3)/\alpha\beta$, product αβ**	★★★	3.7
18	**$b^2 - 4ac$: = 0 equal · > 0 real distinct · < 0 imaginary · 'real' → ≥ 0**	★★★	3.8
19	Reciprocal roots → c = a · irrational roots in conjugate pairs	★★	3.9, 3.12
20	Roots in ratio p : q → $(p + q)^2ac = pq \cdot b^2$ (double: $2b^2 = 9ac$)	★★	3.10
21	Common root of $x^2 + px + q$ and $x^2 + qx + p$ → root 1, p + q = −1	★	3.11
22	Substitute y = x/(x − 1) or y = √m; √(a + √(a + ...)) → $x^2 - x - a = 0$, positive root	★★	3.13, 3.14

#	One-liner	Weight	Part A ref
23	Pythagoras with shortened sides → quadratic; reject the root giving a non-positive side	★	1.8
24	**Cubic: trial root a → (x − a) factor; group terms; Σα = −b/a, αβγ = −d/a; test options**	★★★	4.1, 4.2, 4.3, 4.4
25	p = x^(1/3) + x^(−1/3) → $p^3 - 3p = x + 1/x$	★	4.5
26	'At least' → ≥ (perimeter); remainder pattern N = LCM·k − common shortfall	★	1.9, 1.10

CHAPTER 3

Linear Inequalities

42 Scanner questions · 15 one-liners · 10 revision pointers

Part A — One-liners mapped to Scanner questions and Study Material

Linear Inequalities

SM Chapter 3, pages 3.1 – 3.22

Topic 1 Linear Inequalities in one variable and the Solution space

42 Scanner questions · ICAI appearances PYQ 32 · RTP 1 · MTP 9

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.1	Linear inequality in two variables: ax + by < c (each variable to power one; no xy product term). The values satisfying it form the solution space (S.S.).	PYQ May 18 Q11	PYQ 2018-May	3.2, p. 3.2
1.2	One-variable inequalities: solve each, then take the common part. x + 2 > 0 and 2x − 6 > 0 → x > 3 → (3, ∞); 8x + 6 < 12x + 4 → x > 1/2 → (1/2, ∞); 2x + 5 > 3x + 2 → x < 3 and 2x − 3 ≤ 4x − 5 → x ≥ 1 → x = 2.	PYQ Jun 19 Q9, PYQ Dec 22 Q10, MTP Apr 26 S2 Q10	PYQ 2019-Jun, 2022-Dec; MTP 2026-Apr S2	3.2, p. 3.2
1.3	Fractional inequalities: multiply by the positive LCM (sign unchanged; reverse it only when multiplying/dividing by a negative). (5 − 2x)/3 ≤ x/6 − 5 → 40 ≤ 5x → x ≥ 8; (5 − 2x)/4 ≤ x/8 − 5 → x ≥ 10 and (x + 4)/3 ≤ 6 → x ≤ 14 → 10 ≤ x ≤ 14; 5x/3 ≤ x/6 − 5 → 9x ≤ −30 → (−∞, −10/3] (closed bracket for ≤); strict system giving x > 10 → infinitely many solutions.	PYQ Sep 25 Q8, PYQ Sep 25 Q9, PYQ Jan 26 Q4, PYQ Jan 26 Q2	PYQ 2025-Sep (×2), 2026-Jan (×2)	Not in SM (PYQ-only)
1.4	Double inequality — apply each step to all three parts: 2 ≤ (3x − 2)/5 ≤ 4 → 12 ≤ 3x ≤ 22 → 4 ≤ x ≤ 7.33 → x ∈ {4, 5, 6, 7} — not offered, so (d) None ({5, 6, 7} is the trap if ≤ is read as <).	PYQ Nov 20 Q10	PYQ 2020-Nov	Not in SM (PYQ-only)
1.5	Word problems in one variable: 'at least' → ≥, 'at most / not more than' → ≤. Triangle x, 2x, 2x − 4 with perimeter ≥ 61 → 5x − 4 ≥ 61 → x ≥ 13; board 91 cm: x + (x + 3) + 2x ≤ 91 → x ≤ 22 (maximum 22); method (ii) better when 170r > 600 + 50r → r > 5 → r = 6.	PYQ May 25 Q10, MTP Apr 26 S1 Q9, MTP Apr 26 S1 Q10	PYQ 2025-May; MTP 2026-Apr S1 (×2)	Not in SM (PYQ-only)
1.6	Translating descriptions: 'not more than' → ≤, 'at least / more than or equal to' → ≥, and always add the non-negativity conditions x ≥ 0, y ≥ 0 (the option with them is the answer). x + y ≤ 11; x + y ≥ 10; 5x + 3y ≥ 30; 5S + 3J ≥ 30; 10x + 5y ≥ 50; time 3x + 5y ≤ 220.	PYQ Jun 19 Q8, PYQ Jun 23 Q9, PYQ Dec 23 Q8, PYQ Jun 24 Q9, MTP Jan 25 S2 Q14, MTP Apr 26 S1 Q11, PYQ May 26 Q5	PYQ 2019-Jun, 2023-Jun, 2023-Dec, 2024-Jun, 2026-May; MTP 2025-Jan S2, 2026-Apr S1	Exercise 3(A) Q1(i) – (ii), p. 3.13

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.7	Ratio constraints: 'not more than 8 men to 3 women' → $x/y \le 8/3$ → $3x \le 8y$, i.e. $8y \ge 3x$; 'not more than 5 experienced to 1 fresh' → $x \le 5y$ → $y \ge x/5$.	PYQ Dec 21 Q14, RTP Sep 24 Q4	PYQ 2021-Dec; RTP 2024-Sep	Exercise 3(A) Q1(iii), p. 3.13
1.8	Resource (capacity) constraints are ≤ the hours/money available; coefficient = requirement per unit. Machine 1: $2x_1 + 3x_2 \le 15$, machine 2: $3x_1 + x_2 \le 12$; plant: $4x_1 + 5x_2 \le 180$; budget $400x + 100y \le 10{,}000$ → $4x + y \le 100$, storage $x + y \le 100$.	PYQ Jun 23 Q10, MTP Jun 24 S3 Q28, PYQ Jan 25 Q28	PYQ 2023-Jun, 2025-Jan; MTP 2024-Jun S3	Examples 3 and 4, pp. 3.8 – 3.9
1.9	Requirement constraints are ≥ the minimum; build one inequality per nutrient (read the table column by column): $20x + 10y \ge 45$, $5x + 2y \ge 25$, $3x + 4y \ge 15$, $2x + 5y \ge 15$, $x \ge 0$, $y \ge 0$.	PYQ Sep 24 Q35	PYQ 2024-Sep	Exercise 3(A) Q2, p. 3.16; Example 11, pp. 3.12 – 3.13
1.10	Objective function = Σ (profit per unit × units); profit is maximised, cost minimised: Maximise $Z = 8x_1 + 13x_2$.	PYQ Jan 25 Q30	PYQ 2025-Jan	Example 2, p. 3.6
1.11	Corner (extreme) points: axis intercepts of each boundary line ($x = 0$, then $y = 0$) plus intersections found by solving pairs simultaneously. $5x + y = 100$ & $x + y = 60$ → (10, 50) with (0, 0), (20, 0), (0, 60); $2x + 5y = 20$ & $3x + 2y = 12$ → (20/11, 36/11) with (0, 0), (0, 4), (4, 0); $6x + y \ge 18$, $x + 4y \ge 12$, $2x + y \ge 10$ → (0, 18), (2, 6), (4, 2), (12, 0).	PYQ Nov 18 Q7, PYQ Nov 19 Q10, MTP Jan 25 S2 Q13, PYQ May 25 Q9	PYQ 2018-Nov, 2019-Nov, 2025-May; MTP 2025-Jan S2	Additional Question Bank Q1 – Q2, p. 3.22
1.12	Testing a point: substitute it in EVERY inequality. $x \le 3$, $y \le 4$, $4x + 3y \le 12$ → only (1, 1) ($4 + 3 = 7 \le 12$); $10x + 29y \ge 40$ and $15x - 4y \le 25$ → only (1, 1.25).	PYQ Jun 24 Q10, PYQ Sep 25 Q10	PYQ 2024-Jun, 2025-Sep	Example 5, pp. 3.9 – 3.10
1.13	Reading a shaded graph: test the origin — shading towards the origin means the origin satisfies (≤ for lines like $x + y = k$); shading away means ≥. Right of $x + y = 6$ and below $y = 2x$ → $x + y > 6$, $2x - y > 0$, $x > 0$; $x + y \le 6$ → shading towards O; band below $x_1 + x_2 = 2$ and beyond $x_1 + x_2 = 4$; closed polygon → all ≤ with $x, y \ge 0$; region of $x_1 + x_2 < 4$ and $2x_1 - x_2 > 6$ → ΔABE.	PYQ Jun 19 Q10, PYQ Dec 21 Q15, PYQ Sep 24 Q38, MTP Dec 24 S1 Q11, MTP Dec 24 S1 Q12	PYQ 2019-Jun, 2021-Dec, 2024-Sep; MTP 2024-Dec S1 (×2)	3.2, pp. 3.3 – 3.4; Exercise 3(A) Q5, pp. 3.17 – 3.18
1.14	Shape of the common region from its vertices: $x + y \le 4$, $x - y \le 4$, $x \ge 2$ → (2, 2), (2, −2), (4, 0); two sides $\sqrt{8}$ → isosceles triangle.	PYQ Jan 21 Q8	PYQ 2021-Jan	Example 7, pp. 3.10 – 3.11
1.15	Feasible region (solution set) is a polygonal convex set; it is bounded if it can be enclosed in a (very large) circle. $x \ge 0$, $y \ge 0$, $x + y \ge 6$ → unbounded; only two crossing half-planes ($2x + 3y < 9$, $5x - y > 3$) → unbounded; $2x + y \ge 8$, $x + y \ge 12$, $3x + 2y \le 34$, $x, y \ge 0$ → triangle (0, 12), (0, 17), (10, 2) → feasible bounded.	PYQ Jan 26 Q56, PYQ May 26 Q2, PYQ May 26 Q3, PYQ Sep 26 Q31	PYQ 2026-Jan, 2026-May (×2), 2026-Sep	3.2, p. 3.5; Example 11, p. 3.13

Part B — Chapter 3 One-liner Revision Sheet

Deduplicated and in Study Material order. Click a 'Part A ref' to jump to the Part A row(s) carrying the full wording, the Scanner questions and the SM page. Refs read Unit.Topic.Row in chapters with several units and Topic.Row otherwise. Weight: ★★★ asked by ICAI 6 or more times · ★★ 3 – 5 times · ★ once or twice. The ★★★ lines alone cover about 60% of ICAI appearances in this chapter.

Linear Inequalities

#	One-liner	Weight	Part A ref
1	Linear inequality ax + by < c (no xy term); solution space = values satisfying it	★	1.1
2	**One variable: solve each, intersect; multiply by positive LCM; reverse sign only for a negative multiplier**	★★★	1.2, 1.3, 1.4
3	**'At least' ≥ · 'not more than / at most' ≤ · add x ≥ 0, y ≥ 0**	★★★	1.5, 1.6
4	Ratio constraint 'not more than 8 men to 3 women' → 3x ≤ 8y	★	1.7
5	Resources ≤ capacity; requirements ≥ minimum (one inequality per resource/nutrient)	★★	1.8, 1.9
6	Objective: Maximise Z = Σ profit × units	★	1.10
7	Corner points: intercepts + simultaneous solution of boundary lines	★★	1.11
8	**Test a point in every inequality; origin test fixes the side of shading**	★★★	1.12, 1.13
9	Region shape from its vertices	★	1.14
10	Feasible region is convex; bounded if it fits in a circle	★★	1.15

CHAPTER 4

Mathematics of Finance

302 Scanner questions · 89 one-liners · 46 revision pointers

Part A — One-liners mapped to Scanner questions and Study Material

Mathematics of Finance

SM Chapter 4, pages 4.1 – 4.47

Topic 1 Simple Interest

47 Scanner questions · ICAI appearances PYQ 35 · RTP 1 · MTP 11

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.1	Simple interest: I = Pit, A = P + I = P(1 + it), with i the annual rate in decimal and t in years — convert months to years first (4½ yrs, 5 yrs 4 m = 16/3 yrs); when rate and time come from an equation, solve it first ($x^2 - 11x + 30 = 0 \rightarrow 5$ and 6).	PYQ Jun 19 Q14, PYQ Jun 19 Q20, PYQ Dec 22 Q13	PYQ 2019-Jun (×2), 2022-Dec	4.4.1, p. 4.4; Exercise 4(A) Q2, p. 4.8
1.2	Principal: from the amount P = A ÷ (1 + it) (e.g. 66,480 ÷ 1.385); from the interest P = I ÷ (it). For a monthly interest, first annualise it (₹1,200 × 12 ÷ 0.18 = ₹80,000). If the interest is stated relative to the sum (₹520 less than the sum lent), write I = P – 520 = Pit (0.2P = P – 520 → P = ₹650). Trap: dividing A by it instead of (1 + it).	PYQ Nov 18 Q13, PYQ Sep 24 Q42, PYQ Sep 25 Q16, MTP Apr 26 S1 Q24, MTP Apr 26 S2 Q20, PYQ May 26 Q63	PYQ 2018-Nov, 2024-Sep, 2025-Sep, 2026-May; MTP 2026-Apr S1, 2026-Apr S2	Examples 7 and 9, pp. 4.6 – 4.7; Exercise 4(A) Q8, p. 4.8
1.3	Time: t = (A – P) ÷ (P × i) = I ÷ (Pi); if only I = kP is given, t = k ÷ i (0.125P at 10% → 1.25 yrs). Answer is in years — 3.5 yrs, not 3 yrs 5 months.	PYQ Nov 19 Q17, PYQ Dec 21 Q17, PYQ Dec 23 Q13, PYQ Dec 23 Q21, PYQ Jan 25 Q44	PYQ 2019-Nov, 2021-Dec, 2023-Dec (×2), 2025-Jan	Examples 6 and 10, pp. 4.6 – 4.7
1.4	Rate: i = (A – P) ÷ (P × t); find the rate from one sum and reuse it on another (6,400 → 7,840 in 2 yrs gives 11.25%, so ₹84 for 4 yrs = 84 × 1.45 = ₹121.80). Fractional time: 1 yr 8 m = 5/3 yr. A difference in SI for the same P and t gives the rate difference: $P \times t \times (r_1 - r_2)/100 = \Delta I$ (1,500 × 3 × Δr/100 = 18 → 0.4).	PYQ Nov 19 Q12, PYQ Jun 24 Q20, MTP Aug 24 S2 Q16, MTP Jan 25 S2 Q15	PYQ 2019-Nov, 2024-Jun; MTP 2024-Aug S2, 2025-Jan S2	Examples 5 and 8, pp. 4.5 – 4.7
1.5	Two amounts at two times (same sum, SI): yearly SI = $(A_2 - A_1) \div (t_2 - t_1)$; $P = A_1 - t_1 \times$ yearly SI; rate = yearly SI ÷ P (6,200 & 7,400 → SI 1,200/yr, P = 3,800; 2,688 & 2,784 → P = 2,400, R = 4%).	PYQ Jun 19 Q11, PYQ Jun 19 Q12, MTP Dec 24 S1 Q14	PYQ 2019-Jun (×2); MTP 2024-Dec S1	Exercise 4(A) Q9, p. 4.8
1.6	Multiples under SI: a sum becomes k times when SI = (k – 1)P, so t = (k – 1) × 100 ÷ R and time is proportional to (k – 1): doubles in 10 yrs → triples in 20; doubles at 12.5% → 8 yrs; R = 100 ÷ T for doubling (5 yrs → 20%, triple in 8 yrs → 25%).	PYQ Nov 18 Q10, PYQ Jun 22 Q13, PYQ Jan 25 Q35	PYQ 2018-Nov, 2022-Jun, 2025-Jan	4.4.1, p. 4.4; Exercise 4(A) Q10, p. 4.8

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.7	Rate equal to time (R = T): I/P = $R^2/100$, so R = √(100 × I/P) (I = P/4 → R = 5; I = P/25 → R = 2%); SI of ₹p at p% for p years gives P = 100/p.	PYQ Dec 21 Q20, MTP Aug 24 S2 Q14, PYQ May 26 Q61	PYQ 2021-Dec, 2026-May; MTP 2024-Aug S2	4.4.1, p. 4.4
1.8	Splitting a sum: equal interest after different times → P ∝ 1/T (2, 3, 4 yrs → ½ : ⅓ : ¼ = 6 : 4 : 3); equal amounts → P ∝ 1/(1 + iT) (8,829 at 4% for 5, 6, 8 yrs → 3,069 : 2,970 : 2,790); given $SI_1 = k \times SI_2$, $P_1R_1T_1 = k \times P_2R_2T_2$ ($42P_1 = 90P_2$ → 15 : 7).	PYQ Nov 18 Q15, MTP Apr 26 S2 Q21, RTP May 26 Q4	PYQ 2018-Nov; RTP 2026-May; MTP 2026-Apr S2	4.4.1, p. 4.4
1.9	Mixed rates: interest on the parts = overall rate × total (12,000 × 10% + x × 20% = 14% × (12,000 + x) → x = 8,000, total ₹20,000); for loans made at different dates, use each loan's own time (₹725 for 1 yr at i + ₹362.50 for 4 m at 2i = ₹33.50 → i ≈ 3.46%).	PYQ Nov 19 Q11, PYQ Jun 23 Q19, PYQ May 25 Q11, PYQ Jan 26 Q61	PYQ 2019-Nov, 2023-Jun, 2025-May, 2026-Jan	4.4.1, p. 4.4
1.10	Same time, two scenarios: build A = P(1 + it) for both and divide or subtract (750 → 840 at 4% gives t = 3, then P = 575 ÷ 1.15 = ₹500; r vs r + 2 → 0.06P = 762; amounts 400 at 10% and 200 at 4% → 1 + 0.1t = 2(1 + 0.04t) → t = 50 yrs).	PYQ Jan 21 Q9, PYQ Jul 21 Q20, MTP Aug 24 S2 Q15	PYQ 2021-Jan, 2021-Jul; MTP 2024-Aug S2	4.4.1, p. 4.4; Example 10, p. 4.7
1.11	Interest added to principal every n years (SI in blocks): after 10 yrs ₹1,000 at 5% → ₹1,500; the remaining ₹500 at 5% on ₹1,500 takes 6⅔ yrs, total 16⅔ yrs. Borrow-and-lend gain per year = P × ($r_2 - r_1$) ÷ 100 (5,000 × 2¼% = ₹112.50). Rough effective SI rate = interest ÷ principal × 12/months.	PYQ May 18 Q14, PYQ May 18 Q15, MTP Aug 24 S2 Q17	PYQ 2018-May (×2); MTP 2024-Aug S2	4.4.1, p. 4.4
1.12	SI ↔ CI on the same sum: yearly SI = 2-yr SI ÷ 2; for 2 years, CI − SI = interest on the first year's interest = $SI_1 \times R/100$ (660 − 600 = 60 = 300 × R → R = 20%, P = ₹1,500); then CI = P[$(1 + i)^2 - 1$] (P = 1,000 at 4% → ₹81.60).	PYQ May 18 Q16, PYQ Jan 21 Q13	PYQ 2018-May, 2021-Jan	4.4.2, p. 4.9
1.13	*See Topic 5: compare a compounded rate with a simple rate through the effective rate $E = (1 + i)^n - 1$ (9% quarterly → 9.31% > 9.1% SI; 10% quarterly → 10.38%).*	PYQ Jan 21 Q14, PYQ Jan 26 Q60	PYQ 2021-Jan, 2026-Jan	4.5, p. 4.18; Example 24, p. 4.19
1.14	*See Topic 8: deferred perpetuity — R ÷ i gives the value one period before the first receipt (₹10 from year 6 at 20% → ₹50 at end of year 5), then discount: $50 \div (1.2)^5$ = ₹20.09.*	PYQ Nov 20 Q22	PYQ 2020-Nov	4.11.1, p. 4.36
1.15	*See Topic 2: these are compound-interest questions — $P = A \div (1 + i)^n$ ($₹5,200 \div 1.05^6$ = ₹3,880; under SI it would be ₹4,000); if a sum doubles in T years at CI it becomes 2^k times in kT years ($8 = 2^3$ → 3 × 15 = 45 yrs; under SI it would be 105 yrs).*	MTP Dec 24 S1 Q13, MTP Jan 25 S2 Q16	MTP 2024-Dec S1, 2025-Jan S2	Exercise 4(D) Q1, p. 4.44

Topic 2 Compound Interest

87 Scanner questions · ICAI appearances PYQ 71 · RTP 1 · MTP 15

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.1	Compound amount, annual compounding: $A_n = P(1 + i)^n$ (₹8,000 at 5% for 3 yrs = 8,000 × 1.157625 = ₹9,261); the same formula projects a population growing at a fixed % a year (1,00,000 × 1.05^2 = 1,10,250).	PYQ Nov 18 Q9, PYQ Nov 18 Q11, PYQ Dec 23 Q20, PYQ Jun 24 Q16	PYQ 2018-Nov (×2), 2023-Dec, 2024-Jun	4.4.4, p. 4.11; Example 25, p. 4.24
2.2	Conversion periods: i = annual rate ÷ periods per year, n = years × periods per year (half-yearly ÷2/×2, quarterly ÷4/×4, monthly ÷12/×12), then $A_n = P(1 + i)^n$ (8% quarterly for 2 yrs → $(1.02)^8$; 10% half-yearly for 3 yrs → $(1.05)^6$). Trap: using the annual rate with the period count.	PYQ Nov 18 Q8, PYQ Nov 18 Q19, PYQ Dec 23 Q14, RTP Sep 24 Q7, MTP Dec 24 S1 Q16, PYQ May 25 Q15, PYQ May 25 Q18, PYQ Sep 25 Q20	PYQ 2018-Nov (×2), 2023-Dec, 2025-May (×2), 2025-Sep; RTP 2024-Sep; MTP 2024-Dec S1	4.4.3 – 4.4.4, pp. 4.10 – 4.11; Example 12, p. 4.12
2.3	Compound interest, annual: $CI = P[(1 + i)^n - 1]$ (₹3,200 at 15% for 2 yrs = 3,200 × 0.3225 = ₹1,032); a rate found from SI data (60% in 6 yrs → 10%) is then used in the CI formula.	PYQ Jun 24 Q15, PYQ May 25 Q12, PYQ Jan 26 Q8	PYQ 2024-Jun, 2025-May, 2026-Jan	4.4.4, p. 4.11; Example 11, pp. 4.9 – 4.10
2.4	CI for part-years with frequent compounding: n = months ÷ months per period (9 months quarterly → n = 3; 1¼ yrs quarterly → n = 5; 1½ yrs half-yearly → n = 3), $CI = P[(1 + i)^n - 1]$; interest earned in year 2 alone = $A_8 - A_4$ for quarterly compounding.	PYQ Jan 21 Q10, PYQ Jul 21 Q12, PYQ Jun 23 Q14, PYQ Dec 23 Q19, PYQ Sep 24 Q43, PYQ Sep 25 Q11, PYQ May 26 Q59, PYQ May 26 Q10	PYQ 2021-Jan, 2021-Jul, 2023-Jun, 2023-Dec, 2024-Sep, 2025-Sep, 2026-May (×2)	Examples 13 and 14, pp. 4.12 – 4.13; Exercise 4(B) Q10, Q11, Q14, pp. 4.20 – 4.21
2.5	Different rates in successive periods: $A = P(1 + r_1)(1 + r_2)(1 + r_3)\ldots$ (25,000 × 1.03 × 1.04 × 1.05 = 28,119; half-yearly rests at 6%, 6%, 9% → $(1.03)^4 (1.045)^2$); work backwards with P = A ÷ product.	PYQ Jun 19 Q13, PYQ Nov 19 Q15, MTP Jan 25 S2 Q24	PYQ 2019-Jun, 2019-Nov; MTP 2025-Jan S2	Additional Question Bank Q2, p. 4.45
2.6	Present value, annual compounding: $P = A_n \div (1 + i)^n$ — the factor $1/(1 + i)^n$ is always below 1 (₹1,000 after 2 yrs at 10% → ₹826; ₹2,00,000 at 5% for 2 yrs → ₹1.81 lakh); fractional rates convert to exact fractions (6¼% → $(17/16)^3$).	PYQ Nov 18 Q17, PYQ Jul 21 Q10, PYQ Jun 23 Q16, PYQ Dec 23 Q22, PYQ Jun 24 Q17, PYQ Sep 24 Q41, PYQ Sep 24 Q45, PYQ Jan 25 Q37, PYQ Sep 25 Q21, PYQ May 26 Q9	PYQ 2018-Nov, 2021-Jul, 2023-Jun, 2023-Dec, 2024-Jun, 2024-Sep (×2), 2025-Jan, 2025-Sep, 2026-May	4.8, p. 4.28; Examples 29 and 30, pp. 4.28 – 4.29

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.7	Present value or principal with half-yearly / quarterly compounding: P = A ÷ (1 + i)^n with i and n per conversion period (₹1,20,000 at 4% half-yearly → ÷ (1.02)^2 = ₹1,15,340; ₹10,000 due in 2 yrs at 5% half-yearly → ÷ (1.025)^4 ≈ ₹9,060).	PYQ Nov 20 Q13, PYQ Dec 21 Q19, PYQ Jan 25 Q32, MTP Jan 25 S2 Q25	PYQ 2020-Nov, 2021-Dec, 2025-Jan; MTP 2025-Jan S2	Example 19, p. 4.15; Additional Question Bank Q4, p. 4.45
2.8	Principal from CI: P = CI ÷ [(1 + i)^n − 1] (₹3,280 ÷ 0.1025 = ₹32,000), then SI = Pit for whatever rate and time the question sets (CI ₹102 at 4% for 2 yrs → P = 1,250, SI = ₹100; double time and rate → SI = P × 2i × 2t). If the time is unknown, get it from A/P first (9,075/7,500 = 1.21 = 1.1^2 → 2 yrs).	PYQ Nov 18 Q14, PYQ Nov 20 Q11, PYQ Jul 21 Q15, MTP Aug 24 S2 Q18, PYQ Jan 25 Q42, PYQ May 25 Q14, PYQ Sep 26 Q2	PYQ 2018-Nov, 2020-Nov, 2021-Jul, 2025-Jan, 2025-May, 2026-Sep; MTP 2024-Aug S2	Example 15, pp. 4.13 – 4.14
2.9	Rate from amount: (1 + i)^n = A/P, so i = (A/P)^(1/n) − 1 (121/100 → 10%; 8 times in 5 yrs → 8^(1/5) − 1 = 51.57%; tripled in 4 yrs → 3^(1/4) − 1 = 31.6%); a growth rate over n years is the same CAGR = (V_end/V_start)^(1/n) − 1 (EPS 5 → 22 in 10 yrs → 15.97%).	PYQ Nov 18 Q12, PYQ Dec 22 Q16, PYQ Jun 24 Q21, PYQ Jan 25 Q41, PYQ Sep 25 Q17, PYQ Jan 26 Q7	PYQ 2018-Nov, 2022-Dec, 2024-Jun, 2025-Jan, 2025-Sep, 2026-Jan	Examples 16 and 18, pp. 4.14 – 4.15; 4.14, p. 4.40
2.10	Comparing compounding frequencies: equal annual yields mean equal effective rates, (1 + r/2)^2 = (1 + 0.10/4)^4 → r = 10.125%; the extra earned by half-yearly over annual compounding = P[(1 + i/2)^{2n} − (1 + i)^n] (0.0241P = 482 → P = ₹20,000).	PYQ Jun 24 Q24, PYQ Jan 26 Q59	PYQ 2024-Jun, 2026-Jan	4.5, p. 4.18; Example 12, p. 4.12
2.11	Doubling or k-fold time at CI: solve (1 + i)^n = k by trial or n = log k ÷ log(1 + i) — doubles at 5% in ≈ 14.2 yrs (14 yrs 2 months), at 6% in ≈ 12 yrs, at 8% in 9 yrs; trebles at 8% in ≈ 14.28 yrs; at 20% the amount first exceeds double in year 4.	PYQ Dec 21 Q21, PYQ Jun 24 Q23, MTP Jun 24 S3 Q30, MTP Jun 24 S3 Q40, MTP Dec 24 S1 Q15, MTP Jan 25 S2 Q17	PYQ 2021-Dec, 2024-Jun; MTP 2024-Jun S3 (×2), 2024-Dec S1, 2025-Jan S2	Exercise 4(D) Q3, Q5, p. 4.44; Additional Question Bank Q6, p. 4.46
2.12	Time to reach a given amount: (1 + i)^n = A/P, by trial or logs — n = log(A/P) ÷ log(1 + i) (log 1.5 ÷ log 1.08 = 5.27 ≈ 5.3 yrs; 1.4 = (1.02)^n → ≈ 17 yrs for a 40% population rise; 4,56,976/3,90,625 = (1.04)^4 → 4 yrs).	PYQ Jun 23 Q22, PYQ May 26 Q64, PYQ Sep 26 Q1	PYQ 2023-Jun, 2026-May, 2026-Sep	Examples 17 and 20, pp. 4.14 – 4.16; Exercise 4(B) Q6, p. 4.20
2.13	Doubling rule: if a sum doubles in T years at CI, it becomes 2^k times in kT years (doubles in 4 → 8 times in 12, 32 times in 20; doubles in 5 → 16 times in 20, so ₹12,000 → ₹1,92,000). Trap: multiplying by 4 instead of using powers of 2.	PYQ Dec 22 Q20, PYQ Dec 22 Q23, MTP Jun 24 S3 Q39, PYQ Sep 24 Q46	PYQ 2022-Dec (×2), 2024-Sep; MTP 2024-Jun S3	4.4.4, p. 4.11; Example 16, p. 4.14

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.14	Ratio of two amounts of the same sum: $A_{t_2} \div A_{t_1} = (1+i)^{(t_2 - t_1)}$, so P is found without i (27,900 → 41,850 in 3 yrs → $(1+i)^3 = 1.5$, P = 27,900 ÷ 1.5 = ₹18,600; 64 → 83.20 in 2 yrs → $(1+i)^2 = 1.3$, so ₹86 for 4 yrs = 86×1.3^2 = ₹145.34).	PYQ Nov 20 Q12, PYQ Jul 21 Q23, PYQ Dec 22 Q12, MTP Apr 26 S1 Q23	PYQ 2020-Nov, 2021-Jul, 2022-Dec; MTP 2026-Apr S1	4.4.4, p. 4.11
2.15	Splitting a sum between two parties or schemes: equal amounts at different times → $A(1+i)^7 = B(1+i)^9$, so A : B = $(1.04)^2$: 1 (A = 3,903 × 1.0816 ÷ 2.0816 = ₹2,028); two rates with known total CI → 0.1664x + 0.1881(27,000 − x) = 4,818.30.	PYQ Dec 22 Q19, MTP Aug 24 S2 Q21	PYQ 2022-Dec; MTP 2024-Aug S2	4.4.4, p. 4.11
2.16	Uneven cash flows are not an annuity: compound or discount each flow separately and add $1{,}000(1.1)^2 + 2{,}000(1.1) + 3{,}000$ = ₹6,410); an investment worth 400 at year 3 and 500 at year 6 implies $(1+i)^3 = 1.25$, so PV = 400 ÷ 1.25 = ₹320.	PYQ Jun 24 Q22, PYQ Sep 25 Q22	PYQ 2024-Jun, 2025-Sep	4.7, p. 4.24; 4.8, p. 4.28
2.17	*See Topic 6: future value of an annuity regular $A(n, i) = A[(1+i)^n - 1] \div i$ (₹1,000 for 7 yrs at 14% = ₹10,730.70); annuity due = regular FV × (1 + i); sinking-fund deposit = target ÷ A(n, i) (₹1,500 in 12 quarters at 1.5% → ₹115.01).*	PYQ Nov 20 Q15, PYQ Jan 21 Q11, MTP Dec 24 S1 Q22, MTP Jan 25 S2 Q22	PYQ 2020-Nov, 2021-Jan; MTP 2024-Dec S1, 2025-Jan S2	4.7.1 – 4.7.2, pp. 4.26 – 4.27; 4.9, p. 4.33; Exercise 4(C) Q11, pp. 4.41 – 4.42
2.18	*See Topic 7: present value of an annuity $V = A \times P(n, i)$, $P(n, i) = [(1+i)^n - 1] \div [i(1+i)^n]$; instalment $A = V \div P(n, i)$ on the unpaid balance (₹20,000 ÷ 3.12717 = ₹6,395; ₹1,00,000 at 6% for 20 half-years → ₹8,718.45); PV of an annuity due exceeds that of an ordinary annuity.*	PYQ Nov 20 Q18, MTP Jan 25 S2 Q20, PYQ Jan 26 Q58	PYQ 2020-Nov, 2026-Jan; MTP 2025-Jan S2	4.8.1 – 4.8.2, pp. 4.30 – 4.32; Example 33, p. 4.32; Exercise 4(D) Q8, p. 4.44
2.19	*See Topic 8: perpetuity $V = A \div i$ (₹300 a year at 10% → ₹3,000).*	MTP Jan 25 S2 Q21	MTP 2025-Jan S2	4.11.1, p. 4.36; Exercise 4(C) Q13, p. 4.42
2.20	*See Topic 5: effective rate $E = (1+i)^n - 1$, i per conversion period, n periods in a year.*	PYQ Jan 21 Q19	PYQ 2021-Jan	4.5, p. 4.18
2.21	*See Topic 4: for 2 years, CI − SI = $P \cdot i^2$ ($P \times 0.08^2 = 96$ → P = ₹15,000).*	PYQ Jun 19 Q18	PYQ 2019-Jun	Exercise 4(B) Q12, p. 4.21
2.22	*See Topic 1: under simple interest, time ∝ (k − 1) — doubles in 8 yrs → four times in 3 × 8 = 24 yrs.*	PYQ Jan 26 Q5	PYQ 2026-Jan	4.4.1, p. 4.4; Exercise 4(A) Q10, p. 4.8

Topic 3 Depreciation

15 Scanner questions · ICAI appearances PYQ 10 · RTP 1 · MTP 4

Ref	One-liner for the student	Scanner Q	Asked in	SM source
3.1	Value after n years on reducing balance: $A = P(1-i)^n$ — depreciation is compound interest at a negative rate (i = −r), charged on the opening value each year; scrap value = cost × $(1-r)^n$ (e.g. $10{,}000 \times 0.9^7$ = ₹4,782.96).	PYQ Nov 19 Q16, PYQ Nov 19 Q18, PYQ Dec 23 Q18	PYQ 2019-Nov (×2), 2023-Dec	4.4.4, p. 4.11; Exercise 4(B) Q8, p. 4.20

Ref	One-liner for the student	Scanner Q	Asked in	SM source
3.2	Total depreciation over n years = $P - P(1-r)^n = P[1-(1-r)^n]$; trap: $P(1-r)^n$ is the residual value, not the depreciation ($1,00,000 \times 0.9^7 = 47,829.69$ left, so depreciation = ₹52,170.31).	RTP Jan 25 Q15	RTP 2025-Jan	4.4.4, p. 4.11
3.3	Value n years ago / original cost: $P = A \div (1-r)^n$ ($7,290 \div 0.9^3 = 10,000$; $44,370 \div 0.85^5 = 1,00,000$) — divide, never add back r% of the present value.	PYQ Nov 19 Q20, PYQ Sep 24 Q39, MTP Dec 24 S1 Q19, PYQ May 26 Q8, PYQ Sep 26 Q58	PYQ 2019-Nov, 2024-Sep, 2026-May, 2026-Sep; MTP 2024-Dec S1	4.4.4 (to find the principal), pp. 4.13 – 4.14
3.4	Time to fall to a given value: $(1-r)^n = A/P$, then try the options or $n = \log(A/P) \div \log(1-r)$; a fractional n converts to years + months (5.5 years = 5 years 6 months).	PYQ Dec 22 Q11, PYQ Jun 23 Q18, MTP Jun 24 S3 Q35, PYQ Sep 25 Q13, MTP Jan 25 S2 Q23	PYQ 2022-Dec, 2023-Jun, 2025-Sep; MTP 2024-Jun S3, 2025-Jan S2	Exercise 4(B) Q4, p. 4.20; Additional Question Bank Q8 – Q9, p. 4.46
3.5	*See Topic 6: sinking-fund provision = amount required ÷ $A(n, i)$, $A(n, i) = [(1+i)^n - 1]/i$ ($5,00,000 \div 41.646$ = ₹12,006).*	MTP Jun 24 S3 Q36	MTP 2024-Jun S3	4.9, p. 4.33; Additional Question Bank Q12, p. 4.46

Topic 4 Difference Between Compound Interest and Simple Interest

14 Scanner questions · ICAI appearances PYQ 11 · RTP – · MTP 3

Ref	One-liner for the student	Scanner Q	Asked in	SM source
4.1	2 years: CI − SI = $P \times i^2 = P(r/100)^2$; so $P = D \div i^2$ and $i = \sqrt{(D/P)}$ ($372 \div 0.01 = 37,200$; $\sqrt{(96/15,000)} = 8\%$). Valid only for annual compounding over exactly 2 years.	PYQ Nov 18 Q16, PYQ Nov 19 Q19, PYQ Dec 22 Q21, PYQ Jun 24 Q19, PYQ Sep 24 Q44, PYQ Sep 25 Q12, PYQ Sep 25 Q15, PYQ Sep 26 Q4	PYQ 2018-Nov, 2019-Nov, 2022-Dec, 2024-Jun, 2024-Sep, 2025-Sep (×2), 2026-Sep	4.4.2, p. 4.10; Exercise 4(B) Q12, p. 4.21
4.2	3 years: CI − SI = $P[(1+i)^3 - 1 - 3i] = P(3i^2 + i^3) = P{\cdot}r^2(300+r)/100^3$ (6%: factor 0.011016, so 110.16 → ₹10,000; 13.77 → ₹1,250).	PYQ Jun 23 Q21, MTP Aug 24 S2 Q19, PYQ May 26 Q6	PYQ 2023-Jun, 2026-May; MTP 2024-Aug S2	Exercise 4(B) Q7, p. 4.20
4.3	Any n years: CI − SI = $P[(1+i)^n - 1 - n{\cdot}i]$ (20,000 at 5% for 4 years = $20,000 \times 0.0155$ = ₹310; 10,000 at 10% for 4 years = ₹641).	MTP Jun 24 S3 Q29, MTP Dec 24 S1 Q17	MTP 2024-Jun S3, 2024-Dec S1	4.4.4, p. 4.11; Additional Question Bank Q1, p. 4.45
4.4	Fractional period (2⅔ years): compound for the whole years, then simple interest on that amount for the fraction; SI = P·i·t for the full 2.4 years; difference = ₹147.20.	PYQ Jul 21 Q21	PYQ 2021-Jul	4.4.1, p. 4.4 and 4.4.4, p. 4.11 (fraction-of-year convention Not in SM — PYQ-only)

Topic 5 Effective Rate of Interest

22 Scanner questions · ICAI appearances PYQ 20 · RTP 1 · MTP 1

Ref	One-liner for the student	Scanner Q	Asked in	SM source
5.1	Half-yearly: $E = (1 + r/2)^2 - 1 = r + r^2/4$ (5% → 5.0625%, 6% → 6.09%, 8% → 8.16%, 10% → 10.25%, 12% → 12.36%).	PYQ Nov 19 Q13, PYQ Jun 24 Q18, PYQ Sep 24 Q40, RTP Jan 25 Q6, PYQ May 25 Q13, PYQ Sep 25 Q18	PYQ 2019-Nov, 2024-Jun, 2024-Sep, 2025-May, 2025-Sep; RTP 2025-Jan	4.5, p. 4.18; Example 23, p. 4.19
5.2	Quarterly: $E = (1 + r/4)^4 - 1$ (7% → 7.18%, 8% → 8.24%, 10% → 10.38%, 12% → 12.55%); i = nominal rate ÷ 4, n = 4 conversions in one year.	PYQ Nov 19 Q14, PYQ Jan 21 Q15, PYQ Jun 22 Q16, PYQ Jun 23 Q11, PYQ Dec 23 Q12, PYQ Jan 25 Q38, PYQ May 26 Q11, PYQ Sep 26 Q3	PYQ 2019-Nov, 2021-Jan, 2022-Jun, 2023-Jun, 2023-Dec, 2025-Jan, 2026-May, 2026-Sep	4.5, p. 4.18; Example 22, p. 4.18; Exercise 4(B) Q9, p. 4.20
5.3	Monthly: $E = (1 + r/12)^{12} - 1$ (12% → 12.68%, 24% → 26.82%); a rate quoted '% per month' in these questions means the annual rate compounded monthly (i = 1% per month).	PYQ Jul 21 Q11, PYQ Jun 24 Q14	PYQ 2021-Jul, 2024-Jun	4.13 (Effective Rate $(1 + i/m)^m - 1$), p. 4.39; Example 24, p. 4.19
5.4	E is not related to the principal — it depends only on the rate and the frequency of compounding; E > nominal rate whenever interest is compounded more than once a year (E = nominal if annual).	MTP Dec 24 S1 Q20, PYQ May 25 Q19	PYQ 2025-May; MTP 2024-Dec S1	4.5, p. 4.18
5.5	*See Topic 2: varying successive rates $A = P(1 + i_1)(1 + i_2)\ldots$ (25,000 × 1.04 × 1.05 = ₹27,300); P : CI = 216 : 127 → A/P = 343/216 = $(7/6)^3$, so i = 1/6 = 0.1666.*	PYQ Nov 18 Q18, PYQ Nov 20 Q21	PYQ 2018-Nov, 2020-Nov	4.4.4, p. 4.11; Additional Question Bank Q2, p. 4.45
5.6	*See Topic 1: capital split at different simple rates — annual income = Σ(part × rate): x(7/3 + 8/4 + 10×5/12)% = 8.5% of x = 561 → x = ₹6,600.*	PYQ Jan 21 Q16	PYQ 2021-Jan	4.4.1, p. 4.4
5.7	*See Topic 6: monthly instalment for a target future value $A = FV \times i \div [(1 + i)^n - 1]$ (50,000 × 0.01 ÷ 0.104622 = ₹4,779).*	PYQ Jan 26 Q6	PYQ 2026-Jan	4.7.1, p. 4.26; Example 27, p. 4.26

Topic 6 Future Value of Annuity

45 Scanner questions · ICAI appearances PYQ 39 · RTP 2 · MTP 4

Ref	One-liner for the student	Scanner Q	Asked in	SM source
6.1	FV of annuity regular (payments at the end of each year): $A(n, i) = A[(1 + i)^n - 1]/i$; when the question gives $(1 + i)^n$, chain [(given) − 1] ÷ i × A; if nothing says 'from today/beginning', treat it as regular.	PYQ Nov 20 Q16, PYQ Jul 21 Q22, PYQ Dec 22 Q18, PYQ Dec 23 Q15, PYQ Jun 24 Q13, RTP Sep 24 Q9, PYQ Jan 25 Q40, RTP Jan 25 Q5, MTP Apr 26 S1 Q22, PYQ May 26 Q62, PYQ May 26 Q7, PYQ Sep 26 Q5	PYQ 2020-Nov, 2021-Jul, 2022-Dec, 2023-Dec, 2024-Jun, 2025-Jan, 2026-May (×2), 2026-Sep; RTP 2024-Sep, 2025-Jan; MTP 2026-Apr S1	4.7.1, p. 4.26; Example 26, p. 4.26
6.2	Monthly/quarterly annuity: i = annual rate ÷ periods per year and n = number of payments (after the 10th payment n = 10): $200 \times [(1.005)^{10} - 1]/0.005$ = ₹2,044.	PYQ Jun 22 Q12, PYQ Jun 22 Q15, PYQ Dec 22 Q22, PYQ Sep 24 Q48	PYQ 2022-Jun (×2), 2022-Dec, 2024-Sep	4.7.1, p. 4.26; Example 27, pp. 4.26 – 4.27
6.3	Instalment needed to accumulate a target: A = FV ÷ A(n, i) = FV × i ÷ $[(1 + i)^n - 1]$ (3,00,000 ÷ 15.9374 = ₹18,823.6); the factor A(n, i) is a future-value factor even when printed as 'P(n, i)'.	PYQ May 18 Q13, PYQ Jun 19 Q17, PYQ Dec 21 Q16, PYQ Dec 22 Q14, PYQ Dec 23 Q9, PYQ Jan 25 Q39, PYQ May 25 Q21	PYQ 2018-May, 2019-Jun, 2021-Dec, 2022-Dec, 2023-Dec, 2025-Jan, 2025-May	4.9, p. 4.33; Example 35, p. 4.33
6.4	Sinking fund: periodic deposit = amount required ÷ A(n, i), deposits at year end (2,00,000 ÷ 57.275 = ₹3,491.92; 10,00,000 ÷ 15.937425 = ₹62,745).	PYQ Jun 22 Q18, PYQ Jun 23 Q20, PYQ Sep 24 Q50, PYQ Sep 26 Q57	PYQ 2022-Jun, 2023-Jun, 2024-Sep, 2026-Sep	4.9, p. 4.33; Example 35, p. 4.33
6.5	Factors: FV interest factor of an annuity = $[(1 + i)^n - 1]/i$; sinking-fund factor is its reciprocal; $[(1 + i)^n - 1]/[i(1 + i)^n]$ is the PV factor, not the FV factor.	PYQ Dec 22 Q24, MTP Jun 24 S3 Q33	PYQ 2022-Dec; MTP 2024-Jun S3	4.7.1, p. 4.26; 4.9, p. 4.33
6.6	FV of annuity due ('starting from today', 'beginning of each year') = FV of annuity regular × (1 + i): 10,000 × 14.4866 × 1.08 = ₹1,56,454.88.	PYQ May 18 Q12, PYQ Dec 22 Q17, PYQ Jun 23 Q17, PYQ Dec 23 Q10, MTP Aug 24 S2 Q28, PYQ Jan 25 Q48, PYQ May 25 Q17, PYQ Sep 25 Q14	PYQ 2018-May, 2022-Dec, 2023-Jun, 2023-Dec, 2025-Jan, 2025-May, 2025-Sep; MTP 2024-Aug S2	4.7.2, p. 4.27; Example 28, p. 4.27

Ref	One-liner for the student	Scanner Q	Asked in	SM source
6.7	Quarterly annuity due: i = rate ÷ 4, n = years × 4 (8 years 9 months = 35 quarters), then multiply once by (1 + i); dropping the × (1 + i) gives the annuity-regular figure.	PYQ May 25 Q23, MTP Apr 26 S1 Q15	PYQ 2025-May; MTP 2026-Apr S1	4.7.2, p. 4.27
6.8	*See Topic 7: PV of annuity regular $V = A[(1 + i)^n - 1]/[i(1 + i)^n]$; PV of annuity due = A + A·P(n − 1, i).*	PYQ Jan 21 Q20, PYQ Jan 26 Q57	PYQ 2021-Jan, 2026-Jan	4.8.1, p. 4.30; 4.8.2, p. 4.32
6.9	Single sum: future value $F = P(1 + i)^n$; present value $P = A \div (1 + i)^n$ (1,00,000 ÷ 1.5386 = ₹64,994.15; $10,000 \div 1.08^5$ = ₹6,805).	PYQ Nov 20 Q14, PYQ Dec 21 Q18, PYQ Jan 26 Q54	PYQ 2020-Nov, 2021-Dec, 2026-Jan	4.7, p. 4.24; 4.8, p. 4.28; Example 30, pp. 4.28 – 4.29
6.10	*See Topic 1: two equal simple-interest deposits — difference in interest = $P \times r \times (t_2 - t_1)$: $P \times 0.15 \times 1.5 = 144 \rightarrow P$ = ₹640.*	PYQ Jan 21 Q12	PYQ 2021-Jan	4.4.1, p. 4.4

Topic 7 Present Value of Annuity

34 Scanner questions · ICAI appearances PYQ 28 · RTP 1 · MTP 5

Ref	One-liner for the student	Scanner Q	Asked in	SM source
7.1	PV of annuity regular (loan amount from instalments): $V = A \cdot P(n, i)$, $P(n, i) = [(1 + i)^n - 1]/[i(1 + i)^n] = [1 - (1 + i)^{-n}]/i$; for monthly/quarterly payments use i per period and n = number of payments.	PYQ Jun 22 Q11, MTP Dec 24 S1 Q23, MTP Jan 25 S2 Q18, PYQ Jan 25 Q45, PYQ May 25 Q16, RTP May 26 Q7	PYQ 2022-Jun, 2025-Jan, 2025-May; RTP 2026-May; MTP 2024-Dec S1, 2025-Jan S2	4.8.1, p. 4.30; Example 32, p. 4.31
7.2	Equal instalment (amortisation / EMI): $A = V \div P(n, i)$, where V = price − down payment; total interest = n × A + down payment − cash price (4,38,200 ÷ 2.32163 × 3 + 60,000 − 4,98,200 = ₹1,28,040).	PYQ Jul 21 Q16, PYQ Jun 22 Q14, PYQ Jun 23 Q12, PYQ Jun 24 Q11, PYQ Sep 24 Q52, PYQ Jan 25 Q36, PYQ May 25 Q22, PYQ May 26 Q60, PYQ May 26 Q67	PYQ 2021-Jul, 2022-Jun, 2023-Jun, 2024-Jun, 2024-Sep, 2025-Jan, 2025-May, 2026-May (×2)	4.8.1, pp. 4.30 – 4.31; Examples 31 and 33, pp. 4.31 – 4.32
7.3	Deferred instalments (first payment at the end of year 5): carry the loan forward to one period before the first payment, $50,000 \times (1.1)^4$, then A = that ÷ P(5, 0.10) = ₹19,311.	MTP Apr 26 S1 Q21	MTP 2026-Apr S1	4.8.1, p. 4.30 (deferral step Not in SM — MTP-only)
7.4	PV of annuity due/immediate = initial receipt + PV of annuity regular for (n − 1) periods: 50,000 + 50,000 × P(4, 0.10) = ₹2,08,493.5.	PYQ Jun 23 Q23, PYQ Dec 23 Q17	PYQ 2023-Jun, 2023-Dec	4.8.2, p. 4.32; Example 34, pp. 4.32 – 4.33

Ref	One-liner for the student	Scanner Q	Asked in	SM source
7.5	Leasing: PV of lease rentals = rent × P(n, i); PV > cost → favourable to the lessor; for the user, lease if PV of rentals < purchase price.	PYQ Jun 19 Q16, PYQ Jun 22 Q20, PYQ Dec 23 Q11, PYQ Sep 26 Q32	PYQ 2019-Jun, 2022-Jun, 2023-Dec, 2026-Sep	4.10.1, p. 4.34; Examples 36 – 37, p. 4.34
7.6	Capital expenditure: NPV = PV of cash inflows − PV of cash outflows (equal inflows: A × P(n, i) − outlay); accept if NPV > 0, reject if NPV < 0.	PYQ Jul 21 Q19, PYQ May 25 Q24, PYQ Sep 26 Q34, PYQ Sep 26 Q56	PYQ 2021-Jul, 2025-May, 2026-Sep (×2)	4.10.2, p. 4.34; NPV technique and Example 43, pp. 4.38 – 4.39
7.7	Bond price = coupon × P(n, i) + par ÷ $(1 + i)^n$ at the investor's yield; coupon rate > yield → price above par (₹1,033.55).	MTP Apr 26 S2 Q22	MTP 2026-Apr S2	4.10.3, p. 4.35; Example 40, p. 4.35
7.8	PV of a single amount due after n years: P = A ÷ $(1 + i)^n$ (25,000 ÷ 1.06^{10} = ₹13,960; $(1.06)^{10}$ = $(1.33823)^2$).	PYQ Dec 21 Q22	PYQ 2021-Dec	4.8, p. 4.28
7.9	*See Topic 6: sinking-fund provision = (cost of new machine − scrap value) ÷ A(n, i) = 8,00,000 ÷ 40.995 = ₹19,514.*	PYQ Jan 26 Q10	PYQ 2026-Jan	4.9, p. 4.33; Additional Question Bank Q13, p. 4.46
7.10	*See Topic 8: perpetuity PV = R ÷ i with i per payment period (80 ÷ 0.02 = ₹4,000).*	MTP Aug 24 S2 Q27	MTP 2024-Aug S2	4.11.1, p. 4.36
7.11	*See Topic 8: CAGR = (V_end/V_begin)^(1/(t_n − t_0)) − 1 (NAV 100 → 200 over 4 years = 2^¼ − 1 = 18.92%).*	PYQ Jan 26 Q11	PYQ 2026-Jan	4.14, p. 4.40
7.12	*See Topic 5: gain from quarterly over annual compounding = E − r = $(1 + 0.045/4)^4$ − 1 − 0.045 = 0.076%; CI for one year quarterly = P[$(1 + r/4)^4$ − 1].*	PYQ Nov 20 Q19, PYQ Jan 26 Q55	PYQ 2020-Nov, 2026-Jan	4.5, p. 4.18; 4.4.4, p. 4.11
7.13	*See Topic 1: principal from simple interest P = I ÷ (i × t) (42,800 ÷ (0.025 × 3.25) = ₹5,26,769).*	PYQ Nov 20 Q20	PYQ 2020-Nov	4.4.1, p. 4.4

Topic 8 Perpetuity; Nominal Rate of Interest; Compounded Annual Growth Rate

38 Scanner questions · ICAI appearances PYQ 29 · RTP 1 · MTP 8

Ref	One-liner for the student	Scanner Q	Asked in	SM source
8.1	Perpetuity PV = R ÷ i, with i per payment period (monthly receipts → i = annual rate ÷ 12); add any down payment or immediate first receipt separately (45,00,000 + 80,000/0.16 = ₹50,00,000).	PYQ Jun 19 Q19, PYQ Jul 21 Q17, PYQ Jun 23 Q15	PYQ 2019-Jun, 2021-Jul, 2023-Jun	4.11.1, p. 4.36; Example 41, p. 4.36
8.2	Implied rate of a perpetuity: i = R ÷ PV (50 ÷ 5,000 = 1%; 2,000 ÷ 25,000 = 8%).	PYQ Sep 25 Q23, PYQ Sep 26 Q81	PYQ 2025-Sep, 2026-Sep	4.11.1, p. 4.36

Ref	One-liner for the student	Scanner Q	Asked in	SM source
8.3	Growing perpetuity PV = R ÷ (i − g), R = the first cash flow (50 ÷ (0.07 − 0.05) = 2,500); do not multiply R by (1 + g).	PYQ Jul 21 Q13, PYQ Jun 22 Q17, PYQ Jun 23 Q13, PYQ Jun 24 Q12, PYQ Sep 24 Q49, PYQ Jan 25 Q50, PYQ Sep 26 Q80	PYQ 2021-Jul, 2022-Jun, 2023-Jun, 2024-Jun, 2024-Sep, 2025-Jan, 2026-Sep	4.11.2, p. 4.37; Example 42, p. 4.37
8.4	CAGR from a year-wise table: (V_end/V_begin)^(1/(t_n − t_0)) − 1, where t_n − t_0 = number of intervals (5 yearly values → 4); ignore the in-between values.	PYQ Jul 21 Q18, PYQ Jun 23 Q24, PYQ Sep 24 Q47, PYQ Sep 26 Q79	PYQ 2021-Jul, 2023-Jun, 2024-Sep, 2026-Sep	4.14, p. 4.40
8.5	CAGR of an investment: (Final/Initial)^(1/t) − 1, with t in years (24 months = 2; 96 months = 8): √1.5 − 1 = 22.47%; √2 − 1 = 41.42%.	PYQ Jun 22 Q19, PYQ Dec 23 Q16, PYQ Jan 25 Q43, PYQ Sep 25 Q19, PYQ Sep 25 Q24, PYQ May 26 Q65	PYQ 2022-Jun, 2023-Dec, 2025-Jan, 2025-Sep (×2), 2026-May	4.14, p. 4.40
8.6	CAGR used forward: future value = $P(1 + g)^t$ (2,00,000 × 2.2878 = 4,57,560); time t = log(A/P) ÷ log(1 + g) (0.2219 ÷ 0.037 ≈ 6 years).	PYQ May 25 Q20, PYQ Sep 26 Q33	PYQ 2025-May, 2026-Sep	4.14 (applications: forecasting), p. 4.40
8.7	Nominal rate = Real rate + Inflation (real = 17% − 9% = 8%; real GDP after 6 years = $P(1.08)^6$ = 1.587P).	PYQ Jul 21 Q14, MTP Jun 24 S3 Q37	PYQ 2021-Jul; MTP 2024-Jun S3	4.13, p. 4.39
8.8	NPV decision rule: NPV > 0 → accept the proposal; NPV < 0 → reject.	MTP Jun 24 S3 Q38	MTP 2024-Jun S3	NPV technique (decision rule), p. 4.38
8.9	Bond price = Σ coupon/$(1 + i)^t$ + par/$(1 + i)^n$ (3-year ₹1,000 10% bond at 14% = ₹907.125); reverse it to find par: price ÷ 0.90713.	PYQ Sep 24 Q51, PYQ Jan 26 Q9	PYQ 2024-Sep, 2026-Jan	4.10.3, p. 4.35; Example 40, p. 4.35
8.10	*See Topic 5: effective rate $E = (1 + i/m)^m − 1$ (9.9% monthly → 10.36%; 3% half-yearly → 3.0225%).*	MTP Jun 24 S3 Q34, MTP Jan 25 S2 Q26	MTP 2024-Jun S3, 2025-Jan S2	4.13, p. 4.39; Exercise 4(B) Q3, p. 4.20
8.11	*See Topic 6: FV of annuity due = $A[(1 + i)^n − 1]/i × (1 + i)$; sinking-fund deposit = target ÷ A(n, i) (2,00,000 ÷ 33.066 = ₹6,049; 15,00,000 ÷ 57.275 = ₹26,189.44).*	MTP Aug 24 S2 Q25, MTP Dec 24 S1 Q25, PYQ Jan 25 Q49	PYQ 2025-Jan; MTP 2024-Aug S2, 2024-Dec S1	4.7.2, p. 4.27; 4.9, p. 4.33
8.12	*See Topic 7: equal instalment A = V ÷ P(n, i) (5,00,000 ÷ 8.51356 = ₹58,729.84); PV of annuity due = A + A·P(n − 1, i) (10,000 + 10,000 × 8.304236 = ₹93,042).*	MTP Dec 24 S1 Q24, MTP Dec 24 S1 Q26	MTP 2024-Dec S1 (×2)	4.8.1, p. 4.31 (Example 31); 4.8.2, p. 4.32

Ref	One-liner for the student	Scanner Q	Asked in	SM source
8.13	*See Topic 2: compound interest A = P(1 + i)ⁿ with i per conversion period — half-yearly minus annual CI on 20,000 at 20% for 2 years = 9,282 − 8,800 = ₹482; varying rates multiply (25,000 × 1.03 × 1.04 × 1.05 = 28,119).*	PYQ Jan 21 Q17, RTP Sep 24 Q6	PYQ 2021-Jan; RTP 2024-Sep	4.4.4, p. 4.11; Additional Question Bank Q2, p. 4.45

Part B — Chapter 4 One-liner Revision Sheet

Deduplicated and in Study Material order. Click a 'Part A ref' to jump to the Part A row(s) carrying the full wording, the Scanner questions and the SM page. Refs read Unit.Topic.Row in chapters with several units and Topic.Row otherwise. Weight: ★★★ asked by ICAI 6 or more times · ★★ 3 – 5 times · ★ once or twice. The ★★★ lines alone cover about 74% of ICAI appearances in this chapter.

Mathematics of Finance

#	One-liner	Weight	Part A ref
1	**SI: I = Pit · A = P(1 + it) · convert months to years first**	★★★	1.1, 1.2
2	**SI unknowns: t = I ÷ Pi · i = I ÷ Pt · P = A ÷ (1 + it)**	★★★	1.2, 1.3, 1.4
3	**Two SI amounts: yearly SI = ΔA ÷ Δt · P = $A_1 - t_1$ × yearly SI**	★★★	1.5, 1.10
4	**SI k-fold: t = (k − 1) × 100 ÷ R · time ⇒(k − 1) · R = T ⍰ I/P = R^2/100**	★★★	1.6, 1.7, 2.22
5	**Splitting under SI: equal interest ⇒ P ∝ 1/T · equal amounts ⇒ P ∝ 1/(1 + iT) · mixed rates: Σ part-interest = overall rate × total**	★★★	1.8, 1.9
6	Interest capitalised every n yrs: restart SI on the new principal · lending gain = P(r_2 − r_1)/100 a year	★★	1.11
7	CI vs SI, 2 yrs: CI − SI = interest on first year's interest = P·i^2	★★	1.12, 2.21
8	**CI: A_n = P(1 + i)^n · CI = P[(1 + i)^n − 1]**	★★★	2.1, 2.3
9	**Conversion periods: i = rate ÷ m, n = t × m (half-yearly 2, quarterly 4, monthly 12)**	★★★	2.2, 2.4
10	Changing rates: A = P(1 + r_1)(1 + r_2)(1 + r_3)	★★	2.5
11	**Finding P, i, n: P = CI ÷ [(1 + i)^n − 1] · (1 + i)^n = A/P · i = (A/P)^(1/n) − 1**	★★★	2.8, 2.9, 2.14, 2.15
12	**Time: n = log(A/P) ÷ log(1 + i) · doubles in T ⇒ 2^k times in kT · doubles ≈ 14.2 yrs at 5%, 12 at 6%, 9 at 8%**	★★★	2.11, 2.12, 2.13, 1.15
13	Effective rate E = (1 + i)^n − 1 · equal yields ⇒ equal E	★★	2.10, 2.20, 1.13
14	**Future value F = C.F.(1 + i)^n · uneven flows: compound each separately**	★★★	2.1, 2.16
15	**Present value P = A_n ÷ (1 + i)^n — discount factor < 1**	★★★	2.6, 2.7, 2.16
16	**Annuities: FV A[(1 + i)^n − 1]/i · PV A[(1 + i)^n − 1]/[i(1 + i)^n] · perpetuity A/i (deferred: discount R/i back)**	★★★	2.17, 2.18, 2.19, 1.14
17	Simple interest I = P·i·t; P = I ÷ (i·t); split capital → income = Σ part × rate	★★	5.6, 6.10, 7.13
18	Compound amount A = P(1 + i)^n, i = rate ÷ conversions, n = years × conversions; varying rates multiply (1 + i_1)(1 + i_2)…	★★	5.5, 8.13
19	Depreciation = CI at negative rate: A = P(1 − r)^n · residual value, not depreciation	★★	3.1, 3.2
20	Value n years ago / original cost: P = A ÷ (1 − r)^n	★★	3.3
21	Time to depreciate: (1 − r)^n = A/P → try options / logs; 0.5 yr = 6 months	★★	3.4
22	**CI − SI, 2 years = P·i^2 → P = D/i^2, i = √(D/P)**	★★★	4.1

#	One-liner	Weight	Part A ref
23	CI − SI, 3 years = $P(3i^2 + i^3) = P \cdot r^2(300 + r)/10^6$	★★	4.2
24	CI − SI, n years = $P[(1 + i)^n - 1 - n \cdot i]$; fractional year: CI for whole years + SI for fraction	★★	4.3, 4.4
25	**Effective rate $E = (1 + i)^n - 1$ · half-yearly $r + r^2/4$: 6%→6.09, 8%→8.16, 10%→10.25, 12%→12.36**	★★★	5.1
26	**Quarterly: 7%→7.18, 8%→8.24, 10%→10.38, 12%→12.55 · monthly: 12%→12.68, 24%→26.82**	★★★	5.2, 5.3, 8.10
27	E independent of principal; E > nominal if compounded more than once a year	★★	5.4, 7.12
28	FV single sum $F = P(1 + i)^n$	★★	6.9
29	**FV annuity regular $A(n, i) = A[(1 + i)^n - 1]/i$ — default when timing not stated**	★★★	6.1
30	Monthly/quarterly annuity: i per period, n = number of payments	★★	6.2
31	**FV annuity due = FV regular × (1 + i) ('from today', 'beginning of year')**	★★★	6.6, 8.11
32	Quarterly annuity due: n = years × 4; multiply by (1 + i) once	★	6.7
33	PV single sum $P = A \div (1 + i)^n$	★★	6.9, 7.8
34	**PV annuity regular $V = A \cdot P(n, i)$, $P(n, i) = [1 - (1 + i)^{-n}]/i$**	★★★	7.1, 6.8
35	**EMI / amortisation $A = V \div P(n, i)$; V = price − down payment; total interest = nA + down − cash price**	★★★	7.2, 8.12
36	Deferred loan: grow loan to one period before first instalment, then $A = V' \div P(n, i)$	★	7.3
37	PV annuity due = $A + A \cdot P(n - 1, i)$	★★	7.4, 8.12
38	**Sinking fund deposit = target ÷ A(n, i); net of scrap value; factor = 1/FVIFA**	★★★	6.3, 6.4, 6.5, 3.5, 7.9
39	Leasing: PV of rentals > cost → lessor gains; PV of rentals < price → lease, don't buy	★★	7.5
40	Capital expenditure / NPV = PV inflows − PV outflows; NPV > 0 accept	★★	7.6, 8.8
41	Bond price = $\text{coupon} \cdot P(n, i) + \text{par}/(1 + i)^n$; coupon > yield → above par	★★	7.7, 8.9
42	**Perpetuity PV = R/i (i per payment period); implied rate i = R/PV**	★★★	8.1, 8.2, 7.10
43	**Growing perpetuity PV = R/(i − g), R = first cash flow**	★★★	8.3
44	Nominal = Real + Inflation	★	8.7
45	CAGR = $(V_{end}/V_{begin})^{(1/(t_n - t_0))} - 1$; count intervals, not values	★★	8.4, 7.11
46	**CAGR of investment: (Final/Initial)^(1/t) − 1, t in years; forward: $A = P(1 + g)^t$; $t = \log(A/P)/\log(1 + g)$**	★★★	8.5, 8.6

CHAPTER 5

Permutations and Combinations

112 Scanner questions · 63 one-liners · 26 revision pointers

Part A — One-liners mapped to Scanner questions and Study Material

Permutations and Combinations

SM Chapter 5, pages 5.1 – 5.44

Topic 1 The Factorial

5 Scanner questions · ICAI appearances PYQ 3 · RTP – · MTP 2

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.1	n! = n(n − 1)(n − 2) … 3·2·1 and 0! = 1. To solve factorial equations, write every term over the largest factorial: 1/7! + 1/8! = N/9! → (9 × 8 + 9)/9! = N/9! → N = 81 (same method as 1/9! + 1/10! = x/11! → x = 121).	PYQ Nov 18 Q23	PYQ 2018-Nov	5.2, Examples 1 – 3, pp. 5.2 – 5.3
1.2	$^nC_r = {}^nP_r \div r!$ (since $^nC_r \cdot r! = {}^nP_r$): r! = $^nP_r \div {}^nC_r$ = 720 ÷ 120 = 6 = 3! → r = 3.	PYQ Nov 18 Q24	PYQ 2018-Nov	5.7, p. 5.15; Example 10, pp. 5.18 – 5.19
1.3	Cancel factorials with n! = n·(n − 1)!: n!/10 = (n − 1)!/(n − 1 − n + 3)! = (n − 1)!/2! → n/10 = 1/2 → n = 5. Simplify the bracket inside the factorial first (it is a constant, 2).	PYQ Jun 22 Q23	PYQ 2022-Jun	5.2, Example 4, p. 5.3
1.4	*See Topic 3: circular arrangement with two persons in a fixed relative position (tallest always on the right of shortest) — treat the pair as one unit whose order is fixed: (4 − 1)! = 6.*	MTP Jan 25 S2 Q28	MTP 2025-Jan S2	5.5, p. 5.9; Exercise 5(B) Q21, p. 5.15
1.5	*See Topic 6: 'at least one from each section' = $(2^a - 1)(2^b - 1)$, because each question is taken or left (2 ways) and the 'none' case is removed in each section: $(2^6 - 1)(2^4 - 1) = 63 \times 15 = 945$.*	MTP Jan 25 S2 Q29	MTP 2025-Jan S2	5.8 III and Example 3, pp. 5.22 – 5.24

Topic 2 Permutation

31 Scanner questions · ICAI appearances PYQ 14 · RTP 2 · MTP 15

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.1	^nP_r = n!/(n − r)! = n(n − 1) … (n − r + 1), exactly r factors; ^nP_n = n!/0! = n!. Since 0! = 1! = 1, $^nP_n = {}^nP_{n-1}$ = n! — the correct statement.	PYQ Jun 19 Q21	PYQ 2019-Jun	5.4 Results 1 – 3, pp. 5.4 – 5.5
2.2	Solving ^nP_r equations: cancel the common factors and reduce to a product of consecutive integers — $^3P_2 : {}^2P_2 = (n - 2) : 1 \rightarrow n = 4$; $^4P_4 = 20 \cdot {}^2P_2 \rightarrow (n - 2)(n - 3) = 20 \rightarrow n = 7$; $^6P_6 = 20 \cdot {}^4P_4 \rightarrow (n - 4)(n - 5) = 20 \rightarrow n = 9$; $^5P_5 = 20 \cdot {}^3P_3 \rightarrow (n - 3)(n - 4) = 20 \rightarrow n = 8$; $^2P_2 = n(n - 1) = 12 \rightarrow 4$, = 72 = 9 × 8 → 9. Reject the negative root.	PYQ Nov 19 Q25, PYQ Nov 20 Q25, PYQ Jul 21 Q24, PYQ Dec 21 Q25, PYQ Jun 23 Q27, PYQ Dec 23 Q25, PYQ Sep 25 Q26	PYQ 2019-Nov, 2020-Nov, 2021-Jul, 2021-Dec, 2023-Jun, 2023-Dec, 2025-Sep	5.4, Examples 6 and 8, pp. 5.5 – 5.6; Exercise 5(A) Q9 – 10, pp. 5.7 – 5.8

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.3	Distinct objects to distinct ordered places, no repetition = ${}^{n}P_{r}$: 1st/2nd/3rd from 12 teams = ${}^{12}P_{3}$ = 1,320; 3 prizes of 5 to 3 brothers (one each) = ${}^{5}P_{3}$ = 60; 4 of the 8 distinct letters of SPLENDOR = ${}^{8}P_{4}$ = 1,680; six-digit numbers from 10 distinct digits = ${}^{10}P_{6}$.	MTP Jun 24 S3 Q16, MTP Jun 24 S3 Q21, MTP Jan 25 S2 Q30, PYQ Sep 26 Q6	PYQ 2026-Sep; MTP 2024-Jun S3 (×2), 2025-Jan S2	5.4, Examples 2 and 4, p. 5.5; Exercise 5(A) Q18, p. 5.8
2.4	'Rearranged' excludes the given order: n distinct letters can be rearranged in n! − 1 ways — COMPUTER = 8! − 1 = 40,319 (trap: 40,320).	MTP Jan 25 S2 Q27	MTP 2025-Jan S2	5.4 Result 1, p. 5.4; Exercise 5(A) Q14, p. 5.8
2.5	Repetition allowed: r places each filled from n choices = n^{r} — 12 Yes/No questions = 2^{12} = 4,096.	MTP Jun 24 S3 Q17	MTP 2024-Jun S3	5.8 II, p. 5.22
2.6	Diagonals of an n-sided polygon = ${}^{n}C_{2} - n = n(n-3)/2$: $n(n-3)/2 = 44 \rightarrow n^{2} - 3n - 88 = 0 \rightarrow n = 11$.	MTP Jun 24 S3 Q19	MTP 2024-Jun S3	Exercise 5(C) Q10 (Hint), p. 5.27
2.7	Painting the 6 faces of a cube with 6 different colours = 6! ÷ 24 rotations = 30 (fix one colour on top: 5 choices for the bottom × (4 − 1)! = 6 circular arrangements of the sides).	MTP Jun 24 S3 Q20	MTP 2024-Jun S3	Not in SM (MTP-only)
2.8	Direct counting, not a P&C formula: females = grandmother + mother + 4 wives + 4 × 2 daughters = 14.	MTP Jun 24 S3 Q58	MTP 2024-Jun S3	Not in SM (MTP-only)
2.9	*See Topic 6: selection from two groups with a cap or minimum — list the admissible cases and add ${}^{a}C^{x} \times {}^{b}C_{y}$: 6 of 10 (5 + 5), not more than 4 from either → (4,2) + (3,3) + (2,4) = 50 + 100 + 50 = 200; 8 of 12 (7 + 5), at least 3 from each → (5,3) + (4,4) + (3,5) = 210 + 175 + 35 = 420.*	MTP Aug 24 S2 Q30, MTP Dec 24 S1 Q29	MTP 2024-Aug S2, 2024-Dec S1	5.7, Example 4, p. 5.16; Additional Question Bank Q109, p. 5.40
2.10	*See Topic 6: conditional selection by complement — 3 books of 8 = ${}^{8}C_{3}$ = 56, less those with Part II but not Part I (Part II in, Part I out: ${}^{6}C_{2}$ = 15) → 41.*	MTP Dec 24 S1 Q28	MTP 2024-Dec S1	5.7, p. 5.15 (complement of ${}^{n}C_{r}$)
2.11	*See Topic 6: voting for 1, 2 or up to r of n candidates = ${}^{n}C_{1} + {}^{n}C_{2} + \ldots + {}^{n}C_{r}$: 6 candidates, up to 3 → 6 + 15 + 20 = 41.*	PYQ Sep 25 Q27	PYQ 2025-Sep	Exercise 5(C) Q13, p. 5.28; Additional Question Bank Q108, p. 5.40
2.12	*See Topic 1: 1/9! + 1/10! = x/11! → (11 × 10 + 11)/11! → x = 121.*	MTP Aug 24 S2 Q31	MTP 2024-Aug S2	5.2, Example 3, p. 5.3
2.13	${}^{n}P_{r} = {}^{n-1}P_{r} + r \cdot {}^{n-1}P_{r-1}$ (permutations excluding a specified thing + those including it), and ${}^{n}P_{r} = n!/(n-r)!$ — so ${}^{n-1}P_{r} + r \cdot {}^{n-1}P_{r-1}$ equals both (a) and (b).	MTP Aug 24 S2 Q32	MTP 2024-Aug S2	5.7, Example 15(ii), p. 5.21; Exercise 5(D) Q16, p. 5.30
2.14	Items always together = one block: (n − k + 1)! × k! — 6 boys and 4 girls with the girls together = 7! × 4!.	RTP Sep 24 Q5	RTP 2024-Sep	5.6, Example 8(i), p. 5.12

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.15	Letters restricted to odd/even places: arrange the restricted letters in the available places (${}^{n}P_{k}$), then the rest in the remaining places — FAILURE, 3 consonants in 4 odd places = ${}^{4}P_{3} \times 4! = 576$; TROPICAL, 3 vowels in 4 odd places = ${}^{4}P_{3} \times 5! = 2{,}880$; ARTICLE, 3 vowels in 3 even places = $3! \times 4! = 144$.	MTP Dec 24 S1 Q30, PYQ Sep 25 Q28, RTP Jan 25 Q8	PYQ 2025-Sep; RTP 2025-Jan; MTP 2024-Dec S1	Additional Question Bank Q35 and Q75 – 76, pp. 5.34, 5.37; Exercise 5(A) Q23, p. 5.8
2.16	Circular, no two of one group adjacent: seat the other group first in $(n-1)!$, then fill the n gaps in n! ways — 4 men and 4 women = $3! \times 4! = 144$.	MTP Dec 24 S1 Q31	MTP 2024-Dec S1	5.5, p. 5.9; Additional Question Bank Q12, p. 5.32
2.17	'A always speaks before B' among n speakers: the SM key treats A, B as one ordered block → $(n-1)! = 4! = 24$. Trap: if 'before' is not 'immediately before', half of all orders qualify → $n!/2 = 60$.	PYQ May 25 Q27	PYQ 2025-May	Exercise 5(B) Q15, p. 5.14
2.18	Alike letters: $n!/(p!\,q!\,r!)$; 'not together' = total − together (block): MISSISSIPPI = $11!/(4!\,4!\,2!) = 34{,}650 - 8!/(4!\,2!) = 840 \rightarrow 33{,}810$; MATHEMATICS with vowels together = $8!/(2!\,2!) \times 4!/2! = 10{,}080 \times 12 = 1{,}20{,}960$.	PYQ May 25 Q25, PYQ Sep 25 Q25	PYQ 2025-May, 2025-Sep	5.8 I, pp. 5.21 – 5.22; 5.6 Example 2, p. 5.10; Additional Question Bank Q21, p. 5.32

Topic 3 Circular Permutations

1 Scanner question · ICAI appearances PYQ 1 · RTP – · MTP –

Ref	One-liner for the student	Scanner Q	Asked in	SM source
3.1	n different things in a circle = $(n-1)!$; no two of group B adjacent → seat group A in $(n-1)!$, then put B in the n gaps in n! ways: 5 Americans and 5 Indians = $4! \times 5!$.	PYQ May 26 Q66	PYQ 2026-May	5.5, p. 5.9; Additional Question Bank Q92, p. 5.39

Topic 4 Permutation with Restrictions

23 Scanner questions · ICAI appearances PYQ 19 · RTP 1 · MTP 3

Ref	One-liner for the student	Scanner Q	Asked in	SM source
4.1	No two girls together (gap method): arrange the b boys in b! ways, then place the g girls in the (b + 1) gaps in ${}^{b+1}P_g$ ways — 5 boys, 3 girls = $5! \times {}^{6}P_{3} = 14{,}400$; 4 boys, 3 girls = $4! \times {}^{5}P_{3} = 1{,}440$.	PYQ Nov 19 Q21, PYQ Jun 24 Q26, PYQ Sep 24 Q55	PYQ 2019-Nov, 2024-Jun, 2024-Sep	5.6, Example 8(ii), p. 5.12
4.2	Round table, no two boys adjacent: girls first in $(5-1)! = 24$, boys in the 5 gaps in $5! = 120 \rightarrow 2{,}880$.	PYQ Jul 21 Q27	PYQ 2021-Jul	5.5, p. 5.9; Additional Question Bank Q92, p. 5.39
4.3	No two boys and no two girls together in a row (6 boys, 5 girls): boys must take the odd places, girls the even places → $6! \times 5! = 86{,}400$ (equal numbers would give $2 \times n! \times n!$).	PYQ Dec 21 Q27	PYQ 2021-Dec	5.6, Example 10, p. 5.13

Ref	One-liner for the student	Scanner Q	Asked in	SM source
4.4	Vowels in odd/even places: ${}^{p}P_{v}$ × (remaining letters)! — DETAIL, 3 vowels in 3 odd places = 3! × 3! = 36; VIOLENT, 3 vowels in 3 even places = 3! × 4! = 144; ORIENTAL, A and E in 4 odd places = ${}^{4}P_{2}$ × 6! = 8,640.	PYQ Dec 21 Q26, MTP Apr 26 S1 Q30, RTP May 26 Q11	PYQ 2021-Dec; RTP 2026-May; MTP 2026-Apr S1	Additional Question Bank Q75 – 76, p. 5.37; Exercise 5(A) Q23, p. 5.8
4.5	Fixed positions: place the restricted items, arrange the rest — one trophy fixed in the middle = 4! = 24; President and Vice-President in the two centre seats = 2! × 6!; 5 children in the 5 gaps between 6 trees = 5! = 120.	PYQ Jun 22 Q25, PYQ Jun 24 Q28, MTP Apr 26 S2 Q25	PYQ 2022-Jun, 2024-Jun; MTP 2026-Apr S2	Additional Question Bank Q98 – 99, p. 5.39; 5.4 Example 3, p. 5.5
4.6	Vowels always together: (consonants + 1)! × (vowels)!, dividing by factorials of repeated letters — SOFTWARE = 6! × 3! = 4,320; STADIUM = 5! × 3!; CORPORATION = 7!/2! × 5!/3! = 2,520 × 20 = 50,400.	PYQ Jun 23 Q28, PYQ Dec 23 Q23, PYQ Jun 24 Q27	PYQ 2023-Jun, 2023-Dec, 2024-Jun	5.6, Example 1, p. 5.10; Additional Question Bank Q36, p. 5.34
4.7	Each group together: (number of groups)! × each group's internal arrangement — 5 doctors, 4 professors, 6 auditors = 3! × 5! × 4! × 6!.	PYQ Jan 25 Q46	PYQ 2025-Jan	5.6, Example 3, p. 5.11
4.8	Two particular persons never together = n! − 2!(n − 1)! = (n − 2)(n − 1)!: 5 people → 120 − 48 = 72. All 4 women together with 5 men = 6! × 4! = 17,280.	PYQ Sep 26 Q9, PYQ Sep 26 Q10	PYQ 2026-Sep (×2)	5.6, Examples 2 and 8(i), pp. 5.10 – 5.12
4.9	Numbers without repetition: fill the restricted place first (units digit for even/divisible by 5) — 3-digit from 2, 3, 5, 6, 7, 9 divisible by 5 → 5 × 4 × 1 = 20; 5-digit even from 1 – 7 → 3 × ${}^{6}P_{4}$ = 3 × 360 = 1,080.	PYQ Jan 26 Q65, PYQ May 26 Q12	PYQ 2026-Jan, 2026-May	5.6, Examples 4 – 5, p. 5.11
4.10	'Greater than' numbers: count by number of digits and allowed leading digits — > 2,000 from 1 – 5: 4 × ${}^{4}P_{3}$ + 5! = 96 + 120 = 216; between 2,000 and 7,000 from 0, 1, 2, 3, 4, 5, 7, 9: leading digit 2/3/4/5 (4 ways; 7 is excluded as 7xxx ≥ 7,000) × ${}^{7}P_{3}$ = 4 × 210 = 840.	PYQ Jan 26 Q64, PYQ Sep 26 Q7	PYQ 2026-Jan, 2026-Sep	5.6, Examples 5 – 6, pp. 5.11 – 5.12
4.11	Begin with X and not end with Y = (n − 1)! − (n − 2)!: MONDAY → 5! − 4! = 120 − 24 = 96.	MTP Apr 26 S2 Q27	MTP 2026-Apr S2	Exercise 5(B) Q18, p. 5.14
4.12	Fundamental (multiplication) principle with a position restriction: first place uppercase, the other uppercase in any of the 5 remaining places (5 ways), then 6 distinct letters in order → 5 × 26 × 25 × 24 × 23 × 22 × 21.	PYQ Jun 24 Q25	PYQ 2024-Jun	5.1 Fundamental principles, p. 5.2

Topic 5 Combinations

36 Scanner questions · ICAI appearances PYQ 32 · RTP – · MTP 4

Ref	One-liner for the student	Scanner Q	Asked in	SM source
5.1	Triangles from n points of which k are collinear = ${}^{n}C_{3}$ − ${}^{k}C_{3}$: 12 points, 7 collinear → 220 − 35 = 185; 20 points, 5 collinear → 1,140 − 10 = 1,130.	PYQ May 18 Q18, PYQ Dec 22 Q25	PYQ 2018-May, 2022-Dec	Exercise 5(C) Q11, p. 5.27; Additional Question Bank Q123 – 124, p. 5.42

Ref	One-liner for the student	Scanner Q	Asked in	SM source
5.2	${}^{n+1}C_r = {}^nC_r + {}^nC_{r-1}$ with ${}^nC_r = {}^nC_{n-r}$: ${}^{999}C_{97} + {}^{999}C_{98}$ (= ${}^{999}C_{901}$) = ${}^{1000}C_{98}$ → x = 999; ${}^nC_p + 2\cdot{}^nC_{p-1} + {}^nC_{p-2} = {}^{n+1}C_p + {}^{n+1}C_{p-1} = {}^{n+2}C_p$.	PYQ May 18 Q19, PYQ Jan 21 Q26	PYQ 2018-May, 2021-Jan	5.7 Property 2, p. 5.19; Examples 12 and 14, p. 5.20; Exercise 5(C) Q20, p. 5.28
5.3	Handshakes / single matches among n = ${}^nC_2 = n(n-1)/2$: 40 guests → 780; 105 handshakes → n(n − 1) = 210 = 15 × 14 → n = 15; World Cup minimum = 2 × ${}^6C_2 + {}^6C_2 + {}^4C_2 + 2$ (best of three, minimum 2) = 30 + 15 + 6 + 2 = 53.	PYQ Jun 19 Q22, PYQ Jun 23 Q25, PYQ Sep 24 Q57	PYQ 2019-Jun, 2023-Jun, 2024-Sep	5.7, p. 5.15; Exercise 5(C) Q14, p. 5.28
5.4	Eight-oared boat, 4 seats a side: seat the side-restricted rowers first, then the rest — ${}^4P_3 \times {}^4P_2 \times 3!$ = 24 × 12 × 6 = 1,728.	PYQ Jun 19 Q23	PYQ 2019-Jun	Exercise 5(D) Q4, p. 5.29; Additional Question Bank Q111, p. 5.41
5.5	Simple selection, order irrelevant: ${}^nC_r = n!/(r!(n-r)!)$ — 3 of 5 = 10; 2 of 6 branch heads = 15; 3 apples of 7 = 35; 4 of 7 men (no women) = 35.	PYQ Nov 19 Q23, PYQ Nov 20 Q23, PYQ Jan 21 Q27, PYQ May 26 Q68	PYQ 2019-Nov, 2020-Nov, 2021-Jan, 2026-May	5.7, Examples 3, 6 and 9(a), pp. 5.16 – 5.18
5.6	Independent selections multiply: exactly 2 girls of 4 and 2 boys of 6 = ${}^4C_2 \times {}^6C_2 = 90$; 1 man of 2 and 2 women of 3 = ${}^2C_1 \times {}^3C_2 = 6$; one Jack and three Aces = ${}^4C_1 \times {}^4C_3 = 16$ (none of the options).	PYQ Nov 19 Q24, PYQ May 25 Q28, PYQ May 26 Q69	PYQ 2019-Nov, 2025-May, 2026-May	5.8 V, p. 5.23; Additional Question Bank Q103, p. 5.40
5.7	Select then arrange = ${}^nC_r \times r! = {}^nP_r$: women in 2 of chairs 1 – 4 = ${}^4P_2 = 12$, men in 3 of the other 6 = ${}^6P_3 = 120$ → 1,440; 4-letter words from 10 distinct letters = ${}^{10}P_4 = 5{,}040$; from LOGARITHM (9 distinct) = ${}^9P_4 = 3{,}024$.	PYQ Jan 21 Q21, PYQ Dec 21 Q23, PYQ Jun 22 Q22	PYQ 2021-Jan, 2021-Dec, 2022-Jun	5.7, p. 5.15 (${}^nC_r \cdot r! = {}^nP_r$); 5.4 Example 2, p. 5.5; Additional Question Bank Q8, p. 5.31
5.8	*See Topic 4: numbers — fill the restricted place first: 5-digit from 1 – 6 not divisible by 5 = ${}^6P_5 - {}^5P_4 = 600$; 7-digit from 3 – 9 not ending in 5 = 7! − 6! = 4,320; 4-digit odd from 0, 1, 2, 3, 4, 7, 8 = 3 (units) × 5 (thousands, no 0) × ${}^5P_2 = 300$; with repetition, 3-digit odd from 5 – 9 = 5 × 5 × 3 = 75.*	PYQ Nov 19 Q22, PYQ Jan 21 Q24, PYQ Jul 21 Q25, PYQ Dec 22 Q28	PYQ 2019-Nov, 2021-Jan, 2021-Jul, 2022-Dec	5.6, Examples 4 – 5, p. 5.11; Additional Question Bank Q33 – 34, pp. 5.33 – 5.34
5.9	*See Topic 2: go and return by a different mode = m × (m − 1): 11 × 10 = 110; 10 × 9 = 90.*	PYQ Jul 21 Q26, PYQ Jun 22 Q21	PYQ 2021-Jul, 2022-Jun	5.1 Fundamental principles, p. 5.2; Exercise 5(B) Q16, p. 5.14
5.10	*See Topic 4: a letter not in the first place = n! − (n − 1)!: PETROL → 720 − 120 = 600.*	PYQ Dec 21 Q24	PYQ 2021-Dec	5.6, Example 4(i), p. 5.11
5.11	*See Topic 6: repetition allowed = n^r — 5 questions with 4 options each = $4^5 = 1{,}024$.*	PYQ Jun 22 Q26	PYQ 2022-Jun	5.8 II, p. 5.22

Ref	One-liner for the student	Scanner Q	Asked in	SM source
5.12	${}^nC_x = {}^nC_y \Rightarrow x = y$ or $x + y = n$: ${}^{11}C_x = {}^{11}C_{2x-4}$ $(x \neq 4) \rightarrow 3x - 4 = 11 \rightarrow x = 5$, ${}^7C_5 = {}^7C_2 = 21$; ${}^{15}C_{3r} = {}^{15}C_{r+3} \rightarrow 4r + 3 = 15 \rightarrow r = 3$; ${}^nC_7 = {}^nC_5 \rightarrow n = 12$.	PYQ Jun 22 Q28, PYQ Dec 23 Q24, MTP Aug 24 S2 Q33	PYQ 2022-Jun, 2023-Dec; MTP 2024-Aug S2	5.7 Property 1 and Example 11, pp. 5.19 – 5.20; Exercise 5(C) Q3 and Q7, p. 5.27
5.13	*See Topic 4: alternate in a row, 4 boys and 3 girls (B G B G B G B) = 4! × 3! = 144.*	PYQ Dec 22 Q26	PYQ 2022-Dec	5.6, Example 10, p. 5.13
5.14	${}^nC_r \cdot r! = {}^nP_r$: $r! = 3{,}024 \div 126 = 24 \rightarrow r = 4$; ${}^nP_4 = 3{,}024 = 9 \times 8 \times 7 \times 6 \rightarrow n = 9$.	PYQ Dec 22 Q27	PYQ 2022-Dec	5.7, Example 10, pp. 5.18 – 5.19; Exercise 5(C) Q2, p. 5.27
5.15	${}^nC_1 + {}^nC_2 + \ldots + {}^nC_n = 2^n - 1$ (trap: 2^n includes ${}^nC_0$).	MTP Jun 24 S3 Q22	MTP 2024-Jun S3	5.8 III, pp. 5.22 – 5.23; Exercise 5(D) Q20, p. 5.30
5.16	Ratios of combinations: ${}^{2n}C_3 : {}^nC_3 = 4(2n - 1)/(n - 2) = 11 \rightarrow n = 6$; ${}^nC_r \div {}^nC_{r-1} = (n - r + 1)/r$ — 56/28 gives $n - 3r = -1$, 70/56 gives $4n - 9r = 5 \rightarrow n = 8, r = 3$.	MTP Aug 24 S2 Q34, PYQ Jan 26 Q62	PYQ 2026-Jan; MTP 2024-Aug S2	5.7, Example 13, p. 5.20; Exercise 5(C) Q4, p. 5.27
5.17	*See Topic 4: each profession together = 3! × 5! × 2! × 3! = 8,640.*	PYQ Jan 26 Q63	PYQ 2026-Jan	5.6, Example 3, p. 5.11
5.18	Room lit if at least one good bulb = total − all defective: ${}^5C_2 - {}^3C_2 = 10 - 3 = 7$.	MTP Apr 26 S1 Q28	MTP 2026-Apr S1	Exercise 5(C) Q22, p. 5.28

Topic 6 Standard Results

16 Scanner questions · ICAI appearances PYQ 16 · RTP – · MTP –

Ref	One-liner for the student	Scanner Q	Asked in	SM source
6.1	'At least one' = total − none: at least one black ball = ${}^9C_3 - {}^6C_3 = 84 - 20 = 64$; team of 5 with at least one girl = ${}^{11}C_5 - {}^7C_5 = 462 - 21 = 441$; panel of 3 with at least one engineer = ${}^8C_3 - {}^5C_3 = 56 - 10 = 46$.	PYQ Nov 18 Q21, PYQ Nov 20 Q24, PYQ Jun 22 Q24, PYQ Jan 25 Q59	PYQ 2018-Nov, 2020-Nov, 2022-Jun, 2025-Jan	Exercise 5(C) Q8, p. 5.27; Additional Question Bank Q134, p. 5.43
6.2	'At least k' by cases — add ${}^aC_x \times {}^bC_y$ over each admissible split: at least 2 of 4 women in a committee of 4 = 168 + 32 + 1 = 201; at least 2 of 5 women in 3 = 30 + 10 = 40; at least one odd and one even of 8 counters, 4 at a time = 16 + 36 + 16 = 68 (= ${}^8C_4 - 2$).	PYQ Nov 20 Q26, PYQ Sep 24 Q56, PYQ Jan 25 Q65	PYQ 2020-Nov, 2024-Sep, 2025-Jan	5.8, Example 5, pp. 5.24 – 5.25; Additional Question Bank Q141, p. 5.44
6.3	Independent selections: ${}^{n1}C_{r1} \times {}^{n2}C_{r2}$ — 2 of 5 males × 3 of 6 females = 10 × 20 = 200; Principal from the 2 eligible, then 2 Vice-Principals from the remaining 5 = ${}^2C_1 \times {}^5C_2 = 20$.	PYQ Sep 24 Q53, PYQ Jan 25 Q53	PYQ 2024-Sep, 2025-Jan	5.8 V, p. 5.23; Additional Question Bank Q130, p. 5.43
6.4	Words = select then arrange: ${}^7C_3 \times {}^4C_2 \times 5! = 35 \times 6 \times 120 = 25{,}200$ (trap: 210 counts only the selections).	PYQ May 25 Q26	PYQ 2025-May	Exercise 5(D) Q3, p. 5.29; Additional Question Bank Q110, p. 5.41

Ref	One-liner for the student	Scanner Q	Asked in	SM source
6.5	Things alike: n!/(p! q! r!) where p + q + r = n — 13 balls printed as 13!/(4! 6! 5!) = 3,003 (data do not add up — see Editorial). Never together = total − together: BHARAT = 6!/2! = 360 − (5!/2!) × 2! = 120 → 240.	PYQ Nov 18 Q22, PYQ Jan 25 Q56	PYQ 2018-Nov, 2025-Jan	5.8 I and Example 2, pp. 5.21 – 5.24; 5.6 Example 2, p. 5.10
6.6	Two people who refuse to serve together: total − committees containing both = ${}^{8}C_{3} \times {}^{7}C_{4} - {}^{7}C_{2} \times {}^{6}C_{3}$ = 1,960 − 420 = 1,540.	PYQ Jun 23 Q26	PYQ 2023-Jun	Exercise 5(C) Q19, p. 5.28
6.7	Parallelograms from a set of m parallel lines cut by n parallel lines = ${}^{m}C_{2} \times {}^{n}C_{2}$: 6 and 4 → 15 × 6 = 90.	PYQ Jun 22 Q27	PYQ 2022-Jun	Exercise 5(C) Q15, p. 5.28
6.8	Go and return by a different flight = m × (m − 1): 10 × 9 = 90.	PYQ Jan 21 Q23	PYQ 2021-Jan	5.1 Fundamental principles, p. 5.2; Exercise 5(B) Q16, p. 5.14
6.9	n keys to n locks, maximum trials = (n − 1) + (n − 2) + … + 1 = $\Sigma_{k=2}^{n}$ (k − 1) = n(n − 1)/2 = ${}^{n}C_{2}$.	PYQ Jan 21 Q22	PYQ 2021-Jan	Not in SM (PYQ-only)

Part B — Chapter 5 One-liner Revision Sheet

Deduplicated and in Study Material order. Click a 'Part A ref' to jump to the Part A row(s) carrying the full wording, the Scanner questions and the SM page. Refs read Unit.Topic.Row in chapters with several units and Topic.Row otherwise. Weight: ★★★ asked by ICAI 6 or more times · ★★ 3 – 5 times · ★ once or twice. The ★★★ lines alone cover about 46% of ICAI appearances in this chapter.

Permutations and Combinations

#	One-liner	Weight	Part A ref
1	AND → multiply, OR → add; go and return by a different route = m(m − 1)	★★	4.12, 5.9, 6.8
2	n! = n·(n − 1)!, 0! = 1; clear fractions over the largest factorial (1/9! + 1/10! = 121/11!)	★★	1.1, 1.3, 2.12
3	${}^{n}P_r = n!/(n-r)! = n(n-1)\ldots(n-r+1)$; ${}^{n}P_n = {}^{n}P_{n-1} = n!$	★★	2.1, 2.3
4	**${}^{n}P_r$ equations: cancel to consecutive integers, e.g. ${}^{n}P_4 = k\cdot{}^{n}P_2 \rightarrow (n-2)(n-3) = k$**	★★★	2.2
5	Rearrangements of n distinct letters = n! − 1	★	2.4
6	Circle (n − 1)!; no two of B adjacent → (n − 1)! × n!; fixed pair → (n − 2)!	★★	3.1, 2.16, 4.2, 1.4
7	Particular object excluded ${}^{n-1}P_r$; included $r\cdot{}^{n-1}P_{r-1}$; sum = ${}^{n}P_r$	★	2.13
8	**Together = block: (n − k + 1)! × k!; groups together = g! × each group's internal !**	★★★	2.14, 4.6, 4.7, 5.17
9	Two never together = n! − 2(n − 1)! = (n − 2)(n − 1)!	★	4.8
10	No two together = b! × ${}^{b+1}P$_g; alternate = b! × g!	★★	4.1, 4.3, 5.13
11	**Odd/even places: ${}^{p}P_v$ × (rest)!**	★★★	2.15, 4.4
12	Fixed seats, begin with X, not first: fix then arrange; (n − 1)! − (n − 2)!	★★	4.5, 4.11, 5.10
13	**Numbers: fill the restricted digit (units / leading, no 0) first; > N → split by digits**	★★★	4.9, 4.10, 5.8
14	'A before B': SM key (n − 1)! — strictly n!/2	★	2.17
15	**${}^{n}C_r = n!/(r!(n-r)!) = {}^{n}P_r/r!$**	★★★	5.5, 1.2, 5.14
16	Select then arrange = ${}^{n}C_r \times r! = {}^{n}P_r$; words = ${}^{a}C_x \times {}^{b}C_y \times (x+y)!$	★★	5.7, 6.4
17	${}^{n}C_x = {}^{n}C_y \rightarrow x = y$ or $x + y = n$	★★	5.12
18	${}^{n}C_r + {}^{n}C_{r-1} = {}^{n+1}C_r$; ${}^{n}C_r/{}^{n}C_{r-1} = (n-r+1)/r$	★★	5.2, 5.16
19	**Handshakes ${}^{n}C_2$; diagonals n(n − 3)/2; triangles ${}^{n}C_3 - {}^{k}C_3$; parallelograms ${}^{m}C_2 \times {}^{n}C_2$**	★★★	5.3, 2.6, 5.1, 6.7
20	Alike things n!/(p! q! r!) (p + q + r must equal n)	★★	2.18, 6.5
21	Repetition allowed: n^r	★	2.5, 5.11
22	Some or all = $2^n - 1$; one from each section $(2^a - 1)(2^b - 1)$; up to r = ${}^{n}C_1 + \ldots + {}^{n}C_r$	★★	5.15, 1.5, 2.11
23	Independent selections multiply: ${}^{n1}C_{r1} \times {}^{n2}C_{r2}$	★★	5.6, 6.3
24	**At least one = total − none; at least k = add the cases**	★★★	6.1, 6.2, 2.9, 2.10, 5.18

#	One-liner	Weight	Part A ref
25	Pair refusing together = total − both included	★	6.6
26	Odd ones: boat crew ${}^4P_3 \times {}^4P_2 \times 3!$; locks ${}^nC_2$; cube $6!/24 = 30$; family head-count	★★	5.4, 6.9, 2.7, 2.8

CHAPTER 6

Sequence and Series

88 Scanner questions · 39 one-liners · 20 revision pointers

Part A — One-liners mapped to Scanner questions and Study Material

Sequence and Series

SM Chapter 6, pages 6.1 – 6.34

Topic 1 Arithmetic Progression

49 Scanner questions · ICAI appearances PYQ 37 · RTP – · MTP 12

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.1	Three terms in A.P.: a, b, c are in A.P. ⇔ b − a = c − b ⇔ a + c = 2b. Set 2 × (middle) = (first + third) and solve: 7K + 3, 4K − 5, 2K + 10 → K = −23; x + 1, 3x, 4x + 2 → 6x = 5x + 3 → x = 3.	PYQ Nov 18 Q28, MTP Jun 24 S3 Q5, MTP Dec 24 S1 Q33	PYQ 2018-Nov; MTP 2024-Jun S3, 2024-Dec S1	6.3, p. 6.3
1.2	nth term $t_n = a + (n − 1)d$, $d = t_2 − t_1$ (d may be negative or algebraic): 8, 5, 2, … → $t_9 = 8 + 8(−3) = −16$; 1/3, (1 − 3b)/3, … → d = −b. Equal nth terms of two A.P.s: equate 11 − 2n = 18 − 3n → n = 7 (the question asks for n, not the term).	PYQ Jun 22 Q29, PYQ Jan 25 Q51, PYQ Sep 25 Q29	PYQ 2022-Jun, 2025-Jan, 2025-Sep	6.3, Example 1, p. 6.4
1.3	Two terms given: write t_m = a + (m − 1)d and t_k = a + (k − 1)d, subtract to get d = (t_k − t_m)/(k − m), back-substitute for a, then find the required term (e.g. $t_6 = 38$, $t_{10} = 66$ → d = 7, a = 3, $t_{20} = 136$). Word conditions ($t_4 = 3a$; $t_7 = 2t_3 + 1$) become two linear equations in a and d.	PYQ Nov 20 Q28, PYQ Jun 23 Q29, PYQ Dec 23 Q26, PYQ Jun 24 Q31, MTP Dec 24 S1 Q34	PYQ 2020-Nov, 2023-Jun, 2023-Dec, 2024-Jun; MTP 2024-Dec S1	6.3, Example 3, p. 6.4
1.4	If t_p = q and t_q = p then d = −1, a = p + q − 1, so t_r = p + q − r and t_(p+q) = 0.	PYQ Nov 18 Q25, PYQ Dec 22 Q29	PYQ 2018-Nov, 2022-Dec	Additional Question Bank Q3 – Q4, p. 6.20
1.5	Equidistant-term shortcut: t_m + t_n = 2t_k when k = (m + n)/2 ($t_4 + t_8 = 2t_6 = 2(a + 5d)$); and S_(2k−1) = (2k − 1) × t_k (middle term). So $t_8 = 15$ → $S_{15} = 15 × 15 = 225$; $t_4 + t_8 = 10$ → $S_{11} = 11 × 5 = 55$; $t_4 + t_8 = 120$ → $t_6 = 60$.	MTP Jun 24 S3 Q3, PYQ Jan 25 Q47, PYQ May 26 Q15	PYQ 2025-Jan, 2026-May; MTP 2024-Jun S3	6.3, p. 6.6
1.6	Zero or equal terms fix d: $t_4 = 0$ → a = −3d, so $t_{25} : t_{11} = 21d : 7d = 3$; $t_7 = x$ and t_(x+7) = 0 → d = −1, t_x = $t_7 + (x − 7)d = 7$; $t_2 = t_8 = α$ → d = 0, so $S_n = nα$.	PYQ Jun 24 Q29, PYQ Jun 24 Q30, PYQ Sep 24 Q62	PYQ 2024-Jun (×2), 2024-Sep	6.3, p. 6.4
1.7	Multiples of k between two numbers form an A.P. with d = k: first multiple above the lower limit, last below the upper; n = (l − a)/d + 1 and S = n(a + l)/2. Between 74 and 25,556 divisible by 5: 75 … 25,555 → n = 5,097; between 200 and 600 divisible by 13: 208 … 598, n = 31, S = 31 × 403 = 12,493.	PYQ Jun 23 Q30, PYQ Sep 25 Q31	PYQ 2023-Jun, 2025-Sep	Exercise 6(A) Q18, p. 6.8; Exercise 6(C) Q23, p. 6.19

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.8	Three numbers in A.P.: take a − d, a, a + d so the sum gives a directly (69 → a = 23), then use the product condition: 23(23 − d) = 460 → d = 3 → 20, 23, 26.	PYQ Nov 20 Q29	PYQ 2020-Nov	6.3, Example 4, p. 6.5
1.9	Inserting k arithmetic means between a and b: total terms = k + 2, so d = (b − a)/(k + 1); A.M. of two numbers = (a + b)/2. Two A.M.s between 68 and 260 → d = 64 → 132, 196; four between 2 and 22 → d = 4 → 6, 10, 14, 18.	PYQ May 18 Q21, PYQ May 25 Q31	PYQ 2018-May, 2025-May	6.3, Examples 5 – 6, p. 6.5
1.10	Sum of n terms $S_n = (n/2)[2a + (n − 1)d]$; when t_n is given as a formula, read $a = t_1$ and $d = t_2 − t_1$ first ($t_n = 7n − 2$ → a = 5, d = 7 → $S_n = 0.5(7n^2 + 3n)$; $t_n = 5n + 1$ → $S_n = n(5n + 7)/2$). 7 + 14 + … to 17 terms = (17/2)(14 + 112) = 1,071.	PYQ Dec 21 Q29, PYQ Dec 23 Q27, PYQ May 25 Q29	PYQ 2021-Dec, 2023-Dec, 2025-May	6.3, p. 6.6; Exercise 6(A) Q19, p. 6.8
1.11	Finding n from S_n: set $(n/2)[2a + (n − 1)d] = S$ and solve the quadratic; reject negative roots, and in instalment problems reject the root that makes later terms negative (975 = (n/2)[200 − 5(n − 1)] → n = 15 or 26 → 15 months). For 'minimum n with $S_n > S$', take the first integer above the root (a = 7, d = 3: $S_{16} = 472$, $S_{17} = 527$ → 17).	PYQ Nov 18 Q27, PYQ Jul 21 Q29, PYQ Jun 22 Q31, PYQ Sep 26 Q8	PYQ 2018-Nov, 2021-Jul, 2022-Jun, 2026-Sep	Exercise 6(A) Q23, p. 6.9; Exercise 6(C) Q27, p. 6.19
1.12	First and last terms known: S = n(a + l)/2, so n = 2S/(a + l): −4 … 146, S = 7171 → n = 101; 5 … 905, S = 45,955 → n = 101.	MTP Jan 25 S2 Q33, MTP Apr 26 S1 Q34	MTP 2025-Jan S2, 2026-Apr S1	6.3, p. 6.6; Exercise 6(A) Q24, p. 6.9
1.13	Last term x unknown in a + … + x = S: first find n from $S_n = (n/2)[2a + (n − 1)d]$, then x = a + (n − 1)d (2 + 6 + … + x = 882 → n = 21, x = 82; 1 + 7 + … + x = 225 → n = 9, x = 49).	PYQ Jun 19 Q26, PYQ Dec 23 Q29	PYQ 2019-Jun, 2023-Dec	6.3, p. 6.6
1.14	Sum of first n natural numbers 1 + 2 + … + n = n(n + 1)/2 (= 55 → n = 10).	PYQ Jan 25 Q52	PYQ 2025-Jan	6.3, p. 6.6
1.15	S_n given as a function of n: $a = t_1 = S_1$ and $t_n = S_n − S_{n-1}$ ($d = S_2 − 2S_1$). For $S_n = pn^2 + qn$, $t_n = p(2n − 1) + q$ and d = 2p: $3n^2 + 5n$ → 8, 14, 20, …; $2n^2$ → $t_5 = 18$; $3n^2 + 2n$ → 6n − 1; $2n^2 + 5n$ → 4n + 3; $4n^2 + 3n$ → $t_{10} = S_{10} − S_9 = 79$.	PYQ Jul 21 Q30, PYQ Dec 21 Q30, MTP Aug 24 S2 Q35, MTP Apr 26 S2 Q29, PYQ May 26 Q14	PYQ 2021-Jul, 2021-Dec, 2026-May; MTP 2024-Aug S2, 2026-Apr S2	Exercise 6(A) Q10 & Q17, p. 6.8; Additional Question Bank Q31, p. 6.23
1.16	Ratio of sums of n terms of two A.P.s → ratio of their mth terms: replace n by (2m − 1) in the sum ratio. (n + 1) : (n − 1) → 2m : (2m − 2) = m : (m − 1); (3x + 5) : (5x + 3) at x = 19 → 62 : 98 = 31 : 49.	PYQ Jun 19 Q24, MTP Apr 26 S2 Q30	PYQ 2019-Jun; MTP 2026-Apr S2	Additional Question Bank Q15 & Q41, pp. 6.21, 6.24
1.17	A.P.–G.P. combinations: G.P. condition $b^2 = ac$, A.P. condition 2b = a + c; solve together or test the options. x, 8, y in G.P. and x, y, −8 in A.P. → xy = 64, x = 2y + 8 → x = 16, y = 4; three numbers in G.P. summing to 70 with 4a, 5ar, $4ar^2$ in A.P. → $2r^2 − 5r + 2 = 0$ → 10, 20, 40.	PYQ Sep 24 Q61, MTP Jan 25 S2 Q32	PYQ 2024-Sep; MTP 2025-Jan S2	Exercise 6(C) Q6 & Q17, pp. 6.18 – 6.19

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.18	*See Topic 2: these are G.P. questions. 25, 5, 1, …, 1/3125: $t_n = ar^{n-1} \rightarrow (1/5)^{n-1} = (1/5)^7 \rightarrow n = 8$; infinite G.P. with $S\infty = a/(1 - r) = 8$ and $ar = 7/8 \rightarrow 64r^2 - 64r + 7 = 0 \rightarrow r = 1/8, a = 7$.*	PYQ Nov 19 Q29, PYQ Sep 24 Q60	PYQ 2019-Nov, 2024-Sep	6.4, pp. 6.10 – 6.12
1.19	*See Topic 2: repeated-digit series. 0.5 + 0.55 + … = (5/9)[0.9 + 0.99 + …] = (5/9)[n − (1/9)(1 − (0.1)^n)] = 5n/9 − (5/81)[1 − (0.1)^n].*	MTP Dec 24 S1 Q32	MTP 2024-Dec S1	6.4, Example 4, p. 6.13; Additional Question Bank Q135, p. 6.32
1.20	See Chapter 7 (Sets): 'English only' = n(E) − n(E ∩ M) = 30 − 15 = 15 (check: n(E ∪ M) = 30 + 25 − 15 = 40).	MTP Dec 24 S1 Q35	MTP 2024-Dec S1	7.2, p. 7.18

Topic 2 Geometric Progression

36 Scanner questions · ICAI appearances PYQ 30 · RTP 1 · MTP 5

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.1	G.P.: $t_n = ar^{n-1}$, $r = t_n/t_{n-1}$. Two terms given → divide to eliminate a: $t_3 = 2/3$, $t_6 = 2/81 \rightarrow r^3 = 1/27$, $r = 1/3$, $a = 6$; $t_5 = 27$, $t_8 = 729 \rightarrow r = 3$, $a = 1/3$, $t_{11} = 3^9 = 19{,}683$; $t_2 = 12$, $t_6 = 192 \rightarrow r^4 = 16$, $r = 2$, $a = 6$, $t_{11} = 6{,}144$. Trap: $r^3 = -1/8$ gives $r = -1/2$ and $a = 1/r^2 = 4$ (a is positive). Sums of pairs: $a(1 + r) = 12$ and $ar^2(1 + r) = 48 \rightarrow r^2 = 4$.	PYQ Nov 18 Q26, PYQ Jan 21 Q29, PYQ Dec 22 Q30, MTP Apr 26 S1 Q33, PYQ Sep 26 Q85	PYQ 2018-Nov, 2021-Jan, 2022-Dec, 2026-Sep; MTP 2026-Apr S1	6.4, Example 2, p. 6.11
2.2	Equidistant terms of a G.P.: t_(k−m) × t_(k+m) = t_k². Hence t_4, t_7, $t_{10} = p, q, r$ give $q^2 = pr$; product of the first 7 terms = t_4^7 ($t_4 = 3 \rightarrow 3^7$); first 5 terms = t_3^5 ($t_3 = 5 \rightarrow 5^5$); three terms a/r, a, ar → product a^3 ($512 \rightarrow a = 8$).	PYQ Jun 19 Q25, PYQ Jun 23 Q31, PYQ Jan 25 Q54, PYQ Jan 26 Q12	PYQ 2019-Jun, 2023-Jun, 2025-Jan, 2026-Jan	Exercise 6(B) Q13, p. 6.15; Exercise 6(C) Q20, p. 6.19
2.3	Three numbers in G.P. with given sum and product: take a/r, a, ar → $a = \sqrt[3]{}$(product), then a/r + a + ar = sum gives a quadratic in r (both r and 1/r give the same set, reversed). 130 & 27,000 → 10, 30, 90 or 90, 30, 10; 7 & 8 → 1, 2, 4 so next (4th) term = 8; 21/2 & 27 → 3/2, 3, 6; 38 & 1728 → $a = 12$, $6r^2 - 13r + 6 = 0 \rightarrow 8, 12, 18$.	PYQ Nov 20 Q27, PYQ Dec 21 Q28, PYQ May 25 Q30, PYQ Sep 26 Q82	PYQ 2020-Nov, 2021-Dec, 2025-May, 2026-Sep	6.4, Example 6, pp. 6.13 – 6.14; Additional Question Bank Q147, p. 6.33
2.4	G.P. condition for three terms: $b^2 = ac$. $(2x + 2)^2 = x(3x + 3) \rightarrow x = -4$ or -1; $x = -1$ gives a zero term, so $x = -4$: $-4, -6, -9$, $t_4 = -13.5$. For 2/7, x, 7/2 (signs as printed): $x^2 = 1 \rightarrow x = \pm 1$.	MTP Jun 24 S3 Q5, PYQ Sep 25 Q30	PYQ 2025-Sep; MTP 2024-Jun S3	6.4, p. 6.10
2.5	A.P. converted to G.P. (or vice versa) by adding/subtracting numbers: write the A.P. as a − d, a, a + d (or the G.P. as a/r, a, ar), apply the second condition $b^2 = ac$ or $2b = a + c$. Sum 21 → 7 − d, 7, 7 + d; adding 1, 5, 15 → $144 = (8 - d)(22 + d) \rightarrow d = 2$ → 5, 7, 9. G.P. 4, 8, 16 (sum 28) minus 7, 2, 1 → −3, 6, 15 (A.P.) → sum of squares 336.	PYQ Jul 21 Q28, MTP Jan 25 S2 Q31	PYQ 2021-Jul; MTP 2025-Jan S2	Exercise 6(C) Q1, p. 6.18

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.6	A.M. and G.M. of two numbers: A = (a + b)/2, G = √(ab) → a + b = 2A, ab = G^2; the numbers are the roots of $x^2 - 2Ax + G^2 = 0$. A = 6.5, G = 6 → 9 and 4. Trap: A = 8, G = 2 → x = 8 ± 2√15 = 15.746, 0.254, so the option 15.75, 0.25 is only approximate.	PYQ Nov 19 Q31, PYQ Jan 25 Q9	PYQ 2019-Nov, 2025-Jan	6.3, p. 6.5; 6.4, p. 6.10; Exercise 6(C) Q11, p. 6.18
2.7	Sum of n terms of a G.P.: $S_n = a(1 - r^n)/(1 - r)$ for r < 1, $a(r^n - 1)/(r - 1)$ for r > 1, na for r = 1. $1/5 + 1/5^2 + \ldots + 1/5^n = (1/4)[1 - (1/5)^n]$; $1/2 + 1/4 + \ldots$: $S_n = 1 - (1/2)^n$, $S_8 = 0.99609 < 0.998 < S_9$, so n = 8.	PYQ Nov 19 Q28, PYQ Dec 21 Q31	PYQ 2019-Nov, 2021-Dec	6.4, p. 6.11
2.8	$S_8 = 5S_4$: $(r^8 - 1) = 5(r^4 - 1) \rightarrow r^4 + 1 = 5 \rightarrow r^4 = 4 \rightarrow r = \pm\sqrt{2}$ (watch for √ signs lost in printing: '2' means √2).	PYQ Jun 22 Q30, MTP Apr 26 S1 Q35	PYQ 2022-Jun; MTP 2026-Apr S1	Additional Question Bank Q130, p. 6.31
2.9	G.P. of 2n terms: every even-place term = r × the preceding odd-place term, so $S_2 = rS_1$ and $r = S_2/S_1$.	PYQ Jan 26 Q68	PYQ 2026-Jan	Not in SM (PYQ-only)
2.10	Sum to infinity $S\infty = a/(1 - r)$, valid only for −1 < r < 1: 1/2 + 1/6 + 1/18 + … = (1/2)/(2/3) = 3/4; 1 − 1/5 + 1/25 − … = 1/(1 + 1/5) = 5/6; 12, 4, 4/3, … = 12/(2/3) = 18. Alternating $1/2 + 1/3^2 + 1/2^3 + 1/3^4 + \ldots$ splits into two G.P.s: (1/2)/(3/4) + (1/9)/(8/9) = 2/3 + 1/8 = 19/24.	PYQ Nov 19 Q27, PYQ Jan 26 Q13, PYQ May 26 Q16, PYQ Sep 26 Q84	PYQ 2019-Nov, 2026-Jan, 2026-May, 2026-Sep	6.4, p. 6.12; Additional Question Bank Q103 & Q137, pp. 6.29, 6.32
2.11	S∞ with a second condition: a = S∞(1 − r), then substitute. Second term ar given (S∞ = 4, ar = 3/4 → $16r^2 - 16r + 3 = 0 \rightarrow$ r = 1/4, a = 3 or r = 3/4, a = 1); first two terms a(1 + r) = 14, S∞ = 32 → $1 - r^2 = 7/16$ → r = 0.75; a − ar = 4, S∞ = 100 → $(1 - r)^2 = 0.04 \rightarrow$ r = 4/5 (reject 1.2 since |r| < 1).	PYQ Dec 23 Q28, PYQ Sep 25 Q32, PYQ May 26 Q13	PYQ 2023-Dec, 2025-Sep, 2026-May	Exercise 6(C) Q4, p. 6.18; Additional Question Bank Q146, p. 6.33
2.12	$y = 1 + x + x^2 + \ldots$ to ∞ is a G.P. with a = 1, r = x: y = 1/(1 − x) → x = (y − 1)/y.	PYQ Jun 19 Q27	PYQ 2019-Jun	6.4, p. 6.12
2.13	If a^(1/x) = b^(1/y) = c^(1/z) = k then $a = k^x$, $b = k^y$, $c = k^z$; a, b, c in G.P. ($b^2 = ac$) → 2y = x + z, so x, y, z are in A.P.	MTP Jun 24 S3 Q6	MTP 2024-Jun S3	Additional Question Bank Q119, p. 6.30; Exercise 6(C) Q8, p. 6.18
2.14	(b + c − a)/a, (c + a − b)/b, (a + b − c)/c in A.P.: add 2 to each → (a + b + c)/a, (a + b + c)/b, (a + b + c)/c in A.P. → 1/a, 1/b, 1/c in A.P. → a, b, c in H.P.	PYQ Nov 19 Q26	PYQ 2019-Nov	Additional Question Bank Q27, p. 6.22
2.15	*See Topic 1: an A.P. question. $S_5 = (5/2)(2a + 4d) = 5(a + 2d) = 5t_3 \rightarrow t_3 = 75/5 = 15$.*	PYQ Nov 19 Q30	PYQ 2019-Nov	6.3, p. 6.6
2.16	*See Topic 1: multiples of 3 between 250 and 1,000: 252 … 999, n = (999 − 252)/3 + 1 = 250, S = 125 × 1,251 = 1,56,375.*	RTP May 26 Q13	RTP 2026-May	6.3, p. 6.6; Additional Question Bank Q35, p. 6.23

Topic 3 Special Series

3 Scanner questions · ICAI appearances PYQ 3 · RTP – · MTP –

Ref	One-liner for the student	Scanner Q	Asked in	SM source
3.1	*See Topic 1: $S_n = 3n^2 - n \rightarrow a = S_1 = 2$ (check $d = S_2 - 2S_1 = 10 - 4 = 6$).*	PYQ May 18 Q20	PYQ 2018-May	Exercise 6(A) Q10, p. 6.8
3.2	nth term of a series whose differences form an A.P.: 3, 7, 13, 21, 31 has differences 4, 6, 8, 10, so t_n is quadratic; test options at n = 1, 2, 3 → $t_n = n^2 + n + 1$.	PYQ Jan 21 Q28	PYQ 2021-Jan	Additional Question Bank Q79 – Q81, p. 6.27
3.3	*See Topic 2: $1 + 1/2 + 1/4 + \ldots$ to 6 terms = $[1 - (1/2)^6]/(1 - 1/2) = 2 \times 63/64 = 63/32$.*	PYQ May 25 Q32	PYQ 2025-May	6.4, p. 6.11

Part B — Chapter 6 One-liner Revision Sheet

Deduplicated and in Study Material order. Click a 'Part A ref' to jump to the Part A row(s) carrying the full wording, the Scanner questions and the SM page. Refs read Unit.Topic.Row in chapters with several units and Topic.Row otherwise. Weight: ★★★ asked by ICAI 6 or more times · ★★ 3 – 5 times · ★ once or twice. The ★★★ lines alone cover about 60% of ICAI appearances in this chapter.

Sequence and Series

#	One-liner	Weight	Part A ref
1	**A.P.: a, b, c in A.P. ⇔ 2b = a + c; $t_n = a + (n-1)d$, $d = t_2 - t_1$**	★★★	1.1, 1.2
2	Two terms given → subtract to get d = (t_k − t_m)/(k − m), then a	★★	1.3
3	t_p = q, t_q = p ⇒ d = −1, t_r = p + q − r, t_(p+q) = 0	★	1.4
4	**Equidistant terms: t_m + t_n = 2t_mid; S_(2k−1) = (2k − 1)·t_k; $t_4 = 0$ ⇒ a = −3d**	★★★	1.5, 1.6
5	Multiples of k in a range: first/last multiple, n = (l − a)/k + 1, S = n(a + l)/2	★★	1.7, 2.16
6	Three numbers in A.P.: a − d, a, a + d; k A.M.s between a and b: d = (b − a)/(k + 1)	★★	1.8, 1.9
7	**$S_n = (n/2)[2a + (n-1)d] = (n/2)(a + l)$; solve the quadratic for n, reject negative/inadmissible roots**	★★★	1.10, 1.11, 1.12, 1.13
8	$\Sigma n = n(n+1)/2 \cdot \Sigma(2n-1) = n^2 \cdot \Sigma n^2 = n(n+1)(2n+1)/6 \cdot \Sigma n^3 = [n(n+1)/2]^2$	★	1.14
9	**S_n given: $a = S_1$, $t_n = S_n - S_{n-1}$; $S_n = pn^2 + qn$ ⇒ d = 2p**	★★★	1.15, 3.1
10	Ratio of sums of two A.P.s → ratio of mth terms: put n = 2m − 1	★	1.16
11	**G.P.: $t_n = ar^{n-1}$; divide two given terms to get r ($r^3 = -1/8$ ⇒ r = −1/2, a positive)**	★★★	2.1, 1.18
12	Equidistant G.P. terms: t_(k−m)·t_(k+m) = t_k²; product of first 2k − 1 terms = t_k^(2k−1)	★★	2.2
13	Three numbers in G.P.: a/r, a, ar ⇒ a = ∛product; then sum gives quadratic in r	★★	2.3
14	**G.P. test $b^2 = ac$; A.P.–G.P. mixes: solve both conditions or test options**	★★★	2.4, 2.5, 1.17
15	A.M. = (a + b)/2, G.M. = √(ab); numbers are roots of $x^2 - 2Ax + G^2 = 0$; A ≥ G	★	2.6
16	**$S_n = a(1-r^n)/(1-r)$ (r < 1), $a(r^n-1)/(r-1)$ (r > 1); $S_8 = 5S_4$ ⇒ $r = \pm\sqrt{2}$; S_2/S_1 (even/odd places) = r**	★★★	2.7, 2.8, 2.9, 3.3
17	**$S_\infty = a/(1-r)$, $\lvert r\rvert < 1$; split alternating mixed series into two G.P.s**	★★★	2.10, 2.12, 1.18
18	S_∞ with a second condition: $a = S_\infty(1-r)$, substitute; reject $\lvert r\rvert \geq 1$	★★	2.11
19	0.5 + 0.55 + … = (5/9)[n − (1/9)(1 − 0.1^n)]; a^(1/x) = b^(1/y) = c^(1/z), a, b, c in G.P. ⇒ x, y, z in A.P.	★	1.19, 2.13
20	Series with A.P. differences (3, 7, 13, 21) ⇒ quadratic t_n; test options at n = 1, 2, 3	★	3.2

CHAPTER 7

Sets, Relations and Functions, Limits and Continuity

89 Scanner questions · 40 one-liners · 19 revision pointers

Part A — One-liners mapped to Scanner questions and Study Material

Sets, Relations and Functions, Limits and Continuity

SM Chapter 7, pages 7.1 – 7.41

Topic 1 Sets

26 Scanner questions · ICAI appearances PYQ 19 · RTP 3 · MTP 4

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.1	Set difference A − B = {x : x ∈ A, x ∉ B}; do brackets first. {1, ..., 7} − {2, 4, 6, 8} = {1, 3, 5, 7} → n = 4; (A − B) ∪ C = {2, 6, 9} ∪ {2, 6, 8} = {2, 6, 8, 9}; A − (B ∪ C) = {1}.	PYQ Nov 18 Q31, PYQ Jun 19 Q28, PYQ May 25 Q34	PYQ 2018-Nov, 2019-Jun, 2025-May	7.1, p. 7.4; Exercise 7(A) Q32 (hint), p. 7.8; Exercise 7(C) Q17, p. 7.21
1.2	A set with n elements has 2^n subsets: {3, 4, 5} → 8. Two sets: $2^x - 2^y = 56 \rightarrow 64 - 8 \rightarrow x = 6, y = 3$.	PYQ Jun 19 Q30, PYQ Jun 22 Q34	PYQ 2019-Jun, 2022-Jun	7.1, p. 7.3; Exercise 7(A) Q1 – Q2, p. 7.6
1.3	Proper subsets (SM convention) = $2^n - 1$ (every subset except the set itself; φ is counted): 5 elements → 31; A ∩ B = {2, 4, 7, 9} → 15. Trap: non-empty proper subsets = $2^n - 2$.	PYQ Dec 22 Q31, PYQ Dec 23 Q32, MTP Jun 24 S3 Q14, PYQ Sep 24 Q65, PYQ Jan 25 Q55	PYQ 2022-Dec, 2023-Dec, 2024-Sep, 2025-Jan; MTP 2024-Jun S3	7.1, p. 7.3; Summary, p. 7.18
1.4	Power set P(A) = collection of all 2^n subsets, including φ and A itself; an option that omits φ or A (or lists only some subsets) is not P(A).	MTP Aug 24 S2 Q22	MTP 2024-Aug S2	7.2 (Power Set), p. 7.6
1.5	Finite vs infinite: the set of cubes of natural numbers {1, 8, 27, ...} never ends, so it is an infinite set (not null, not singleton).	PYQ Jan 21 Q30	PYQ 2021-Jan	7.1, p. 7.2; Exercise 7(A) Q11, p. 7.6
1.6	Cartesian product A × B = {(a, b) : a ∈ A, b ∈ B}, first element from the first set; n(A × B) = n(A) × n(B). Evaluate the bracket first: A × (B ∩ C) = {2, 3} × {5} = {(2, 5), (3, 5)}; (A − B) × (B ∩ C) = {a} × {c, d}; n[(A ∪ C) × B] = 6 × 2 = 12.	PYQ Jun 22 Q35, PYQ Jun 23 Q35, PYQ Dec 23 Q33, PYQ Jan 25 Q60	PYQ 2022-Jun, 2023-Jun, 2023-Dec, 2025-Jan	7.3, pp. 7.8 – 7.9; Exercise 7(C) Q15, p. 7.21
1.7	De Morgan's laws: $(A \cup B)' = A' \cap B'$ and $(A \cap B)' = A' \cup B'$ — true for any sets, so no listing is needed.	PYQ Jun 22 Q36, MTP Jan 25 S2 Q34	PYQ 2022-Jun; MTP 2025-Jan S2	7.1, p. 7.4; Exercise 7(A) Q23 – Q24, p. 7.7; Exercise 7(C) Q13, p. 7.21

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.8	Two sets: n(A ∪ B) = n(A) + n(B) − n(A ∩ B); 'neither' = n(U) − n(A ∪ B) = n(A′ ∩ B′). 80 + 60 − 40 = 100; 50 + 66 − 36 = 80; 50,000 − (28,000 + 23,000 − 4,000) = 3,000; n(A′ ∩ B′) = 400 with n(A ∪ B) = 500 → n(U) = 900.	MTP Jan 25 S2 Q36, RTP Jan 25 Q9, RTP Jan 25 Q10, PYQ May 26 Q70	PYQ 2026-May; RTP 2025-Jan (×2); MTP 2025-Jan S2	7.2, p. 7.5; Exercise 7(C) Q16, p. 7.21
1.9	Three sets: n(A ∪ B ∪ C) = Σn(A) − Σn(A ∩ B) + n(A ∩ B ∩ C); exactly one set = Σn(A) − 2Σn(A ∩ B) + 3n(A ∩ B ∩ C) (122 − 32 + 6 = 96). If everyone uses at least one, n(A ∪ B ∪ C) = total: 100 = 120 − 45 + x → x = 25.	PYQ Nov 20 Q30, PYQ Dec 23 Q30	PYQ 2020-Nov, 2023-Dec	7.2, p. 7.5; Additional Question Bank Q70, p. 7.38
1.10	*See Topic 4: gof(3) = g(f(3)) = g(8) = 19; 'aRb and bRc ⇒ aRc' is the definition of a transitive relation.*	RTP Jan 25 Q11, PYQ Sep 25 Q33	PYQ 2025-Sep; RTP 2025-Jan	7.6, p. 7.13; Types of relations, p. 7.15

Topic 2 Venn Diagrams

9 Scanner questions · ICAI appearances PYQ 9 · RTP – · MTP –

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.1	Three-set Venn counts from n(A ∪ B ∪ C) = Σn − Σpairs + triple: 'A only' = n(A) − n(A ∩ B) − n(A ∩ C) + n(A ∩ B ∩ C) (8,000 − 1,000 − 800 + 400 = 6,600); 'none' = total − n(A ∪ B ∪ C) (250 − 240 = 10); 1 − 100 not divisible by 3, 5 or 7 = 100 − (33 + 20 + 14 − 6 − 2 − 4 + 0) = 45.	PYQ May 18 Q23, PYQ Jan 21 Q33, PYQ Sep 26 Q83	PYQ 2018-May, 2021-Jan, 2026-Sep	7.2, p. 7.5
2.2	Venn diagram with an unknown region: fill each region in terms of x and equate the total (20 teachers: 9 − 4 − x + x + 7 − x + 4 + 6 = 20 → x = 2; only Physics = 9 − 4 − 2 = 3).	PYQ Dec 21 Q32	PYQ 2021-Dec	Problems using Venn Diagram, Problem 1, p. 7.17
2.3	Everybody likes at least one: n(A ∪ B) = 100%, so n(A ∩ B) = n(A) + n(B) − 100 = 74 + 68 − 100 = 42%.	PYQ Jun 23 Q33	PYQ 2023-Jun	Problems using Venn Diagram, Problem 2, p. 7.17
2.4	n(A′ ∩ B′) = n((A ∪ B)′) = n(U) − n(A ∪ B): 650 − (310 + 190 − 95) = 245; 50,000 − 47,000 = 3,000.	PYQ Jul 21 Q34, PYQ Sep 24 Q66	PYQ 2021-Jul, 2024-Sep	7.1, p. 7.4; 7.2, p. 7.5; Exercise 7(C) Q16, p. 7.21
2.5	*See Topic 6: inverse of f(y) = 3y — put x = 3y, solve y = x/3, so $f^{-1}(y) = y/3$.*	PYQ Nov 20 Q31	PYQ 2020-Nov	7.6 (Inverse Function), p. 7.13; Exercise 7(B) Q16, p. 7.15
2.6	*See Topic 3: (A ∪ B) × (A ∩ B) = {1, 2, 3, 4} × {2} = {(1, 2), (2, 2), (3, 2), (4, 2)} — order (first set, second set) matters.*	PYQ Dec 23 Q31	PYQ 2023-Dec	7.3, p. 7.8

Topic 3 Product Sets

3 Scanner questions · ICAI appearances PYQ 2 · RTP – · MTP 1

Ref	One-liner for the student	Scanner Q	Asked in	SM source
3.1	Product of sets after a set operation: evaluate the bracket, then pair each element of the first set with each of the second: (A − C) × B = {2, 4} × {2, 4}; A × (B ∩ C) = {2, 3} × {5} = {(2, 5), (3, 5)}.	MTP Dec 24 S1 Q36, PYQ Jan 26 Q17	PYQ 2026-Jan; MTP 2024-Dec S1	7.3, p. 7.8; Exercise 7(C) Q15, p. 7.21
3.2	Inverse relation $R^{-1} = \{(b, a) : (a, b) \in R\}$; $Dom(R^{-1}) = Range(R)$. x + y = 10, x ≥ y on {1, ..., 10} → R = {(5, 5), (6, 4), (7, 3), (8, 2), (9, 1)} → $Dom(R^{-1}) = \{1, 2, 3, 4, 5\}$.	PYQ Jun 19 Q29	PYQ 2019-Jun	Inverse Relation, p. 7.16

Topic 4 Relations and Functions

29 Scanner questions · ICAI appearances PYQ 22 · RTP 1 · MTP 6

Ref	One-liner for the student	Scanner Q	Asked in	SM source
4.1	Any subset of A × B is a relation from A to B, so the number of relations = 2^(n(A) × n(B)) = 2^4 = 16.	PYQ Nov 18 Q30	PYQ 2018-Nov	7.4, p. 7.9; Domain & Range of a relation, p. 7.16
4.2	Function test: every element of the domain must appear exactly once as a first element (no element left out, none paired twice). H = {(x, 1), (y, 2), (y, 3), ...} is not a function (y has two images, w none); only R_4 = {(a, p), (b, r), (c, q), (d, s)} qualifies.	PYQ Jun 19 Q32, MTP Aug 24 S2 Q23	PYQ 2019-Jun; MTP 2024-Aug S2	7.4, p. 7.9; Exercise 7(B) Q1, p. 7.14
4.3	Composite functions: (gof)(x) = g(f(x)) — apply f first; (fog)(x) = f(g(x)); in general fog ≠ gof. f = x^2, g = √x → gof(3) = 3; f = x^8, g = $2x^2 + 1$ → fog = $(2x^2 + 1)^8$; f = x + 2, g = 7^x → gof = 7^(x+2) = 49·7^x; f = x/(1 − x), g = (x − 1)/x → gof = (2x − 1)/x ('none of these'); f = x^2 + 3x − 1, g = 2x + 3 → fog = $4x^2$ + 18x + 17.	PYQ Jun 19 Q31, MTP Jun 24 S3 Q13, RTP Sep 24 Q10, MTP Jan 25 S2 Q35, PYQ Jan 26 Q69	PYQ 2019-Jun, 2026-Jan; RTP 2024-Sep; MTP 2024-Jun S3, 2025-Jan S2	7.6 (composite function), p. 7.13; Exercise 7(B) Q12, Q13 & Q17, pp. 7.14 – 7.15
4.4	Evaluating functions: substitute carefully, using the correct branch of a piecewise rule (f(−1) = 3(−1), f(2) = 2^2, f(4) = 2 × 4 → 9), a recurrence step by step (f(n) = f(n − 1) + f(n − 2): 0, 1, 1, 2, 3, 5, 8, 13 → f(7) = 13), or an equation such as 4f(x) = f(2x) → x = 3/2. For f(f(1/x)) work inside out: f(x) = 1 + 1/x → f(1/x) = 1 + x → f(1 + x) = (x + 2)/(x + 1).	PYQ Nov 19 Q32, PYQ Jan 21 Q32, PYQ Sep 24 Q59, PYQ Jan 26 Q66, PYQ Sep 26 Q59	PYQ 2019-Nov, 2021-Jan, 2024-Sep, 2026-Jan, 2026-Sep	7.4, p. 7.9; Exercise 7(B) Q10 – Q11, p. 7.14
4.5	On lines in a plane: 'is parallel to' is reflexive, symmetric and transitive (equivalence); 'is perpendicular to' is symmetric only (a line is not ⊥ to itself; a ⊥ b, b ⊥ c gives a ∥ c).	PYQ Jan 21 Q31, MTP Jun 24 S3 Q15	PYQ 2021-Jan; MTP 2024-Jun S3	Types of relations, pp. 7.15 – 7.16; Exercise 7(C) Q4, p. 7.20
4.6	'a − b is even' or 'a − b divisible by k' is an equivalence relation: a − a = 0 (reflexive), b − a = −(a − b) (symmetric), (a − c) = (a − b) + (b − c) (transitive).	PYQ Dec 21 Q33, PYQ Jun 23 Q34, PYQ May 26 Q71, PYQ Sep 26 Q86	PYQ 2021-Dec, 2023-Jun, 2026-May, 2026-Sep	Types of relations, p. 7.15

Ref	One-liner for the student	Scanner Q	Asked in	SM source
4.7	Testing a listed relation on a finite set: reflexive needs every (a, a); symmetric needs (b, a) for each (a, b); transitive needs (a, c) whenever (a, b) and (b, c). The identity relation {(a, a)} is an equivalence. {(1, 1), (2, 2), (3, 3), (1, 2), (2, 3), (1, 3)} → reflexive (and transitive) but not symmetric; {(1, 1), (2, 3), (2, 2), (3, 3), (1, 2)} → reflexive only ((1, 3) missing); {(3, 4), (4, 6), (3, 6)} → transitive, not reflexive.	PYQ Jun 22 Q32, PYQ Jun 24 Q32, PYQ Sep 24 Q58, MTP Dec 24 S1 Q37, PYQ May 25 Q33	PYQ 2022-Jun, 2024-Jun, 2024-Sep, 2025-May; MTP 2024-Dec S1	Identity Relation and Illustrations (i) – (iii), pp. 7.16 – 7.17
4.8	Smallest equivalence containing R on {1, 2, 3}: add the missing diagonal pairs, then symmetric pairs, then pairs needed for transitivity. R = {(1, 2), (2, 3)} needs (1, 1), (2, 2), (3, 3), (2, 1), (3, 2), (1, 3), (3, 1) = 7 pairs (the full A × A).	PYQ Jun 23 Q32	PYQ 2023-Jun	Types of relations, p. 7.15
4.9	*See Topic 1: subsets of a set with n elements = 2^n ({0, 1, 2, 3} → 16); non-empty proper subsets = 2^n – 2 (5 elements → 30).*	PYQ Dec 22 Q32, PYQ Sep 25 Q34	PYQ 2022-Dec, 2025-Sep	7.1, p. 7.3
4.10	$x^2 + 1/x^2 \geq 2$ for $x > 0$ (A.M. ≥ G.M. on x^2 and $1/x^2$: $(x^2 + 1/x^2)/2 \geq 1$), equality at x = 1.	PYQ Jul 21 Q35	PYQ 2021-Jul	Exercise 6(C) Q10, p. 6.18
4.11	Derivative question (outside the SM chapter): $f(x) = x^2 - 6x + 8 \rightarrow f'(x) = 2x - 6$; $f'(5) - f'(8) = 4 - 10 = -6 = 3f'(2)$.	MTP Jan 25 S2 Q40	MTP 2025-Jan S2	Not in SM (MTP-only)

Topic 5 Domain & Range of a Function

3 Scanner questions · ICAI appearances PYQ 3 · RTP – · MTP –

Ref	One-liner for the student	Scanner Q	Asked in	SM source
5.1	Range = set of images $f(A) = \{f(x) : x \in A\}$, which may be smaller than the co-domain: A = {1, 2, 3, 4}, $f(x) = x^2$ → range {1, 4, 9, 16} (25 in B has no pre-image).	PYQ Nov 18 Q29	PYQ 2018-Nov	7.5, Illustration, p. 7.9
5.2	Range from the formula: $\sqrt{(16 - x^2)}$ is never negative and is largest at x = 0 → [0, 4]; a linear function 3x – 2 takes every real value → (–∞, ∞).	PYQ Jul 21 Q31, PYQ May 25 Q35	PYQ 2021-Jul, 2025-May	7.5, p. 7.9; Exercise 7(B) Q8, p. 7.14

Topic 6 Various Types of Functions

11 Scanner questions · ICAI appearances PYQ 11 · RTP – · MTP –

Ref	One-liner for the student	Scanner Q	Asked in	SM source
6.1	One-one (different elements → different images) + onto (range = co-domain) = bijective. f : N → E, f(x) = 2x: $2x_1 = 2x_2 \Rightarrow x_1 = x_2$ and every even number 2x has pre-image x, so one-one onto.	PYQ May 18 Q22	PYQ 2018-May	7.6, Illustration, pp. 7.10 – 7.11
6.2	A relation is a function only if no two ordered pairs share a first element; {(1, 2), (2, 2), (3, 2), (4, 2)} is a (constant, many-one) function, while {(1, 1), (1, 2), (1, 3)} is not.	PYQ Nov 18 Q32	PYQ 2018-Nov	7.4, p. 7.9; 7.6 (Constant Function), pp. 7.11 – 7.12

Ref	One-liner for the student	Scanner Q	Asked in	SM source
6.3	Inverse function: put y = f(x), solve for x, then interchange: f(x) = (x + 1)/x → $f^{-1}(x)$ = 1/(x − 1); u(x) = 1/(1 − x) → $u^{-1}(x)$ = 1 − 1/x; f(y) = (y − 1)/y → $f^{-1}(y)$ = 1/(1 − y); 4x + 3 → (x − 3)/4; (2 + 3x)/(x + 5) → (2 − 5y)/(y − 3); (x − 2)/(x − 3) → (3x − 2)/(x − 1), so $f^{-1}(1/2)$ = 1. Only one-one onto functions are invertible (x^2 + 3 on R is not; ±3 both map to 12).	PYQ Nov 19 Q33, PYQ Jul 21 Q32, PYQ Dec 21 Q34, PYQ Jun 22 Q33, PYQ Jun 23 Q36, PYQ Sep 25 Q36, PYQ May 26 Q72	PYQ 2019-Nov, 2021-Jul, 2021-Dec, 2022-Jun, 2023-Jun, 2025-Sep, 2026-May	7.6 (Inverse Function), p. 7.13; Exercise 7(C) Q25, p. 7.22
6.4	Composite with modulus or fractions: work inside out. fog(3) = f(|9|) = 80, gof(−3) = g(8) = |19| = 19 → 61; f = 1/(1 + y), g = (y + 1)/y → fog(y) = 1/(1 + (y + 1)/y) = y/(2y + 1).	PYQ Jul 21 Q33, PYQ Sep 25 Q35	PYQ 2021-Jul, 2025-Sep	7.6 (composite function), p. 7.13

Topic 7 Concept of Limit

6 Scanner questions · ICAI appearances PYQ 4 · RTP – · MTP 2

Ref	One-liner for the student	Scanner Q	Asked in	SM source
7.1	Limit of a rational function: substitute first; if it gives 0/0, factorise and cancel the common factor, then substitute. (y^2 − 4)/(y − 2) → y + 2 = 4; (x^2 − 2x − 8)/(x − 4) → x + 2 = 6; (x^2 + 4x + 3)/(x^2 + 6x + 9) at x → 3 is not 0/0, so direct substitution gives 24/36 = 2/3.	MTP Aug 24 S2 Q36, PYQ Jan 25 Q58, PYQ May 25 Q36	PYQ 2025-Jan, 2025-May; MTP 2024-Aug S2	7.7, p. 7.23; Example 2, p. 7.25
7.2	Standard limit: lim(x→a) (x^n − a^n)/(x − a) = na^{n-1}; with x + 2 in place of x: [(x + 2)^(5/3) − (a + 2)^(5/3)]/(x − a) → (5/3)(a + 2)^(2/3).	MTP Apr 26 S1 Q38	MTP 2026-Apr S1	Some important limits (e), p. 7.25
7.3	x → ∞ of a ratio of polynomials of equal degree: divide numerator and denominator by the highest power; the limit is the ratio of leading coefficients: (x^2 + 2x + 2)/(3x^2 + x + 1) → 1/3.	PYQ May 26 Q73, PYQ Sep 26 Q61	PYQ 2026-May, 2026-Sep	Example 8, p. 7.28

Topic 8 Useful Rules of Limits

1 Scanner question · ICAI appearances PYQ 1 · RTP – · MTP –

Ref	One-liner for the student	Scanner Q	Asked in	SM source
8.1	Rules of limits apply after removing the 0/0 factor: (x^2 − 4x + 4)/(x − 2) = $(x - 2)^2$/(x − 2) = x − 2 → 0 as x → 2.	PYQ Jun 24 Q33	PYQ 2024-Jun	7.8, p. 7.24; Example 2, p. 7.25

Topic 9 Continuity

1 Scanner question · ICAI appearances PYQ 1 · RTP – · MTP –

Ref	One-liner for the student	Scanner Q	Asked in	SM source
9.1	Continuity at x = a needs lim(x→a^-) f = lim(x→a^+) f = f(a); a removable gap is filled by assigning f(a) = lim f(x): (x^2 − 25)/(x − 5) = x + 5 → f(5) = 10.	PYQ Jan 26 Q67	PYQ 2026-Jan	7.9, Example 4, p. 7.30

Part B — Chapter 7 One-liner Revision Sheet

Deduplicated and in Study Material order. Click a 'Part A ref' to jump to the Part A row(s) carrying the full wording, the Scanner questions and the SM page. Refs read Unit.Topic.Row in chapters with several units and Topic.Row otherwise. Weight: ★★★ asked by ICAI 6 or more times · ★★ 3 – 5 times · ★ once or twice. The ★★★ lines alone cover about 72% of ICAI appearances in this chapter.

Sets, Relations and Functions, Limits and Continuity

#	One-liner	Weight	Part A ref
1	A − B = {x ∈ A, x ∉ B}; work brackets first	★★	1.1
2	**Subsets 2^n · proper subsets $2^n - 1$ (SM) · non-empty proper $2^n - 2$ · power set has 2^n members**	★★★	1.2, 1.3, 1.4, 4.9
3	Cardinal number n(A); cubes of natural numbers form an infinite set	★	1.5
4	De Morgan: $(A \cup B)' = A' \cap B'$, $(A \cap B)' = A' \cup B'$	★	1.7
5	**n(A ∪ B) = n(A) + n(B) − n(A ∩ B); neither = n(U) − n(A ∪ B)**	★★★	1.8, 2.3, 2.4
6	n(A ∪ B ∪ C) = Σn − Σpairs + triple; exactly one = Σn − 2Σpairs + 3·triple; A only = n(A) − pairs with A + triple	★★	1.9, 2.1
7	Venn with unknown x: fill regions, equate total	★	2.2
8	**A × B = {(a, b)}, order matters; n(A × B) = n(A)·n(B)**	★★★	1.6, 3.1, 2.6
9	Relation = subset of A × B; number of relations = 2^(mn); $Dom(R^{-1}) = Range(R)$	★	4.1, 3.2
10	**Function: each domain element has exactly one image; range = f(A) ⊆ co-domain**	★★★	4.2, 5.1, 5.2, 6.2
11	**Reflexive (a, a) · symmetric (a, b) ⇒ (b, a) · transitive (a, b), (b, c) ⇒ (a, c); all three = equivalence**	★★★	4.7, 4.8, 1.10
12	**∥ lines: equivalence; ⊥ lines: symmetric only; a − b divisible by k: equivalence**	★★★	4.5, 4.6
13	**gof(x) = g(f(x)) (f first), fog(x) = f(g(x)); evaluate inside out**	★★★	4.3, 6.4, 4.4
14	One-one + onto = bijective; f : N → E, f(x) = 2x is one-one onto	★	6.1
15	**Inverse: y = f(x), solve for x, interchange; only one-one onto functions are invertible**	★★★	6.3, 2.5
16	Limits: substitute; 0/0 ⇒ factorise and cancel; $\lim (x^n - a^n)/(x - a) = na^{n-1}$	★★	7.1, 7.2, 8.1
17	$x \to \infty$: divide by highest power ⇒ ratio of leading coefficients	★	7.3
18	Continuous at a: LHL = RHL = f(a); removable gap ⇒ set f(a) = lim f(x)	★	9.1
19	Outside Ch 7: $x^2 + 1/x^2 \geq 2$ (A.M. ≥ G.M.); derivative items are not in this SM chapter	★	4.10, 4.11

CHAPTER 8

Differential and Integral Calculus

102 Scanner questions · 73 one-liners · 22 revision pointers

Part A — One-liners mapped to Scanner questions and Study Material

Differential and Integral Calculus

SM Chapter 8, pages 8.1 – 8.46

Topic 1 Derivative or Differential Coefficient

4 Scanner questions · ICAI appearances PYQ 4 · RTP – · MTP –

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.1	$d/dx(x^n) = nx^{n-1}$: if $xy = 1$ then $y = x^{-1}$, $dy/dx = -1/x^2 = -y^2$, so $y^2 + dy/dx = 0$ (Exercise 8(A) Q7).	PYQ Nov 18 Q36	PYQ 2018-Nov	8.A.3, p. 8.5; Exercise 8(A) Q7, p. 8.19
1.2	Product of factors — expand first (or product rule $d(uv)/dx = u\cdot dv/dx + v\cdot du/dx$): $(x - 1)\cdot x\cdot(x + 1) = x^3 - x \rightarrow dy/dx = 3x^2 - 1$. Trap: the middle factor x is printed as '×'; read as $(x - 1)(x + 1)$ the derivative would be 2x.	PYQ Jun 24 Q37	PYQ 2024-Jun	8.A.3, Basic laws (iii), p. 8.6
1.3	$d/dx(e^{ax}) = a\cdot e^{ax}$: $f(x) = e^{3x} \rightarrow f'(x) = 3e^{3x}$ (not $3xe^{3x}$).	PYQ Jun 24 Q39	PYQ 2024-Jun	8.A.3 (5), p. 8.5
1.4	*See Topic 6: variable powers — take logs: $x^y\cdot y^x = 16 \rightarrow y \log x + x \log y = \log 16 \rightarrow dy/dx = -(y/x + \log y)/(\log x + x/y) = -(1 + \log 2)/(\log 2 + 1) = -1$ at (2, 2).*	PYQ Sep 24 Q67	PYQ 2024-Sep	8.A.7, pp. 8.9 – 8.10

Topic 2 Some Standard Results (Formulas)

4 Scanner questions · ICAI appearances PYQ 4 · RTP – · MTP –

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.1	Logarithmic differentiation: $y = x^x \rightarrow \log y = x \log x \rightarrow (1/y)dy/dx = 1 + \log x \rightarrow dy/dx = x^x(1 + \log x)$.	PYQ Nov 19 Q38	PYQ 2019-Nov	8.A.7 Example, p. 8.10
2.2	Quotient rule $d(u/v)/dx = [v\cdot u' - u\cdot v']/v^2$: $y = x^4/e^x \rightarrow (e^x\cdot 4x^3 - x^4e^x)/e^{2x} = x^3(4 - x)/e^x$. Trap: option (a) leaves $(e^x)^2$ uncancelled.	PYQ Dec 21 Q36	PYQ 2021-Dec	8.A.3, Basic laws (iv) and Example (f), pp. 8.6 – 8.7
2.3	Chain rule with $d/dx(\sqrt{x}) = 1/(2\sqrt{x})$: $d/dx\ \sqrt{(x + \sqrt{x})} = [1/(2\sqrt{(x + \sqrt{x})})]\cdot(1 + 1/(2\sqrt{x}))$ (Exercise 8(A) Q8).	PYQ Jun 22 Q40	PYQ 2022-Jun	8.A.4, p. 8.8; Exercise 8(A) Q8, p. 8.19
2.4	*See Topic 12: $\int(ax + b)^n\,dx = (ax + b)^{n+1}/[a(n + 1)] + c \rightarrow \int(2x + 5)^7\,dx = (2x + 5)^8/16 + c$ (SM works $\int(2x + 3)^7\,dx$). Trap: forgetting to divide by a = 2.*	PYQ Jan 25 Q64	PYQ 2025-Jan	8.B.3 Example, p. 8.26

Topic 3 Derivative of a Function of Function

8 Scanner questions · ICAI appearances PYQ 6 · RTP – · MTP 2

Ref	One-liner for the student	Scanner Q	Asked in	SM source
3.1	Chain rule dy/dx = (dy/du)·(du/dx); d/dx[$e^{f(x)}$] = $e^{f(x)}$·f ′(x): f = 3e^(x^4) → f′ = $4x^3$·f, so f′ − $4x^3$f + ⅓f(0) − f′(0) = 0 + 1 − 0 = 1; f = 3e^(x^2) → f′ = 2x·f, so f′ − 2xf + (1/6)f(0) − f′(0) = 0 + 0.5 − 0 = 0.5.	PYQ Jul 21 Q38, PYQ Jan 26 Q15	PYQ 2021-Jul, 2026-Jan	8.A.4, p. 8.8
3.2	Differential = derivative × dx, with the chain rule: d[√(x^2 + 2)] = ½(x^2 + 2)^(−1/2)·2x dx = [x/√(x^2 + 2)] dx.	PYQ May 25 Q40	PYQ 2025-May	8.A.4, p. 8.8
3.3	*See Topic 8: gradient = dy/dx at the point: y = $2x^3$ − $5x^2$ − 3x → $6x^2$ − 10x − 3 = −3 at x = 0 (Exercise 8(A) Q2).*	MTP Jan 25 S2 Q38	MTP 2025-Jan S2	8.A.10, p. 8.13; Exercise 8(A) Q2, p. 8.19
3.4	*See Topic 6: f(x) = (x + 1)^(x+1) → log f = (x + 1) log(x + 1) → f′ = f·[1 + log(x + 1)] → f′(0) = 1·(1 + log 1) = 1.*	PYQ Jun 24 Q38	PYQ 2024-Jun	8.A.7, pp. 8.9 – 8.10
3.5	*See Topic 12: substitution in a definite integral — put √x = t, dx/√x = 2dt, change limits 0 → 0, 2 → √2: $\int_0^2$ 3^√x/√x dx = 2$\int_0$^√2 3^t dt = 2(3^√2 − 1)/$\log_e 3$, using $\int a^x dx = a^x/\log_e a$.*	PYQ May 18 Q26	PYQ 2018-May	8.B.3, p. 8.26; 8.B.2 (vi), p. 8.24
3.6	Curve from its slope: f(x) = ∫f′(x) dx + C, then fix C from the given point: f′ = $10x^2$ + 4x, f(−3) = 17 → −90 + 18 + C = 17 → C = 89, f = $10x^3/3$ + $2x^2$ + 89; f′ = x − 1 through (1, 0) → y = $x^2/2$ − x + ½ (Exercise 8(B) Q35).	PYQ Jun 22 Q38, MTP Aug 24 S2 Q38	PYQ 2022-Jun; MTP 2024-Aug S2	8.B.5 Example (curve with slope 9x), p. 8.31; Exercise 8(B) Q35, p. 8.39

Topic 4 Implicit Functions

7 Scanner questions · ICAI appearances PYQ 7 · RTP – · MTP –

Ref	One-liner for the student	Scanner Q	Asked in	SM source
4.1	Implicit function f(x, y) = 0: differentiate every term w.r.t. x, writing d(y^n)/dx = ny^{n-1}·dy/dx and d(xy)/dx = x·dy/dx + y, then collect dy/dx: x^5 + y^5 − 5xy = 0 → ($y - x^4$)/(y^4 − x); x^3 + y^3 − 3axy = 0 → (ay − x^2)/(y^2 − ax); x^2y^2 + y = 0 → −2xy^2/(2x^2y + 1); x^2y − y^2 + 4x = 7 → (2xy + 4)/(2y − x^2).	PYQ Dec 22 Q37, PYQ Dec 23 Q35, PYQ Sep 25 Q37, PYQ Sep 26 Q60	PYQ 2022-Dec, 2023-Dec, 2025-Sep, 2026-Sep	8.A.5, pp. 8.8 – 8.9; Exercise 8(A) Q12, p. 8.20
4.2	*See Topic 2: product of factors — expand, then differentiate term by term: y = x(x − 1)(x − 2) = x^3 − $3x^2$ + 2x → dy/dx = $3x^2$ − 6x + 2 (Exercise 8(A) Q6).*	PYQ Nov 20 Q34	PYQ 2020-Nov	8.A.3, Basic laws (iii), p. 8.6; Exercise 8(A) Q6, p. 8.19
4.3	Rate of change of a quantity = its derivative: v = $3x^2$ − 5x + 4 → dv/dx = 6x − 5 = 1 at x = 1.	PYQ Dec 21 Q37	PYQ 2021-Dec	Applications of Differential Calculus (rate of change), p. 8.14
4.4	*See Topic 15: piecewise f(x) — split the integral at the break point (Property III): $\int_{-2}^{2} f = \int_{-2}^{0}(1 + x)\,dx + \int_0^2(1 - 2x)\,dx = [x + x^2/2]_{-2}^{0} + [x - x^2]_0^2 = 0 + (-2) = -2$.*	PYQ Jul 21 Q39	PYQ 2021-Jul	8.B.7 Property III, p. 8.32

Topic 5 Parametric Equation

9 Scanner questions · ICAI appearances PYQ 7 · RTP 1 · MTP 1

Ref	One-liner for the student	Scanner Q	Asked in	SM source
5.1	Parametric form $x = f(t)$, $y = h(t)$: $dy/dx = (dy/dt) \div (dx/dt)$: $x = 5t^2 + 3$, $y = 2t^2 + 1 \rightarrow 4t/10t = 2/5$; $x = 2t + 5$, $y = t^2 - 2 \rightarrow 2t/2 = t$; $x = at^2$, $y = a(t^3 - t) \rightarrow (3t^2 - 1)/2t$; $x = ct$, $y = c/t \rightarrow (-c/t^2)/c = -1/t^2$; $x = am^2$, $y = a/m^2 \rightarrow (-2a/m^3)/(2am) = -1/m^4$.	PYQ Dec 23 Q36, RTP Sep 24 Q11, PYQ Jan 25 Q61, MTP Apr 26 S2 Q37, PYQ May 26 Q17	PYQ 2023-Dec, 2025-Jan, 2026-May; RTP 2024-Sep; MTP 2026-Apr S2	8.A.6, p. 8.9; Exercise 8(A) Q14, p. 8.20
5.2	SM example $x = at^3$, $y = a/t^3$: $dx/dt = 3at^2$, $dy/dt = -3a/t^4 \rightarrow dy/dx = -1/t^6$. Trap: with $y = a/t^2$ (as printed) $dy/dx = -2at^{-3}/3at^2 = -2/(3t^5)$, which matches none of (a)–(c).	PYQ Nov 18 Q33	PYQ 2018-Nov	8.A.6 Example, p. 8.9
5.3	$x = (e^t + e^{-t})/2$, $y = (e^t - e^{-t})/2 \rightarrow dx/dt = (e^t - e^{-t})/2 = y$ and $dy/dt = (e^t + e^{-t})/2 = x$, so $dy/dx = x/y$.	PYQ May 25 Q39	PYQ 2025-May	8.A.6, p. 8.9
5.4	Second derivative in parametric form: $d^2y/dx^2 = [d/dt(dy/dx)] \div (dx/dt)$: $x = t^2$, $y = t^3 \rightarrow dy/dx = 3t/2 \rightarrow d^2y/dx^2 = (3/2) \div 2t = 3/(4t)$. Trap: 3/2 is only $d/dt(dy/dx)$.	PYQ Sep 24 Q63	PYQ 2024-Sep	8.A.6, p. 8.9; 8.A.9, p. 8.12
5.5	When $dx/dm = 0$ the slope dy/dx is infinite: $X = m + 1/m$, $Y = m - 1/m \rightarrow dY/dX = (1 + 1/m^2)/(1 - 1/m^2)$; at $m = 1$ the denominator is 0, so $dY/dX = \infty$ (at $t = 2$ the SM version gives 5/3).	PYQ Sep 26 Q62	PYQ 2026-Sep	8.A.6, p. 8.9; Exercise 8(A) Q19, p. 8.20

Topic 6 Logarithmic Differentiation

6 Scanner questions · ICAI appearances PYQ 5 · RTP – · MTP 1

Ref	One-liner for the student	Scanner Q	Asked in	SM source
6.1	Log differentiation for a variable power: $y = x^x \rightarrow \log y = x \log x \rightarrow dy/dx = x^x(1 + \log x)$; at $x = 1$, $dy/dx = 1 \cdot (1 + 0) = 1$.	PYQ Dec 22 Q35	PYQ 2022-Dec	8.A.7 Example, p. 8.10
6.2	$x^y = y^x \rightarrow y \log x = x \log y \rightarrow y/x + \log x \cdot y' = (x/y)y' + \log y \rightarrow dy/dx = y(x \log y - y)/[x(y \log x - x)]$.	PYQ May 26 Q19	PYQ 2026-May	8.A.7, pp. 8.9 – 8.10; 8.A.8 Example 3, p. 8.11
6.3	$d/dx(a^x) = a^x \log_e a$, with the chain rule for 2^y and 2^{x-y}: $2^x - 2^y = 2^{x-y} \rightarrow dy/dx = (2^{x-y} - 2^x)/(2^{x-y} - 2^y) = (1 - 4)/(1 - 4) = 1$ at $x = y = 2$.	PYQ Jun 19 Q34	PYQ 2019-Jun	8.A.3 (3), p. 8.5; 8.A.5, p. 8.8
6.4	Product rule: $d/dx(e^x \log x) = e^x/x + e^x \log x = (e^x/x)(1 + x \log x)$.	MTP Jun 24 S3 Q7	MTP 2024-Jun S3	8.A.3 Example (d), p. 8.7
6.5	*See Topic 11: integration by parts twice (ILATE: x^2 first, e^x second): $\int x^2 e^x\,dx = x^2e^x - 2xe^x + 2e^x + c$.*	PYQ Nov 19 Q39	PYQ 2019-Nov	8.B.4, pp. 8.27 – 8.29
6.6	*See Topic 12: $\int (ax + b)^n\,dx = (ax + b)^{n+1}/[a(n + 1)] + c \rightarrow \int (2x - 3)^5\,dx = (2x - 3)^6/12 + c$. Trap: (a) divides by 6 only.*	PYQ Dec 22 Q36	PYQ 2022-Dec	8.B.3 Example, p. 8.26

Topic 7 Some More Examples

2 Scanner questions · ICAI appearances PYQ 2 · RTP – · MTP –

Ref	One-liner for the student	Scanner Q	Asked in	SM source
7.1	MC = dC/dx; MC is minimum where d(MC)/dx = 0 (with $d^2(MC)/dx^2 > 0$): $C = 500 - 20x^2 + x^3/3 \rightarrow MC = x^2 - 40x \rightarrow 2x - 40 = 0 \rightarrow x = 20$.	PYQ Dec 21 Q35	PYQ 2021-Dec	Applications of Differential Calculus, Example 2, p. 8.16
7.2	*See Topic 1: $xy = 1 \rightarrow dy/dx = -1/x^2 = -y^2$, so $y^2 + dy/dx = 0$.*	PYQ Jun 23 Q39	PYQ 2023-Jun	8.A.3, p. 8.5; Exercise 8(A) Q7, p. 8.19

Topic 8 Geometric Interpretation of the Differentiation

4 Scanner questions · ICAI appearances PYQ 3 · RTP – · MTP 1

Ref	One-liner for the student	Scanner Q	Asked in	SM source
8.1	Gradient (slope of the tangent) of y = f(x) at a point = dy/dx at that x: $y = 3x^2 - 6x + 4 \rightarrow 6x - 6 = 0$ at x = 1. Trap: the SM example is $y = 3x^2 - 5x + 4$, whose gradient at (1, 2) is 1.	MTP Jun 24 S3 Q9	MTP 2024-Jun S3	8.A.10 Example, p. 8.13
8.2	Rate of change of the slope: $y = 2 - x^2 \rightarrow$ slope $m = dy/dx = -2x \rightarrow dm/dt = -2 \cdot (dx/dt) = -2 \times 3 = -6$, so the slope decreases at 6 units/s.	PYQ Jun 23 Q38	PYQ 2023-Jun	8.A.10, p. 8.13; 8.A.4, p. 8.8
8.3	Maxima and minima: stationary points from dy/dx = 0; $d^2y/dx^2 < 0 \rightarrow$ maximum, $d^2y/dx^2 > 0 \rightarrow$ minimum: $y = 2x^3 - 15x^2 + 36x + 10 \rightarrow 6(x - 2)(x - 3) = 0$; $y'' = 12x - 30 = -6$ at x = 2 (maximum), +6 at x = 3 (minimum).	PYQ Dec 22 Q34	PYQ 2022-Dec	8.A.9, p. 8.12; Applications of Differential Calculus, Example 1, pp. 8.15 – 8.16
8.4	Area under y = f(x) between x = a and x = b = $\int_a^b f(x)\,dx$: $\int_0^1 (x^2 + 5x + 2)\,dx = 1/3 + 5/2 + 2 = 29/6 = 4.833$.	PYQ Dec 22 Q33	PYQ 2022-Dec	8.B.1, p. 8.23; 8.B.6, pp. 8.31 – 8.32

Topic 9 Applications of Differential calculus in Economics

14 Scanner questions · ICAI appearances PYQ 13 · RTP – · MTP 1

Ref	One-liner for the student	Scanner Q	Asked in	SM source
9.1	AC = C(x)/x and MC = dC/dx; for 'AC = MC' equate and reject x = 0: $C = 150x - 5x^2 + x^3/6 \rightarrow (150 - 5x + x^2/6) = (150 - 10x + x^2/2) \rightarrow 5x - x^2/3 = 0 \rightarrow x = 15$; $C = 50x - 5x^2 + x^3/6 \rightarrow x = 15$ likewise.	PYQ Jun 19 Q33, PYQ Jan 26 Q16	PYQ 2019-Jun, 2026-Jan	Applications of Differential Calculus (cost function, AC, MC), p. 8.15
9.2	From AC to MC: total cost C = Q × AC, then MC = dC/dQ: $AC = 2Q + 6 + 13/Q \rightarrow C = 2Q^2 + 6Q + 13 \rightarrow MC = 4Q + 6 = 66$ at Q = 15. Trap: differentiating AC itself.	PYQ Nov 20 Q35	PYQ 2020-Nov	Applications of Differential Calculus (cost function, AC, MC), p. 8.15
9.3	MC is minimum where d(MC)/dx = 0; AC is minimum where d(AC)/dx = 0 (SM Example 2): $C = x^3/2 - 15x^2 + 36x \rightarrow MC = 3x^2/2 - 30x + 36$, minimum at x = 10; $AC = x^2/2 - 15x + 36$, minimum at x = 15; $C = 500 - 5x^2 + x^3/3 \rightarrow MC = x^2 - 10x$, minimum at x = 5.	PYQ Jan 21 Q34, PYQ Sep 25 Q38	PYQ 2021-Jan, 2025-Sep	Applications of Differential Calculus, Example 2, p. 8.16

Ref	One-liner for the student	Scanner Q	Asked in	SM source
9.4	Optimum of a cost, revenue or expense function: f′(x) = 0, then the sign of f″(x) decides (negative = maximum, positive = minimum): C = $2x^3 - 15x^2 + 36x + 15 \rightarrow x = 2$ (C″ = −6, maximum), x = 3 (C″ = +6, minimum); R = $100x - 2x^2 \rightarrow 100 - 4x = 0 \rightarrow x = 25$, R″ = −4 < 0 (maximum); p = $-8x^2 + 400x - 1{,}000 \rightarrow x = 25$ is stationary but p″ = −16 < 0 (see editorial note).	PYQ May 18 Q28, PYQ Jul 21 Q36, PYQ May 26 Q20	PYQ 2018-May, 2021-Jul, 2026-May	8.A.9, p. 8.12; Applications of Differential Calculus, Example 1 and Revenue function, pp. 8.15 – 8.16
9.5	Profit P(x) = R(x) − C(x) with R = x·p(x); marginal profit = dP/dx evaluated at the stated output (not set to zero): P = $1{,}000x - x^3/3 - 125 \rightarrow P'(x) = 1{,}000 - x^2 \rightarrow P'(18) = 1{,}000 - 324 = 676$.	PYQ Jul 21 Q37	PYQ 2021-Jul	Profit function and Marginal Profit, p. 8.17
9.6	No loss / break-even: P = R − C ≥ 0, with P = 0 at break-even: price 25 − 2y, cost ₹10 → $(25 - 2y)y - 10y \geq 0 \rightarrow y \leq 7.5 \rightarrow 7$ units; C = 1,000 + 5x, R = 9x → P = 4x − 1,000: x = 250 break-even, 150 loss ₹400, 300 profit ₹200, 275 profit ₹100.	MTP Dec 24 S1 Q39, PYQ Sep 26 Q29	PYQ 2026-Sep; MTP 2024-Dec S1	Examples 3 and 4 (break-even point), pp. 8.17 – 8.18
9.7	Total function from marginal function: C(x) = ∫(MC) dx + k, k = fixed cost; R(x) = ∫(MR) dx + k, with k = 0 because R = 0 at x = 0: $MR = 5 - 4x + 3x^2 \rightarrow R = 5x - 2x^2 + x^3$; $MC = 12 - 4X + 3X^2$, fixed cost ₹500 → $C = X^3 - 2X^2 + 12X + 500$.	PYQ Jan 25 Q57, PYQ Sep 26 Q38	PYQ 2025-Jan, 2026-Sep	8.C.1, p. 8.41; 8.C.3.2, p. 8.42
9.8	*See Topic 14: $\int_0^1 (2x^2 - x^3)\,dx = [2x^3/3 - x^4/4]_0^1 = 2/3 - 1/4 = 5/12$ (Exercise 8(B) Q16).*	PYQ Jan 26 Q72	PYQ 2026-Jan	8.B.6, p. 8.32; Exercise 8(B) Q16, p. 8.37

Topic 10 Integration Calculus

7 Scanner questions · ICAI appearances PYQ 1 · RTP 1 · MTP 5

Ref	One-liner for the student	Scanner Q	Asked in	SM source
10.1	$\int e^{ax}\,dx = e^{ax}/a + c$ and $\int a^x\,dx = a^x/\log_e a + c$; combine the bases first: $2^{3x} \cdot 3^{2x} \cdot 5^x = (8 \times 9 \times 5)^x = 360^x \rightarrow \int = 360^x/\log 360 + C$.	RTP Jan 25 Q12, MTP Jan 25 S2 Q37	RTP 2025-Jan; MTP 2025-Jan S2	8.B.2 (iv) and (vi), p. 8.24
10.2	$\int f'(x)/f(x)\,dx = \log f(x) + c$: $\int dx/(x \log x)$ — f = log x, f′ = 1/x → $\log\lvert\log x\rvert + c$.	MTP Jun 24 S3 Q11	MTP 2024-Jun S3	8.B.3, Important standard formulae (h), p. 8.27
10.3	Integration by parts $\int uv\,dx = u\int v\,dx - \int[(du/dx)\int v\,dx]\,dx$ (ILATE order; for log x take v = 1): $\int xe^x\,dx = (x - 1)e^x + C$; $\int x^2 e^{3x}\,dx = x^2e^{3x}/3 - 2xe^{3x}/9 + 2e^{3x}/27 + C$; $\int \log_e x\,dx = x\log_e x - x + c = x\log_e(x/e) + c$.	MTP Aug 24 S2 Q39, PYQ Sep 24 Q64, MTP Dec 24 S1 Q40	PYQ 2024-Sep; MTP 2024-Aug S2, 2024-Dec S1	8.B.4, pp. 8.27 – 8.29; Exercise 8(B) Q13 – Q15, p. 8.37
10.4	$f(x) = \int f'(x)\,dx + C$, with C from the given value: $f' = 3x^2 + 2$, f(0) = 0 → $f = x^3 + 2x \rightarrow f(2) = 12$.	MTP Apr 26 S2 Q39	MTP 2026-Apr S2	8.B.5 Example (equation of curve), p. 8.31

Topic 11 Basic Formulas

6 Scanner questions · ICAI appearances PYQ 6 · RTP – · MTP –

Ref	One-liner for the student	Scanner Q	Asked in	SM source
11.1	$\int(ax+b)^n\,dx = (ax+b)^{n+1}/[a(n+1)] + c$: $\int(4x+3)^6\,dx = (4x+3)^7/28 + c$ (Exercise 8(B) Q8). Trap: (b) forgets the factor 1/4.	PYQ Nov 19 Q35	PYQ 2019-Nov	8.B.3 Example, p. 8.26; Exercise 8(B) Q8, p. 8.36
11.2	By parts (x first, e^x second): $\int xe^x\,dx = xe^x - \int e^x\,dx = e^x(x-1) + c$.	PYQ Nov 20 Q32	PYQ 2020-Nov	8.B.4 (i), p. 8.28
11.3	$\int e^x\{f(x) + f'(x)\}\,dx = e^x \cdot f(x) + c$: $e^x(x\log x + 1)/x = e^x(\log x + 1/x)$, $f = \log x \rightarrow e^x \log x + c$.	PYQ Nov 20 Q33	PYQ 2020-Nov	8.B.3, Important standard formulae (e), p. 8.27
11.4	By parts with v = 1, applied twice: $\int(\log x)^2\,dx = x(\log x)^2 - 2\int\log x\,dx = x(\log x)^2 - 2x\log x + 2x + c$.	PYQ Jun 22 Q39	PYQ 2022-Jun	8.B.4, pp. 8.27 – 8.28
11.5	$\int x^n\,dx = x^{n+1}/(n+1) + c$, then fix C from the given value: $f' = 12x^2 - 4x \rightarrow f = 4x^3 - 2x^2 + C$; $f(-3) = -108 - 18 + C = 17 \rightarrow C = 143$.	PYQ May 25 Q38	PYQ 2025-May	8.B.2 (i), p. 8.24; 8.B.5 Example, p. 8.31
11.6	Simplify by the law of indices first: $x^{25}/x^{26} = x^{-1}$, and $\int dx/x = \log x + c$ ($n = -1$ is the exception to the power rule). Trap: (b) omits the constant of integration.	PYQ May 26 Q18	PYQ 2026-May	8.B.2 (i) and (v), p. 8.24

Topic 12 Method of Substitution (change of variable)

7 Scanner questions · ICAI appearances PYQ 5 · RTP – · MTP 2

Ref	One-liner for the student	Scanner Q	Asked in	SM source
12.1	Substitution: put $z = f(x)$ and adjust $dz = f'(x)\,dx$: $\int x(x^2+4)^5\,dx \rightarrow t = x^2 + 4$, $x\,dx = dt/2 \rightarrow (x^2+4)^6/12 + c$ (Exercise 8(B) Q9); $\int dx/[x(\log x)^2] \rightarrow t = \log x$, $dt = dx/x \rightarrow \int t^{-2}\,dt = -1/\log x + k$.	PYQ Nov 18 Q34, PYQ Dec 21 Q38	PYQ 2018-Nov, 2021-Dec	8.B.3, p. 8.26; Exercise 8(B) Q9, p. 8.36
12.2	$\int a^x\,dx = a^x/\log_e a + c$ (since $d/dx(a^x/\log_e a) = a^x$).	PYQ Nov 19 Q34	PYQ 2019-Nov	8.B.2 (vi), p. 8.24
12.3	Multiply numerator and denominator by x^{n-1}, put $x^n = t$, then split into partial fractions: $\int dx/[x(x^5+1)] = \int x^4\,dx/[x^5(x^5+1)] = (1/5)\int[1/t - 1/(t+1)]\,dt = (1/5)\log[x^5/(x^5+1)] + c$ (the SM example with x^3 gives 1/3).	PYQ Sep 24 Q71	PYQ 2024-Sep	8.B.5 Example $\int dx/x(x^3+1)$, p. 8.31
12.4	*See Topic 14: $\int_{-1}^{1}(2x^2 - x^3)\,dx = [2x^3/3 - x^4/4]_{-1}^{1} = (2/3 - 1/4) - (-2/3 - 1/4) = 4/3$ (the odd term x^3 contributes 0 over symmetric limits).*	PYQ Nov 19 Q36	PYQ 2019-Nov	8.B.6, p. 8.32; 8.B.7 Property VI, p. 8.33
12.5	*See Topic 6: $y = \sqrt{[(1-x)/(1+x)]} \rightarrow \log y = \frac{1}{2}\{\log(1-x) - \log(1+x)\} \rightarrow (1/y)dy/dx = -1/(1-x^2) \rightarrow (1-x^2)dy/dx = -y$.*	MTP Jun 24 S3 Q8	MTP 2024-Jun S3	8.A.8 Example 1, p. 8.10
12.6	*See Topic 3: curve from slope: $f'(x) = 2x - 1 \rightarrow y = x^2 - x + C$; through (1, 0) $\rightarrow C = 0 \rightarrow y = x^2 - x$.*	MTP Jun 24 S3 Q10	MTP 2024-Jun S3	8.B.5 Example (equation of curve), p. 8.31

Topic 13 Method of Partial Fraction

1 Scanner question · ICAI appearances PYQ 1 · RTP – · MTP –

Ref	One-liner for the student	Scanner Q	Asked in	SM source
13.1	Partial fractions for non-repeated linear factors, $A/(x - a) + B/(x - b)$: $1/[(x - 1)(x - 2)] = 1/(x - 2) - 1/(x - 1) \rightarrow \int = \log[(x - 2)/(x - 1)] + c$. Trap: (c) inverts the ratio.	PYQ Jun 23 Q37	PYQ 2023-Jun	8.B.5 Type I, p. 8.29; Important standard formulae (a), p. 8.27

Topic 14 Definite Integration

13 Scanner questions · ICAI appearances PYQ 10 · RTP – · MTP 3

Ref	One-liner for the student	Scanner Q	Asked in	SM source
14.1	$\int_a^b F(x)\,dx = f(b) - f(a)$, with no constant of integration: $\int_{-1}^{3}(1 + 3x - x^3)\,dx = 4 + 12 - 20 = -4$; $\int_2^4(3x - 2)^2\,dx = 168 - 72 + 8 = 104$; $\int_1^4(2x + 5)\,dx = [x^2 + 5x]_1^4 = 36 - 6 = 30$; $\int_0^1 e^x\,dx = e - 1$.	PYQ Nov 18 Q35, PYQ May 25 Q37, MTP Jan 25 S2 Q39, PYQ Sep 26 Q35	PYQ 2018-Nov, 2025-May, 2026-Sep; MTP 2025-Jan S2	8.B.6, pp. 8.31 – 8.32; Exercise 8(B) Q17 and Q26, pp. 8.37 – 8.38
14.2	Improper fraction — divide before integrating: $(1 - x)/(1 + x) = -1 + 2/(1 + x) \rightarrow \int_1^2 = -1 + 2\log(3/2)$; $(x + 3)/(x + 2) = 1 + 1/(x + 2) \rightarrow \int_0^4 = 4 + \log_e 6 - \log_e 2$.	PYQ May 18 Q25, PYQ Sep 25 Q39	PYQ 2018-May, 2025-Sep	8.B.2 Example (iv), p. 8.25; 8.B.6, p. 8.32; Exercise 8(B) Q29, p. 8.38
14.3	$\int f'(x)/f(x)\,dx = \log f(x)$: $\int 2x/(1 + x^2)\,dx = \log(1 + x^2) \rightarrow \int_1^2 = \log_e 5 - \log_e 2 = \log_e(5/2)$; $\int_3^4 = \log(17/10)$; $\int_2^4 x/(x^2 + 1)\,dx = \frac{1}{2}\log(17/5)$. Trap: an option carrying '+ k' cannot be a definite integral.	PYQ Dec 22 Q38, MTP Jun 24 S3 Q12, MTP Aug 24 S2 Q40, PYQ Sep 25 Q40	PYQ 2022-Dec, 2025-Sep; MTP 2024-Jun S3, 2024-Aug S2	8.B.3, Important standard formulae (h), p. 8.27; Exercise 8(B) Q27, p. 8.38
14.4	*See Topic 15: $\int^{a}{}^{b} f(x)\,dx = \int^{a}{}^{b} f(a + b - x)\,dx$ (Property IV extended to limits a to b), so $\int^{a}{}^{b} f(x)/[f(x) + f(a + b - x)]\,dx = (b - a)/2$: $\int_2^3 \sqrt{x}/(\sqrt{(5 - x)} + \sqrt{x})\,dx = (3 - 2)/2 = 1/2$.*	PYQ Jun 19 Q35	PYQ 2019-Jun	8.B.7 Property IV and Example, pp. 8.32 – 8.33
14.5	*See Topic 11: $\int e^x\{f(x) + f'(x)\}\,dx = e^x f(x) + c$ with $f = x^2$, $f' = 2x$: $\int e^x(x^2 + 2x)\,dx = x^2e^x + c$.*	PYQ Jun 19 Q36	PYQ 2019-Jun	8.B.3, Important standard formulae (e), p. 8.27
14.6	*See Topic 9: AC minimum — $AC = C/x$, set $d(AC)/dx = 0$ and check $d^2(AC)/dx^2 > 0$: $C = 600x - 10x^2 + x^3/2 \rightarrow AC = 600 - 10x + x^2/2 \rightarrow -10 + x = 0 \rightarrow x = 10$.*	PYQ Jan 26 Q18	PYQ 2026-Jan	Applications of Differential Calculus, Example 2(ii), p. 8.16

Topic 15 Important Properties

10 Scanner questions · ICAI appearances PYQ 10 · RTP – · MTP –

Ref	One-liner for the student	Scanner Q	Asked in	SM source
15.1	Property IV: $\int_0^a f(x)\,dx = \int_0^a f(a - x)\,dx$ (for limits a to b use $a + b - x$); add the two forms so the integrand becomes 1: $\int_0^2 \sqrt{x}/(\sqrt{x} + \sqrt{(2 - x)})\,dx = 1$; $\int_2^8 \sqrt{x}/(\sqrt{x} + \sqrt{(10 - x)})\,dx = (8 - 2)/2 = 3$; $\int_0^1 \mu(1 - \mu)^{10}\,d\mu = \int_0^1(1 - \mu)\mu^{10}\,d\mu = 1/11 - 1/12 = 1/(12 \times 11)$.	PYQ May 18 Q27, PYQ Nov 20 Q36, PYQ Jun 24 Q35	PYQ 2018-May, 2020-Nov, 2024-Jun	8.B.7 Property IV and Example, pp. 8.32 – 8.33

Ref	One-liner for the student	Scanner Q	Asked in	SM source
15.2	$\int e^x\{f(x)+f'(x)\}\,dx = e^x f(x)$: $f = 1/x$, $f' = -1/x^2 \to \int_1^2 e^x(1/x - 1/x^2)\,dx = [e^x/x]_1^2 = e^2/2 - e = e(e/2 - 1)$.	PYQ Jan 21 Q35	PYQ 2021-Jan	8.B.3, Important standard formulae (e), p. 8.27
15.3	By parts with limits: $\int_0^1 xe^x\,dx = [xe^x - e^x]_0^1 = (e - e) - (0 - 1) = 1$ (Exercise 8(B) Q18).	PYQ Jun 22 Q37	PYQ 2022-Jun	8.B.4 (i), p. 8.28; Exercise 8(B) Q18, p. 8.37
15.4	Substitution in a definite integral — change the limits with the variable: $\int_0^1 x\sqrt{(x^2+4)}\,dx$, $t = x^2 + 4$ (4 to 5) $\to (1/3)(5\sqrt{5} - 8)$; $\int_0^1 x^2\sqrt{(x^3+4)}\,dx$, $t = x^3 + 4$ (4 to 5) $\to$ (2/9)(5^(3/2) − 4^(3/2)).	PYQ Dec 23 Q34, PYQ Jun 24 Q34	PYQ 2023-Dec, 2024-Jun	8.B.3, p. 8.26; 8.B.6, p. 8.32
15.5	Split and integrate term by term: $\int_1^3 (e^x - x^{-2})\,dx = (e^3 - e) - [-1/x]_1^3 = e^3 - e - 2/3$. Trap: sign of $\int x^{-2}\,dx = -1/x$.	PYQ Dec 23 Q37	PYQ 2023-Dec	8.B.2, Elementary rules, p. 8.24; 8.B.6, p. 8.32
15.6	Simplify the integrand first: $\log(a^x) = x \log a$, so $\int \log(a^x)\,dx = \log a \cdot x^2/2 + c$. Trap: (c) is $\int \log(ax)\,dx$.	PYQ Jun 19 Q37	PYQ 2019-Jun	8.B.2 (i), p. 8.24
15.7	*See Topic 2: product rule $d(uv)/dx = u \cdot dv/dx + v \cdot du/dx$: $d/dx(x \log x) = x \cdot (1/x) + \log x = 1 + \log x$.*	PYQ Nov 19 Q37	PYQ 2019-Nov	8.A.3, Basic laws (iii), p. 8.6

Part B — Chapter 8 One-liner Revision Sheet

Deduplicated and in Study Material order. Click a 'Part A ref' to jump to the Part A row(s) carrying the full wording, the Scanner questions and the SM page. Refs read Unit.Topic.Row in chapters with several units and Topic.Row otherwise. Weight: ★★★ asked by ICAI 6 or more times · ★★ 3 – 5 times · ★ once or twice. The ★★★ lines alone cover about 33% of ICAI appearances in this chapter.

Differential and Integral Calculus

#	One-liner	Weight	Part A ref
1	d/dx: $x^n \to nx^{n-1}$ · $e^{ax} \to ae^{ax}$ · $a^x \to a^x \log_e a$ · $\log x \to 1/x$ · constant → 0; $xy = 1 \Rightarrow y^2 + dy/dx = 0$	★★	1.1, 1.3, 7.2
2	Product $(uv)' = uv' + vu'$ · quotient $(u/v)' = (vu' - uv')/v^2$ · expand products of factors first	★★	1.2, 2.2, 4.2, 6.4, 15.7
3	Chain rule dy/dx = dy/du · du/dx · $(e^f)' = e^f f'$ · $(\sqrt{u})' = u'/(2\sqrt{u})$ · differential d(y) = y′ dx	★★	2.3, 3.1, 3.2
4	Implicit: differentiate term by term, $(y^n)' = ny^{n-1}y'$, $(xy)' = xy' + y$, collect y′	★★	4.1, 6.3
5	**Parametric: dy/dx = (dy/dt)/(dx/dt); d^2y/dx^2 = [d(dy/dx)/dt] ÷ dx/dt; dx/dt = 0 ⇒ slope ∞**	★★★	5.1, 5.2, 5.3, 5.4, 5.5
6	Log differentiation for variable powers: $x^x \to x^x(1 + \log x)$; $x^y = y^x$ and $x^y y^x = k$ → take logs, then implicit	★★	6.1, 6.2, 2.1, 1.4, 3.4
7	$\sqrt{[(1 - x)/(1 + x)]} \to (1 - x^2)y' = -y$ (SM 'Some more examples')	★	12.5
8	Gradient = dy/dx at the point · rate of change = derivative · rate of slope = d(dy/dx)/dt	★★	8.1, 8.2, 3.3, 4.3
9	Max/min: f′ = 0, then f″ < 0 maximum, f″ > 0 minimum	★★	8.3, 9.4
10	AC = C/x · MC = dC/dx · AC = MC → solve, reject x = 0 · from AC: C = x·AC first	★★	9.1, 9.2
11	MC minimum: d(MC)/dx = 0 · AC minimum: d(AC)/dx = 0	★★	9.3, 7.1, 14.6
12	P = R − C, R = x·p · marginal profit = P′ at the stated x · break-even R = C; no loss P ≥ 0	★★	9.5, 9.6
13	$\int x^n = x^{n+1}/(n + 1)$ $(n \neq -1)$ · $\int dx/x = \log x$ · $\int e^{ax} = e^{ax}/a$ · $\int a^x = a^x/\log_e a$ · combine bases · keep + c	★★	10.1, 11.6, 12.2, 15.6
14	**Substitution z = f(x), dz = f′dx · $\int (ax + b)^n = (ax + b)^{n+1}/[a(n + 1)]$**	★★★	11.1, 2.4, 6.6, 12.1, 3.5
15	$\int f'/f = \log f$ · $\int e^x\{f + f'\} = e^x f$	★★	10.2, 11.3, 14.5, 15.2
16	**By parts $\int uv = u\int v - \int(u'\int v)$ (ILATE) · $\int xe^x = (x - 1)e^x$ · $\int \log x = x \log x - x$ · $\int (\log x)^2 = x(\log x)^2 - 2x \log x + 2x$**	★★★	10.3, 11.2, 11.4, 6.5
17	Partial fractions A/(x − a) + B/(x − b) · multiply by x^{n-1} and put $x^n = t$	★	13.1, 12.3
18	Curve from slope: f = ∫f′ dx + C, C from the given point	★★	3.6, 10.4, 11.5, 12.6
19	**Definite: $[F]_a^b = F(b) - F(a)$, no + c · area = $\int_a^b f\,dx$ · divide improper fractions first**	★★★	14.1, 14.2, 14.3, 8.4, 9.8, 12.4
20	Definite by substitution — change the limits · split sums, $\int x^{-2} = -1/x$ · by parts with limits	★★	15.4, 15.5, 15.3

#	One-liner	Weight	Part A ref
21	Properties: III split at a break point · IV $\int_0^a f(x) = \int_0^a f(a - x) \rightarrow 2I$ trick, answer $(b - a)/2$	★★	15.1, 14.4, 4.4
22	Economics: $C = \int MC\, dx$ + fixed cost · $R = \int MR\, dx$ ($k = 0$)	★	9.7

CHAPTER 9

Number Series, Coding and Decoding, Odd Man Out

126 Scanner questions · 42 one-liners · 26 revision pointers

Part A — One-liners mapped to Scanner questions and Study Material

Number Series, Coding and Decoding, Odd Man Out

SM Chapter 9, pages 9.1 – 9.9

Topic 1 Number Series

44 Scanner questions · ICAI appearances PYQ 36 · RTP 1 · MTP 7

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.1	Alternate-term (two-step) series: two operations repeat in turn, so read the odd and even positions separately — +4, +2 → 29 + 2 = 31; +6, −3 → 27 − 3 = 24; +5, −2 → 34 + 5 = 39.	PYQ Nov 18 Q38, MTP Jun 24 S3 Q41, RTP Sep 24 Q14	PYQ 2018-Nov; RTP 2024-Sep; MTP 2024-Jun S3	Exercise 9(A) Q3, p. 9.5 and Q12, p. 9.6
1.2	Differences in A.P.: take first differences; if they rise by a constant (second difference constant), extend them — 2, 7, 16, 29, 46 (+5, +9, +13, +17); 4, 13, 28, 49, 76 (+9, +15, +21, +27, i.e. $3n^2 + 1$); 11, 17, 39, 85, 163, 281 (+6, +22, +46, +78, +118: second differences +16, +24, +32, +40); interleaved 3, 5, 5, 19, 7, 41, 9, ?, 11, 109 → odd places 3, 5, 7, 9, 11, even places +14, +22, +30, +38 → 71. Trap: in 4, 13, __, 49, 76 the term is 28, not 26.	PYQ Dec 21 Q41, PYQ Dec 22 Q41, PYQ Dec 22 Q43, PYQ Jan 25 Q63	PYQ 2021-Dec, 2022-Dec (×2), 2025-Jan	9.1 A Case 1, Example 1, p. 9.1
1.3	Differences are squares, cubes or a running square-sum: 1, 5, 21, 57 → $+2^2$, $+4^2$, $+6^2$, $+8^2$ = 121; 7, 11, 27, 63, 127 → +4, +16, +36, +64, +100 = 227; 51, 52, 60, 87, 151 → $+1^3$, $+2^3$, $+3^3$, $+4^3$, $+5^3$ = 276; 1, 5, 14, 30, 55, 91 = Σn^2 → 91 + 7^2 = 140.	PYQ Nov 20 Q42, PYQ Jun 22 Q45, PYQ Jun 24 Q43, MTP Aug 24 S2 Q45	PYQ 2020-Nov, 2022-Jun, 2024-Jun; MTP 2024-Aug S2	Example 16, p. 9.5 (Σn^2 pattern); square/cube differences Not in SM (PYQ-only)
1.4	Multiply-and-add series (×2 ± k): each term = 2 × previous ± a constant or a growing constant — 3, 7, 15, 31 → ×2 + 1 = 63 (also $2^n - 1$); 2, 5, 11, 23, 47 → ×2 + 1 = 95; 5, 7, 11, 19, 35 → ×2 − 3 (differences double: 2, 4, 8, 16) = 19; 6, 13, 28, 59 → ×2 + 1, +2, +3, +4 = 122; 6, 13, 25, 51, 101 → ×2 + 1, ×2 − 1 alternately = 203.	PYQ Jun 22 Q46, PYQ Jun 22 Q47, MTP Jun 24 S3 Q42, PYQ Sep 24 Q72, MTP Apr 26 S1 Q41	PYQ 2022-Jun (×2), 2024-Sep; MTP 2024-Jun S3, 2026-Apr S1	Exercise 9(A) Q26 and Q28, p. 9.7
1.5	Growing multiplier (×n ± n): when differences show no pattern, test term × 1, × 2, × 3 … with an add-on — 7, 8, 18, 57, 232, 1165 = ×n + n → 1165 × 6 + 6 = 6996; 8, 6, 9, 23, 87 = ×n − (n + 1) → 87 × 5 − 6 = 429.	PYQ May 26 Q78, PYQ Sep 26 Q36	PYQ 2026-May, 2026-Sep	Not in SM (PYQ-only)
1.6	Constant-ratio (geometric) series: each term = previous × r — 4, 16, __, 256, 1024 (r = 4) → 64; 4, 6, 9, 13.5, __, 30.375 (r = 1.5) → 20.25.	PYQ Nov 19 Q42, PYQ Jun 22 Q43	PYQ 2019-Nov, 2022-Jun	Exercise 9(A) Q18, p. 9.6

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.7	Squares of n: 4, 16, 36, 64, 100 = $(2n)^2$ → 12^2 = 144; 4, 9, 16, … , 49 = $(n + 1)^2$ → 8^2 = 64; 2, 5, 10, 17, 26, 37, 50 = $n^2 + 1$, so 64 is the wrong term (should be 65).	PYQ Nov 19 Q40, MTP Jun 24 S3 Q45, PYQ Sep 25 Q42	PYQ 2019-Nov, 2025-Sep; MTP 2024-Jun S3	Example 3, p. 9.1
1.8	Cubes of n (and cube-based polynomials): 7, 26, 63, 124, 215, 342 = $n^3 - 1$ (n = 2 …) → 511 or 342; 1, 1, 8, 4, 27, __, 64, 16 = n^3, n^2 interleaved → 3^2 = 9; 4, 18, __, 100 = $n^3 - n^2$ → 64 − 16 = 48; 2, 8, 26, 62, 122, 212 = $n^3 - n + 2$ → 343 − 7 + 2 = 338.	PYQ Jul 21 Q40, PYQ Jun 22 Q41, PYQ Jun 23 Q43, PYQ May 25 Q41, PYQ May 25 Q42	PYQ 2021-Jul, 2022-Jun, 2023-Jun, 2025-May (×2)	Example 2, p. 9.1; Exercise 9(A) Q19, p. 9.6 and Q25, p. 9.7
1.9	Prime-number series: 23, 29, 31, 37, 41, 43 → next prime 47; $p^2 - 2$ on consecutive primes 3, 5, 7, 11, 13 → $17^2 - 2$ = 287; odd one in 7, 11, 13, 15, 19, 23 is 15 (the only non-prime).	PYQ Jun 19 Q38, PYQ Jan 26 Q21, MTP Apr 26 S2 Q44	PYQ 2019-Jun, 2026-Jan; MTP 2026-Apr S2	Exercise 9(A) Q55 (non-prime odd one), p. 9.9; prime series Not in SM (PYQ-only)
1.10	Term built from earlier terms: 0, 2, 3, 6, 10 = sum of previous two + 1 → 17 + 28 + 1 = 46; 1, 3, 4, 8, 15, 27 = sum of previous three → 50; 11, 12, 14, 17, 22, 30 = differences 1, 2, 3, 5, 8 (Fibonacci) → +13 = 43; 2, 3, 8, 63, 3968 = $(\text{previous})^2 - 1$ → $8^2 - 1$ = 63.	PYQ Nov 20 Q37, PYQ Dec 23 Q42, MTP Aug 24 S2 Q44, PYQ May 26 Q21	PYQ 2020-Nov, 2023-Dec, 2026-May; MTP 2024-Aug S2	Not in SM (PYQ-only)
1.11	Fraction series: run numerators and denominators as two separate series — 3/8, 8/19, 18/41 → numerators +5, +10, +20, +40, denominators +11, +22, +44, +88 → 38/85; 1/2, 3/4, 5/8, 7/16 → odd numerators, denominators 2^n → 9/32.	PYQ Nov 20 Q38, PYQ Jan 21 Q36	PYQ 2020-Nov, 2021-Jan	Not in SM (PYQ-only)
1.12	Alphabet series: convert letters to positions A = 1 … Z = 26 (reverse Z = 1 … A = 26) and wrap after Z — R, U, X, A, D (+3) → G; AZ, GT, MN, __, YB, EV → first letter +6, second −6 → SH; CEGI, XVTR, GIKM → +2/−2 groups and mirror pairs (G ↔ T, I ↔ R, K ↔ P, M ↔ N) → TRPN; FMAMJJASON = initials of months → DJF.	PYQ Dec 21 Q40, PYQ Jun 24 Q40, PYQ Sep 24 Q70, PYQ Jan 25 Q66	PYQ 2021-Dec, 2024-Jun, 2024-Sep, 2025-Jan	9.1 B Alphabet series (position table), Example 4, p. 9.2
1.13	Alpha-numeric terms: split each term into first letter, number and last letter and solve each strand — P3C, R5F, T8I, V12L → +2 letters, +2, +3, +4 … numbers, +3 letters → X17O; Q1F, S2E, U6D, W21C → +2 letters, ×n + n numbers (1, 2, 6, 21, 88), −1 letters → Y88B.	PYQ Jan 21 Q37, PYQ Jun 23 Q41	PYQ 2021-Jan, 2023-Jun	Example 4, p. 9.2 (strand-wise letter moves); numbers Not in SM (PYQ-only)
1.14	*See Topic 2: MADRAS → NBESBT is letter coding, +1 to every letter, so DELHI → EFMIJ.*	PYQ Sep 25 Q43	PYQ 2025-Sep	Example 6, p. 9.3; Exercise 9(A) Q31, p. 9.7

Topic 2 Coding and Decoding

56 Scanner questions · ICAI appearances PYQ 41 · RTP 3 · MTP 12

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.1	Letter shift +1/−1 (forward/backward coding): compare word and code letter by letter — MYSTIFY → NZTUJGZ, DELHI → EFMIJ so JAIPUR → KBJQVS (+1); TAP → SZO so FRIEND → EQHDMC (−1); HEALTH → IFBMUL: +1 except last H +4, so NORTH → OPSUL.	PYQ Nov 20 Q40, PYQ Jul 21 Q41, PYQ Sep 24 Q73, PYQ Jan 25 Q69	PYQ 2020-Nov, 2021-Jul, 2024-Sep, 2025-Jan	9.2 Type 1 Case 1, Examples 6 and 7, p. 9.3
2.2	Letter shift +2/−2/+4 (wrap Z → A, digits shift too): TEACHER → VGCEJGT so CHILDREN → EJKNFTGP; SUBJECT → UWDLGEV so MENTION → OGPVKQP; MIND → KGLB (−2) so DIAGRAM → BGYEPYK; CH4IR → GL8MV (+4, 4 → 8) so 1N5T4GR4M → 5R9X8KV8Q. Decoding: HONEY → JQPGA (+2), so VCTIGVU reverses (−2) to TARGETS.	PYQ Jun 24 Q42, MTP Dec 24 S1 Q44, RTP Jan 25 Q20, PYQ May 25 Q44, PYQ May 26 Q77, PYQ Sep 26 Q11	PYQ 2024-Jun, 2025-May, 2026-May, 2026-Sep; RTP 2025-Jan; MTP 2024-Dec S1	Example 9 (decoding), p. 9.3; Exercise 9(A) Q42–43, p. 9.8
2.3	Position-wise alternating shifts: write the shift for each position and apply it in order — SIKKIM → THLJJL (+1, −1 …) → TRAINING = UQBHOHOF; MONKEY → NNOJFX (+1, −1 …) → PUZZLE = QTAYMD; GLAMOUR → IJCNMWP (+2, −2, +2, +1, −2, +2, −2) → MUSICAL = OSUJACJ; SUMMER → RUNNER (1st −1, 3rd and 4th +1, rest unchanged) → WINTER = VIOUER.	PYQ Dec 23 Q38, PYQ Sep 25 Q44, PYQ Jan 26 Q73, MTP Apr 26 S1 Q45	PYQ 2023-Dec, 2025-Sep, 2026-Jan; MTP 2026-Apr S1	9.2 Type 1, pp. 9.2 – 9.3; alternating shifts Not in SM (PYQ-only)
2.4	Reverse-alphabet (opposite-letter) coding: a letter is replaced by its mirror, position n ↔ 27 − n (A ↔ Z, B ↔ Y, M ↔ N) — BEAT → YVZG so MILD → NROW; FLOWER → UOLDVI so TERMINAL → GVINRMZO.	PYQ Jan 21 Q39, MTP Jan 25 S2 Q45	PYQ 2021-Jan; MTP 2025-Jan S2	9.1 B Alphabet series (forward and reverse position table), p. 9.2
2.5	Reversal and rearrangement coding (letters unchanged, order changed): full reversal — STATEMENT → TNEMETATS so POLITICAL → LACITILOP; TELEPHONE → ENOHPELET so ALIGATOR → ROTAGILA; REFRIGERATOR → ROTAREGIRFER so NOITINUMMA decodes to AMMUNITION. Part reversal — THANKS → SKNTHA (last three reversed, then first three) so STUPID → DIPSTU; INACTIVE → VITCANIE (first seven reversed, last fixed) so COMPUTER → ETUPMOCR.	PYQ Dec 21 Q43, PYQ Dec 23 Q41, PYQ Jun 24 Q44, MTP Jan 25 S2 Q50, PYQ Sep 26 Q37	PYQ 2021-Dec, 2023-Dec, 2024-Jun, 2026-Sep; MTP 2025-Jan S2	9.2 Type 1, Example 8, p. 9.3 (rearrangement); full reversal Not in SM (PYQ-only)
2.6	First letter shifted, rest swapped in pairs: MENTION → LNEITNO (M −1 = L; EN, TI, ON reversed two at a time) so PRESENT → O + ER ES TN = OERESTN (option (d), not ONESERP).	PYQ Jun 23 Q44	PYQ 2023-Jun	Example 8, p. 9.3
2.7	Reverse-then-shift coding: FROZEN reversed = NEZORF, each +1 → OFAPSG, so MOLTEN → NETLOM → OFUMPN; HEALTH reversed = HTLAEH, each −1 → GSKZDG, so NORTH → HTRON → GSQNM.	PYQ Dec 22 Q39, MTP Dec 24 S1 Q43	PYQ 2022-Dec; MTP 2024-Dec S1	9.2 Type 1, pp. 9.2 – 9.3; Not in SM (MTP/PYQ-only) as a combined rule

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.8	Letter-to-digit substitution: build a letter → digit table from the given words (a letter keeps one digit throughout) and read the new word off it — RIPPLE 613382, LIFE 8192 → PILLER 318826, RIFFLE 619982 (check which option letter carries 318826: (a) in 2018-May, (b) in 2024-Sep).	PYQ May 18 Q29, PYQ Jan 21 Q40, PYQ Sep 24 Q69	PYQ 2018-May, 2021-Jan, 2024-Sep	9.2 Type 2 Case 1, Example 11, p. 9.4; Exercise 9(A) Q48, p. 9.8
2.9	Letter-to-digit table (two-word key): PLAY 8123 + RHYME 49367 → MALE 6217; CLOCK 34235 + TIME 8679 → MOTEL 72894; MOUSE 34651 + KEY 217 → YES 715; LOTUS 14682 + STRANGE 2690753 → GESTURE 5326893; EARTH 16235 + VENUS 91784 → SATURN 463827.	PYQ May 18 Q37, PYQ Jul 21 Q44, PYQ Dec 21 Q39, PYQ Jun 22 Q42, PYQ Jun 22 Q44	PYQ 2018-May, 2021-Jul, 2021-Dec, 2022-Jun (×2)	Example 11, p. 9.4; Exercise 9(A) Q37, p. 9.7
2.10	Letter-to-digit table (three-word or repeated-letter key): TOUR/CLEAR/SPARE → CARE 5847; ROSE/CHAIR/PREACH → SEARCH 214673; CLOCK 75276 + EARTH 83491 → COAT 7239; DOCTOR/PATIENT → OPERATION 289765120; TWENTY 863985 + ELEVEN 323039 → TWELVE 863203; PREMONITION 68530492904 → MONITOR 3049208; GARDEN 3,25,764 + WATER 9,21,65 → WARDEN 9,25,764 (commas only group digits).	PYQ Dec 22 Q42, PYQ Dec 22 Q44, MTP Jun 24 S3 Q43, MTP Aug 24 S2 Q42, PYQ Jan 25 Q62, PYQ May 26 Q74, PYQ Sep 26 Q13	PYQ 2022-Dec (×2), 2025-Jan, 2026-May, 2026-Sep; MTP 2024-Jun S3, 2024-Aug S2	Example 11, p. 9.4
2.11	Missing-letter elimination: if a letter of the new word has no known digit, strike out options whose digit at that place already belongs to another letter — SYSTEM 131625 → TERMS 6 2 _ 5 1; R cannot be 2 (E) → 62451.	PYQ Nov 19 Q43	PYQ 2019-Nov	Example 11, p. 9.4 (table method); elimination Not in SM (PYQ-only)
2.12	Digit-to-letter decoding: invert the table — LOSE 1357, GAIN 2468 → 82146 = NGLAI; CODE 1357, GAMER 24678 → 84178 = RACER.	PYQ May 18 Q31, PYQ May 26 Q75	PYQ 2018-May, 2026-May	9.2 Type 2 Case 2, Example 12, p. 9.4; Exercise 9(A) Q39, p. 9.7
2.13	Position-value coding: code = alphabet position (A = 1 … Z = 26) or a function of it — FRAME 06 18 01 13 05 → ARISE 0118091905; PEAR 7519 = digit sum of positions (P 16 → 7) → DOCTOR 463269; F = 6, MAT = 13 + 1 + 20 = 34 → CAR = 22; Z = 52 (2 × 26), ACT = 2 × 24 = 48 → BAT = 2 × 23 = 46; reverse values A = 26, SUN = 8 + 6 + 13 = 27 → CAT = 24 + 26 + 7 = 57.	PYQ Jul 21 Q42, PYQ Dec 23 Q39, MTP Jun 24 S3 Q44, MTP Aug 24 S2 Q41, RTP Sep 24 Q12	PYQ 2021-Jul, 2023-Dec; RTP 2024-Sep; MTP 2024-Jun S3, 2024-Aug S2	Example 10, p. 9.4; Exercise 9(A) Q34, p. 9.7
2.14	Sentence (phrase) coding: the word common to two sentences takes the digit common to their codes; eliminate known words to isolate the target — ‘and’ = 8; ‘bright’ = 2 (boy = 1, little = 3); ‘beautiful’ = 6 (capital = 9, Delhi/is = 7/5); ‘luck’ = 3 (best = 6); ‘are’ = 2 (old = 5, books = 3).	PYQ May 18 Q30, MTP Aug 24 S2 Q43, RTP Jan 25 Q17, PYQ May 25 Q45, MTP Apr 26 S1 Q44	PYQ 2018-May, 2025-May; RTP 2025-Jan; MTP 2024-Aug S2, 2026-Apr S1	Exercise 9(A) Q51, p. 9.8
2.15	*See Topic 1: ABD, DGK, HMS, MTB, SBL is an alphabet series — first letters +3, +4, +5, +6, +7; second +5 … +9; third +7 … +11 (wrap after Z) → ZKW.*	MTP Jan 25 S2 Q44	MTP 2025-Jan S2	Example 4, p. 9.2

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.16	*See Topic 3: wrong term — 50, 82, 170, 290 are each (odd number)² + 1 (7², 9², 13², 17²); 48 is not of that form, so 48 is wrong.*	PYQ Sep 25 Q45	PYQ 2025-Sep	Example 2, p. 9.1 (wrong term of a series)
2.17	*See Topic 3: odd letter group — CEHL, KMPT, OQTX move +2, +3, +4; NPSV moves +2, +3, +3 → odd one NPSV.*	PYQ Jan 26 Q19	PYQ 2026-Jan	9.3 Odd man out, p. 9.4
2.18	Misfiled (Statistics — data interpretation): average interest = Σx ÷ n = (23.4 + 32.5 + 41.6 + 36.4 + 49.4) ÷ 5 = 183.3 ÷ 5 = 36.66 million rupees.	PYQ Dec 21 Q44	PYQ 2021-Dec	Not in SM Chapter 9 (PYQ-only; arithmetic mean, SM Chapter 15)

Topic 3 Odd man out

26 Scanner questions · ICAI appearances PYQ 21 · RTP 1 · MTP 4

Ref	One-liner for the student	Scanner Q	Asked in	SM source
3.1	Prime-number odd man out: all terms prime except one — 7, 9, 13, 17, 19 → 9; 41, 43, 47, 53, 61, 71, 83, 95 → 95 (= 5 × 19).	PYQ Nov 18 Q41, PYQ Jun 23 Q45	PYQ 2018-Nov, 2023-Jun	Exercise 9(A) Q55, p. 9.9
3.2	Perfect squares/cubes: the odd one is the term that breaks the power pattern — 16, 25, 36, 72, 144 → 72 not a square; 225, 196 … 100, 77, 64 → 77; 8, 25, 64, 125, 216 = n^3 → 25 (should be 27); 15, 21, 63, 81, 69 → 81 the only perfect square.	PYQ Nov 18 Q40, PYQ Jan 21 Q38, PYQ Jul 21 Q43, MTP Jun 24 S3 Q46	PYQ 2018-Nov, 2021-Jan, 2021-Jul; MTP 2024-Jun S3	Example 17, p. 9.5; Exercise 9(A) Q56, p. 9.9
3.3	$n^2 + 1$ pattern: 5, 10, 17, 26, 37 = $n^2 + 1$ (n = 2 … 6), so 27 is odd (it should be 26; 27 is also the only cube) — answer (c), not 17; 145, 197, 257, 325 = (even n)² + 1 (12², 14², 16², 18²) → 20² + 1 = 401, so 399 is wrong.	PYQ Nov 19 Q41, MTP Jan 25 S2 Q43	PYQ 2019-Nov; MTP 2025-Jan S2	Example 2, p. 9.1 (wrong term from a power pattern)
3.4	Divisibility, parity and digit-sum tests: 6, 9, 15, 21, 24, 26, 30 → all multiples of 3 except 26; 121, 143, 165, 186, 209 → multiples of 11 (+22), so 186 (should be 187); 295, 381, 552, 729 → 552 the only even number; 190, 145, 136, 352, 460, 324, 631, 244 → digit sum 10 except 324 (digit sum 9).	PYQ Nov 20 Q39, PYQ Jun 23 Q42, MTP Dec 24 S1 Q41, MTP Jan 25 S2 Q41	PYQ 2020-Nov, 2023-Jun; MTP 2024-Dec S1, 2025-Jan S2	9.3, Examples 14 and 15, pp. 9.4 – 9.5
3.5	Wrong term in a Σn^2 / power-plus-constant series: 1, 5, 14, 30, 49, 55, 91 = Σn^2 → after 30 comes 30 + 5^2 = 55, so 49 is wrong; 3, 10, 29, 66, 127, 220, 345 = n^3 + 2 → 220 (should be 218); 7, 23, 47, 119, 171, 287 = p^2 − 2 (primes) → 171 (should be 167).	PYQ Nov 19 Q44, PYQ Sep 24 Q68, PYQ Sep 26 Q39	PYQ 2019-Nov, 2024-Sep, 2026-Sep	Example 16, p. 9.5; Exercise 9(A) Q58, p. 9.9
3.6	Wrong term in a multiply/add rule: 4, 12, 44, 176, 890 = ×n + 2(n − 1) → 42 not 44; 34, 105, 424, 2123, 12756 = ×n + n → 2125 not 2123; 2, 10, 18, 54 … = ×3 → 6 not 10; 445, 221, 109, 46, 25, 11, 4 → differences halve (224, 112, 56, 28 …) → 53 not 46; G4T, J10R, M20P, P43N, S90L → numbers ×2 + 1, +2, +3, +4 → 9 not 10, so J10R.	PYQ Jun 19 Q39, PYQ Nov 20 Q41, PYQ Dec 22 Q40, RTP Jan 25 Q16, PYQ May 25 Q43	PYQ 2019-Jun, 2020-Nov, 2022-Dec, 2025-May; RTP 2025-Jan	9.3 Odd man out, p. 9.4; rule-based wrong term Not in SM (PYQ-only)

Ref	One-liner for the student	Scanner Q	Asked in	SM source
3.7	Odd letter group: compare the step pattern inside each group — BDFH, JLNP, RTVX skip one letter (+2); ZBDE ends +1 (should be ZBDF).	PYQ Jun 24 Q41	PYQ 2024-Jun	9.3 Odd man out, p. 9.4
3.8	Word classification: find the common quality and spot the stranger — Zebra, Giraffe, Horse are herbivores, Tiger is a carnivore; Marriage, Wedlock, Matrimony are synonyms, Divorce is the opposite.	PYQ Dec 21 Q42, PYQ Jan 25 Q70	PYQ 2021-Dec, 2025-Jan	9.3, Example 13, p. 9.4
3.9	*See Topic 1: complete-the-series questions — 0, 6, 24, 60, 120, 210 = $n^3 - n$ → 343 − 7 = 336; 1, 7, 17, 31, 49, 71 → differences +6, +10 … +22 rise by 4 → 71 + 26 = 97.*	PYQ Sep 25 Q41, PYQ Jan 26 Q70	PYQ 2025-Sep, 2026-Jan	Example 1, p. 9.1
3.10	*See Topic 2: PAINT 74128 and ACCEPT 455978 give P 7, A 4, I 1, N 2, T 8, C 5, E 9 → PATIENT = 7481928 (74,81,928).*	PYQ Jan 26 Q71	PYQ 2026-Jan	Example 11, p. 9.4

Part B — Chapter 9 One-liner Revision Sheet

Deduplicated and in Study Material order. Click a 'Part A ref' to jump to the Part A row(s) carrying the full wording, the Scanner questions and the SM page. Refs read Unit.Topic.Row in chapters with several units and Topic.Row otherwise. Weight: ★★★ asked by ICAI 6 or more times · ★★ 3 – 5 times · ★ once or twice. The ★★★ lines alone cover about 52% of ICAI appearances in this chapter.

Number Series, Coding and Decoding, Odd Man Out

#	One-liner	Weight	Part A ref
1	Missing term: take differences; constant second difference → extend (2, 7, 16, 29, 46)	★★	1.2
2	**Differences = squares / cubes / Σn^2 → add the next power**	★★★	1.3, 3.5
3	Two operations alternating (+a, −b) → read odd and even places separately	★★	1.1
4	**×2 ± k and ×n ± n series → test ratio of successive terms first**	★★★	1.4, 1.5
5	Constant ratio r → G.P. (×4, ×1.5)	★	1.6
6	**Power patterns: n^2, $(2n)^2$, $n^2 + 1$, $n^3 - 1$, $n^3 - n^2$, interleaved n^3, n^2**	★★★	1.7, 1.8, 3.3
7	Primes: consecutive primes, $p^2 - 2$; non-prime is the odd one	★★	1.9, 3.1
8	Recursive: sum of previous two/three, Fibonacci differences, $(\text{previous})^2 - 1$	★★	1.10
9	Fractions: numerator and denominator are separate series	★	1.11
10	**Wrong term: find the rule from the majority, then test each term against it**	★★★	3.5, 3.6, 2.16
11	Alphabet series: A = 1 … Z = 26, reverse Z = 1; wrap after Z; month initials	★★	1.12, 2.15
12	Alpha-numeric terms: solve letter, number, letter strands separately	★	1.13
13	Letter coding: uniform shift +1/−1 (MYSTIFY → NZTUJGZ; TAP → SZO)	★★	2.1, 1.14
14	**Uniform shift ±2/±4 incl. digits; decoding = apply the shift in reverse**	★★★	2.2
15	Position-wise alternating shifts (+1, −1 …; +2, −2, +2, +1 …)	★★	2.3
16	Opposite-letter coding: n ↔ 27 − n (A ↔ Z, M ↔ N)	★	2.4
17	**Rearrangement: full reversal, part reversal, first letter −1 + pairs swapped (MENTION → LNEITNO)**	★★★	2.5, 2.6
18	Reverse then shift (FROZEN → OFAPSG; HEALTH → GSKZDG)	★	2.7
19	**Number coding: build the letter → digit table from the given words; read off the new word**	★★★	2.8, 2.9, 2.10, 3.10
20	Unknown letter → eliminate options whose digit is already taken	★	2.11
21	Digit → letter decoding: invert the table (84178 = RACER)	★	2.12
22	Value coding: A = 1 positions, sums, 2 × sum, digit sums, reverse values	★★	2.13
23	Sentence coding: common word ↔ common digit; eliminate	★★	2.14

#	One-liner	Weight	Part A ref
24	Odd man out: classify by common quality (months, herbivores, synonyms)	★	3.8
25	**Numeric odd man out: multiple of 3/11, parity, digit sum, perfect square**	★★★	3.2, 3.4
26	Letter-group odd one: compare internal steps (+2, +3, +4)	★	3.7, 2.17

CHAPTER 10

Direction Tests

110 Scanner questions · 22 one-liners · 17 revision pointers

Part A — One-liners mapped to Scanner questions and Study Material

Direction Tests

SM Chapter 10, pages 10.1 – 10.11

Topic 1 Introduction

110 Scanner questions · ICAI appearances PYQ 85 · RTP 3 · MTP 22

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.1	Turn rules (heading only): a right turn = 90° clockwise (N → E → S → W → N), a left turn = 90° anticlockwise (N → W → S → E → N). SM table: left + left or right + right = reverse of the start (facing Up → Down); left + right or right + left = back to the start direction. So pairs of opposite turns cancel — count only the unmatched turns. 'Turns back' = 180°. Trap: when the question asks 'which direction is he moving/facing', ignore all distances.	PYQ May 18 Q34, PYQ May 18 Q37, PYQ Nov 18 Q44, PYQ Nov 19 Q46, PYQ Nov 19 Q47, PYQ Nov 19 Q48, PYQ Dec 23 Q46	PYQ 2018-May (×2), 2018-Nov, 2019-Nov (×3), 2023-Dec	'Always Remember' table, p. 10.2; Exercise Q15, p. 10.6; Q40, p. 10.9; Q52 – Q54, pp. 10.10 – 10.11
1.2	Walk with distances but asked for the final facing: track only the heading leg by leg (N + right = E, E + right = S, S + right = W, W + right = N; reverse for left). 'Walks straight in the same direction' or a rest stop does not change the heading. Extension: if an object is 'in front of him at 100 m' after he ends facing North, he is South of that object.	PYQ Dec 21 Q48, PYQ Jun 24 Q45, MTP Jun 24 S3 Q47, MTP Jun 24 S3 Q48, MTP Jun 24 S3 Q49, PYQ Jan 25 Q68, PYQ Sep 25 Q50, PYQ May 26 Q24	PYQ 2021-Dec, 2024-Jun, 2025-Jan, 2025-Sep, 2026-May; MTP 2024-Jun S3 (×3)	Examples 1, 4 & 5, pp. 10.2 – 10.4; Exercise Q1 & Q3, p. 10.5; Q25, p. 10.7; Q41, p. 10.9
1.3	Position from the start (cardinal answer): add the North–South legs (N +, S −) and the East–West legs (E +, W −) separately; when one net component is zero the answer is the single direction of the other (e.g. N 15, W 10, S 5, E 10 → net 10 N → North). Draw the path; do not judge from the last leg.	PYQ May 18 Q32, PYQ Nov 18 Q42, PYQ Nov 18 Q45, MTP Dec 24 S1 Q47, PYQ Jan 25 Q73, PYQ Jan 26 Q22	PYQ 2018-May, 2018-Nov (×2), 2025-Jan, 2026-Jan; MTP 2024-Dec S1	Example 2, p. 10.3; Exercise Q8, p. 10.5; Q34, p. 10.8

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.4	Position from the start (intercardinal answer): when both net components are non-zero, combine them — net N + net E = North-East, N + W = North-West, S + E = South-East, S + W = South-West (e.g. W 5, left 2, left 7 → 2 E, 2 S → South-East). With no distances given (N, left, right, left), assume each leg is positive: two W legs and two N legs → North-West.	PYQ Nov 18 Q43, PYQ Jun 19 Q42, PYQ Dec 23 Q44, PYQ Jun 24 Q49, MTP Dec 24 S1 Q48, PYQ Jan 25 Q67, PYQ Sep 25 Q47, PYQ Sep 25 Q46, MTP Apr 26 S1 Q46, PYQ May 26 Q22	PYQ 2018-Nov, 2019-Jun, 2023-Dec, 2024-Jun, 2025-Jan, 2025-Sep (×2), 2026-May; MTP 2024-Dec S1, 2026-Apr S1	Example 3, p. 10.3; Exercise Q9, p. 10.6; Q49, p. 10.10
1.5	Diagonal legs: a move of d towards NE/NW/SE/SW = d/√2 along each axis (NE = +x, +y; SE = +x, −y; NW = −x, +y; SW = −x, −y). Equal diagonal legs in opposite senses cancel (SE 7 then NW 7 cancel the N–S parts, leaving only the E–W legs: 14 W − 4 E = 10 km). Facing NE and turning left = facing NW.	PYQ Nov 20 Q44, PYQ Dec 22 Q45, PYQ Jun 24 Q48, MTP Dec 24 S1 Q49	PYQ 2020-Nov, 2022-Dec, 2024-Jun; MTP 2024-Dec S1	Exercise Q11, p. 10.6; Q43, p. 10.9
1.6	Return direction / direction of the back: the direction to go back to the start is the exact opposite of the displacement (W then left = SW of home → move North-East to return). Moving from a point towards home reverses the home-to-point direction; the back is opposite the face (moving SW → back to NE).	PYQ Nov 19 Q45, PYQ Dec 21 Q47, MTP Dec 24 S1 Q49	PYQ 2019-Nov, 2021-Dec; MTP 2024-Dec S1	Not in SM (PYQ/MTP-only); opposite directions as SM figure, p. 10.1
1.7	Sun fixes the start: the Sun rises in the East and sets in the West. Morning + facing the Sun = facing East; evening + facing the Sun = facing West. Shadow falls opposite the Sun — in the morning towards the West (shadow in front ⇒ facing West), in the evening towards the East. Then apply the turn rules; to find the starting direction, work the turns backwards from the final facing.	PYQ May 18 Q35, PYQ Dec 22 Q46, PYQ Jan 25 Q74, PYQ Jan 26 Q20, PYQ May 26 Q76	PYQ 2018-May, 2022-Dec, 2025-Jan, 2026-Jan, 2026-May	Exercise Q16, pp. 10.6 – 10.7; Q36 & Q42, p. 10.9; Q51, p. 10.10
1.8	Shadow to a person's side: morning shadow points West. Shadow on someone's left ⇒ his left = West ⇒ he faces North (shadow on his right ⇒ faces South). Back to back ⇒ the other faces the opposite way; face to face ⇒ the other faces the person's facing reversed.	PYQ Jul 21 Q46, PYQ Sep 24 Q74	PYQ 2021-Jul, 2024-Sep	Not in SM (PYQ-only); Sun–shadow principle as Exercise Q20, p. 10.7
1.9	Landmarks and the Sun: the rising Sun seen behind X puts X in the East; the setting Sun behind Y puts Y in the West, so X is East of Y. If A's shadow falls on B in the morning (shadows point West), B is West of A, i.e. A is on the Eastern side of B.	PYQ Nov 19 Q49, PYQ Dec 21 Q46, PYQ Jun 24 Q46	PYQ 2019-Nov, 2021-Dec, 2024-Jun	Exercise Q20, p. 10.7; Q33, p. 10.8
1.10	Body orientation: face the direction such that the named hand points correctly — right hand South ⇒ facing East ⇒ back West. Standing on the head swaps left and right but not the face: face North upright → left hand West; upside down → left hand East.	PYQ May 18 Q36, PYQ Sep 24 Q77	PYQ 2018-May, 2024-Sep	Exercise Q22 & Q24, p. 10.7; Q31, p. 10.8

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.11	Circle seating facing the centre: a person facing SW sits at the NE point; the person 'right opposite' sits diametrically across and faces the reverse direction. Place all on the compass rose, then the person midway between two seats faces the centre from there (sitting at W ⇒ facing East).	PYQ Jun 23 Q50	PYQ 2023-Jun	Exercise Q17, p. 10.7
1.12	Diagonal neighbours at equal distances: NW of R, then SW of R, then SE of that, then NE of that — plot each 45° step as (±1, ±1); the fourth house lands SE of the first (relative position = difference of coordinates: (1, −1) − (−1, 1) = (2, −2) ⇒ South-East).	PYQ Sep 24 Q76	PYQ 2024-Sep	Exercise Q12 & Q13, p. 10.6; Q48, p. 10.10
1.13	Relative position of places: fix one place at the origin, place each 'X is to the East/North… of Y' on a grid (assume equal unit distances when none are given; decode symbol codes such as % = east, + = north first), then read the direction of the asked place from the coordinate difference (both components non-zero ⇒ intercardinal).	PYQ Jul 21 Q45, PYQ Jul 21 Q48, PYQ Jun 22 Q50, MTP Apr 26 S1 Q47, MTP Apr 26 S1 Q48, PYQ May 26 Q23, PYQ Sep 26 Q90	PYQ 2021-Jul (×2), 2022-Jun, 2026-May, 2026-Sep; MTP 2026-Apr S1 (×2)	Not in SM (PYQ/MTP-only); compass rose, p. 10.1
1.14	Common-data village grid: plot every village with its km coordinates from one anchor; distance between two villages = $\sqrt{(\Delta x^2 + \Delta y^2)}$; the farthest pair has the largest combined Δx and Δy (F (0, 2) and B (2, −2): $\sqrt{20} \approx 4.47$ km).	MTP Aug 24 S2 Q51, MTP Aug 24 S2 Q52, MTP Aug 24 S2 Q53, MTP Aug 24 S2 Q54	MTP 2024-Aug S2 (×4)	Not in SM (MTP-only)
1.15	Shortest distance on one line: when the net displacement lies on one axis, distance = |net N–S| or |net E–W| (equal opposite legs cancel; a closed rectangle gives 0). Trap: 'total distance walked' = sum of all legs (5 + 3 + 5 = 13 km), not the displacement.	PYQ Jun 22 Q49, PYQ Jun 22 Q51, PYQ Jun 23 Q46, PYQ Jun 24 Q47, MTP Jun 24 S3 Q59, RTP Sep 24 Q15, PYQ Jan 25 Q71, MTP Jan 25 S2 Q58, MTP Jan 25 S2 Q59, PYQ May 25 Q47, PYQ Sep 25 Q48, PYQ Sep 26 Q14	PYQ 2022-Jun (×2), 2023-Jun, 2024-Jun, 2025-Jan, 2025-May, 2025-Sep, 2026-Sep; RTP 2024-Sep; MTP 2024-Jun S3, 2025-Jan S2 (×2)	Not in SM (PYQ/MTP/RTP-only); path tracing as Example 2, p. 10.3
1.16	Pythagorean shortest distance after back-tracking: go North a, then South b on the same line ⇒ net (a − b) N; then c East/West ⇒ distance = $\sqrt{[(a - b)^2 + c^2]}$ (10 − 6 = 4, with 3 ⇒ 5 km; 14 − 8 = 6, with 8 ⇒ 10 km), direction from the signs (N + E = North-East).	PYQ Jan 21 Q42, PYQ Dec 23 Q43, PYQ Dec 23 Q45, PYQ Jan 26 Q76	PYQ 2021-Jan, 2023-Dec (×2), 2026-Jan	Not in SM (PYQ-only)

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.17	Pythagorean shortest distance (general): resolve the whole path into net x and net y; distance = √(x² + y²). Common triples 3-4-5, 6-8-10, 30-40-50, 60-80-100, 3000-4000-5000; isosceles case = side × √2 (25 and 25 ⇒ 35.36 m). Convert step counts to metres first (steps × metres per step).	PYQ Nov 20 Q45, PYQ Dec 21 Q45, PYQ Jun 23 Q47, PYQ Sep 25 Q49, PYQ Jan 26 Q74, PYQ Sep 26 Q12, PYQ Sep 26 Q89	PYQ 2020-Nov, 2021-Dec, 2023-Jun, 2025-Sep, 2026-Jan, 2026-Sep (×2)	Not in SM (PYQ/MTP-only)
1.18	Two movers on one road: only the legs parallel to the road change progress along it; detour legs out and back cancel. Gap = road length − (progress of the first + progress of the second); if equal speeds make one walk further than the gap, they have crossed and the gap is the overshoot.	PYQ Jul 21 Q47, PYQ May 25 Q49	PYQ 2021-Jul, 2025-May	Not in SM (PYQ-only)
1.19	Degree rotation: write the start as a bearing (N 0°, NE 45°, E 90°, SE 135°, S 180°, SW 225°, W 270°, NW 315°); clockwise = +, anticlockwise = −; net angle mod 360°. W + 45 + 180 − 270 = 225° = South-West; N + 70 + 300 = 370 ≡ 10° (nearest option North-East).	PYQ Jun 19 Q44, PYQ Jun 22 Q52, PYQ Dec 22 Q48, PYQ Jun 23 Q49, MTP Dec 24 S1 Q50, MTP Jan 25 S2 Q57, PYQ May 25 Q46, RTP May 26 Q16, PYQ Sep 26 Q87	PYQ 2019-Jun, 2022-Jun, 2022-Dec, 2023-Jun, 2025-May, 2026-Sep; RTP 2026-May; MTP 2024-Dec S1, 2025-Jan S2	Not in SM (PYQ/MTP/RTP-only)
1.20	Turn through an angle after a walk: take the current heading as a bearing and add the turn (right/clockwise +, left/anticlockwise −): heading South, right 45° ⇒ 225° = South-West; heading East, clockwise 135° ⇒ 225° = South-West.	PYQ Jun 19 Q43, MTP Dec 24 S1 Q46, RTP Jan 25 Q19, PYQ May 26 Q25	PYQ 2019-Jun, 2026-May; RTP 2025-Jan; MTP 2024-Dec S1	Not in SM (PYQ/MTP/RTP-only)
1.21	Clock-face directions: the given hand position fixes how far the dial is rotated (3 o'clock hour hand pointing West ⇒ dial turned 180°: 12 → S, 3 → W, 6 → N, 9 → E). Then read the asked hand — minute hand at :15 points to '3', :30 to '6', :45 to '9'; the hour hand at 3 o'clock is 90° clockwise of the minute hand.	PYQ Dec 21 Q49, PYQ Dec 22 Q47, PYQ Jun 23 Q48, PYQ Sep 24 Q78, MTP Apr 26 S1 Q50	PYQ 2021-Dec, 2022-Dec, 2023-Jun, 2024-Sep; MTP 2026-Apr S1	Not in SM (PYQ/MTP-only)
1.22	Rotated or renamed compass: find the turn that maps the given pair (SE → E is 45° anticlockwise; W → S is 90° anticlockwise; W → NE is 135° clockwise; SW → N is 135° clockwise) and apply the same turn to every other direction (N → NW; labelled E → actual N; S → NW; NE → S).	PYQ Jun 22 Q48, MTP Aug 24 S2 Q55, PYQ May 25 Q48, PYQ Jan 26 Q77, MTP Apr 26 S1 Q49	PYQ 2022-Jun, 2025-May, 2026-Jan; MTP 2024-Aug S2, 2026-Apr S1	Not in SM (PYQ/MTP-only)

Part B — Chapter 10 One-liner Revision Sheet

Deduplicated and in Study Material order. Click a 'Part A ref' to jump to the Part A row(s) carrying the full wording, the Scanner questions and the SM page. Refs read Unit.Topic.Row in chapters with several units and Topic.Row otherwise. Weight: ★★★ asked by ICAI 6 or more times · ★★ 3 – 5 times · ★ once or twice. The ★★★ lines alone cover about 71% of ICAI appearances in this chapter.

Direction Tests

#	One-liner	Weight	Part A ref
1	**Right = clockwise (N→E→S→W); left = anticlockwise; L+L / R+R = reverse; L+R / R+L = no change; 'facing' questions ignore distances.**	★★★	1.1, 1.2
2	**Direction from start: net N–S and net E–W separately; one zero ⇒ cardinal, both non-zero ⇒ NE/NW/SE/SW.**	★★★	1.3, 1.4
3	Diagonal leg d = d/√2 on each axis; equal opposite diagonals cancel.	★★	1.5
4	Way home / back = opposite of displacement.	★★	1.6
5	Morning: Sun East, shadow West; evening: Sun West, shadow East; facing Sun AM = East, PM = West.	★★	1.7
6	Shadow on left in morning ⇒ facing North; on right ⇒ facing South; back-to-back faces opposite.	★	1.8
7	Rising Sun behind X ⇒ X East; morning shadow of A on B ⇒ A East of B.	★★	1.9
8	Right hand South ⇒ facing East; on head ⇒ left/right swap (face N ⇒ left hand E).	★	1.10
9	Circle facing centre: facing SW sits NE; opposite seat faces reverse.	★	1.11
10	Diagonal neighbours: plot (±1, ±1) steps; read the difference.	★	1.12
11	**Relative places: origin + unit grid; decode symbols first; equal distances if none given.**	★★★	1.13, 1.14
12	**Distance on one axis = |net|; closed loop = 0; total walked = sum of legs.**	★★★	1.15
13	**Shortest distance = √(x² + y²); triples 3-4-5, 6-8-10, 3k-4k-5k; isosceles = side × √2.**	★★★	1.16, 1.17
14	Two movers on a road: only along-road legs count; gap = length − both progresses.	★	1.18
15	**Bearings N 0, E 90, S 180, W 270; clockwise +, anticlockwise −; reduce mod 360.**	★★★	1.19, 1.20
16	Clock: fix the dial rotation from the given hand; :15 → '3', :30 → '6', :45 → '9'.	★★	1.21
17	Renamed/rotated compass: same angular shift applies to every direction.	★★	1.22

CHAPTER 11

Seating Arrangements

102 Scanner questions · 26 one-liners · 19 revision pointers

Part A — One-liners mapped to Scanner questions and Study Material

Seating Arrangements

SM Chapter 11, pages 11.1 – 11.12

Topic 1 Introduction

102 Scanner questions · ICAI appearances PYQ 81 · RTP – · MTP 21

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.1	Sort the clues before drawing (SM): definite information (a fixed seat, e.g. 'at the extreme end'), comparative information ('to the right of X') and negative information ('not next to'). Persons named by role: professor and businessman at the two ends; 'author left of the businessman' rules out the businessman at the left end, so the professor is on the left; 'student between professor and advocate' then gives Professor – Student – Advocate – Author – Businessman: author 4th from the professor's end. Trap: without the 'student between' clue the author could be 2nd, 3rd or 4th.	PYQ Nov 19 Q52, PYQ Jun 24 Q53	PYQ 2019-Nov, 2024-Jun	11.1, pp. 11.1 – 11.2
1.2	Bench with definite seats: place the definite clues first (E at the left end = seat 1; C second from the right = seat 4 of 5, or 'third from right' = seat 4 of 6), then the 'next to / together' clues (A next to C and to the right of B) ⇒ E B A C D (five) or E B A C D F (six, F right of D). Then read off 'A between B and C', 'B second from left' or 'D second from right'.	PYQ Jan 21 Q46, PYQ Jul 21 Q50, MTP Jan 25 S2 Q53, MTP Jan 25 S2 Q54, MTP Jan 25 S2 Q55, PYQ May 25 Q52, PYQ Jan 26 Q75	PYQ 2021-Jan, 2021-Jul, 2025-May, 2026-Jan; MTP 2025-Jan S2 (×3)	11.1 (definite information), p. 11.1; Example 6, p. 11.4
1.3	Five in a row, 'who is in the middle / at the ends?': if no facing is given take North (your left = their left). Turn each 'immediate left/right' clue into a block (A immediately left of B ⇒ A B), join blocks through the shared person, then attach the open clue ('Q is right of S' ⇒ S before Q): S Q P T R; A C B D E; D B A E C; C A B D E; P T S Q R; C D A B E. The middle is seat 3. Trap: 'to the right of' is not 'immediate right' — use it only to attach a block.	PYQ Nov 18 Q48, PYQ Nov 19 Q51, PYQ Dec 21 Q51, MTP Jun 24 S3 Q50, PYQ Jan 25 Q80, MTP Jan 25 S2 Q60, PYQ May 25 Q54, PYQ Jan 26 Q26, PYQ May 26 Q79, PYQ Sep 26 Q63	PYQ 2018-Nov, 2019-Nov, 2021-Dec, 2025-Jan, 2025-May, 2026-Jan, 2026-May, 2026-Sep; MTP 2024-Jun S3, 2025-Jan S2	11.2, p. 11.2; Examples 5 – 8, p. 11.4; Exercise Q1 & Q3, p. 11.9

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.4	'To the left / right of' (not 'immediate') fixes order only: chain the clues transitively ('X left of Y but right of Z' ⇒ Z … X … Y), e.g. Shikha – Reena – Reeta – Manju; Bindu – Seema – Rani – Reeta – Mary; Himani – Gayatri – Priyanka – Diksha – Chandresh – Kuldeep – Reshma (middle = 4th of 7 = Diksha). 'Between' means sandwiched; 'second from the left' counts from the left end.	PYQ Jun 19 Q45, PYQ Jul 21 Q49, PYQ Sep 24 Q83	PYQ 2019-Jun, 2021-Jul, 2024-Sep	11.2, p. 11.2; Exercise Q12, p. 11.10
1.5	'Between' = sandwiched: B between F and D ⇒ block F B D (either way round); E between A and C ⇒ A E C. Join the blocks with the negative clues (A not next to F or D; C not next to D) ⇒ A E C F B D — F is between B and C. Same pattern with P – U: P T R U Q S ⇒ U between R and Q.	PYQ May 18 Q39, PYQ May 18 Q47, PYQ Jun 19 Q46, PYQ Dec 21 Q50, PYQ Sep 24 Q79	PYQ 2018-May (×2), 2019-Jun, 2021-Dec, 2024-Sep	11.1 (negative information), p. 11.2; Exercise Q4, p. 11.9
1.6	Row not facing North: facing South (towards you) a person's right is the viewer's left — write the order from the persons' own left to right and count 'third to the left' from their side (J G H K I ⇒ J third to the left of K; A 4th from the right end ⇒ C, B, E to its right ⇒ E is 5th from the left). Facing East: left = North end, right = South end (B E C A D ⇒ D at the South end; L Z A B R T P ⇒ P immediately right of T). Facing West: R at the South end, S at the North end ⇒ S P Q T R, Q in the middle.	PYQ Nov 20 Q46, PYQ Dec 22 Q51, PYQ Jun 24 Q54, PYQ Jan 25 Q79, PYQ Sep 25 Q54	PYQ 2020-Nov, 2022-Dec, 2024-Jun, 2025-Jan, 2025-Sep	11.2 (B) direction of face towards you, p. 11.3
1.7	Two rows facing each other (SM diagram): the far row faces South, so its 'left' is the viewer's right; persons in the same column are opposite ('in front of'); an end seat and the far end of the other row are diagonally opposite (A – F, C – D). Put the 'not at an end' person in the middle seat; 'X second to the left of Y' puts X and Y at the two ends of one row: D B F / A E C ⇒ A diagonal to F; J M B / K D C ⇒ B, M, J in one row and M immediately left of B; H E C D / G A B F ⇒ A in front of E. Rows facing the same way: only the two middle seats (C, E) are not at an end.	PYQ Dec 22 Q50, PYQ Sep 24 Q81, PYQ Sep 24 Q82, PYQ Jan 25 Q75, PYQ Sep 25 Q52	PYQ 2022-Dec, 2024-Sep (×2), 2025-Jan, 2025-Sep	Two Rows Sequence, p. 11.3; Exercise Q7 – Q8, p. 11.10; Q25 – Q27, p. 11.12
1.8	Flats in two rows (North-/South-facing or East-/West-facing): first sort people into rows (R South-facing and next to U ⇒ U South-facing; S diagonal to U ⇒ S North-facing), then the 'not next to' clue fixes the middle seat (Q not next to S ⇒ T between them). North row Q T S, South row U R P ⇒ the other diagonal pair is Q – P and the South-facing flats are U, R, P. East row B E D, West row F C A ⇒ C's flat is between A and F.	PYQ Nov 18 Q49, PYQ Sep 24 Q75, MTP Dec 24 S1 Q52, MTP Dec 24 S1 Q53	PYQ 2018-Nov, 2024-Sep; MTP 2024-Dec S1 (×2)	Two Rows Sequence, p. 11.3
1.9	Adjacency with a negative clue: seat the end-fixed person first (R at the extreme left, K next to R), then try each remaining seat and strike out any order that breaks a 'not next to' clue — R K S P T ⇒ S's neighbours are K and P; with 'P not next to T' and K at an end, K R P S T or K R T S P ⇒ S's neighbours are P and T. Four seats: P next to Q but not R, R not next to S ⇒ R Q P S or S P Q R — only P is adjacent to S.	PYQ May 18 Q40, PYQ Jun 19 Q47, MTP Apr 26 S2 Q53	PYQ 2018-May, 2019-Jun; MTP 2026-Apr S2	Example 3, p. 11.3; Exercise Q10, p. 11.10

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.10	Eight in a line: number the seats 1 – 8 from the left (facing North) and turn ordinal clues into arithmetic — 'X fourth to the right of Y' ⇒ X = Y + 4, 'fourth to the left' ⇒ Y – 4; 'only two persons between' ⇒ a gap of 3. The seat limits leave two cases; test each against the 'not neighbour' clues and reject the one that fails: G H C F A D B E; T O N R M S Q P; T U V W P Q R S (ends T and S); W Q P R T S U V.	PYQ Nov 18 Q46, PYQ Dec 21 Q53, PYQ Jun 23 Q53, MTP Dec 24 S1 Q51, PYQ Sep 25 Q55	PYQ 2018-Nov, 2021-Dec, 2023-Jun, 2025-Sep; MTP 2024-Dec S1	Example 4, pp. 11.3 – 11.4; Exercise Q13 – Q17, p. 11.11
1.11	Seven in a row: same seat-number method; an end clue pins a seat ('the person third to the left of D is at an end' ⇒ D = 4th; 'S at an end and Q second to the right of S' ⇒ S is the left end). Seat 4 is the middle: G B C D E F A ⇒ E, F, A right of D; A F G D C B E ⇒ B's neighbours C and E, A at the extreme left; E C B A G D F ⇒ A in the middle; S U Q P O R T ⇒ P in the middle. With H and N four seats apart and the other clues: H K M O N I J ⇒ K between H and M.	PYQ Jul 21 Q51, PYQ Jun 23 Q52, PYQ Dec 23 Q47, MTP Aug 24 S2 Q56, MTP Aug 24 S2 Q57, MTP Aug 24 S2 Q58, PYQ May 25 Q51	PYQ 2021-Jul, 2023-Jun, 2023-Dec, 2025-May; MTP 2024-Aug S2 (×3)	11.2, p. 11.2; Example 4, pp. 11.3 – 11.4; Exercise Q12, p. 11.10
1.12	Six in a row facing North: 'D third to the left of E' ⇒ D = E – 3; with 'D not at an end' ⇒ E = 5, D = 2, B (immediate right of E) = 6, C between A and E ⇒ C = 4, A = 3, F = 1: F D A C E B (F left of D, A immediately right of D, four persons to the right of D, A immediately left of C). Ends first: E at the left end, C at the right end, A immediately left of C, B two seats from A ⇒ E B F D A C; A at the left end, F – C – E two apart ⇒ A F B C D E.	MTP Jun 24 S3 Q51, MTP Jan 25 S2 Q56, MTP Apr 26 S1 Q52, MTP Apr 26 S1 Q54, PYQ May 26 Q80, PYQ May 26 Q26	PYQ 2026-May (×2); MTP 2024-Jun S3, 2025-Jan S2, 2026-Apr S1 (×2)	11.2, p. 11.2; Example 4, pp. 11.3 – 11.4
1.13	Nine in a row: start with the end clue (K at an end and O third to the left of K ⇒ K is the right end, O = 6), then the adjacency chain (Q next to O and P ⇒ Q = 7, P = 8; the other side leaves no room for 'L third to the right of N'), then L = N + 3 with J immediately right of L: N R M L J O Q P K — J (5th) is the centre and R is immediately left of M.	PYQ Dec 23 Q50, PYQ Dec 23 Q51	PYQ 2023-Dec (×2)	Example 4, pp. 11.3 – 11.4 (method); Not in SM (PYQ-only) as a nine-person set
1.14	Circle facing the centre: left = clockwise, right = anticlockwise (SM). Number the seats clockwise 0, 1, 2 …: 'X immediate left of Y' ⇒ X = Y + 1, 'immediate right' ⇒ X = Y – 1. Five seats: A between B and C, D immediate right of C, E immediate left of B ⇒ A B E D C (clockwise) — E between D and B; C immediate left of E, A between E and D ⇒ D between B and A; Abhinav's right neighbour is Alok.	PYQ Jan 25 Q72, MTP Apr 26 S1 Q51, PYQ May 26 Q82	PYQ 2025-Jan, 2026-May; MTP 2026-Apr S1	Circular Arrangement, p. 11.5
1.15	Six round a circle facing the centre: 'nth to the left' = n seats clockwise, 'nth to the right' = n seats anticlockwise; 3 seats either way = opposite (so '4th to the right' = 2nd to the left). Pin one person at 0, place those tied to them by distance, fill the rest from the adjacency clues: Parikh is Bablu's immediate right; F A … ⇒ D second to the right of F; V immediately left of X; Revathi immediately right of Nisha; A C E D B F (clockwise) ⇒ F and C are not neighbours.	PYQ Nov 19 Q50, PYQ Jun 23 Q51, PYQ Jun 24 Q52, MTP Jun 24 S3 Q52, PYQ Sep 25 Q51, PYQ Sep 26 Q88	PYQ 2019-Nov, 2023-Jun, 2024-Jun, 2025-Sep, 2026-Sep; MTP 2024-Jun S3	Circular Arrangement, p. 11.5; Example 12, pp. 11.8 – 11.9

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.16	Hexagonal table = six-seat circle (polygon arrangement): P second to the left of U, T second to the left of S, Q between R and S ⇒ (clockwise) U T P R Q S — P and S opposite. Q between R and S, P opposite Q, T on S's left ⇒ T faces R. With no facing given, use neighbours only: D F C B round the corners, A not next to B ⇒ D F C B E A — A and F are not neighbours.	PYQ Jun 22 Q53, PYQ May 25 Q55, PYQ Sep 25 Q53, PYQ Jan 26 Q25	PYQ 2022-Jun, 2025-May, 2025-Sep, 2026-Jan	11.1 (polygon arrangements), p. 11.1; Circular Arrangement, p. 11.5
1.17	Square table, two per side, facing the centre: go round it like a circle (left = clockwise) but 'opposite' means directly across the table, not four seats away. I G F J L H K E (clockwise) ⇒ J immediately left of F; 3 persons between K and F either way. Rectangle with A alone at one end and F facing A at the other: D (F's immediate left) on one long side, C facing D on the other, B beside C ⇒ C sits between B and F.	MTP Aug 24 S2 Q59, MTP Aug 24 S2 Q60, PYQ Sep 26 Q65	PYQ 2026-Sep; MTP 2024-Aug S2 (×2)	Circular Arrangement note (ii), p. 11.5; Two Rows Sequence, p. 11.3
1.18	SM Example 9 (four ladies, four gentlemen alternating, facing the centre): C between G and E facing D; F between D and A facing G. The 'H and B' clue decides which side of C G sits. H on B's right (SM, 2021-Dec, 2024-Sep): clockwise C E A F D H B G ⇒ F is A's immediate left, E faces H, B's neighbours G and H. H on B's LEFT (2021-Jan version): C G B H D F A E ⇒ E is A's immediate left. Trap: check which version is printed before reusing the SM answer.	PYQ Jan 21 Q45, PYQ Dec 21 Q52, PYQ Sep 24 Q80	PYQ 2021-Jan, 2021-Dec, 2024-Sep	Example 9, pp. 11.5 – 11.6
1.19	Facing outward reverses the circle rule: right = clockwise, left = anticlockwise (SM Example 10). E A D B C (clockwise) ⇒ D is A's immediate right; 'C third to the left of D' leaves 2 persons between them one way and 1 the other way, so 'how many between' depends on the direction counted (the Scanner keys 1). Six seats: E A B C D F (clockwise) ⇒ 2 persons between A and D either way.	PYQ Jan 25 Q78, PYQ May 26 Q81, PYQ Sep 26 Q64	PYQ 2025-Jan, 2026-May, 2026-Sep	Example 10, pp. 11.6 – 11.7
1.20	Round table of six with no facing clue: only neighbour / opposite relations matter, and opposite = 3 seats away. A between D and F, C opposite D, E next to D ⇒ B opposite A; A between E and F, E opposite D, C not next to E ⇒ B opposite F; C opposite D, E beside C, A two seats from F ⇒ A and F take the two seats beside D — A is next to D in both cases.	PYQ Jan 21 Q44, PYQ Jun 24 Q50, MTP Dec 24 S1 Q54	PYQ 2021-Jan, 2024-Jun; MTP 2024-Dec S1	Example 11, pp. 11.7 – 11.8
1.21	Eight round a circle facing the centre: 4th to the left = 4th to the right = opposite; 'three persons between S and T' ⇒ opposite; 'two persons between' ⇒ 3 seats apart. Chain the distance clues from one anchor (A = 0: D = 3, E = 7, B = 6, G = 4, C = 5, H = 2, F = 1 ⇒ A between F and E), then use 'not opposite' / 'not neighbour' clues to kill the second case: J L M P N I K O ⇒ M is not between N and L; W V T R U Q S P ⇒ one person between S and U; B opposite D ⇒ A immediately left of H.	PYQ Nov 20 Q47, PYQ Dec 23 Q48, PYQ Jun 24 Q51, PYQ Jan 26 Q24, PYQ Sep 26 Q40	PYQ 2020-Nov, 2023-Dec, 2024-Jun, 2026-Jan, 2026-Sep	Example 12, pp. 11.8 – 11.9

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.22	Floors / stairs (vertical arrangement): 'above / below' are order clues on a vertical axis — chain them top to bottom: Manu > Ashokan > Gaurav > Lokesh > Rakesh (Manu on top). With a broken chain (Mahesh > Ashok kept apart from Gaurav > Lokesh > Rakesh), only the last person of a chain can be on the ground floor — Rakesh or Ashok.	PYQ May 18 Q38, PYQ Dec 23 Q49	PYQ 2018-May, 2023-Dec	Exercise Q9 & Q11, p. 11.10
1.23	Position from both ends: total in the row = position from left + position from right − 1. First move the person to the end you know: Q 3rd to the left of P (13th from left) ⇒ Q 10th from left; 10 + 24 − 1 = 33. B 5th to the left of A (12th) ⇒ 7th; 7 + 20 − 1 = 26.	PYQ Dec 21 Q54, PYQ Jan 26 Q23	PYQ 2021-Dec, 2026-Jan	Not in SM (PYQ-only)
1.24	Card / carrom partners sit opposite and face opposite directions: A faces West ⇒ partner B faces East; D faces North ⇒ partner C faces South. R faces West with S on R's right ⇒ S sits on the North side facing South, so S's partner Q faces North.	PYQ Jan 21 Q43, PYQ Dec 22 Q49	PYQ 2021-Jan, 2022-Dec	Not in SM (PYQ-only)
1.25	Rows all facing North read as a grid: 'just to the right of' = East, 'just behind' = South, 'in the North of' = in front. R north of A, P east of A, Q behind P ⇒ Q is South-East of R.	PYQ May 25 Q50	PYQ 2025-May	11.2 direction of face (N – E – S – W diagram), p. 11.2
1.26	Grouping on benches (not seats): build the closed group first ('F sits with only B' ⇒ {F, B} is a full bench; F is a boy so B must be a girl), then the exclusions (C not with A, D, E ⇒ C with G on bench III; A, D, E on bench I), then 'at least one girl per bench' ⇒ D is a girl: girls B, C, D.	PYQ May 25 Q53	PYQ 2025-May	Not in SM (PYQ-only)

Part B — Chapter 11 One-liner Revision Sheet

Deduplicated and in Study Material order. Click a 'Part A ref' to jump to the Part A row(s) carrying the full wording, the Scanner questions and the SM page. Refs read Unit.Topic.Row in chapters with several units and Topic.Row otherwise. Weight: ★★★ asked by ICAI 6 or more times · ★★ 3 – 5 times · ★ once or twice. The ★★★ lines alone cover about 69% of ICAI appearances in this chapter.

Seating Arrangements

#	One-liner	Weight	Part A ref
1	**Clues: definite (fixed seat) first → comparative ('right of X') → negative ('not next to'); roles at ends fixed first.**	★★★	1.1, 1.2
2	**No facing given ⇒ North; 'immediate left' ⇒ block; 'to the left of' ⇒ order only; middle of 5 = seat 3.**	★★★	1.3, 1.4
3	'Between' = sandwiched: F B D + A E C + negatives ⇒ A E C F B D.	★★	1.5
4	**Facing South: right = viewer's left; facing East: left = North end, right = South end.**	★★★	1.6, 1.25
5	**Two rows face to face: same column = opposite; end ↔ far end of other row = diagonal; far row's left = viewer's right.**	★★★	1.7, 1.8
6	Negative adjacency: seat the end person, try remaining seats, strike orders breaking 'not next to'.	★★	1.9
7	**Seat numbers 1 – n: 'kth right of Y' = Y + k; 'two between' = gap 3; seat limits ⇒ two cases, reject one.**	★★★	1.10, 1.11
8	**'Third to the left of D is at an end' ⇒ D = 4; 'D third left of E, D not at end' ⇒ E = 5 of 6.**	★★★	1.11, 1.12, 1.13
9	**Circle facing centre: left = clockwise, right = anticlockwise; immediate left = Y + 1.**	★★★	1.14, 1.15
10	**Six seats: 3 apart = opposite; '4th to the right' = 2nd to the left; hexagon = six-seat circle.**	★★★	1.15, 1.16
11	Square table: go round like a circle, but 'opposite' = directly across the table.	★★	1.17
12	Example 9 alternating set: 'H right of B' ⇒ F is A's left; 'H left of B' ⇒ E is A's left.	★★	1.18
13	Facing outward: right = clockwise, left = anticlockwise; 'how many between' may differ by direction.	★★	1.19
14	Round table without facing: opposite = n/2 seats away; only neighbour/opposite relations.	★★	1.20
15	Eight seats: 4th either way = opposite; 'three between' = opposite; anchor A = 0 and chain.	★★	1.21
16	Floors/stairs: chain above/below top to bottom; ground floor = last of a chain.	★	1.22
17	Total in row = left rank + right rank − 1 (shift to the known person first).	★	1.23
18	Partners at cards/carrom sit opposite and face opposite ways.	★	1.24
19	Groups on benches: closed group first, then exclusions, then 'at least one girl'.	★	1.26

CHAPTER 12

Blood Relations

118 Scanner questions · 26 one-liners · 18 revision pointers

Part A — One-liners mapped to Scanner questions and Study Material

Blood Relations

SM Chapter 12, pages 12.1 – 12.11

Topic 1 Introduction

118 Scanner questions · ICAI appearances PYQ 96 · RTP 2 · MTP 21

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.1	Self-reference shortcut: 'my father's wife' = my mother, 'my mother's husband' = my father (SM q, r); so 'the only son of my mother / of my father's wife' is the speaker himself, 'my wife's mother's only daughter' and 'the only daughter of my mother-in-law' are the speaker's wife, and 'the only daughter of your father' is the woman addressed. Replace the phrase by that person, then read the last link: his/her daughter → Daughter/Father; 'no brothers or sisters, my father's son's son' → Son.	PYQ May 18 Q5, PYQ Nov 20 Q49, PYQ Dec 23 Q54, MTP Jun 24 S3 Q57, RTP Jan 25 Q18, PYQ Jan 26 Q80	PYQ 2018-May, 2020-Nov, 2023-Dec, 2026-Jan; RTP 2025-Jan; MTP 2024-Jun S3	12.2 (q), (r), p. 12.3; Exercise 12(A) Q54 – Q55, p. 12.10
1.2	'Mother of my son's wife's daughter' unwinds from the inside: son's wife's daughter = my granddaughter; her mother = my son's wife = Daughter-in-law (SM f: son's wife → daughter-in-law). So the speaker is the lady's Father-in-law; if 'Daughter-in-law' is not offered, the answer is 'None'.	PYQ Jun 19 Q48, PYQ Dec 23 Q57, PYQ May 26 Q27	PYQ 2019-Jun, 2023-Dec, 2026-May	12.2, item 6 and (f), p. 12.2
1.3	Maternal side (SM 12.1(ii)): 'only brother of my father's wife' = my mother's brother = maternal uncle; 'my mother's mother has a son' = maternal uncle; children of maternal uncle → Cousin. So the speaker and the uncle's son are Cousins.	PYQ May 18 Q41, PYQ Nov 20 Q50, PYQ Jul 21 Q52	PYQ 2018-May, 2020-Nov, 2021-Jul	12.1(ii), p. 12.1; Exercise 12(A) Q46, p. 12.9 and Q51, p. 12.10
1.4	Uncle's or aunt's son or daughter is my Cousin (SM n): mother's sister's child, the daughter of mother's brother-in-law (father's brother or mother's sister's husband), the brother of my uncle's daughter, children of two brothers (L/N/K) — all Cousins. Trap: 'son of the daughter of the father of my uncle' is Brother if that daughter is my mother, Cousin if she is my aunt — pick whichever the options carry (Brother in 2021-Dec, 'Cousin/Brother' in 2025-Sep).	PYQ Jul 21 Q55, PYQ Dec 21 Q56, PYQ Dec 23 Q55, PYQ Jan 25 Q76, PYQ Sep 25 Q58, PYQ Sep 25 Q56, PYQ Sep 26 Q17	PYQ 2021-Jul, 2021-Dec, 2023-Dec, 2025-Jan, 2025-Sep (×2), 2026-Sep	12.2, item 11 and (n), p. 12.2; Example 13, p. 12.5; Exercise 12(A) Q32, p. 12.8 and Q49, p. 12.10
1.5	'Only daughter of my mother' = my sister; so 'X's mother is the only daughter of my mother' or 'son of the only daughter of the father of my brother' → speaker is X's Maternal uncle; reversed ('his mother's only daughter is my mother', 'only son of my mother's mother') → the speaker is the man's Niece. A's nephew's maternal grandmother, where A's sister has no sister, is A's sister's own Mother.	PYQ Jun 19 Q51, PYQ Nov 20 Q52, PYQ Jun 22 Q57, PYQ May 25 Q57, PYQ Sep 26 Q41	PYQ 2019-Jun, 2020-Nov, 2022-Jun, 2025-May, 2026-Sep	12.1(ii), p. 12.1; Exercise 12(A) Q53, p. 12.10

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.6	Paternal side (SM 12.1(i)): 'mother of the husband of my mother' = father's mother = grandmother; her daughter = Aunt (bua); her son = Father or Uncle (SM: grandmother's son → father or uncle), so the speaker is his Son (or nephew). 'Brother of my grandfather's son' = father/uncle → speaker is Niece.	PYQ May 18 Q42, PYQ Nov 20 Q48, PYQ Jan 21 Q49, PYQ Dec 22 Q55	PYQ 2018-May, 2020-Nov, 2021-Jan, 2022-Dec	12.1(i), p. 12.1; 12.2, items 1 – 2, p. 12.2; Exercise 12(A) Q42, p. 12.9
1.7	Common-parent technique: 'his mother's husband's sister is my aunt' / 'your mother's husband's sister is my aunt' → same father → Brother; 'the father of his brother is the only son of my grandfather' → his father is my father → Sister; 'his son is my son's uncle' → his son is my brother → I am his Son.	PYQ Jun 19 Q49, PYQ Jun 19 Q50, PYQ Nov 20 Q51, PYQ Sep 24 Q85, MTP Dec 24 S1 Q57	PYQ 2019-Jun (×2), 2020-Nov, 2024-Sep; MTP 2024-Dec S1	12.2 (a), (b), (e) and item 3, p. 12.2; Exercise 12(A) Q44, p. 12.9
1.8	Grandparent chain: mother's or father's father/mother = grandfather/grandmother (SM c, item 5); go one generation at a time — A's sister's mother's father → A is Granddaughter; mother's mother → Grandmother; wife's father of B's mother → Grand Father. Trap: when the sex of the grandchild is not stated, choose the only consistent option (Granddaughter in SM Ex Q11).	PYQ Dec 21 Q57, PYQ Jun 23 Q57, PYQ Jun 24 Q56, MTP Jun 24 S3 Q54, MTP Aug 24 S2 Q46, PYQ May 26 Q28, PYQ Sep 26 Q18	PYQ 2021-Dec, 2023-Jun, 2024-Jun, 2026-May, 2026-Sep; MTP 2024-Jun S3, 2024-Aug S2	12.2 (c), item 5, p. 12.2; Example 10, p. 12.4; Exercise 12(A) Q3, Q7, Q11, p. 12.6
1.9	Grandchild chain: my son's or daughter's son/daughter is my Grandson/Grand-daughter (SM s, t). B is daughter of Y, A brother of B → Y parent of A → Y's mother X is grandmother of A; F only son of C's wife → A's Grandson.	PYQ Jan 25 Q83, PYQ Jan 25 Q84, MTP Jan 25 S2 Q48	PYQ 2025-Jan (×2); MTP 2025-Jan S2	12.2 (s), (t), p. 12.3; Example 8, p. 12.4
1.10	Spouse by common child: if X is father of one child and Y is mother of that child or of its sibling, X and Y are husband and wife (SM Example 3: E is wife of C); hence the husband of a mother is the Father of all her children (A mother of D, G husband of A → Father; A married to B, B mother of D → Daughter).	PYQ Dec 21 Q60, PYQ Jun 23 Q56, PYQ Dec 23 Q52, MTP Jun 24 S3 Q53, MTP Jun 24 S3 Q55, PYQ Sep 24 Q84, PYQ Jan 25 Q77, PYQ Sep 25 Q60	PYQ 2021-Dec, 2023-Jun, 2023-Dec, 2024-Sep, 2025-Jan, 2025-Sep; MTP 2024-Jun S3 (×2)	Example 3, p. 12.3; Example 15, p. 12.5; Exercise 12(A) Q31, p. 12.8
1.11	'Daughter-in-law of X and sister-in-law of X's other son' → she is the Wife of X's son who is 'the only brother' of that other son (Suman/Ramesh, Sandhya/Manak).	PYQ Dec 22 Q57, PYQ Sep 24 Q90	PYQ 2022-Dec, 2024-Sep	Exercise 12(A) Q41, p. 12.9
1.12	Brother-in-law = sister's husband, or husband's/wife's brother (SM j, m): 'son of the father of my daughter's mother' = wife's brother; husband of my sister/cousin (granddaughter of my father's father); husband's brother; wife's brother; husband of a sibling's mother → brother-in-law of her brother.	PYQ Dec 22 Q56, PYQ Dec 23 Q53, PYQ Dec 23 Q56, PYQ Jun 24 Q59, MTP Aug 24 S2 Q47	PYQ 2022-Dec, 2023-Dec (×2), 2024-Jun; MTP 2024-Aug S2	12.2 (j), (m), p. 12.2

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.13	Son-in-law / daughter-in-law / father-in-law (SM f, g, o): daughter's husband → Son-in-law (G father of S's grandchild through her daughter); the girl married to my mother's grandson (my son) → I am Father-in-law; the lady's husband is my mother's son-in-law → she is my sister; 'son of her only brother is brother of my wife' → she is my father-in-law's sister; Rekha is mother-in-law and daughter of my grandfather → I am Deepika's Sister-in-law.	PYQ Jan 21 Q48, PYQ Jul 21 Q53, PYQ Jun 23 Q59, PYQ Dec 23 Q58, PYQ May 26 Q31	PYQ 2021-Jan, 2021-Jul, 2023-Jun, 2023-Dec, 2026-May	12.2 (f), (g), (o), p. 12.2 – 12.3
1.14	'This man's son's sister' = the man's daughter: if she is my mother-in-law, my husband is her son → the man's Grandson; if she is my sister-in-law (husband's sister), my husband is the man's Son.	PYQ Dec 22 Q58, PYQ Jun 24 Q57	PYQ 2022-Dec, 2024-Jun	Exercise 12(A) Q43, p. 12.9
1.15	Maternal uncle: mother's brother → maternal uncle (SM 12.1(ii)). A is son of C, C and Q sisters, Z mother of Q, P son of Z → P is A's Maternal uncle; F brother of B's mother D → Uncle.	PYQ Jul 21 Q54, PYQ Dec 21 Q55, PYQ Sep 24 Q89, PYQ Jan 26 Q78, PYQ Sep 26 Q15	PYQ 2021-Jul, 2021-Dec, 2024-Sep, 2026-Jan, 2026-Sep	12.1(ii), p. 12.1; Exercise 12(A) Q22, p. 12.7
1.16	Father's brother = Uncle; brother's son/daughter = Nephew/Niece (SM e, h, i): paternal uncle of my daughter = my Brother; K brother of J (father of P) → K uncle; P's son is S's brother → Q is R's Uncle; aunt's granddaughter → Uncle; Rohit is son of Suresh's sister → Nephew.	PYQ May 18 Q43, PYQ Nov 18 Q51, PYQ Dec 22 Q52, PYQ Jun 23 Q58, MTP Jun 24 S3 Q56, PYQ Jan 25 Q85, PYQ Sep 25 Q57	PYQ 2018-May, 2018-Nov, 2022-Dec, 2023-Jun, 2025-Jan, 2025-Sep; MTP 2024-Jun S3	12.2 (e), (h), (i), p. 12.2; Exercise 12(A) Q6, Q8, p. 12.6; Q18, p. 12.7; Q34, p. 12.8; Q45, p. 12.9; Q48, p. 12.10
1.17	Sibling of a child is also that parent's child (SM Examples 4 – 5): A brother of B, B son of P → A is P's Son; B brother of A whose only sister is mother of C, D maternal grandmother of C → A is D's Daughter; D son of E, E father of B → D is B's brother; the Professor father of my brother is my Father.	PYQ Jan 26 Q81, MTP Apr 26 S1 Q56, PYQ May 26 Q30, PYQ May 26 Q29	PYQ 2026-Jan, 2026-May (×2); MTP 2026-Apr S1	Examples 4 – 5, pp. 12.3 – 12.4
1.18	Family-tree puzzle with professions / two couples: fix the couples first (the 'doctor who is mother of R and U' married to T; Q married to P with one son and one grandson), then fill sexes and professions by elimination — granddaughter = Student, grandson = male Engineer; Q (doctor) is husband of P; T the boy is Q's son; R and Q grandparents of T.	PYQ Dec 21 Q59, PYQ Jun 23 Q55, PYQ Sep 24 Q88, MTP Dec 24 S1 Q60, PYQ May 25 Q59, PYQ Jan 26 Q29	PYQ 2021-Dec, 2023-Jun, 2024-Sep, 2025-May, 2026-Jan; MTP 2024-Dec S1	Exercise 12(A) Q36, p. 12.8

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.19	Gender clues: 'B is the son of C but C is not the mother of B' → C is the father (male); 'B is the brother of D but D is not the brother of B' → D is female; the spouse of a known male is female; then count or answer (2 females; 4 males; F is B's Uncle; A has 3 children; A is mother of B; C is Brother-in-law of B; F, mother of A, is mother of C).	PYQ Nov 18 Q50, PYQ Nov 19 Q53, PYQ Nov 19 Q54, PYQ Nov 19 Q55, PYQ Jun 23 Q54, PYQ Dec 23 Q52, PYQ Dec 23 Q56	PYQ 2018-Nov, 2019-Nov (×3), 2023-Jun, 2023-Dec (×2)	Exercise 12(A) Q37, p. 12.9
1.20	Counting members: count each generation separately — Sanjay + one son (each daughter's brother is the same son) = 2 males; man + 4 sons + 4 × 3 grandsons = 17 males; mother + 3 daughters-in-law + 1 daughter + 4 granddaughters = 9 females. Trap: 'each daughter has a brother' does not mean one brother each.	PYQ Dec 22 Q54, RTP Sep 24 Q17, MTP Jan 25 S2 Q47	PYQ 2022-Dec; RTP 2024-Sep; MTP 2025-Jan S2	Exercise 12(A) Q37, p. 12.9 (counting pattern); joint-family counts Not in SM (PYQ/MTP-only)
1.21	Clue-set with 'two fathers, three brothers and a mother': D father of A and grandfather of F → A is a father; E's husband is A; B brother of A; F the third brother → brothers ABF, males A, B, D, F = Four, F is E's Son.	MTP Aug 24 S2 Q48, MTP Aug 24 S2 Q49, MTP Aug 24 S2 Q50	MTP 2024-Aug S2 (×3)	Not in SM (MTP-only)
1.22	Coded relations — choose the expression: decode each symbol left to right and keep the sex fixed by the last symbol (R ÷ M + N: R father of M, M mother of N → M is R's daughter; M + K − R: M brother of K, K mother of R → maternal uncle; M9N5K3J: N wife of M, N daughter of K, K mother of J → K mother-in-law of M).	PYQ Nov 18 Q52, PYQ Jun 22 Q55, PYQ May 25 Q58	PYQ 2018-Nov, 2022-Jun, 2025-May	Not in SM (PYQ-only); decode with the relation list, 12.2, p. 12.2
1.23	Coded relations — decode the given expression: K $ L # M → K father of L, L daughter of M → K Husband of M; P × Q − S → P son of Q, Q wife of S → S father of P; G @ T # P → T male child of G → T is son of G; D × E + F → D brother of F's father → Uncle; M + N − O × P → M father of O, O mother of P → M is P's Grand father.	PYQ Jun 22 Q58, MTP Jan 25 S2 Q49, PYQ May 25 Q56, PYQ Jan 26 Q79, PYQ Sep 26 Q42	PYQ 2022-Jun, 2025-May, 2026-Jan, 2026-Sep; MTP 2025-Jan S2, 2025-Dec S1	Not in SM (PYQ-only); decode with the relation list, 12.2, p. 12.2
1.24	Long chain with names: draw the tree (+ male, − female, = couple, horizontal line siblings, vertical line generation) and read only the asked link — Ravi is Divya's Grandson; Raja is Ashok's Father; P and Q (daughters of D and H) are Sisters; C is E's Father; lady and boy are Mother and son; B, D are A's Sisters; A and D 'can be' Cousins.	PYQ Jun 22 Q54, PYQ Jun 22 Q56, PYQ Dec 22 Q53, PYQ Jun 24 Q55, PYQ Jun 24 Q58, PYQ May 25 Q60, PYQ Sep 25 Q59	PYQ 2022-Jun (×2), 2022-Dec, 2024-Jun (×2), 2025-May, 2025-Sep	12.2 relation list, pp. 12.2 – 12.3
1.25	'Cannot be definitely true / cannot be determined': when a link's sex or spouse is not fixed, a statement that needs it is not definite — Q's sex is unknown (Q son of T not definite); G's sex and P's spouse are not fixed (G to P cannot be determined); daughter-in-law needs a stated marriage to M's son.	PYQ Jan 21 Q47, MTP Dec 24 S1 Q58, MTP Dec 24 S1 Q59	PYQ 2021-Jan; MTP 2024-Dec S1 (×2)	Example 5 (sex not stated), p. 12.4

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.26	Passage set MTP 2025-Jan S2 [51] – [52]: the common passage is not printed in the Scanner; keyed C is A's Mother and the male count 'Cannot be determined'.	MTP Jan 25 S2 Q51, MTP Jan 25 S2 Q52	MTP 2025-Jan S2 (×2)	Not in SM (MTP-only)

Part B — Chapter 12 One-liner Revision Sheet

Deduplicated and in Study Material order. Click a 'Part A ref' to jump to the Part A row(s) carrying the full wording, the Scanner questions and the SM page. Refs read Unit.Topic.Row in chapters with several units and Topic.Row otherwise. Weight: ★★★ asked by ICAI 6 or more times · ★★ 3 – 5 times · ★ once or twice. The ★★★ lines alone cover about 87% of ICAI appearances in this chapter.

Blood Relations

#	One-liner	Weight	Part A ref
1	**Paternal: father's father/mother → grandfather/grandmother; father's brother/sister → uncle/aunt; their children → cousins.**	★★★	1.6, 1.16
2	**Maternal: mother's brother → maternal uncle; mother's sister → aunt; maternal uncle's children → cousins.**	★★★	1.3, 1.15
3	**Mother's mother's son / father's wife's only brother → maternal uncle → his son is my cousin.**	★★★	1.3, 1.4
4	Only daughter of my mother = my sister → speaker is maternal uncle; reversed → niece.	★★	1.5
5	**Grandfather's/grandmother's son → father or uncle; only son → father; same father → brother/sister.**	★★★	1.6, 1.7
6	Son's wife → daughter-in-law; mother of my son's wife's daughter = daughter-in-law.	★★	1.2
7	**Daughter's husband → son-in-law; wife's/husband's father → father-in-law; man's son's sister = his daughter.**	★★★	1.13, 1.14
8	Sister's husband / spouse's brother → brother-in-law; brother's wife / spouse's sister → sister-in-law.	★★	1.12
9	**Uncle's or aunt's child → cousin; 'son of the daughter of my uncle's father' → brother or cousin.**	★★★	1.4
10	**Father's wife = mother; mother's husband = father; only son of my mother = me.**	★★★	1.1
11	**Parent's parent → grandparent; child's child → grandchild; go one generation at a time.**	★★★	1.8, 1.9
12	**Common child ⇒ couple; husband of the mother = father of every child.**	★★★	1.10, 1.11
13	**Sibling of a child is the same parent's child; sex unstated → pick the only consistent option.**	★★★	1.17, 1.25
14	**Gender clues: 'son of C but C not mother' → C father; 'brother of D but D not brother' → D sister.**	★★★	1.19, 1.21
15	Counting: 'each daughter has a brother' = one son; count generation by generation.	★★	1.20
16	**Professions/two-couples puzzles: fix couples, then sexes, then professions by elimination.**	★★★	1.18
17	**Coded relations: decode symbol by symbol; last symbol fixes the sex of the middle person.**	★★★	1.22, 1.23
18	**Long chains: draw the tree (+, −, =, sibling line, generation line); unfixed sex or spouse → cannot be determined.**	★★★	1.24, 1.25, 1.26

CHAPTER 13

Statistical Description of Data and Sampling

156 Scanner questions · 70 one-liners · 33 revision pointers

Part A — One-liners mapped to Scanner questions and Study Material

Unit 1: Statistical Description of Data

SM Chapter 13, Unit 1, pages 13.1 – 13.42

Topic 1 Introduction of Statistics

5 Scanner questions · ICAI appearances PYQ 3 · RTP – · MTP 2

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.1.1	Descriptive statistics only summarise the data actually observed ("the average salary is ₹47,000", "annual profit is ₹67,000"). Inferential statistics draw conclusions about a population from a sample. The SM does not use the labels descriptive/inferential; it speaks of statistics in the singular sense as collecting, analysing and presenting data, leading to inferences.	PYQ Nov 20 Q53	PYQ 2020-Nov	Not in SM (PYQ-only)
1.1.2	Limitation II: statistics is concerned with quantitative data; qualitative data can be used only after converting them to quantitative data by giving them a numerical description. So for "cannot deal with ___ data" the answer is qualitative. Trap: in the plural sense statistics = "data, qualitative as well as quantitative", so "Statistics is concerned with" is keyed Both (a) and (b) (SM Set A Q4).	PYQ Nov 20 Q54, MTP Jun 24 S3 Q71	PYQ 2020-Nov; MTP 2024-Jun S3	13.1.1, pp. 13.2 – 13.3; Set A Q4, p. 13.27
1.1.3	A scatter plot (scatter diagram) shows the relationship between two variables. Bar, pie and line charts compare categories, show parts of a whole or show change over time. Scatter diagrams are taught under Correlation, not in this unit.	PYQ Nov 20 Q58	PYQ 2020-Nov	Not in SM (PYQ-only)
1.1.4	*See Topic 5: the median (and the quartiles) are read graphically from the less than type ogive, and the mode from the histogram.*	MTP Jan 25 S2 Q64	MTP 2025-Jan S2	13.1.5, p. 13.22; Set A Q56, p. 13.33

Topic 2 Collection of Data

17 Scanner questions · ICAI appearances PYQ 12 · RTP 1 · MTP 4

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.2.1	Primary data are collected for the first time by the investigator (or agency) himself. Methods: interview (personal, indirect or telephone), mailed questionnaire, observation, and questionnaires filled and sent by enumerators. So the interview method and questionnaires filled by enumerators both give primary data.	PYQ Dec 22 Q59, MTP Aug 24 S2 Q62, PYQ May 26 Q32	PYQ 2022-Dec, 2026-May; MTP 2024-Aug S2	13.1.2, pp. 13.4 – 13.5

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.2.2	Secondary data are data already collected by someone else and reused. Sources: international (WHO, ILO, IMF, World Bank), government (census reports, CSO's Statistical Abstract), private and quasi-government (ISI, ICAR, NCERT), and unpublished research. Census or religion data taken from census reports are therefore secondary.	PYQ Nov 20 Q55, PYQ Jun 22 Q60, PYQ Sep 24 Q86	PYQ 2020-Nov, 2022-Jun, 2024-Sep	13.1.2, pp. 13.4 – 13.5; Set A Q11, p. 13.28
1.2.3	Scrutiny checks the accuracy and consistency of data. Related series are checked for internal consistency, e.g. Density = Population ÷ Area. There are no hard and fast rules; scrutiny relies on the statistician's intelligence, patience and experience.	PYQ Jan 21 Q53	PYQ 2021-Jan	13.1.2, p. 13.5; Set A Q21, p. 13.29
1.2.4	Variable = a measurable (quantitative) characteristic. It is discrete if it takes isolated, countable values (number of students, misprints or accidents) and continuous if it can take any value in an interval (height, weight, income, profit). Attribute = a qualitative characteristic (gender, nationality, colour).	PYQ Sep 25 Q62	PYQ 2025-Sep	13.1.2, p. 13.4
1.2.5	Data classified by an attribute = qualitative (ordinal) data; by a variable = quantitative (cardinal); by time = chronological (temporal, time series); by region = geographical (spatial).	PYQ May 26 Q84	PYQ 2026-May	13.1.3, p. 13.6
1.2.6	Textual presentation (paragraphs) is simple but dull, monotonous and makes comparison impossible. The SM: "For manifold classification, this method cannot be recommended."	PYQ Sep 25 Q63	PYQ 2025-Sep	13.1.3, p. 13.7
1.2.7	Two-way table puzzle: put the given totals in a 2 × 2 table and fill each cell by subtraction. Example: 1,000 persons, of whom 250 are industrial workers. 700 did not watch, and 30% of 700 = 210 of these are industrial, so 250 − 210 = 40 industrial workers watched. Agricultural workers who watched = 300 − 40 = 260.	MTP Dec 24 S1 Q63	MTP 2024-Dec S1	Set B Q1, p. 13.34
1.2.8	*See Topic 3: a pie chart (or a divided bar chart) shows the parts of a total, e.g. the various heads of total cost.*	PYQ Nov 18 Q55, PYQ Jul 21 Q62	PYQ 2018-Nov, 2021-Jul	13.1.3, pp. 13.9, 13.13
1.2.9	*See Topic 3: the stub is the left part of a table and describes the rows.*	MTP Jun 24 S3 Q86	MTP 2024-Jun S3	13.1.3, p. 13.7; Set A Q26, p. 13.29
1.2.10	*See Topic 4: there are 2 types of cumulative frequency, less than and more than. The class interval (class length) is the upper limit minus the lower limit; strictly, class width = UCB − LCB.*	PYQ Nov 20 Q56, MTP Jan 25 S2 Q62	PYQ 2020-Nov; MTP 2025-Jan S2	13.1.4, p. 13.18
1.2.11	*See Topic 5: the histogram determines the mode graphically.*	RTP Sep 24 Q27	RTP 2024-Sep	13.1.5, p. 13.20

Topic 3 Presentation of Data

39 Scanner questions · ICAI appearances PYQ 32 · RTP – · MTP 7

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.3.1	Classification = arranging data into groups or classes according to the similarities of the observations. Classifying by one criterion = simple (one-way) classification; by two or more = manifold classification.	PYQ Nov 20 Q59, PYQ Jul 21 Q56	PYQ 2020-Nov, 2021-Jul	13.1.3, pp. 13.6 – 13.7
1.3.2	Four kinds of classified data: chronological (temporal, time series); geographical (spatial: by state or region); qualitative (ordinal: by attribute); quantitative (cardinal: by variable). Data arranged state-wise are geographical. Research data are qualitative or quantitative.	PYQ Dec 21 Q62, PYQ Jun 22 Q64, PYQ Jun 22 Q66	PYQ 2021-Dec, 2022-Jun (×2)	13.1.3, p. 13.6; Addl Q58, p. 13.41
1.3.3	Attribute = a qualitative characteristic that cannot be measured (gender, nationality, colour, drinking habit). Sweetness is a quality, so it is an attribute. A variable is measurable: discrete or continuous.	PYQ Jan 21 Q52, PYQ Jan 21 Q59, PYQ Jun 22 Q61	PYQ 2021-Jan (×2), 2022-Jun	13.1.2, p. 13.4; Set A Q5, Q8, Q9, pp. 13.27
1.3.4	The three modes of presentation are textual, tabular and diagrammatic. Numerical data written out in descriptive paragraphs = textual presentation. Regression analysis is analysis, not a mode of presentation.	PYQ Jun 22 Q62, PYQ Jun 23 Q63, PYQ Sep 24 Q92	PYQ 2022-Jun, 2023-Jun, 2024-Sep	13.1.3, pp. 13.6 – 13.7; Set A Q22, p. 13.29
1.3.5	Stub = the LEFT part of a table, giving the description of the ROWS. Trap options: right part, or columns.	MTP Aug 24 S2 Q64, PYQ Jan 25 Q89, PYQ Sep 26 Q92	PYQ 2025-Jan, 2026-Sep; MTP 2024-Aug S2	13.1.3, p. 13.7; Set A Q26, p. 13.29
1.3.6	Caption = the upper part of the table that describes the columns and sub-columns (the column headings). Box-head = the ENTIRE upper part: column and sub-column numbers, unit(s) of measurement and the caption. So units of measurement are shown in the box-head.	PYQ Jun 23 Q62, MTP Dec 24 S1 Q64, PYQ Jan 26 Q30, PYQ May 26 Q83	PYQ 2023-Jun, 2026-Jan, 2026-May; MTP 2024-Dec S1	13.1.3, p. 13.7; Set A Q25, Q27, Q28, p. 13.29
1.3.7	Body = the main part, holding the numerical figures. Footnote = at the bottom, giving the source of the data and clarifications. The SM's additional question treats a table as having five parts.	MTP Dec 24 S1 Q62, PYQ May 25 Q69	PYQ 2025-May; MTP 2024-Dec S1	13.1.3, p. 13.7; Set A Q29, p. 13.30; Addl Q5, p. 13.37
1.3.8	Tabulation (rows × columns) suits classified or categorical (nominal) data and complicated data. It aids comparison and is required before diagrams and statistical analysis. Purely descriptive opinions such as "medium/average/heavy" rainfall are keyed as not tabulable.	PYQ Jan 21 Q51, PYQ Jun 24 Q64	PYQ 2021-Jan, 2024-Jun	13.1.3, pp. 13.7 – 13.8
1.3.9	Line diagram (historiagram) is for time series. Use a ratio (log) chart for wide fluctuations, a multiple line chart for two or more related series in the SAME unit, and a multiple-axis chart when there is more than one series AND the units differ. Answer: both conditions.	PYQ Dec 21 Q67	PYQ 2021-Dec	13.1.3, pp. 13.8 – 13.9; Set A Q36, p. 13.30

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.3.10	Bar diagram: rectangles of equal width and varying length. Horizontal bars suit qualitative data or data varying over space; vertical bars suit quantitative or time-series data. Use multiple (grouped) bars to compare related series, and divided (percentage) bars to compare the components of a variable.	PYQ Jan 21 Q50, PYQ Jul 21 Q58	PYQ 2021-Jan, 2021-Jul	13.1.3, p. 13.9
1.3.11	Pictograms (ideographs) represent data by pictures or symbols. Bar diagrams are one-dimensional, pie charts two-dimensional (area) and cube diagrams three-dimensional (volume). Neither point is covered in the SM.	PYQ Jul 21 Q57, MTP Dec 24 S1 Q65	PYQ 2021-Jul; MTP 2024-Dec S1	Not in SM (PYQ-only)
1.3.12	Central angle of a pie sector = (component ÷ total) × 360°. Examples: 90/432 × 360 = 75°; 25% → 90°; for Promoters 120/200 × 360 = 216° and for Public 15/200 × 360 = 27°, a difference of 189°. With % pie charts of different totals, convert to numbers first (% × total) and then add.	PYQ Dec 21 Q63, PYQ Jun 23 Q60, PYQ Jan 25 Q99, PYQ Sep 26 Q66	PYQ 2021-Dec, 2023-Jun, 2025-Jan, 2026-Sep	Example 13.1.3, p. 13.13
1.3.13	A pie chart shows the proportion of each category in the whole, so it suits categorical data. A histogram shows the frequency of each class of a continuous variable.	PYQ Jun 24 Q63, PYQ Sep 24 Q98	PYQ 2024-Jun, 2024-Sep	13.1.3, pp. 13.9, 13.13; Set A Q41, p. 13.31
1.3.14	Raw data allow the least, highest and median score to be found; a "best" score is subjective and cannot be found without a stated criterion.	PYQ Nov 20 Q60	PYQ 2020-Nov	Not in SM (PYQ-only)
1.3.15	*See Topic 4: exclusive (overlapping) classes 10–20, 20–30 include the lower limit and exclude the upper. To read cumulative-frequency tables: the number between 250 and 300 = CF(>250) − CF(>300) = 38 − 15 = 23; the number above 30 = N − CF(<30) = 100 − 65 = 35.*	MTP Jun 24 S3 Q98, MTP Jan 25 S2 Q61, MTP Jan 25 S2 Q63	MTP 2024-Jun S3, 2025-Jan S2 (×2)	13.1.4, pp. 13.17 – 13.18; Set B Q6 – Q7, pp. 13.34 – 13.35
1.3.16	*See Topic 5: ogives give the median and quartiles, not the mean. A bell-shaped curve has its maximum frequency at the centre, falling on both sides.*	PYQ Dec 21 Q64, PYQ Sep 25 Q64	PYQ 2021-Dec, 2025-Sep	13.1.5, pp. 13.22 – 13.23

Topic 4 Frequency Distribution

26 Scanner questions · ICAI appearances PYQ 24 · RTP 1 · MTP 1

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.4.1	Frequency distribution = a table distributing the total frequency over classes. For a discrete variable listed against single values (X: 12, 17, 24 ...) it is a discrete, ungrouped or simple frequency distribution. For a continuous variable grouped into class intervals it is a grouped frequency distribution.	PYQ Nov 18 Q53	PYQ 2018-Nov	13.1.4, p. 13.14; Set A Q43, p. 13.31
1.4.2	Mutually exclusive (overlapping) classes 0–10, 10–20 include the lower limit and EXCLUDE the upper limit. They are used for continuous variables, so the exclusive series is the continuous one. Mutually inclusive classes 0–9, 10–19 include both limits and suit discrete variables.	PYQ Jun 19 Q54, PYQ May 26 Q87	PYQ 2019-Jun, 2026-May	13.1.4, p. 13.17; Set A Q46 – Q48, p. 13.32

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.4.3	Class boundaries are the actual class limits. For inclusive classes, LCB = LCL − D/2 and UCB = UCL + D/2, where D = LCL of the next class − UCL of this class. Example: 10–14, 15–19 gives D = 1, so the boundaries are 9.5–14.5. For exclusive classes the boundaries equal the limits.	PYQ Sep 24 Q99, PYQ Sep 26 Q16	PYQ 2024-Sep, 2026-Sep	13.1.4, p. 13.17
1.4.4	Number of class intervals × class length ≥ Range (L − S); round UP to the next integer. Example: range 78 − 40 = 38 with length 5 gives 7.6, so 8 classes. Class length = Range ÷ number of classes = (45 − 25)/4 = 5.	PYQ Jul 21 Q59, PYQ Dec 23 Q61	PYQ 2021-Jul, 2023-Dec	13.1.4, pp. 13.15 – 13.16 (Example 13.1.6)
1.4.5	Sturges' rule: number of class intervals k = 1 + 3.322 log N, where N = total frequency.	PYQ Dec 22 Q61	PYQ 2022-Dec	Not in SM (PYQ-only)
1.4.6	Frequency density = class frequency ÷ class LENGTH (width). For 30–39, 40–49 and 50–59 (width 10) the frequencies 9, 11, 7 give 0.90, 1.10, 0.70. It is used for histograms with unequal widths. Trap option: ÷ total frequency, which is the relative frequency.	PYQ Dec 21 Q66, PYQ Dec 23 Q64, PYQ May 25 Q62, PYQ Jan 26 Q28	PYQ 2021-Dec, 2023-Dec, 2025-May, 2026-Jan	13.1.4, p. 13.19; Set A Q53, p. 13.33; Set C Q4, p. 13.36
1.4.7	Relative frequency = class frequency ÷ TOTAL frequency (between 0 and 1; all of them add to 1). Percentage frequency = relative frequency × 100.	PYQ Dec 23 Q63	PYQ 2023-Dec	13.1.4, p. 13.19
1.4.8	Less than cumulative frequency = running total of the frequencies up to the class boundary. Example: 5, 18 gives CF 23 for 11 AM–1 PM. A series built by successively adding frequencies is a cumulative frequency series.	PYQ Dec 23 Q60, PYQ Sep 24 Q95	PYQ 2023-Dec, 2024-Sep	13.1.4, pp. 13.18 – 13.19
1.4.9	Reading cumulative tables: the frequency of a class = CF(<upper) − CF(<lower), e.g. 15 − 9 = 6. The number above x = N − CF(<x), e.g. 90 − 65 = 25. "At least ₹1,500" = sum of the top classes ÷ N = (36 + 7)/86 = 50%.	PYQ Jun 23 Q61, PYQ May 25 Q64, PYQ Sep 26 Q93	PYQ 2023-Jun, 2025-May, 2026-Sep	Set B Q5 – Q6, pp. 13.34 – 13.35
1.4.10	Two-way table puzzles: tabulate the totals and get each cell by subtraction. Unmarried females = (200 − 150) − (160 − 120) = 10. Males who did not enjoy = 700 − 30% of 700 = 490. For the multi-year Commerce/Science problem, build the table for each year, add the years, then compare the ratios: x = 2,580/2,220 < y = 1,530/270.	PYQ Jul 21 Q60, PYQ Dec 21 Q61, PYQ Jan 25 Q88	PYQ 2021-Jul, 2021-Dec, 2025-Jan	Set B Q1, p. 13.34; Set C Q1 – Q2, p. 13.35
1.4.11	*See Topic 3: central angle = (component ÷ total) × 360°. Largest − smallest = (35 − 12)/90 × 360 = 92°.*	RTP Sep 24 Q19	RTP 2024-Sep	Example 13.1.3, p. 13.13; Set B Q3, p. 13.34
1.4.12	*See Topic 5: an ogive is the graph of a cumulative frequency distribution.*	PYQ Nov 18 Q57, MTP Aug 24 S2 Q63	PYQ 2018-Nov; MTP 2024-Aug S2	13.1.5, p. 13.22
1.4.13	*See Topic 2: religion data from census reports are secondary. See Topic 1: merely stating the observed profit is descriptive statistics.*	PYQ Nov 20 Q57, PYQ Jul 21 Q61	PYQ 2020-Nov, 2021-Jul	13.1.2, p. 13.4; Set A Q11, p. 13.28

Topic 5 Graphical Representation of Frequency Distribution

40 Scanner questions · ICAI appearances PYQ 38 · RTP – · MTP 2

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.5.1	Histogram (area diagram): adjacent rectangles erected on class boundaries, with the class interval as the base. The height is the frequency, or the frequency DENSITY when class widths are unequal, so a histogram can be drawn for equal or unequal intervals.	PYQ May 18 Q46, PYQ Jun 19 Q53, PYQ Jun 22 Q63	PYQ 2018-May, 2019-Jun, 2022-Jun	13.1.5, pp. 13.19 – 13.20; Addl Q29, Q41, pp. 13.39 – 13.40
1.5.2	The histogram locates the MODE graphically (mode = 66.50 kg in the SM example). The mean can be estimated only roughly, and the standard deviation cannot be found from it.	PYQ Jun 19 Q56, PYQ Nov 19 Q57, PYQ Jan 21 Q54, PYQ Jan 21 Q56, PYQ May 25 Q61	PYQ 2019-Jun, 2019-Nov, 2021-Jan (×2), 2025-May	13.1.5, p. 13.20; Set A Q55, p. 13.33
1.5.3	An ogive (cumulative frequency graph or curve) is the graphical representation of a cumulative frequency distribution. It is not a histogram or a frequency polygon, which use simple frequencies.	PYQ Nov 19 Q56, PYQ Jan 21 Q58, PYQ Jun 22 Q65, MTP Dec 24 S1 Q61, PYQ Jan 26 Q33, PYQ May 26 Q33	PYQ 2019-Nov, 2021-Jan, 2022-Jun, 2026-Jan, 2026-May; MTP 2024-Dec S1	13.1.5, p. 13.22; Addl Q17, Q49, pp. 13.38, 13.41
1.5.4	Plot the cumulative frequency (y-axis) against the class boundary (x-axis); the less than ogive uses the upper boundaries. There are two ogives, less than and more than type. The less than ogive shows the number of observations below a given value.	PYQ Jun 23 Q64, PYQ Dec 23 Q59, PYQ Dec 23 Q62, PYQ Jun 24 Q60, PYQ Jun 24 Q62, PYQ May 25 Q63	PYQ 2023-Jun, 2023-Dec (×2), 2024-Jun (×2), 2025-May	13.1.5, p. 13.22; Addl Q54, p. 13.41
1.5.5	Ogives give the quartiles graphically. The perpendicular from the intersection of the less than and more than ogives meets the x-axis at the MEDIAN (Q_2). Ogives can also be used for short-term projections.	PYQ Jun 19 Q55, PYQ Jun 22 Q59, PYQ Dec 23 Q65, PYQ Sep 24 Q91, PYQ Jan 25 Q93	PYQ 2019-Jun, 2022-Jun, 2023-Dec, 2024-Sep, 2025-Jan	13.1.5, p. 13.22
1.5.6	Frequency polygon: plot (mid-point, frequency) and close the figure at both ends. Two distributions can be compared on the same sheet with frequency polygons. A frequency curve is the limiting form of the polygon or histogram.	PYQ Jun 24 Q61	PYQ 2024-Jun	13.1.5, pp. 13.21, 13.23
1.5.7	Bell-shaped curve: frequency rises from a low value to its MAXIMUM near the centre, then falls to its minimum at the ends (so maximum in the middle, minimum at the ends). Most commonly used distributions are bell-shaped, e.g. height, weight, marks and profit (such as a blue-chip company's profits).	PYQ Jan 21 Q57, PYQ Jun 24 Q65, MTP Aug 24 S2 Q66, PYQ Jan 26 Q83	PYQ 2021-Jan, 2024-Jun, 2026-Jan; MTP 2024-Aug S2	13.1.5, p. 13.23; Set A Q59 – Q60, p. 13.34

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.5.8	J-shaped curve: starts at the minimum frequency and rises to the maximum at the other extremity, e.g. commuters arriving from early morning to the peak morning hour. U-shaped: minimum in the centre and maximum at both ends (commuters over the whole day).	PYQ Sep 24 Q93, PYQ May 25 Q68, PYQ Sep 26 Q91	PYQ 2024-Sep, 2025-May, 2026-Sep	13.1.5, p. 13.23
1.5.9	Bar charts: simple bars compare distinct categories (students of various disciplines). Adjacent (multiple or grouped) bars compare two related series, such as two salespersons week by week. Divided bars compare the components of a variable AND relate them to the whole, so the answer is (a) and (b).	PYQ May 18 Q47, PYQ Sep 25 Q67, PYQ Sep 25 Q69	PYQ 2018-May, 2025-Sep (×2)	13.1.3, p. 13.9; Set A Q39 – Q40, p. 13.31
1.5.10	Frequency = the number of times an observation occurs in a class. The cumulative frequency of class 20–30 = 4 + 6 + 20 = 30.	PYQ Nov 18 Q56, PYQ Nov 18 Q58	PYQ 2018-Nov (×2)	13.1.4, pp. 13.14, 13.18
1.5.11	*See Topic 2: data collected by the investigator himself are primary. A subset extracted from data already collected (data on women out of a salary survey) is treated as secondary.*	PYQ Nov 18 Q54, PYQ Sep 25 Q68	PYQ 2018-Nov, 2025-Sep	13.1.2, p. 13.4

Unit 2: Sampling

SM Chapter 13, Unit 2, pages 13.43 – 13.57

Topic 2 Basic Principles of Survey

3 Scanner questions · ICAI appearances PYQ 3 · RTP – · MTP –

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.2.1	Law of Statistical Regularity: if a sample of fairly large size is drawn at random from the population, then ON AN AVERAGE it possesses the characteristics of that population. Trap: the option without "on an average" is wrong. The other principles are inertia of large numbers, optimisation and validity.	PYQ May 25 Q65, PYQ Jan 26 Q82	PYQ 2025-May, 2026-Jan	13.2.2, pp. 13.43 – 13.44; Set A Q2, p. 13.54
2.2.2	*See Topic 5: mixed sampling (partly probabilistic, partly a fixed rule) = systematic sampling.*	PYQ Sep 25 Q61	PYQ 2025-Sep	13.2.6, p. 13.52

Topic 3 Errors in Sampling

2 Scanner questions · ICAI appearances PYQ 1 · RTP – · MTP 1

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.3.1	Sampling error arises only because a part (sample) of the population is studied instead of a complete census. It falls as the sample size increases. Non-sampling errors occur in both census and sample: wrong recording, non-response, faulty questions, bias of enumerators.	MTP Dec 24 S1 Q69, PYQ May 26 Q37	PYQ 2026-May; MTP 2024-Dec S1	13.2.3(d), p. 13.45; 13.2.4, pp. 13.45 – 13.46

Topic 4 Some important terms associated with sampling

7 Scanner questions · ICAI appearances PYQ 7 · RTP – · MTP –

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.4.1	Standard Error = the standard deviation of the sampling distribution of a statistic. SE($\bar{x}$) = $\sigma/\sqrt{n}$ for SRSWR and $(\sigma/\sqrt{n}) \times \sqrt{[(N-n)/(N-1)]}$ for SRSWOR. SE is inversely proportional to √n, so it DECREASES as n increases.	PYQ Jan 25 Q81, PYQ May 26 Q86, PYQ Sep 26 Q43	PYQ 2025-Jan, 2026-May, 2026-Sep	13.2.5, p. 13.48 (13.2.8); Set A Q11, Q13, pp. 13.55 – 13.56
2.4.2	Computing SE: for the mean, 10/√100 = 1.0 cm. With the finite population correction √(900/999) it is 0.95, still nearest 1.0. For a proportion, SE(p) = √(PQ/n) (SRSWR) = √(0.6 × 0.4/50) = 0.0693 = 6.93%.	PYQ Jan 25 Q98, PYQ Sep 26 Q45	PYQ 2025-Jan, 2026-Sep	13.2.5, p. 13.48 (13.2.8 – 13.2.9)
2.4.3	Number of possible samples of size n from N: N^n with replacement ($5^2 = 25$) and ${}^{N}C_{n}$ without replacement (${}^{25}C_{2} = 300$).	PYQ May 25 Q66	PYQ 2025-May	13.2.5, p. 13.48; Example 13.2.2, p. 13.49; Set A Q15, p. 13.56
2.4.4	SRS gives every unit an equal chance (with replacement the unit is returned; without replacement it is never drawn again). It is effective only if the population is not very large, the sample is not very small and the population is NOT heterogeneous. So "effective for a large, heterogeneous population" is false.	PYQ May 25 Q67	PYQ 2025-May	13.2.6, p. 13.52; Set A Q16, p. 13.56

Topic 5 Types of Sampling

17 Scanner questions · ICAI appearances PYQ 16 · RTP – · MTP 1

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.5.1	There are three types of sampling: probability sampling (SRS, stratified, multi-stage, multi-phase, cluster), non-probability sampling (= purposive or judgement sampling) and mixed sampling (= systematic sampling). "Stand-alone" is not a type. Quota sampling is non-probability.	PYQ Jun 24 Q67, MTP Dec 24 S1 Q68, PYQ Jan 25 Q87	PYQ 2024-Jun, 2025-Jan; MTP 2024-Dec S1	13.2.6, p. 13.52
2.5.2	Purposive (judgement) sampling depends solely on the sampler's discretion: his belief, prejudice and interest. Examples: picking the 50 most reputed doctors, or self-selected voters liking a contestant on an app. No hypothesis can be tested on it.	PYQ Jun 24 Q66, PYQ Sep 25 Q66, PYQ Jan 26 Q31, PYQ May 26 Q85	PYQ 2024-Jun, 2025-Sep, 2026-Jan, 2026-May	13.2.6, pp. 13.52, 13.54; Set A Q22, p. 13.57
2.5.3	Simple random sampling is completely free from the sampler's biases, because each unit has an equal chance; the Scanner keys exit polls as random sampling.	PYQ Sep 24 Q87, PYQ Jan 26 Q32	PYQ 2024-Sep, 2026-Jan	13.2.6, p. 13.52

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.5.4	Stratified sampling is for a LARGE and HETEROGENEOUS population. Divide it into strata with little variation within and maximum variation between, then sample randomly from EACH stratum. This represents every subgroup (proportionally) and gives stratum-wise and overall estimates. It is not advisable if the population is small, prior information is lacking or there is little heterogeneity.	PYQ Sep 24 Q100, PYQ Jan 25 Q90, PYQ Jan 26 Q27, PYQ Sep 26 Q70	PYQ 2024-Sep, 2025-Jan, 2026-Jan, 2026-Sep	13.2.6, pp. 13.52 – 13.53; Set A Q19, p. 13.56
2.5.5	Allocation in stratified sampling: Bowley's (proportional) allocation is $n_i \propto N_i$, used when strata variances are similar. Neyman's allocation is $n_i \propto N_iS_i$ (size × SD), used when strata variances differ significantly, so pick the SD option, not population size alone or variance.	PYQ Jan 26 Q84	PYQ 2026-Jan	13.2.6, p. 13.53; Set A Q18, p. 13.56
2.5.6	Multi-stage sampling (e.g. state → district → police station → household) gives wide coverage, saves cost and ADDS FLEXIBILITY. It is less accurate than stratified sampling.	PYQ May 26 Q36	PYQ 2026-May	13.2.6, p. 13.53; Set A Q20, p. 13.57
2.5.7	Systematic sampling: sampling interval k = N/n. Pick a random start r from 1 to k, then the i-th unit is r + (i − 1)k. Here k = 4,800/240 = 20, so the 25th unit = 5 + 24 × 20 = 485. Its weakness is a hidden periodicity in the frame.	PYQ Sep 26 Q44	PYQ 2026-Sep	13.2.6, pp. 13.53 – 13.54
2.5.8	*See Topic 2: the four basic principles are statistical regularity, inertia (of large numbers), optimisation and validity. "Principle of Large Numbers" is not on the SM's list.*	PYQ Sep 25 Q65	PYQ 2025-Sep	13.2.2, pp. 13.43 – 13.44

Part B — Chapter 13 One-liner Revision Sheet

Deduplicated and in Study Material order. Click a 'Part A ref' to jump to the Part A row(s) carrying the full wording, the Scanner questions and the SM page. Refs read Unit.Topic.Row in chapters with several units and Topic.Row otherwise. Weight: ★★★ asked by ICAI 6 or more times · ★★ 3 – 5 times · ★ once or twice. The ★★★ lines alone cover about 51% of ICAI appearances in this chapter.

Unit 1: Statistical Description of Data

#	One-liner	Weight	Part A ref
1	Statistics deals with aggregates and quantitative data; qualitative data must be given numbers first ("cannot deal with qualitative"); in the plural sense it covers both.	★	1.1.2
2	Stating an observed figure = descriptive statistics; a scatter plot shows a relationship between two variables.	★	1.1.1, 1.1.3
3	**Primary data: collected first-hand by interview, mailed questionnaire, observation or enumerators' schedules. Secondary data: already collected (census, World Bank, CSO, ISI).**	★★★	1.2.1, 1.2.2, 1.5.11
4	Scrutiny checks accuracy and consistency, e.g. internal consistency through Density = Population ÷ Area.	★	1.2.3
5	Variable: discrete (counted) or continuous (measured). Attribute: qualitative (gender, nationality, sweetness).	★★	1.2.4, 1.3.3
6	**Classification of data: chronological, geographical (state-wise), qualitative (ordinal), quantitative (cardinal); one criterion = simple.**	★★★	1.2.5, 1.3.1, 1.3.2
7	Modes of presentation: textual · tabular · diagrammatic. Textual is not for manifold classification.	★★	1.2.6, 1.3.4
8	**Table parts: caption = column headings; box-head = whole top incl. units; stub = left, rows; body = figures; footnote = source.**	★★★	1.3.5, 1.3.6, 1.3.7
9	Tabulation suits categorical or complicated data and is required before diagrams and analysis.	★	1.3.8
10	Line chart for time series. Multiple line chart = same units; multiple-axis chart = more than one series AND different units; ratio chart = log y.	★	1.3.9
11	Bar: horizontal for qualitative or space data, vertical for quantitative or time. Multiple bars compare related series; divided bars compare components AND relate them to the whole.	★★	1.3.10, 1.5.9
12	**Central angle = (part ÷ total) × 360°. A pie chart shows the parts of a whole (categorical data).**	★★★	1.3.12, 1.3.13, 1.4.11
13	Two-way table puzzles: lay out a 2 × 2 table, fill the known totals and subtract.	★★	1.2.7, 1.4.10
14	Discrete X-list = simple (ungrouped) distribution; class intervals = grouped distribution.	★	1.4.1
15	Exclusive classes 0–10, 10–20 include the lower and exclude the upper limit (continuous); inclusive 0–9, 10–19 include both (discrete).	★★	1.4.2, 1.3.15
16	Boundaries: LCB = LCL − D/2, UCB = UCL + D/2 (10–14 → 9.5–14.5); boundaries are the actual class limits.	★	1.4.3

#	One-liner	Weight	Part A ref
17	Number of classes × class length ≥ Range: round up (38/5 = 7.6 → 8). Sturges: k = 1 + 3.322 log N.	★★	1.4.4, 1.4.5
18	Frequency density = f ÷ class length; relative frequency = f ÷ N.	★★	1.4.6, 1.4.7
19	**Cumulative frequency: less than = running total; 2 types. Class f = CF difference; more than x = N − CF(<x).**	★★★	1.4.8, 1.4.9, 1.5.10
20	**Histogram: adjacent rectangles on boundaries; height = f or frequency density (unequal widths). It gives the MODE, never the SD.**	★★★	1.5.1, 1.5.2
21	**Ogive = graph of a cumulative frequency distribution: CF (y) against class boundary (x); less than and more than types.**	★★★	1.5.3, 1.5.4
22	**Ogives give the median and quartiles; the intersection of the two ogives gives the median (Q_2); also used for short-term projections.**	★★★	1.5.5, 1.3.16
23	Frequency polygon: (mid-point, f); best for comparing two distributions on one sheet.	★	1.5.6
24	**Curves: bell = maximum in the centre (most common: height, marks, profit); J = minimum at one end rising to maximum at the other (commuters until the morning peak); U = maximum at both ends.**	★★★	1.5.7, 1.5.8

Unit 2: Sampling

#	One-liner	Weight	Part A ref
1	Law of statistical regularity: a large random sample possesses the population's characteristics ON AN AVERAGE. The four principles are regularity, inertia, optimisation and validity.	★★	2.2.1, 2.5.8
2	Sampling error arises because only part of the population is studied and falls as n rises; non-sampling errors occur in both census and sample.	★	2.3.1
3	SE = SD of the statistic; SE($\bar{x}$) = σ/√n (× √[(N − n)/(N − 1)] for WOR); SE ∝ 1/√n.	★★	2.4.1, 2.4.2
4	SE(p) = √(PQ/n): 0.6, 0.4, n = 50 → 6.93%.	★	2.4.2
5	Number of samples: N^n with replacement; ${}^{N}C_n$ without replacement.	★	2.4.3
6	SRS: equal chance, free from sampler's bias; poor for a large heterogeneous population.	★★	2.4.4, 2.5.3
7	**Probability (SRS, stratified, multi-stage, cluster) · non-probability = purposive/judgement · mixed = systematic.**	★★★	2.5.1, 2.5.2, 2.2.2
8	Stratified: large, heterogeneous population, homogeneous strata; Bowley $n_i \propto N_i$, Neyman $n_i \propto N_iS_i$.	★★	2.5.4, 2.5.5
9	Multi-stage sampling adds flexibility. Systematic: k = N/n; i-th unit = r + (i − 1)k.	★	2.5.6, 2.5.7

CHAPTER 14

Measures of Central Tendency and Dispersion

269 Scanner questions · 119 one-liners · 48 revision pointers

Part A — One-liners mapped to Scanner questions and Study Material

Measures of Central Tendency and Dispersion

SM Chapter 14, pages 14.1 – 14.83 (Unit I Central Tendency pp. 14.1 – 14.29; Unit II Dispersion pp. 14.30 – 14.60 for cross-referenced dispersion questions; Additional Question Bank pp. 14.61 – 14.83)

Topic 1 Arithmetic Mean

49 Scanner questions · ICAI appearances PYQ 40 · RTP 1 · MTP 8

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.1	AM: $\bar{X} = \Sigma x/n$ (raw data); $\bar{X} = \Sigma fx/N$ for a frequency distribution, where for a grouped distribution x is the mid-value (class mark) of each class = (LCL + UCL)/2, e.g. 35–44 → 39.5 (not 40). Trap: multiply each f by the mid-value, never by a class limit.	PYQ Jun 23 Q67, PYQ Jan 25 Q86, PYQ May 26 Q34, PYQ May 26 Q88	PYQ 2023-Jun, 2025-Jan, 2026-May (×2)	14.1.3 (14.1.1 – 14.1.2), pp. 14.2 – 14.4; class mark: SM Chapter 13, p. 13.18
1.2	Missing frequency/value from a given mean: write Σf and Σfx in terms of the unknown and solve $\bar{x}\cdot\Sigma f = \Sigma fx$ (e.g. mean 11: 11(12 + X) = 150 + 10X → X = 18).	PYQ Nov 18 Q70, PYQ May 25 Q76, PYQ Sep 26 Q95	PYQ 2018-Nov, 2025-May, 2026-Sep	Example 14.1.4, pp. 14.5 – 14.6
1.3	Sum = Mean × n: use totals, not averages — remaining-group mean = $(n\cdot\bar{x} - n_1\bar{x}_1)/(n - n_1)$; replaced/misread value: correct sum = old sum − wrong + right, n unchanged; unknown numbers from sum and difference (a + b = S, a − b = D); two-shift trick $\Sigma(x - 50) = -10$, $\Sigma(x - 46) = 70$ → 4n = 80, n = 20, $\bar{x} = 49.5$. Overlapping groups (4 greatest + 4 smallest of 7) count the middle number twice: 72 + 32 − 84 = 20.	PYQ Jun 19 Q58, PYQ Jul 21 Q63, PYQ Jan 25 Q82, PYQ Sep 25 Q77, MTP Apr 26 S1 Q74, PYQ May 26 Q42, PYQ May 26 Q38	PYQ 2019-Jun, 2021-Jul, 2025-Jan, 2025-Sep, 2026-May (×2); MTP 2026-Apr S1	14.1.3 (14.1.1), p. 14.2
1.4	Combined AM: $\bar{x} = (n_1\bar{x}_1 + n_2\bar{x}_2)/(n_1 + n_2)$, extended to k groups $\bar{x} = \Sigma n_i\bar{x}_i/\Sigma n_i$; reverse it to find a group size or the ratio $n_1 : n_2 = (\bar{x}_2 - \bar{x})/(\bar{x} - \bar{x}_1)$ (80 kg & 50 kg, combined 60 → males : females = 1 : 2). 'Combined salary' in the RTP means the combined mean salary (₹6,160).	PYQ Nov 18 Q65, PYQ Dec 23 Q70, MTP Jun 24 S3 Q76, PYQ Sep 24 Q96, MTP Apr 26 S1 Q65, RTP May 26 Q22	PYQ 2018-Nov, 2023-Dec, 2024-Sep; RTP 2026-May; MTP 2024-Jun S3, 2026-Apr S1	14.1.3 property (iv) (14.1.5 – 14.1.6), Example 14.1.5, p. 14.7
1.5	Change of origin and scale: if y = a + bx then $\bar{y} = a + b\cdot\bar{x}$ (keep the sign of b). Adding/subtracting k to every item adds/subtracts k from the AM; multiplying by k multiplies the AM by k. From px + qy + r = 0, write y = −(r + px)/q first (2u + v + 7 = 0, $\bar{u}$ = 10 → $\bar{v}$ = −27; 4X + 3Y + 5 = 0, $\bar{X}$ = 10 → $\bar{Y}$ = −15).	PYQ May 18 Q48, PYQ May 18 Q51, PYQ Nov 18 Q60, PYQ Jul 21 Q65, MTP Jan 25 S2 Q69, PYQ Sep 25 Q70	PYQ 2018-May (×2), 2018-Nov, 2021-Jul, 2025-Sep; MTP 2025-Jan S2	14.1.3 property (iii), p. 14.7; Additional Question Bank Q47, p. 14.64 and Q258, p. 14.79

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.6	Algebraic sum of deviations from the AM is zero: $\Sigma(x - \bar{x}) = 0$ and $\Sigma f(x - \bar{x}) = 0$ — the key property of the AM (not 'always positive'); the AM can be computed for grouped data and is affected by extreme values.	PYQ Nov 18 Q62, PYQ Jan 25 Q94, PYQ May 26 Q39	PYQ 2018-Nov, 2025-Jan, 2026-May	14.1.3 property (ii) (14.1.4), p. 14.7
1.7	Best measure of central tendency, usually, is the AM — rigidly defined, based on all observations, easy to compute, amenable to mathematical treatment, least affected by sampling fluctuations; its drawbacks are extreme values and open-end classes.	PYQ Jan 25 Q97	PYQ 2025-Jan	General review, pp. 14.19 – 14.20; Set A Q4, p. 14.24
1.8	Moving average = the average of a series of overlapping averages, each based on a fixed number of items of the series (used to smooth a time series). The SM flags this as outside the Foundation syllabus.	PYQ May 18 Q53	PYQ 2018-May	Additional Question Bank Q155, p. 14.72 (marked not in Foundation syllabus)
1.9	*See Topic 3: average speed — equal distances at x and y km/hr → HM = 2xy/(x + y) (30 & 60 → 40); unequal distances → total distance ÷ total time = weighted HM (5 km at 30, 15 km at 45 → 20 ÷ ½ h = 40 km/hr). Never take the simple AM of speeds.*	MTP Jun 24 S3 Q93, MTP Apr 26 S1 Q66	MTP 2024-Jun S3, 2026-Apr S1	14.1.6, weighted HM (14.1.22), p. 14.18; Set B Q14, p. 14.27
1.10	*See Topic 3: two positive numbers from AM and GM — $a + b = 2 \cdot AM$, $ab = GM^2$, $(a - b)^2 = (a + b)^2 - 4ab$ (AM 5, GM 4 → 8 & 2; AM 10, GM 6 → difference 16). AM = GM means all observations are equal, so HM equals them too (AM = GM = 15 → HM = 15).*	PYQ Dec 21 Q69, PYQ Dec 22 Q72, PYQ Dec 23 Q72, PYQ Jun 24 Q79	PYQ 2021-Dec, 2022-Dec, 2023-Dec, 2024-Jun	Example 14.1.20, pp. 14.20 – 14.21; relation (14.1.19), p. 14.18; Set B Q20, p. 14.27
1.11	*See Topic 2: GM of a product is the product of the GMs — if c = ab then GM(c) = GM(a) × GM(b); GM of a ratio = ratio of the GMs.*	PYQ Dec 21 Q71	PYQ 2021-Dec	14.1.6 GM properties (14.1.14 – 14.1.15), p. 14.16
1.12	*See Topic 4: deciles of raw data — $D_k = (n + 1) \cdot k/10$ th value, interpolating between neighbours: D_3 of 8 values = 2.7th = 10 + 0.7 × (11 − 10) = 10.70.*	PYQ Jun 22 Q75	PYQ 2022-Jun	14.1.4 Partition values, Example 14.1.8, pp. 14.11 – 14.12; Set B Q9, p. 14.26
1.13	*See Topic 5: empirical relation for a moderately skewed distribution — Mean − Mode = 3(Mean − Median), i.e. Mode = 3 Median − 2 Mean (55.60, 52.40 → 46).*	PYQ Jun 23 Q68, PYQ Sep 24 Q4	PYQ 2023-Jun, 2024-Sep	14.1.5 (14.1.9A), Example 14.11, p. 14.15; Set A Q12, p. 14.25
1.14	*See Topic 7: mean deviation under y = a + bx — $MD(y) = \lvert b \rvert \times MD(x)$ (origin irrelevant, sign of b ignored); coefficient of MD = MD ÷ (mean or median) × 100 (3x + 4y − 7 = 0: $\bar{y} = 0.85$, MD(y) = 0.3 → 35.3).*	PYQ Jun 23 Q65, PYQ Jan 26 Q89	PYQ 2023-Jun, 2026-Jan	14.2.3 (14.2.3 – 14.2.4), p. 14.34; Example 14.2.8, p. 14.38

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.15	*See Topic 9: quartile deviation — QD(y) = |b| × QD(x) (3x − 4y = 20, QD(x) = 12 → 9); QD is the appropriate measure of dispersion for open-end classification.*	PYQ Dec 23 Q71, MTP Jan 25 S2 Q70	PYQ 2023-Dec; MTP 2025-Jan S2	14.2.5, p. 14.48; Set B Q17 (Unit II), p. 14.58
1.16	*See Topic 8: compare spread by SD = √[Σ(x − x̄)²/n] — sets with values far from their mean have larger SD; a shifted set (103, 100, ...) has small SD regardless of its large values: S_z (1.12) < S_y (2.24) < S_x (4.47).*	PYQ Jun 24 Q76	PYQ 2024-Jun	14.2.4 (14.2.5), p. 14.38
1.17	*See Topic 8: combined SD — $s = \sqrt{\{[n_1(s_1^2 + d_1^2) + n_2(s_2^2 + d_2^2)]/(n_1 + n_2)\}}$, $d_i = \bar{x}_i$ − combined x̄ (30, 20; 55, 60; 5, 6 → x̄ = 57, s = √(1770/50) = 5.95).*	PYQ Jan 26 Q38	PYQ 2026-Jan	14.2.4 (14.2.13), p. 14.43
1.18	Outside Chapter 14 — normal-curve relation: MD ≈ 0.8σ and QD ≈ 0.675σ (≈ ⅔σ), so 4 SD = 5 MD = 6 QD approx.; MD = 1.2 × QD = 1.2 × (40 − 15)/2 = 15.	PYQ Jul 21 Q72	PYQ 2021-Jul	Not in SM Chapter 14 (PYQ-only); SM Chapter 16, normal distribution, p. 16.21
1.19	Outside Chapter 14 — the normal curve's points of inflexion are μ − σ and μ + σ, so mean = midpoint = (40 + 60)/2 = 50 (σ = 10). Key (a) 40 is wrong.	MTP Jan 25 S2 Q94	MTP 2025-Jan S2	Not in SM Chapter 14 (MTP-only); SM Chapter 16, normal distribution, p. 16.22

Topic 2 Geometric Mean

5 Scanner questions · ICAI appearances PYQ 5 · RTP – · MTP –

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.1	GM = $(x_1 \times x_2 \times \ldots \times x_n)^{(1/n)}$, defined only for positive observations; factorise before taking the root: (3 × 6 × 24 × 48)^(1/4) = 20736^(1/4) = 12.	PYQ Nov 18 Q61	PYQ 2018-Nov	14.1.6 (14.1.11), p. 14.15
2.2	Two numbers from AM and GM: a + b = 2 × 6.5 = 13, ab = 6^2 = 36 → 9 and 4 (check both conditions; 6 & 7 satisfy only the AM).	PYQ May 25 Q71	PYQ 2025-May	Example 14.1.20, pp. 14.20 – 14.21; Set B Q6, p. 14.26
2.3	*See Topic 5: Mode = 3 Median − 2 Mean; with Median = 2 Mean, Mode = 3 Median − Median = 2 × Median.*	PYQ Dec 21 Q72	PYQ 2021-Dec	14.1.5 (14.1.9A), p. 14.15
2.4	*See Topic 9: coefficient of QD = $(Q_3 - Q_1)/(Q_3 + Q_1)$ × 100 = 31.5/117 × 100 = 26.92 (the keyed 0.2692 is the same ratio without × 100).*	PYQ Jun 23 Q70	PYQ 2023-Jun	14.2.5 (14.2.15), p. 14.47
2.5	*See Topic 1: mean of x + 1, x + 3, ..., x + 9 = x + 5 (AM of the constants 1, 3, 5, 7, 9 is 5): x + 5 = 125 → x = 120.*	PYQ Jan 26 Q37	PYQ 2026-Jan	14.1.3 (14.1.1), p. 14.2

Topic 3 Harmonic Mean

19 Scanner questions · ICAI appearances PYQ 18 · RTP – · MTP 1

Ref	One-liner for the student	Scanner Q	Asked in	SM source
3.1	HM = n/Σ(1/x) — the reciprocal of the AM of the reciprocals (non-zero observations); grouped: N/Σ(f/x). For a list of reciprocals (1, ⅓, ⅙, 1/9) HM = n ÷ (sum of the whole numbers) = 4/19 = 0.21. HM(A, B) = ⅓ means 1/A + 1/B = 6, so HM(A, B, C, D) = 4/(6 + 10) = ¼. HM(2, 4, 6) = 36/11 = 3.27.	PYQ Nov 20 Q64, PYQ Jan 25 Q100, PYQ Sep 25 Q75	PYQ 2020-Nov, 2025-Jan, 2025-Sep	14.1.6 (14.1.16 – 14.1.17), pp. 14.16 – 14.17; Example 14.15, p. 14.17
3.2	Average speed over equal distances = HM of the speeds = 2xy/(x + y): 500 & 700 → 583.33 km/hr. HM (with GM) is the average for rates and ratios.	PYQ Nov 20 Q66, PYQ May 25 Q70	PYQ 2020-Nov, 2025-May	14.1.6, general review, p. 14.20; Set B Q14, p. 14.27
3.3	Combined HM of two groups = $(n_1 + n_2)/(n_1/H_1 + n_2/H_2) = (n_1 + n_2)H_1H_2/(n_1H_2 + n_2H_1)$ (10, 12; 3, 5 → 3.84; 10, 15; 50, 30 → 35.71). Trap: not the AM of H_1 and H_2.	PYQ Jan 21 Q63, PYQ Sep 25 Q72, PYQ May 26 Q92	PYQ 2021-Jan, 2025-Sep, 2026-May	14.1.6 HM property (ii) (14.1.18), p. 14.17; Set B Q12, p. 14.27
3.4	Weighted HM = Σw/Σ(w/x); for 1, 2, …, n with weights $1^2, 2^2, \ldots, n^2$: $\Sigma n^2/\Sigma n = (2n + 1)/3$ (weighted AM = 3n(n + 1)/[2(2n + 1)]).	PYQ Nov 20 Q61	PYQ 2020-Nov	14.1.6 (14.1.22), Example 14.1.18, pp. 14.18 – 14.19
3.5	For two positive numbers GM^2 = AM × HM (AH = G^2): HM = GM^2/AM = 256/64 = 4; AM 45, HM 15 → GM = √675 = 15√3; AM 25, HM 16 → GM = √400 = 20. Holds only for two observations.	MTP Jun 24 S3 Q99, PYQ May 26 Q91, PYQ Sep 26 Q20	PYQ 2026-May, 2026-Sep; MTP 2024-Jun S3	Example 14.1.19, p. 14.20
3.6	For positive observations AM ≥ GM ≥ HM, equality only when all observations are equal (strictly AM > GM > HM for distinct values).	PYQ Sep 26 Q46	PYQ 2026-Sep	14.1.6 (14.1.19), pp. 14.17 – 14.18; Set A Q14, p. 14.25
3.7	*See Topic 1: combined AM reversed — 76 = (30 × 80 + 70n)/(30 + n) → n = 20; total ages 135 − 65 − 40 = 30 for the last 2 → 15 years.*	PYQ Dec 21 Q70, PYQ Dec 22 Q76	PYQ 2021-Dec, 2022-Dec	14.1.3 (14.1.5 – 14.1.6), p. 14.7
3.8	*See Topic 7: mean deviation is the measure based on absolute deviations $\|x - A\|$.*	PYQ Nov 20 Q68	PYQ 2020-Nov	14.2.3 (14.2.2), p. 14.33
3.9	*See Topic 9: QD = $(Q_3 - Q_1)/2$ (QD 12, Q_1 25 → Q_3 = 49); coefficient of QD = $(Q_3 - Q_1)/(Q_3 + Q_1) \times 100$ = QD/Median × 100 for symmetric data (1.5/5 × 100 = 30).*	PYQ Jun 23 Q78, PYQ Dec 23 Q67	PYQ 2023-Jun, 2023-Dec	14.2.5 (14.2.14 – 14.2.15), p. 14.47; Additional Question Bank Q257, p. 14.79
3.10	*See Topic 6: range under y = a + bx — R(y) = $\|b\|$ × R(x); 5x − 3y = 15 → b = 5/3, R(y) = 5/3 × 24 = 40.*	PYQ Jan 26 Q35	PYQ 2026-Jan	14.2.2 (14.2.1), p. 14.32; Example 14.2.3, p. 14.33

Topic 4 Median, Quartile, Decile, Percentile

36 Scanner questions · ICAI appearances PYQ 26 · RTP – · MTP 10

Ref	One-liner for the student	Scanner Q	Asked in	SM source
4.1	Median of raw data: arrange in order; odd n → ((n + 1)/2)th value; even n → simple average of the two middle values (rank (n + 1)/2, e.g. 5.5 for n = 10). Failed students' unknown marks still count as the lowest values (n = 11 → 6th value = 12).	PYQ May 18 Q52, PYQ Nov 18 Q59, MTP Dec 24 S1 Q66, MTP Jan 25 S2 Q66	PYQ 2018-May, 2018-Nov; MTP 2024-Dec S1, 2025-Jan S2	14.1.4, pp. 14.7 – 14.8; Set A Q7, pp. 14.24 – 14.25
4.2	Median of a discrete frequency distribution: build cumulative frequencies and take the x whose cf first reaches (N + 1)/2 (N = 59 → 30th value = 4).	PYQ Jun 19 Q65	PYQ 2019-Jun	14.1.4, p. 14.8
4.3	Grouped median: $Me = l_1 + [(N/2 - N_l)/(N_u - N_l)] \times C$, l_1 = LCB of the class where N/2 falls, N_l = cf before it, $N_u - N_l$ = its frequency (20 + (30 − 20)/28 × 10 = 23.57; 20 + (50 − 38)/40 × 10 = 23).	PYQ Nov 19 Q68, PYQ Sep 24 Q97	PYQ 2019-Nov, 2024-Sep	14.1.4 (14.1.7), p. 14.8; Example 14.1.6, p. 14.9
4.4	Partition values (raw data): Q_p = (n + 1)p th value, p = ¼, ½, ¾ for quartiles, k/10 for deciles, k/100 for percentiles, interpolating between neighbours; $P_{50} = D_5 = Q_2$ = Median. Q_3 of 9 values = 7.5th value = 35 + 0.5 × (40 − 35) = 37.5.	PYQ Nov 20 Q63, MTP Apr 26 S1 Q73	PYQ 2020-Nov; MTP 2026-Apr S1	14.1.4 Partition values, Example 14.1.8, pp. 14.11 – 14.12
4.5	Median is a positional average: based only on the central 50% of values, unaffected by extreme values, best for open-end classification, determined graphically (ogive; mode from the histogram), but not amenable to mathematical treatment.	PYQ Jun 19 Q61, PYQ Nov 20 Q62, PYQ Nov 20 Q65, PYQ Jan 21 Q61, MTP Jun 24 S3 Q87, PYQ May 25 Q77	PYQ 2019-Jun, 2020-Nov (×2), 2021-Jan, 2025-May; MTP 2024-Jun S3	14.1.4, pp. 14.7, 14.12; general review, p. 14.19; Set A Q5, Q6, Q17, Q20, pp. 14.24 – 14.26
4.6	Median under y = a + bx: Me(y) = a + b·Me(x) (y = 2x − 3, Me(x) = 20 → 37).	MTP Jan 25 S2 Q68	MTP 2025-Jan S2	14.1.4 median property (i), pp. 14.10 – 14.11; Set B Q16, p. 14.27
4.7	Sum of absolute deviations $\Sigma\|x - A\|$ is minimum when A = median, so mean deviation is least about the median.	PYQ Jan 25 Q95	PYQ 2025-Jan	14.1.4 median property (ii), p. 14.11
4.8	*See Topic 5: empirical relation solved for the median — Median = (Mode + 2 Mean)/3 (70.50 & 70.20 → 70.30; 2.13 & 3.57 → 3.09; 18 & 24 → 22); Mode = 3 Median − 2 Mean (26.8, 27.9 → 30.1); Mean − Median = (Mean − Mode)/3 = 63/3 = 21.*	PYQ Dec 21 Q77, PYQ Dec 23 Q75, MTP Jun 24 S3 Q100, MTP Aug 24 S2 Q68, MTP Dec 24 S1 Q70, MTP Dec 24 S1 Q78	PYQ 2021-Dec, 2023-Dec; MTP 2024-Jun S3, 2024-Aug S2, 2024-Dec S1 (×2)	14.1.5 (14.1.9A), p. 14.15; Set A Q12, p. 14.25
4.9	*See Topic 5: grouped mode = $l_1 + [(f_0 - f_{-1})/(2f_0 - f_{-1} - f_1)] \times C$ (30 + 33/35 × 5 = 34.71).*	PYQ Jun 23 Q73	PYQ 2023-Jun	14.1.5 (14.1.9), p. 14.14

Ref	One-liner for the student	Scanner Q	Asked in	SM source
4.10	*See Topic 5: mode under y = a + bx — Mo(y) = a + b·Mo(x) (2x − 3y − 3 = 0 → y = −1 + ⅔x → 9).*	PYQ Jan 26 Q36	PYQ 2026-Jan	14.1.5 (14.1.10), p. 14.15
4.11	*See Topic 3: for two numbers GM = √(AM × HM) (5 × 3.2 → 4; 6 × 9 → 7.35) and HM = GM²/AM (576/30 = 19.2).*	PYQ Nov 19 Q71, PYQ Nov 20 Q67, PYQ Jun 23 Q77	PYQ 2019-Nov, 2020-Nov, 2023-Jun	Example 14.1.19, p. 14.20; Set B Q7, p. 14.26
4.12	*See Topic 1: Sum = Mean × n — new observation = 21 × 17.7 − 20 × 18.3 = 5.7; to keep a 10-year average of ₹40 crores over 11 years, year 11 must equal ₹40 crores.*	PYQ Jun 24 Q75, MTP Dec 24 S1 Q72	PYQ 2024-Jun; MTP 2024-Dec S1	14.1.3 (14.1.1), p. 14.2
4.13	*See Topic 6: Range = L − S (L = 20 + 5 = 25); coefficient of range = (L − S)/(L + S) × 100 = 18/150 × 100 = 12 (0.12 before × 100).*	PYQ Dec 21 Q74, PYQ Dec 23 Q76	PYQ 2021-Dec, 2023-Dec	14.2.2, p. 14.32
4.14	*See Topic 8: SD = √[Σ(x − $\bar{x}$)²/n] = √(Σx²/n − $\bar{X}^2$) (Σx² = 3390, n = 30, s = 7 → $\bar{X}^2$ = 113 − 49 → $\bar{x}$ = 8); CV = s/$\bar{x}$ × 100 (√8/6 × 100 = 47.13); SD of the first n natural numbers = √[(n² − 1)/12] (n = 20 → 5.77).*	PYQ Jun 22 Q76, PYQ Dec 22 Q70, PYQ Jun 24 Q70	PYQ 2022-Jun, 2022-Dec, 2024-Jun	14.2.4 (14.2.5 – 14.2.9), pp. 14.38 – 14.39; Example 14.2.11, p. 14.40
4.15	*See Topic 8: SD (and QD, MD, range) is unaffected by a change of origin — shifting every value by 5 leaves the SD unchanged.*	PYQ Nov 19 Q59	PYQ 2019-Nov	14.2.4 SD property II (14.2.11), p. 14.42

Topic 5 Mode

29 Scanner questions · ICAI appearances PYQ 28 · RTP – · MTP 1

Ref	One-liner for the student	Scanner Q	Asked in	SM source
5.1	Mode = the value occurring the maximum number of times; may be multi-modal or undefined. To force a given mode, make that value strictly most frequent (13 and 8 tie at 3 → 2x + 3 = 13 → x = 5).	PYQ Jan 25 Q96, PYQ May 25 Q79	PYQ 2025-Jan, 2025-May	14.1.5, p. 14.14
5.2	Mode is the average for the most popular/preferred size (shoes, garments) — the modal size.	PYQ Jan 21 Q60	PYQ 2021-Jan	14.1.5, p. 14.14; Additional Question Bank Q175, p. 14.73
5.3	Grouped mode = $l_1 + [(f_0 - f_{-1})/(2f_0 - f_{-1} - f_1)] \times C$, modal class = highest frequency (30–40: 30 + 5/15 × 10 = 33.33).	PYQ Sep 26 Q97	PYQ 2026-Sep	14.1.5 (14.1.9), pp. 14.14 – 14.15; Example 14.1.10
5.4	Empirical relation (moderately skewed): Mean − Mode = 3(Mean − Median), i.e. Mode = 3 Median − 2 Mean and Median = (Mode + 2 Mean)/3 (35.4 & 32.1 → 34.3; 12 & 8 → 0; 70.8 & 68.6 → 64.2; 32 & 26 → 30; 55.10 & 52.40 → 47; 21 & 25 → 33; 24 & 18 → 22). Trap: the factor 3 sits on (Mean − Median), not on (Mean − Mode).	PYQ May 18 Q49, PYQ Nov 18 Q68, PYQ Jun 19 Q59, PYQ Sep 24 Q3, PYQ May 25 Q78, PYQ Sep 25 Q71, PYQ Jan 26 Q87, PYQ Sep 26 Q22	PYQ 2018-May, 2018-Nov, 2019-Jun, 2024-Sep, 2025-May, 2025-Sep, 2026-Jan, 2026-Sep	14.1.5 (14.1.9A), p. 14.15; Example 14.11

Ref	One-liner for the student	Scanner Q	Asked in	SM source
5.5	Symmetric distribution: Mean = Median = Mode (they coincide); the 3 Median − 2 Mean relation is for moderately skewed data.	PYQ Jun 19 Q64	PYQ 2019-Jun	Additional Question Bank Q63, p. 14.65
5.6	Mode under y = a + bx: Mo(y) = a + b·Mo(x) (3 + 4.5 × 20 = 93; 3 + 1.9 × 15 = 31.5; x − y − 10 = 0 → 23 − 10 = 13).	PYQ Jan 21 Q62, PYQ Jul 21 Q66, MTP Aug 24 S2 Q74	PYQ 2021-Jan, 2021-Jul; MTP 2024-Aug S2	14.1.5 (14.1.10), Example 14.1.12, p. 14.15; Set B Q18, p. 14.27
5.7	*See Topic 4: median of an even number of values = average of the two middle values (56 & 66 → 61); total walking distance Σ|x − A| is least at the (weighted) median, so the bus stop goes at the median building.*	PYQ Dec 21 Q73, PYQ Dec 21 Q76	PYQ 2021-Dec (×2)	14.1.4, pp. 14.8, 14.11
5.8	*See Topic 2: GM is defined only for positive observations; with a 0 in the data the product is 0, so the formula gives GM = 0.*	PYQ Jun 23 Q17	PYQ 2023-Jun	14.1.6 (14.1.11), p. 14.15; Additional Question Bank Q48, p. 14.64
5.9	*See Topic 1: mean of x + 1, …, x + 9 = x + 5 = 15 → x = 10.*	PYQ Dec 23 Q69	PYQ 2023-Dec	14.1.3 (14.1.1), p. 14.2
5.10	Measures of central tendency are Mean (AM, GM, HM), Median and Mode; quartile deviation is a measure of dispersion.	PYQ Jun 22 Q68	PYQ 2022-Jun	14.1.1, p. 14.2
5.11	*See Topic 8: CV = SD/Mean × 100, SD = √variance (√80/200 × 100 = 4.47; 12/Mean × 100 = 30 → 40); with y = a + bx, s(y) = |b| s(x): CV 20, mean 5 → s = 1, so s(12 − 3y) = 3, variance 9.*	PYQ Nov 19 Q62, PYQ Dec 22 Q63, PYQ Jun 24 Q73	PYQ 2019-Nov, 2022-Dec, 2024-Jun	14.2.4 (14.2.9), p. 14.39; (14.2.11), p. 14.42; Example 14.2.13, p. 14.43
5.12	*See Topic 8: SD unchanged by a change of origin (add 10 → still 2.45) but multiplied by |b| under a change of scale (all values doubled → 2 × 4.47 = 8.94).*	PYQ Nov 19 Q70, PYQ Jun 23 Q18	PYQ 2019-Nov, 2023-Jun	14.2.4 SD property II (14.2.11), p. 14.42
5.13	*See Topic 6: coefficient of range = (L − S)/(L + S) × 100 with signs kept: (94 − (−6))/(94 + (−6)) × 100 = 100/88 × 100 = 113.6.*	PYQ Jun 24 Q68	PYQ 2024-Jun	14.2.2, p. 14.32
5.14	*See Topic 9: raw data Q_1 = (n + 1)/4 th, Q_3 = 3(n + 1)/4 th value (n = 7 → 2nd = 22, 6th = 88); coefficient of QD = (88 − 22)/(88 + 22) × 100 = 60 (0.6 is the unscaled ratio).*	PYQ Jan 26 Q88	PYQ 2026-Jan	14.1.4 Partition values, p. 14.11; 14.2.5 (14.2.15), p. 14.47
5.15	Class width/size = upper class boundary − lower class boundary (for exclusive classes, UCL − LCL); class mark = (LCL + UCL)/2; range = L − S.	PYQ Nov 19 Q66	PYQ 2019-Nov	Not in SM Chapter 14 (PYQ-only); SM Chapter 13, p. 13.18

Topic 6 Range

17 Scanner questions · ICAI appearances PYQ 15 · RTP – · MTP 2

Ref	One-liner for the student	Scanner Q	Asked in	SM source
6.1	Range = L − S (largest minus smallest observation); coefficient of range = (L − S)/(L + S) × 100. Arrange the data first; with negative values keep the sign (L = 2,000, S = −400 → 2,400/1,600 × 100 = 150). Coefficient is a pure number (%), range carries the unit.	PYQ Nov 18 Q64, PYQ Jun 22 Q73, PYQ Sep 24 Q5, PYQ Sep 24 Q94, PYQ May 25 Q74, PYQ Sep 25 Q74	PYQ 2018-Nov, 2022-Jun, 2024-Sep (×2), 2025-May, 2025-Sep	14.2.2, p. 14.32; Example 14.2.1, p. 14.32
6.2	Change of origin and scale: if y = a + bx, then R_y = | b| × R_x — range ignores the added constant and the sign of b. Rewrite the linear relation as y = … (e.g. 2x + 3y = 10 → y = 10/3 − (2/3)x, so R_y = (2/3)R_x); range of −3x + 50 = 3 × R_x; 3x + 2y + 10 = 0 gives 3R_x = 2R_y.	PYQ Jan 21 Q65, PYQ Jul 21 Q70, MTP Jun 24 S3 Q74, MTP Jan 25 S2 Q71, PYQ Sep 26 Q67	PYQ 2021-Jan, 2021-Jul, 2026-Sep; MTP 2024-Jun S3, 2025-Jan S2	14.2.2, Result (14.2.1), p. 14.32; Example 14.2.3, p. 14.33; Set B Q2, Q4, p. 14.57
6.3	*See Topic 1: the algebraic sum of deviations from the AM is zero, $\Sigma(x_i - \bar{X}) = 0$; so when deviations on either side of the middle value pair off equally (symmetric data), the middle value is the AM.*	PYQ Nov 19 Q69, PYQ Dec 21 Q75	PYQ 2019-Nov, 2021-Dec	14.1.3, Properties of AM (ii) (14.1.4), p. 14.7
6.4	*See Topic 1: correcting a mean — corrected $\Sigma x = n\bar{X}$ − wrong values + correct values, then divide by n (38 × 20 = 760; 760 − 120 + 111 = 751; 751/20 = 37.55).*	PYQ Jun 22 Q74	PYQ 2022-Jun	14.1.3 (14.1.1), p. 14.2; Example 14.2.17, pp. 14.46 – 14.47
6.5	*See Topic 4: if y = a + bx, median of y = a + b × median of x (2x − y = 3, median x = 10 → median y = 17); median is a positional average, so removing the lowest and highest observations leaves it unchanged.*	PYQ Dec 23 Q74, PYQ Jun 24 Q69	PYQ 2023-Dec, 2024-Jun	14.1.4, p. 14.7 (positional average); Properties of median (i), pp. 14.10 – 14.11
6.6	*See Topic 3: for two positive numbers $GM^2 = AM \times HM$, so $GM = \sqrt{(64 \times 16)} = 32$.*	PYQ Jan 26 Q85	PYQ 2026-Jan	Example 14.1.19, p. 14.20

Topic 7 Mean Deviation

17 Scanner questions · ICAI appearances PYQ 16 · RTP – · MTP 1

Ref	One-liner for the student	Scanner Q	Asked in	SM source
7.1	Mean deviation about A: MD = (1/n) $\Sigma\|x_i - A\|$ (grouped: $\Sigma f_i\|x_i - A\|/N$) — the AM of absolute deviations, signs ignored; 'average deviation' means MD. Find the mean first, then total $\|x - \bar{X}\|$ and divide by n.	PYQ Jul 21 Q64, PYQ Jul 21 Q71, PYQ May 26 Q89	PYQ 2021-Jul (×2), 2026-May	14.2.3 (14.2.2), p. 14.33; Example 14.2.4, p. 14.34
7.2	Coefficient of mean deviation = MD about A ÷ A × 100, where A is the average used (mean or median): 5, 7, 8, 10, 11, 13, 19 → $\bar{X}$ = 10.43, MD = 3.35, coefficient ≈ 32.1.	PYQ Jan 21 Q68	PYQ 2021-Jan	14.2.3 (14.2.3), p. 14.34; Examples 14.2.5 – 14.2.6, pp. 14.34 – 14.36

Ref	One-liner for the student	Scanner Q	Asked in	SM source
7.3	MD is unchanged by a change of origin but changes in the same ratio with scale: if y = a + bx, MD_y = |b| × MD_x (4x + 2y + 12 = 0 → |b| = 2 → 2 × 4.5 = 9; Y = 3X + 5 → 3 × 4 = 12). Adding 7 to every value leaves SD, MD and QD unaffected.	PYQ Jul 21 Q69, PYQ Jan 25 Q91, PYQ Sep 26 Q19	PYQ 2021-Jul, 2025-Jan, 2026-Sep	14.2.3 (14.2.4), p. 14.34; Example 14.2.8, p. 14.38; Set A Q20, p. 14.57
7.4	Normal (symmetric) distribution: median = mode = $(Q_1 + Q_3)/2 = 50$; QD = $(Q_3 - Q_1)/2 = 2.70$; QD ≈ 0.675 SD (probable error) → SD = 4; MD ≈ 4/5 SD = 3.20.	MTP Jan 25 S2 Q90	MTP 2025-Jan S2	Not in SM text (MTP-only); Additional Q240, Q243, p. 14.78; Q284, p. 14.81
7.5	Mean deviation is a measure of dispersion, not of central tendency (central tendency = AM, median, mode, GM, HM).	PYQ Nov 18 Q63	PYQ 2018-Nov	14.2.1, p. 14.31
7.6	*See Topic 1: $\Sigma(x - \bar{X}) = 0$ always — for 15, 20, 25 the sum of deviations from the AM is 0.*	PYQ Dec 21 Q68	PYQ 2021-Dec	14.1.3, Properties of AM (ii) (14.1.4), p. 14.7
7.7	*See Topic 1: when the observations do not have equal importance, use a weighted average: $\Sigma wx/\Sigma w$.*	PYQ Jun 22 Q72	PYQ 2022-Jun	Weighted average (14.1.20), p. 14.18
7.8	*See Topic 1: correct mean = wrong mean + (correct value − wrong value)/n = 50 + (50 − 100)/100 = 49.5.*	PYQ Jun 23 Q66	PYQ 2023-Jun	Example 14.2.17, pp. 14.46 – 14.47
7.9	*See Topic 4: median = middle value of ordered data (even n → average of the n/2-th and (n/2 + 1)-th values); adding a constant to every value adds it to the median (32 + 7 = 39).*	PYQ Jun 23 Q72, PYQ Jan 26 Q86	PYQ 2023-Jun, 2026-Jan	14.1.4, pp. 14.7 – 14.8; Properties of median (i), p. 14.10
7.10	*See Topic 5: Mode = 3 Median − 2 Mean (moderately skewed) → 3 × 22.33 − 2 × 22 = 22.99.*	PYQ Jun 24 Q72	PYQ 2024-Jun	14.1.5 (14.1.9A), p. 14.15
7.11	*See Topic 8: SD = CV × $\bar{X}$/100 (40 × 10/100 = 4); y = 30 − 2x → SD_y = |−2| × 4 = 8; variance = SD^2 = 64.*	PYQ Jun 22 Q70	PYQ 2022-Jun	14.2.4 (14.2.9), p. 14.39; Example 14.2.13, p. 14.43
7.12	*See Topic 9: coefficient of QD = $(Q_3 - Q_1)/(Q_3 + Q_1)$ × 100 = 21/134 × 100 = 15.67.*	PYQ Dec 22 Q68	PYQ 2022-Dec	14.2.5 (14.2.15), p. 14.47

Topic 8 Standard Deviation

64 Scanner questions · ICAI appearances PYQ 45 · RTP 2 · MTP 17

Ref	One-liner for the student	Scanner Q	Asked in	SM source
8.1	SD $s = \sqrt{[\Sigma(x_i - \bar{x})^2/n]} = \sqrt{[\Sigma x_i^2/n - \bar{x}^2]}$; variance = s^2 (so SD = √variance; SD 36 → variance 1,296). Use the deviation form when $\bar{x}$ is a whole number, the Σx^2 form when Σx and Σx^2 are given (n = 10, Σx = 20, Σx^2 = 80 → √(8 − 4) = 2).	PYQ Nov 18 Q67, PYQ Nov 18 Q69, MTP Jun 24 S3 Q72, PYQ Sep 24 Q7, PYQ Sep 25 Q78, PYQ Sep 25 Q76	PYQ 2018-Nov (×2), 2024-Sep, 2025-Sep (×2); MTP 2024-Jun S3	14.2.4 (14.2.5), (14.2.7), (14.2.8), pp. 14.38 – 14.39; Example 14.2.9, p. 14.39
8.2	Grouped data: $s = \sqrt{[\Sigma fd^2/N - (\Sigma fd/N)^2]} \times C$ with $d = (x - A)/C$ on class mid-values (or $\sqrt{(\Sigma fx^2/N - \bar{X}^2)}$): 0–10 … 30–40 with f 1, 3, 4, 2 → $\bar{x}$ = 22, variance 81, SD = 9.	MTP Apr 26 S1 Q69	MTP 2026-Apr S1	14.2.4 (14.2.7), (14.2.10), p. 14.41; Example 14.2.12, pp. 14.41 – 14.42
8.3	SD of the first n natural numbers = $\sqrt{[(n^2 - 1)/12]}$: n = 5 → √2; n = 9 → √(80/12) = 2.58; SD = √30 → n^2 = 361, n = 19; SD = 2 → n^2 = 49, n = 7.	PYQ May 18 Q54, PYQ Jun 19 Q62, PYQ Jul 21 Q67, RTP Jan 25 Q28	PYQ 2018-May, 2019-Jun, 2021-Jul; RTP 2025-Jan	Example 14.2.11, pp. 14.40 – 14.41; Set B Q18, p. 14.58
8.4	SD = 0 (and variance = 0) only when all observations are equal, i.e. constant; the same holds for range and MD — e.g. profits unchanged for ten months.	PYQ Jun 19 Q63, PYQ Dec 22 Q74, PYQ May 26 Q35	PYQ 2019-Jun, 2022-Dec, 2026-May	14.2.4, Properties of SD I, p. 14.42; Set A Q14, p. 14.56
8.5	Change of origin: adding or subtracting a constant shifts the mean by that constant but leaves SD and variance unchanged (mean 10, SD 3.2 → +4 → 14, 3.2; mean + SD = a + b → a + b + 2). Series 11–20 and 1–10, or 101–200 and 151–250, have equal SD/variance.	PYQ Jun 19 Q67, PYQ Jan 21 Q66, MTP Jun 24 S3 Q77, MTP Aug 24 S2 Q67, MTP Dec 24 S1 Q67, MTP Dec 24 S1 Q73, RTP Jan 25 Q21, MTP Apr 26 S1 Q68, PYQ Sep 26 Q69	PYQ 2019-Jun, 2021-Jan, 2026-Sep; RTP 2025-Jan; MTP 2024-Jun S3, 2024-Aug S2, 2024-Dec S1 (×2), 2026-Apr S1	14.2.4, Properties of SD II (14.2.11), p. 14.42; 14.1.3 (iii), p. 14.7; Set A Q20, p. 14.57
8.6	Change of scale: if y = a + bx, $s_y = \lvert b \rvert \times s_x$ and $\text{variance}_y = b^2 \times \text{variance}_x$ (y = 2x + 5, var 17 → 68; 5 − 2x, SD 3 → var 36; y = 2 − 3x → SD 3 × SD of x, never −3). Rewrite 2x + 3y + 4 = 0 as y = −4/3 − (2/3)x → s_y = (2/3) × 9 = 6, v(y) = (4/9) × 6 = 8/3. Dividing by 10 → SD/10; doubling every value → 2 × SD; (x − a)/b has SD 1. CV of y = $s_y/\bar{y} \times 100$ with $\bar{y} = a + b\,\bar{x}$.	PYQ Dec 22 Q77, MTP Jun 24 S3 Q95, MTP Aug 24 S2 Q71, MTP Aug 24 S2 Q86, PYQ Sep 24 Q2, PYQ Jan 25 Q2, MTP Jan 25 S2 Q72, MTP Jan 25 S2 Q75, MTP Apr 26 S1 Q67	PYQ 2022-Dec, 2024-Sep, 2025-Jan; MTP 2024-Jun S3, 2024-Aug S2 (×2), 2025-Jan S2 (×2), 2026-Apr S1	14.2.4 (14.2.11), p. 14.42; Examples 14.2.13 – 14.2.14, pp. 14.43 – 14.45; Set B Q12, Q14, Q15, Q19, p. 14.58

Ref	One-liner for the student	Scanner Q	Asked in	SM source
8.7	All measures of dispersion (range, MD, SD, QD) are unaffected by a change of origin but affected by a change of scale — so 'affected by shifting of scale' = all of these.	PYQ Nov 19 Q63	PYQ 2019-Nov	pp. 14.32, 14.34, 14.42, 14.48; Set A Q16, Q20 – Q21, pp. 14.56 – 14.57
8.8	Combined SD: $s = \sqrt{[(n_1s_1^2 + n_2s_2^2 + n_1d_1^2 + n_2d_2^2)/(n_1 + n_2)]}$, $d_1 = \bar{X}_1 - \bar{X}$, $d_2 = \bar{X}_2 - \bar{X}$, $\bar{X}$ = combined mean. Work backwards for a missing group: 100 obs (8, var 9) and 60 obs (10, SD 2) → 40 obs mean 5, variance 1.5 (SD ≈ 1.22). 80 at ₹60,000 (SD 5,000) + 20 at ₹90,000 (SD 8,000) → $\bar{X}$ = 66,000, SD = ₹13,296.60.	PYQ Jun 23 Q75, PYQ Sep 26 Q21	PYQ 2023-Jun, 2026-Sep	14.2.4, Properties of SD III (14.2.12), pp. 14.42 – 14.43; Example 14.2.15, p. 14.45; Set C Q8, p. 14.60
8.9	Missing observations from mean and variance: $\Sigma x = n\bar{x}$ and $\Sigma x^2 = n(s^2 + \bar{x}^2)$; subtract the known values to get $a + b$ and $a^2 + b^2$, then solve (8 obs, mean 6, var 8, known 3, 5, 6, 8, 9, 10 → $a + b = 7$, $a^2 + b^2 = 37$ → 1 and 6).	PYQ Sep 26 Q96	PYQ 2026-Sep	Example 14.2.21, p. 14.50; Example 14.2.17, p. 14.47
8.10	Coefficient of variation CV = SD/AM × 100 (SD over mean, not mean over SD). Any two of CV, SD and mean give the third; variance = SD^2 (CV 80, mean 20 → SD 16, variance 256; $\sigma^2 = 100$, CV 20% → $\bar{X} = 50$; variance 12, mean 40 → $\sqrt{12}/40 = 8.66\%$). If Σfx and N are given, $\bar{X} = \Sigma fx/N$ first.	PYQ Nov 18 Q66, PYQ Jun 19 Q57, PYQ Nov 19 Q60, PYQ Nov 19 Q64, PYQ Jul 21 Q68, PYQ Dec 22 Q73, MTP Jun 24 S3 Q94, MTP Dec 24 S1 Q71, PYQ Jan 25 Q92, PYQ May 25 Q73, PYQ Sep 25 Q76	PYQ 2018-Nov, 2019-Jun, 2019-Nov (×2), 2021-Jul, 2022-Dec, 2025-Jan, 2025-May, 2025-Sep; MTP 2024-Jun S3, 2024-Dec S1	14.2.4 (14.2.9), p. 14.39; Example 14.2.9, pp. 14.39 – 14.40
8.11	CV is a relative, unit-free measure — the one to use for comparing the variability/consistency of two series (lower CV = more consistent).	PYQ Jan 21 Q64	PYQ 2021-Jan	14.2.1, p. 14.31; Example 14.2.16, pp. 14.45 – 14.46; Example 14.2.24, pp. 14.53 – 14.54
8.12	CV after adding/subtracting a constant: SD stays the same but the mean shifts, so set $\sigma/(\bar{X} - 5) = 0.10$ and $\sigma/(\bar{X} + 5) = 0.06$ → $\bar{X} = 20$, $\sigma = 1.5$, original CV = 7.5%.	MTP Dec 24 S1 Q76	MTP 2024-Dec S1	Not in SM (MTP-only); uses (14.2.9), p. 14.39 and (14.2.11), p. 14.42
8.13	Mean deviation is the measure based on absolute deviations; MD (like SD) uses all the observations, whereas QD uses only the central 50%.	PYQ Jun 22 Q71, PYQ Dec 22 Q64	PYQ 2022-Jun, 2022-Dec	14.2.3, p. 14.33; Summary, p. 14.54; Set A Q8 – Q10, pp. 14.55 – 14.56

Ref	One-liner for the student	Scanner Q	Asked in	SM source
8.14	For a moderately skewed (near-normal) distribution QD ≈ 2/3 SD, i.e. SD = (3/2) QD (QD ≈ 0.675 σ, the probable error).	MTP Aug 24 S2 Q61	MTP 2024-Aug S2	Not in SM text (MTP-only); Additional Q241 – Q243, p. 14.78
8.15	The sum of absolute deviations (hence MD) is minimum when deviations are taken from the median; the sum of squared deviations is minimum about the AM — read which sum the question means.	PYQ Nov 19 Q58, PYQ Dec 22 Q22	PYQ 2019-Nov, 2022-Dec	14.2.3, p. 14.34; Properties of median (ii), p. 14.11; Additional Q37, p. 14.63
8.16	*See Topic 1: removing k observations: new mean = (n $\bar{x}$ – sum removed)/(n – k) → (1,800 – 72)/48 = 36.*	PYQ Dec 22 Q71	PYQ 2022-Dec	14.1.3 (14.1.1), p. 14.2
8.17	*See Topic 2: from AM and GM of two numbers, a + b = 2AM and ab = GM², so (a – b)² = (a + b)² – 4ab = 676 – 576 → a – b = 10.*	PYQ Jan 26 Q14	PYQ 2026-Jan	Example 14.1.20, pp. 14.20 – 14.21
8.18	*See Topic 3: for two numbers HM = GM²/AM = 16/5 = 3.2.*	PYQ Dec 22 Q75	PYQ 2022-Dec	Example 14.1.19, p. 14.20
8.19	*See Topic 4: median is a positional average — order the data and take the middle value ((n + 1)/2-th; 15 values → 8th = 6).*	PYQ Jun 23 Q76, PYQ Jun 24 Q74	PYQ 2023-Jun, 2024-Jun	14.1.4, pp. 14.7 – 14.8
8.20	*See Topic 5: grouped mode = $l_1 + (f_0 - f_{-1})/(2f_0 - f_{-1} - f_1) \times C$ on the modal (highest-frequency) class.*	PYQ Nov 19 Q61, PYQ Nov 19 Q67	PYQ 2019-Nov (×2)	14.1.5 (14.1.9), p. 14.14
8.21	*See Topic 5: Mode = 3 Median − 2 Mean → Median = (Mode + 2 Mean)/3 = (7 + 20)/3 = 9.*	PYQ Dec 22 Q62	PYQ 2022-Dec	14.1.5 (14.1.9A), p. 14.15
8.22	*See Topic 5: for qualitative/ordinal attributes (most unlikely … most likely) only the mode — the most frequent category — can be used.*	PYQ Jun 22 Q77	PYQ 2022-Jun	14.1.5, p. 14.14 (attribute use not stated in SM)
8.23	*See Topic 7: coefficient of MD about mean = MD/$\bar{x}$ × 100 = 1.78/3.50 × 100 = 50.86.*	PYQ Jun 24 Q71	PYQ 2024-Jun	14.2.3 (14.2.3), p. 14.34
8.24	*See Topic 9: 25% of values below 30 → Q_1 = 30; one-fourth above 70 → Q_3 = 70; coefficient of QD = 40/100 × 100 = 40.*	PYQ Jun 24 Q77	PYQ 2024-Jun	Partition values, p. 14.11; 14.2.5 (14.2.15), p. 14.47

Topic 9 Quartile Deviation

33 Scanner questions · ICAI appearances PYQ 23 · RTP 2 · MTP 8

Ref	One-liner for the student	Scanner Q	Asked in	SM source
9.1	Quartile deviation (semi-inter-quartile range) QD = (Q_3 – Q_1)/2 — the trap is stopping at the inter-quartile range Q_3 – Q_1; given Q_1, Q_2, Q_3, ignore Q_2 (45, 52, 65 → 10).	RTP Sep 24 Q21, PYQ Jan 25 Q3, MTP Jan 25 S2 Q73, PYQ May 26 Q90	PYQ 2025-Jan, 2026-May; RTP 2024-Sep; MTP 2025-Jan S2	14.2.5 (14.2.14), p. 14.47

Ref	One-liner for the student	Scanner Q	Asked in	SM source
9.2	Coefficient of QD = $(Q_3 - Q_1)/(Q_3 + Q_1) \times 100$; given the coefficient, solve for Q_3/Q_1 ($1/4 \rightarrow 4Q_3 - 4Q_1 = Q_3 + Q_1 \rightarrow Q_3/Q_1 = 5/3$).	PYQ May 18 Q50, PYQ Jun 19 Q66	PYQ 2018-May, 2019-Jun	14.2.5 (14.2.15), p. 14.47; Example 14.2.18, p. 14.48
9.3	Quartiles of raw data: arrange in ascending order; Q_1 = (n + 1)/4-th value, Q_3 = 3(n + 1)/4-th value, interpolating fractional positions (2.75th = 2nd + 0.75 × (3rd − 2nd)); for a discrete series locate the position in the cumulative frequencies. Then QD = $(Q_3 - Q_1)/2$.	PYQ Jun 19 Q60, PYQ Sep 24 Q8, PYQ Sep 25 Q79, MTP Apr 26 S2 Q66, PYQ Sep 26 Q94	PYQ 2019-Jun, 2024-Sep, 2025-Sep, 2026-Sep; MTP 2026-Apr S2	14.1.4, Partition values, p. 14.11; Example 14.1.8, p. 14.12; Example 14.2.18, p. 14.48
9.4	QD is unaffected by a change of origin but changes with scale: if y = a + bx, QD_y = |b| × QD_x (4x + 2y = 3 → x = 3/4 − y/2 → QD_x = 3/2 = 1.5; 3x + 4y = 20 → QD_y = 3/4 × 16 = 12).	RTP Jan 25 Q29, MTP Jan 25 S2 Q74, PYQ Sep 25 Q73	PYQ 2025-Sep; RTP 2025-Jan; MTP 2025-Jan S2	14.2.5, p. 14.48; Example 14.2.19, pp. 14.48 – 14.49; Set B Q17, p. 14.58
9.5	QD is based on the central 50% of observations, so extreme values have no impact on it, and it is the best measure of dispersion for open-end classification (range, MD and SD all need the extreme limits).	MTP Aug 24 S2 Q70, PYQ Sep 24 Q1, PYQ May 25 Q75, PYQ Sep 25 Q73	PYQ 2024-Sep, 2025-May, 2025-Sep; MTP 2024-Aug S2	14.2.5, p. 14.48; Example 14.2.20, p. 14.49; Summary, p. 14.54; Set A Q7, Q11, pp. 14.55 – 14.56
9.6	Absolute measures (range, MD, SD, QD) carry the unit; relative measures (coefficients of range, MD, QD and the CV) are unit-free. The concurrent deviation method measures correlation, not dispersion.	PYQ Jan 21 Q67, PYQ May 25 Q72	PYQ 2021-Jan, 2025-May	14.2.1, p. 14.31 (concurrent deviation is not in this chapter)
9.7	Normal (symmetric) distribution: median = $(Q_1 + Q_3)/2 = Q_1 + QD$ (142 + 18 = 160); QD ≈ 0.675 SD (≈ 2/3 SD) → 0.675 × 4 = 2.70; MD ≈ 4/5 SD → QD 4.05 → SD 6 → MD 4.80.	MTP Jun 24 S3 Q73, MTP Jun 24 S3 Q75, MTP Aug 24 S2 Q69	MTP 2024-Jun S3 (×2), 2024-Aug S2	Not in SM text (MTP-only); Additional Q240, Q243, p. 14.78; Q284, p. 14.81
9.8	*See Topic 4: median — ungrouped: middle value of ordered data (even n → mean of the two middle values); grouped: $M = l_1 + (N/2 - N_l)/f \times C$; if y = a + bx, median y = a + b × median x (4x − 10y = 20, median x = 10 → 2).*	PYQ Nov 19 Q65, PYQ Dec 22 Q65, PYQ Dec 22 Q69, PYQ Dec 23 Q73	PYQ 2019-Nov, 2022-Dec (×2), 2023-Dec	14.1.4 (14.1.7), p. 14.8; Properties of median (i), pp. 14.10 – 14.11
9.9	*See Topic 4: median is the most appropriate measure of central tendency for an open-end classification (the AM cannot be used).*	MTP Jan 25 S2 Q65	MTP 2025-Jan S2	General review of measures of central tendency, p. 14.19
9.10	*See Topic 7: MD about mode (or mean) = $\Sigma\|x - A\|/n$ — find the mode/mean first (3, 10, 10, 4, 7, 18, 5 → mode 10, $\Sigma|d| = 29$, MD = 4.14).*	PYQ Jun 22 Q69, PYQ Jun 23 Q71	PYQ 2022-Jun, 2023-Jun	14.2.3 (14.2.2), p. 14.33

Ref	One-liner for the student	Scanner Q	Asked in	SM source
9.11	*See Topic 3: $GM^2 = AM \times HM$ for two numbers → $\sqrt{(5 \times 3.2)} = 4$.*	PYQ Dec 23 Q66	PYQ 2023-Dec	Example 14.1.19, p. 14.20
9.12	*See Topic 5: Mode = 3 Median − 2 Mean → Mean = (3 Median − Mode)/2 = (18 − 10)/2 = 4.*	PYQ Dec 23 Q68	PYQ 2023-Dec	14.1.5 (14.1.9A), p. 14.15
9.13	*See Topic 1: combined mean $\bar{x} = (n_1\bar{X}_1 + n_2\bar{X}_2)/(n_1 + n_2)$ $(40 \times 50 + 30 \times 60)/70 = 54.29$.*	PYQ Jun 24 Q78, PYQ Jan 26 Q34	PYQ 2024-Jun, 2026-Jan	14.1.3 (14.1.5), p. 14.7

Part B — Chapter 14 One-liner Revision Sheet

Deduplicated and in Study Material order. Click a 'Part A ref' to jump to the Part A row(s) carrying the full wording, the Scanner questions and the SM page. Refs read Unit.Topic.Row in chapters with several units and Topic.Row otherwise. Weight: ★★★ asked by ICAI 6 or more times · ★★ 3 – 5 times · ★ once or twice. The ★★★ lines alone cover about 68% of ICAI appearances in this chapter.

Measures of Central Tendency and Dispersion (Topics 1–5)

#	One-liner	Weight	Part A ref
1	**$\bar{x}$ = Σx/n · Σfx/N (grouped: mid-values, class mark = (LCL + UCL)/2) · missing f: solve $\bar{x}$Σf = Σfx**	★★★	1.1, 1.2
2	**Sum = Mean × n: remaining group, replaced/misread value, added observation, sum-and-difference unknowns**	★★★	1.3, 4.12
3	Mean of x + 1, x + 3, ..., x + 9 = x + 5	★	2.5, 5.9
4	Σ(x − $\bar{x}$) = 0 · AM usually the best measure; hit by extreme values; not for open-end classes	★★	1.6, 1.7
5	**y = a + bx → $\bar{y}$ = a + b$\bar{x}$, Me(y) = a + b·Me(x), Mo(y) = a + b·Mo(x); solve px + qy + r = 0 for y first**	★★★	1.5, 4.6, 4.10, 5.6
6	**Combined AM = Σn$\bar{x}$/Σn; reverse for n or ratio ($n_1 : n_2 = (\bar{x}_2 - \bar{x}) : (\bar{x} - \bar{x}_1)$)**	★★★	1.4, 3.7
7	**Median: odd ((n+1)/2)th; even = average of two middle values; discrete: cf reaches (N+1)/2**	★★★	4.1, 4.2, 5.7
8	Grouped median = $l_1 + (N/2 - N_l)/(N_u - N_l) \times C$	★	4.3
9	Q_p = (n+1)p th value with interpolation; D_k: p = k/10; P_{50} = Median	★★	4.4, 1.12, 5.14
10	**Median: positional, central 50%, ignores extremes, best for open-end, ogive; no mathematical properties; Σ|x − A| least at median**	★★★	4.5, 4.7
11	Mode = most frequent value (modal shoe size); may be multiple or undefined	★★	5.1, 5.2
12	Grouped mode = $l_1 + (f_0 - f_{-1})/(2f_0 - f_{-1} - f_1) \times C$	★	5.3, 4.9
13	**Mean − Mode = 3(Mean − Median) · Mode = 3Me − 2$\bar{x}$ · Me = (Mo + 2$\bar{x}$)/3 · symmetric: all three equal**	★★★	5.4, 5.5, 4.8, 1.13, 2.3
14	GM = (Πx)^(1/n), positive data only; GM(xy) = GM(x)·GM(y)	★★	2.1, 1.11, 5.8
15	HM = n/Σ(1/x) · grouped N/Σ(f/x) · weighted Σw/Σ(w/x) (weights n^2 → (2n+1)/3)	★★	3.1, 3.4
16	Average speed, equal distances = 2xy/(x+y); unequal distances = total distance ÷ total time	★★	3.2, 1.9
17	Combined HM = $(n_1 + n_2)/(n_1/H_1 + n_2/H_2)$	★★	3.3
18	**Two numbers: a + b = 2A, ab = G^2, $(a - b)^2 = (a + b)^2 - 4ab$ · G^2 = AH**	★★★	1.10, 2.2, 3.5, 4.11
19	AM ≥ GM ≥ HM (equal only when all values are equal)	★	3.6
20	**Dispersion cross-refs: R(y), MD(y), QD(y), s(y) = |b| × that of x; all unchanged by origin shift**	★★★	3.10, 1.14, 1.15, 4.15, 5.12

#	One-liner	Weight	Part A ref
21	**Coefficient of range = (L − S)/(L + S) × 100 · QD = $(Q_3 - Q_1)/2$ · coeff QD = $(Q_3 - Q_1)/(Q_3 + Q_1) \times 100$**	★★★	4.13, 5.13, 3.9, 2.4
22	**$s = \sqrt{(\Sigma x^2/n - \bar{X}^2)}$ · CV = $s/\bar{X} \times 100$ · SD of 1...n = $\sqrt{((n^2 - 1)/12)}$ · combined SD**	★★★	4.14, 5.11, 1.16, 1.17
23	Normal curve (Ch 16): inflexion at μ ± σ; MD ≈ 0.8σ, QD ≈ 0.675σ	★	1.18, 1.19
24	Absolute (range, MD, SD, QD) vs relative (coefficients, CV) — relative measures are unit-free; MD is not a central-tendency measure	★★	7.5, 9.6
25	**Range = L − S · coeff. = (L − S)/(L + S) × 100 · keep the sign of negative values**	★★★	6.1
26	$R_y = \lvert b \rvert R_x$ for y = a + bx — solve the relation for y first	★★	6.2
27	**MD = $\Sigma\lvert x - A \rvert/n$ · 'average deviation' = MD · coeff. = MD/A × 100**	★★★	7.1, 7.2, 8.23, 9.10
28	MD minimum about the median; squared deviations minimum about the AM	★	8.15
29	$MD_y = \lvert b \rvert MD_x$ · origin shift leaves MD, SD, QD, range unchanged	★★	7.3, 8.7
30	**SD = $\sqrt{[\Sigma(x - \bar{x})^2/n]} = \sqrt{(\Sigma x^2/n - \bar{X}^2)}$ · variance = SD^2**	★★★	8.1
31	Grouped SD = $\sqrt{[\Sigma fd^2/N - (\Sigma fd/N)^2]} \times C$	★	8.2
32	SD of first n naturals = $\sqrt{[(n^2 - 1)/12]}$ (n = 5 → √2, n = 7 → 2, n = 19 → √30)	★★	8.3
33	All values equal → SD = variance = 0	★★	8.4
34	**Add a constant: mean shifts, SD/variance unchanged**	★★★	8.5
35	**$s_y = \lvert b \rvert s_x$ · $var_y = b^2 var_x$ · (x − a)/b has SD 1**	★★★	8.6, 7.11
36	Combined SD = $\sqrt{[(n_1s_1^2 + n_2s_2^2 + n_1d_1^2 + n_2d_2^2)/(n_1 + n_2)]}$, d = group mean − combined mean	★	8.8
37	Missing values: $\Sigma x = n\bar{X}$, $\Sigma x^2 = n(s^2 + \bar{X}^2)$	★	8.9
38	**CV = SD/AM × 100 — any two give the third; compare series by CV**	★★★	8.10, 8.11
39	CV after ± constant: same σ, shifted mean — set up two equations	★	8.12
40	MD → absolute deviations; QD → central 50%	★	8.13
41	**QD = $(Q_3 - Q_1)/2$ (not $Q_3 - Q_1$) · coeff. QD = $(Q_3 - Q_1)/(Q_3 + Q_1) \times 100$**	★★★	9.1, 9.2, 7.12, 8.24
42	Raw-data quartiles: Q_1 = (n + 1)/4-th, Q_3 = 3(n + 1)/4-th value, interpolate	★★	9.3
43	$QD_y = \lvert b \rvert QD_x$; QD unaffected by origin	★★	9.4
44	QD: no impact of extremes; best for open-end classes	★★	9.5
45	Normal curve: median = $(Q_1 + Q_3)/2$ · QD ≈ 2/3 SD (0.675σ) · MD ≈ 4/5 SD	★★	9.7, 7.4, 8.14
46	**Misfiled AM items: $\Sigma(x - \bar{x}) = 0$ · corrected/combined mean · weighted average**	★★★	6.3, 6.4, 7.6, 7.7, 7.8, 8.16, 9.13

#	One-liner	Weight	Part A ref
47	**Misfiled median/mode items: median y = a + b × median x · median for open-end classes · Mode = 3Me − 2Mean · grouped mode formula · mode for attributes**	★★★	6.5, 7.9, 7.10, 8.19, 8.20, 8.21, 8.22, 9.8, 9.9, 9.12
48	Misfiled GM/HM items: $GM^2 = AM \times HM$; $(a - b)^2 = (a + b)^2 - 4ab$	★★	6.6, 8.17, 8.18, 9.11

CHAPTER 15

Probability

157 Scanner questions · 76 one-liners · 25 revision pointers

Part A — One-liners mapped to Scanner questions and Study Material

Probability

SM Chapter 15, pages 15.1 – 15.61

Topic 1 Introduction

2 Scanner questions · ICAI appearances PYQ 2 · RTP – · MTP –

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.1	Two broad divisions of probability are Subjective Probability (personal judgement and experience; used in decision-making management, outside the syllabus) and Objective Probability (the one studied).	PYQ May 18 Q56	PYQ 2018-May	15.1, p. 15.2; Set A Q2, p. 15.39
1.2	*See Topic 10: $E(x) = \Sigma p_i x_i$, so if $Y \geq X$ for every outcome then $E(Y) - E(X) = E(Y - X) \geq 0$, i.e. $E(X) \leq E(Y)$ — option (b); the key (a) $E(X) > E(Y)$ contradicts the Scanner's own working.*	PYQ Jun 19 Q68	PYQ 2019-Jun	15.10 (15.41), (15.52), pp. 15.28 – 15.29; the ordering result itself is PYQ-only

Topic 2 Random Experiment

26 Scanner questions · ICAI appearances PYQ 13 · RTP – · MTP 13

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.1	Mutually exclusive (incompatible) events cannot occur simultaneously — the occurrence of one rules out the other, so $P(A \cap B) = 0$. Test each pair: a 13-year-old cannot be in college, an under-15 cannot be a voter (exclusive); 'born in India' and 'fine lawyer' can co-exist (not exclusive).	PYQ Jun 19 Q69, PYQ Dec 21 Q79, PYQ Sep 24 Q9	PYQ 2019-Jun, 2021-Dec, 2024-Sep	15.2, p. 15.3; Set A Q6, p. 15.39
2.2	Leap year = 366 days = 52 weeks + 2 odd days; the 7 equally likely odd-day pairs are (Sun, Mon) ... (Sat, Sun) and each weekday appears in 2 → P(53 of a given day) = 2/7. Non-leap year = 52 weeks + 1 odd day → 1/7 per day, so 53 Sundays or Tuesdays or Thursdays = 3/7 (mutually exclusive cases add).	PYQ Nov 18 Q72, MTP Dec 24 S1 Q82	PYQ 2018-Nov; MTP 2024-Dec S1	15.3 (15.1), p. 15.3; Set C Q1, p. 15.47
2.3	Classical definition $P(A) = n(A) \div n(S)$ with equally likely outcomes: two dice → 36, three dice → $6^3 = 216$ (same number on all three = 6/216 = 1/36); sum 9 = {(3,6),(6,3),(4,5),(5,4)} → 4/36 = 1/9; two letters from HOME → ${}^4C_2 = 6$, both consonants = ${}^2C_2 = 1$ → 1/6; spade or an ace not of spade = (13 + 3)/52 = 4/13.	PYQ Nov 18 Q75, MTP Jun 24 S3 Q67, MTP Dec 24 S1 Q80, MTP Jan 25 S2 Q82	PYQ 2018-Nov; MTP 2024-Jun S3, 2024-Dec S1, 2025-Jan S2	15.3 (15.1), p. 15.3; Examples 15.2 – 15.4, pp. 15.5 – 15.7; Set A Q51, p. 15.44
2.4	Odds: if the odds in favour of A are p : q (favourable : unfavourable) then $P(A) = p \div (p + q)$; odds against = q : p.	PYQ Jun 22 Q84	PYQ 2022-Jun	15.3(c) (15.5) – (15.6), p. 15.4; Set A Q21, p. 15.41

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.5	Independence test: A and B are independent ⇔ P(A ∩ B) = P(A) × P(B) (then P(A/B) = P(A), and A & B′, A′ & B, A′ & B′ are independent too). With non-zero probabilities independent events overlap, so P(A ∪ B) = P(A) + P(B) is FALSE; 2/3 × 3/8 = 1/4 = P(A ∩ B) → independent, not exclusive; 'king or queen' and 'queen or jack': 4/52 ≠ (8/52)² → not independent.	PYQ Dec 22 Q81, PYQ Jun 23 Q83, MTP Dec 24 S1 Q83	PYQ 2022-Dec, 2023-Jun; MTP 2024-Dec S1	15.8 (15.26) – (15.30), p. 15.18; Set A Q14 – Q15, p. 15.40
2.6	Only A (difference of events): P(A – B) = P(A ∩ B′) = P(A) – P(A ∩ B); trap: not P(A) – P(B).	PYQ Sep 24 Q6	PYQ 2024-Sep	15.5, pp. 15.11 – 15.12; Example 15.13 (15.21), p. 15.16; Set A Q30, p. 15.42
2.7	Independent trials: P(both) = P(A) × P(B); P(at least one) = P(A) + P(B) – P(A)P(B) = 1 – P(A′)P(B′); P(neither) = P(A′)P(B′). Ram 2/3, Shyam 5/11 → 1 – (1/3)(6/11) = 9/11; Rupesh 5/9, David 6/11 → 79/99; X 1/5, Y 1/3 none selected → (4/5)(2/3) = 8/15; one white from each bag → 3/8 × 4/6 = 1/4; at least one head in n tosses = 1 – (½)^n = 0.875 → n = 3.	PYQ Nov 18 Q74, MTP Dec 24 S1 Q77, PYQ Sep 25 Q80, PYQ Sep 25 Q81, MTP Jan 25 S2 Q85	PYQ 2018-Nov, 2025-Sep (×2); MTP 2024-Dec S1, 2025-Jan S2	15.8 Theorem 6 note, p. 15.19; Example 15.15, pp. 15.19 – 15.20
2.8	Total probability with a random choice of box: P(blue) = ½ × 6/11 + ½ × 7/10 = 137/220 — weight each box's probability by the chance of choosing it.	MTP Aug 24 S2 Q75	MTP 2024-Aug S2	Example 15.26, p. 15.26; Set C Q9, p. 15.48
2.9	Successive draws of 3 from 5 W + 7 B: with replacement the draws are independent → ($^5C_3/^{12}C_3$)($^7C_3/^{12}C_3$) = 7/968; without replacement the second draw is from 9 balls → ($^5C_3/^{12}C_3$)($^7C_3/^9C_3$) = 5/264.	MTP Aug 24 S2 Q76	MTP 2024-Aug S2	15.8 (15.24), (15.31), pp. 15.18 – 15.19; Set C Q5, p. 15.48
2.10	X and Y in a line with 6 OTHER people (8 in all): position pairs with exactly 3 between them are (1,5), (2,6), (3,7), (4,8) → 4 of $^8C_2$ = 28 → 1/7.	MTP Aug 24 S2 Q78	MTP 2024-Aug S2	Set C Q17, p. 15.49
2.11	*See Topic 10: E(x + y) = E(x) + E(y), so the expected sum on two dice = 3.5 + 3.5 = 7.*	MTP Dec 24 S1 Q74	MTP 2024-Dec S1	15.10 (15.52), p. 15.29; Q64, p. 15.57
2.12	Binomial (outside Chapter 15): P(X = r) = $^nC_r\ p^r\ q^{n-r}$. 3 right guesses in 5 true/false = $^5C_3(½)^5$ = 0.3125; failure 0.30 → p(pass) = 0.7, at least 4 of 6 pass = P(4) + P(5) + P(6) = 0.324 + 0.303 + 0.118 ≈ 0.74.	MTP Dec 24 S1 Q84, PYQ May 25 Q89	PYQ 2025-May; MTP 2024-Dec S1	Not in SM Chapter 15 (PYQ and MTP) — binomial distribution, SM Chapter 16
2.13	'At least one' → complement: 12 oranges with 4 bad, 3 drawn → P(at least one good) = 1 – $^4C_3/^{12}C_3$ = 1 – 4/220 = 54/55.	MTP Apr 26 S2 Q90	MTP 2026-Apr S2	15.3(b) (15.4), p. 15.4; Example 15.23, p. 15.24

Topic 3 Classical Definition of Probability

52 Scanner questions · ICAI appearances PYQ 47 · RTP – · MTP 5

Ref	One-liner for the student	Scanner Q	Asked in	SM source
3.1	'Chance', 'odds', 'in all likelihood' and probability are synonyms (True); classical probability lies in 0 ≤ P(A) ≤ 1, P = 1 is a sure event (digits 1, 3, 5 always sum to 9, so every arrangement is divisible by 3).	PYQ May 18 Q57	PYQ 2018-May	15.1, p. 15.2; 15.3(a) (15.3), p. 15.4; Q18, p. 15.53
3.2	Coin tosses: n tosses give 2^n equally likely sequences. Two coins: at least one tail = 3/4 = 0.75, exactly one head = 2/4 = 0.50; three coins: more than one head (2 or 3) = 4/8 = 1/2, exactly two heads = 3/8.	PYQ Nov 20 Q70, PYQ Jan 21 Q73, PYQ Jan 21 Q74, PYQ Dec 22 Q84, MTP Aug 24 S2 Q87	PYQ 2020-Nov, 2021-Jan (×2), 2022-Dec; MTP 2024-Aug S2	Example 15.1, pp. 15.4 – 15.5; Example 15.10, pp. 15.14 – 15.15; Set A Q46 – Q47, p. 15.43
3.3	Specified sequences: one particular sequence of n fair tosses has probability $(½)^n$; 'alternately' = HTHT… or THTH… → $2 \times (½)^6 = 1/32$ for six tosses; a 'first to 4 wins' contest ends at the 4th match only on a 4–0 sweep by either player → $2 \times (½)^4 = 1/8$.	PYQ Nov 18 Q73, PYQ Sep 25 Q85	PYQ 2018-Nov, 2025-Sep	15.8 (15.29), p. 15.18; Example 15.1, pp. 15.4 – 15.5
3.4	Two dice — sums: 36 ordered pairs; ways to get sum s = s − 1 for s ≤ 7 and 13 − s for s ≥ 7. Sum 5 → 4/36 = 1/9; multiple of 3 (3, 6, 9, 12) → 2 + 5 + 4 + 1 = 12/36; multiple of 3 or 5 → 12 + 7 = 19/36; 8 or more → 15/36 = 5/12; dice numbered 4 – 9, sum ≤ 14 → 1 − (sums 15 – 18 = 10)/36 = 13/18.	PYQ Nov 20 Q69, PYQ Jan 21 Q72, PYQ Jun 22 Q78, PYQ May 25 Q80, PYQ Sep 25 Q83	PYQ 2020-Nov, 2021-Jan, 2022-Jun, 2025-May, 2025-Sep	Examples 15.2 – 15.3, pp. 15.5 – 15.7; Q8 – Q9, p. 15.52
3.5	Two dice — a given face on at least one die = 36 − 5 × 5 = 11 outcomes → 11/36 (for 1 or for 5); hence x = 11 when P = x/36.	PYQ Jun 19 Q72, PYQ Jun 22 Q81, PYQ Jun 22 Q82	PYQ 2019-Jun, 2022-Jun (×2)	15.3 (15.1), p. 15.3; Example 15.2, p. 15.5
3.6	Repeated trials: if an experiment has p outcomes and is repeated q times there are p^q equally likely outcomes — three dice $6^3 = 216$ (third die exceeds the sum of the other two in 20 → 20/216); samples of 3 from 7 members WITH replacement = $7^3 = 343$.	PYQ Nov 20 Q71, PYQ Jan 25 Q13	PYQ 2020-Nov, 2025-Jan	Example 15.2, p. 15.5; Example 15.25, p. 15.25
3.7	Single draw: P = favourable ÷ total; 'not' → complement. 15 + 25 + 10 = 50 coins/balls, not the 15 → 35/50 = 0.70; 7 blue + 5 green → blue = 7/12.	PYQ Nov 19 Q75, PYQ Jan 21 Q71, PYQ Jul 21 Q75	PYQ 2019-Nov, 2021-Jan, 2021-Jul	15.3 (15.1) and 15.3(b), pp. 15.3 – 15.4; Set A Q49, p. 15.44
3.8	Selections by combinations: n(S) = ${}^{N}C_r$, n(A) = product of the group choices. 2 Android + 2 Apple = ${}^{10}C_2 \times {}^{6}C_2 / {}^{16}C_4 = 675/1820 \approx 0.37$; 1 girl + 2 boys = ${}^{10}C_1 \times {}^{15}C_2 / {}^{25}C_3 = 1050/2300 = 21/46$; one spade + one heart = $13 \times 13 / {}^{52}C_2 = 13/102$; all four kings = $1/{}^{52}C_4 = 1/2{,}70{,}725$; two letters from HOME, neither a vowel = ${}^{2}C_2/{}^{4}C_2 = 1/6$.	PYQ Nov 19 Q72, PYQ Jul 21 Q77, PYQ May 25 Q83, PYQ May 25 Q84, PYQ Sep 26 Q68	PYQ 2019-Nov, 2021-Jul, 2025-May (×2), 2026-Sep	Example 15.6, pp. 15.7 – 15.8; Example 15.23, p. 15.24
3.9	'Different colours' for 2 balls = sum of cross-products, or 1 − same colour: 4R 5B 6W → $(20 + 30 + 24)/{}^{15}C_2 = 74/105$; 5R 4B 3G → (66 − 10 − 6 − 3)/66 = 47/66.	PYQ Jun 24 Q84, PYQ May 26 Q96	PYQ 2024-Jun, 2026-May	Example 15.6, pp. 15.7 – 15.8; Set B Q1, pp. 15.44 – 15.45

Ref	One-liner for the student	Scanner Q	Asked in	SM source
3.10	Complements: P(A′) = 1 − P(A). Pass and fail are complementary → x/3 + 2/3 = 1 → x = 1; odds 3 : 1 → p = 3/4, non-occurrence in 3 independent trials = $(1/4)^3$ = 1/64; 12 mangoes with 4 bad → P(at least one good of 3) = 1 − $^4C_3/^{12}C_3$ = 54/55.	MTP Apr 26 S1 Q90, PYQ May 26 Q40, PYQ Sep 26 Q23	PYQ 2026-May, 2026-Sep; MTP 2026-Apr S1	15.3(b) – (c) (15.4) – (15.5), p. 15.4; 15.8 (15.29), p. 15.18
3.11	Counting multiples in 1 … N: number of multiples of k = ⌊N/k⌋; 'multiple of a AND b' = multiple of LCM(a, b); 'a OR b' → add and subtract the LCM count. 1 – 48 divisible by 4 → 12/48 = 1/4; 1 – 50 multiple of 3 and 4 (i.e. 12) → 4/50 = 2/25; 1 – 12 multiple of 5 or 6 → {5, 6, 10, 12} = 1/3; two-digit primes (11) or composites 6 – 39 (25) are exclusive → 36/50 = 0.72.	PYQ Jul 21 Q73, PYQ Dec 22 Q83, PYQ Sep 24 Q13, PYQ Sep 25 Q82	PYQ 2021-Jul, 2022-Dec, 2024-Sep, 2025-Sep	Example 15.9, p. 15.14; Example 15.11, p. 15.15; Set B Q10, p. 15.46
3.12	Four-digit numbers from 2, 5, 6, 7 (no repetition): 4! = 24; divisible by 4 ⇔ last two digits divisible by 4 → ends 52, 56, 72 or 76, each with 2! arrangements in front → 8/24 = 1/3.	PYQ Jun 23 Q84, MTP Jan 25 S2 Q83	PYQ 2023-Jun; MTP 2025-Jan S2	Example 15.5, p. 15.7
3.13	Leap year has 52 weeks + 2 odd days; 2 of the 7 odd-day pairs contain any given day → P(53 Sundays/Mondays) = 2/7.	PYQ Jun 22 Q79, PYQ Dec 22 Q80, PYQ May 25 Q86	PYQ 2022-Jun, 2022-Dec, 2025-May	15.3 (15.1), p. 15.3; Set C Q1, p. 15.47
3.14	*See Topic 8: conditional probability shrinks the sample space to the given event — service holder given male = 12/20 = 0.60; first die greater given sum 7 → (4,3), (5,2), (6,1) of 6 = 1/2.*	PYQ Dec 21 Q82, PYQ Jan 26 Q92	PYQ 2021-Dec, 2026-Jan	15.8 (15.24), p. 15.18; Example 15.16, p. 15.20; Example 15.17, pp. 15.20 – 15.21
3.15	*See Topic 8: total probability P(A) = Σ $P(B_i) \times P(A/B_i)$. Three boxes chosen at random, red = ⅓(7/16 + 5/14 + 4/9) = 1249/3024; three companies (10%, 20%, 5% defective) → defective = ⅓(0.35) ≈ 0.12, so defect-free ≈ 0.88.*	PYQ Dec 21 Q83, PYQ Jun 23 Q81	PYQ 2021-Dec, 2023-Jun	Example 15.26, p. 15.26
3.16	Independent components: P(assembly free of defects) = product of (1 − defect rate): 0.92 × 0.95 = 0.874; 0.95 × 0.96 × 0.99 = 0.90288 ≈ 0.90.	PYQ Dec 22 Q78, PYQ Sep 25 Q84	PYQ 2022-Dec, 2025-Sep	15.8 (15.29) – (15.30), p. 15.18; Example 15.22, p. 15.24
3.17	*See Topic 8: A is independent of E iff P(A ∩ E) = P(A) × P(E). A = first toss head (½); A_3 = both alike {HH, TT} (½); A ∩ A_3 = {HH} = ¼ = ½ × ½ → independent of A_3, option (a). A ∩ A_0 = ∅, so A and A_0 are mutually exclusive and therefore dependent — the key (c) is wrong.*	PYQ Jun 24 Q82	PYQ 2024-Jun	15.8 (15.28), p. 15.18
3.18	*See Topics 9 – 10: Σp_i = 1 fixes k (5k + 3k + 4k + 6k + 7k + 9k + 11k = 45k = 1 → k = 1/45); E(x) = Σpx, so for x = 1 with P and 0 with 1 − P the mean = P.*	PYQ Jul 21 Q78, PYQ Jun 23 Q82	PYQ 2021-Jul, 2023-Jun	15.9 (15.34), p. 15.27; 15.10 (15.41), p. 15.28
3.19	Relative-frequency use of an average: wages 500, 620, 400, 700, 450, 560, 320, 450 → mean 4,000/8 = 500; below average = 400, 450, 320, 450 → 4/8 = 0.500.	PYQ Sep 24 Q12	PYQ 2024-Sep	Set B Q7, p. 15.45

Ref	One-liner for the student	Scanner Q	Asked in	SM source
3.20	A and B together in a queue of 5: tie them as one unit → 4! × 2! = 48 of 5! = 120 → 2/5.	MTP Apr 26 S1 Q81	MTP 2026-Apr S1	Not in SM (MTP-only); arrangement rule from SM Chapter 5 (Permutations)
3.21	Normal + binomial (outside Chapter 15): P(X > 2,100) = P(z > (2,100 − 1,800)/300 = 1) = 1 − 0.84 = 0.16; at least one of 5 families = $1 - 0.84^5 = 1 - 0.418$ = 0.582.	MTP Aug 24 S2 Q83	MTP 2024-Aug S2	Not in SM Chapter 15 (MTP-only) — normal and binomial distributions, SM Chapter 16

Topic 4 Statistical Definition of Probability

2 Scanner questions · ICAI appearances PYQ 2 · RTP – · MTP –

Ref	One-liner for the student	Scanner Q	Asked in	SM source
4.1	*See Topic 3: selection by combinations — 4 of 9 (3 men, 2 women, 4 children): n(S) = $^9C_4$ = 126, exactly 2 children = $^4C_2 \times {}^5C_2$ = 60 → 60/126 = 10/21.*	PYQ Jun 23 Q79	PYQ 2023-Jun	Example 15.6, pp. 15.7 – 15.8
4.2	*See Topic 8: total probability — P(defective) = P(A)P(D/A) + P(B)P(D/B) = 0.6 × 0.05 + 0.4 × 0.03 = 0.042 (the production shares are the weights).*	PYQ Jun 24 Q86	PYQ 2024-Jun	Example 15.26, p. 15.26

Topic 5 Operations on Events: Set Theoretic Approach to Probability

17 Scanner questions · ICAI appearances PYQ 10 · RTP – · MTP 7

Ref	One-liner for the student	Scanner Q	Asked in	SM source
5.1	Addition theorem P(A ∪ B) = P(A) + P(B) − P(A ∩ B) — rearrange for the missing term: ½ + ⅓ − ¼ = 7/12; P(A ∩ B) = ½ + ⅓ − ⅔ = 1/6; P(A) = 5/6 − ½ + ⅓ = 2/3 (P(B) = 1 − P(B′)); B.Com 0.85 + CA 0.30 − both 0.25 = 0.90, and of 500 applicants the expected number = 500 × 0.90 = 450.	PYQ Nov 18 Q71, PYQ Dec 23 Q77, PYQ Dec 23 Q81, MTP Jan 25 S2 Q84	PYQ 2018-Nov, 2023-Dec (×2); MTP 2025-Jan S2	15.7 Theorem 3 (15.20), p. 15.15; Example 15.12, p. 15.16
5.2	Complements: P(A′) = 1 − P(A), so P(A′) + P(B′) = 2 − [P(A) + P(B)] = 2 − [P(A ∪ B) + P(A ∩ B)] (0.65 & 0.15 → 1.2; 0.8 & 0.3 → 0.9). Mutually exclusive, exhaustive, equally likely A, B, C → each 1/3, P(A′) = 2/3.	PYQ Nov 18 Q76, PYQ Sep 24 Q11, MTP Jan 25 S2 Q81	PYQ 2018-Nov, 2024-Sep; MTP 2025-Jan S2	15.3(b) (15.4), p. 15.4; 15.5 (15.11) – (15.14), p. 15.13; Example 15.8, p. 15.13
5.3	P(A ∪ B) = P(A) + P(B) only when A and B are mutually exclusive (P(A ∩ B) = 0): P(A) = 1/5, P(B) = 1 − 3/5 = 2/5 → P(A ∪ B) = 3/5.	MTP Aug 24 S2 Q79, PYQ Jan 25 Q14	PYQ 2025-Jan; MTP 2024-Aug S2	15.5 (15.9) – (15.10), p. 15.13; Set A Q27, p. 15.41
5.4	Independent events: P(A ∩ B) = P(A) × P(B), and complements stay independent. Contradiction = one right, other wrong = P(A)P(B′) + P(A′)P(B) = 0.75 × 0.40 + 0.25 × 0.60 = 0.45; win at least one match = 1 − P(lose both) = 1 − (3/5)(1/7) = 32/35.	PYQ Nov 20 Q72, PYQ Jul 21 Q75, MTP Jun 24 S3 Q64	PYQ 2020-Nov, 2021-Jul; MTP 2024-Jun S3	15.8 (15.28), (15.30), p. 15.18; Set C Q12, p. 15.49

Ref	One-liner for the student	Scanner Q	Asked in	SM source
5.5	Conditional probabilities with complements: P(A/B) = P(A ∩ B)/P(B) with P(A ∩ B) from the addition theorem (2/3 + 3/5 − 5/6 = 13/30 → P(A/B) = 13/18); P(A′/B′) = [1 − P(A ∪ B)] ÷ [1 − P(B)] by De Morgan (½, ⅓, ¼ → (5/12)/(2/3) = 5/8).	MTP Aug 24 S2 Q77, MTP Jan 25 S2 Q86	MTP 2024-Aug S2, 2025-Jan S2	Example 15.18, pp. 15.21 – 15.22; Set C Q18, p. 15.49
5.6	An event that can be split into further events is a composite (compound) event; one that cannot is simple (elementary).	PYQ Jan 21 Q69	PYQ 2021-Jan	15.2, p. 15.2; Set A Q5, p. 15.39
5.7	Odds against A = (m − mA) : mA, i.e. P(A′) : P(A): P(A) = 4/9 → odds against = 5 : 4 (trap: 4 : 5 is odds in favour).	MTP Jun 24 S3 Q66	MTP 2024-Jun S3	15.3(c) (15.6), p. 15.4; Set A Q22, p. 15.41
5.8	*See Topic 10: expected earnings E(x) = Σpx = 400 × 0.4 + (−100) × 0.6 = ₹100 (a loss enters as a negative value).*	PYQ Dec 21 Q80	PYQ 2021-Dec	15.10 (15.41), p. 15.28; Example 15.29, p. 15.31

Topic 6 Axiomatic or Modern Definition of Probability

2 Scanner questions · ICAI appearances PYQ 2 · RTP – · MTP –

Ref	One-liner for the student	Scanner Q	Asked in	SM source
6.1	Mutually exclusive and exhaustive events: P(A) + P(B) + P(C) = 1. With P(A) = 2P(B) = 3P(C): P(B)(2 + 1 + ⅔) = 1 → P(B) = 3/11.	PYQ Nov 19 Q73	PYQ 2019-Nov	15.5 (15.11), (15.13), p. 15.13; Set B Q8, p. 15.45
6.2	Axiom (iii)/Theorem 1: for mutually exclusive A and B, P(A ∪ B) = P(A) + P(B) → x = ½ − ⅓ = 1/6.	PYQ Jan 25 Q4	PYQ 2025-Jan	15.6 (15.17), p. 15.13; 15.7 Theorem 1 (15.18), p. 15.14

Topic 7 Addition Theorems

16 Scanner questions · ICAI appearances PYQ 14 · RTP – · MTP 2

Ref	One-liner for the student	Scanner Q	Asked in	SM source
7.1	Theorem 1 (mutually exclusive): P(A ∪ B) = P(A) + P(B). Sum 7 or 11 with two dice = (6 + 2)/36 = 2/9; 1 – 20 divisible by 3 or 7 = (6 + 2)/20 = 8/20 (21 is beyond 20, so no overlap).	PYQ Nov 19 Q74, PYQ May 25 Q81	PYQ 2019-Nov, 2025-May	15.7 Theorem 1 (15.18), p. 15.14; Example 15.9, p. 15.14; Q91, p. 15.59
7.2	Theorem 3 with numbers: n(a or b) = ⌊N/a⌋ + ⌊N/b⌋ − ⌊N/LCM⌋. 1 – 30, 3 or 8 → 10 + 3 − 1 = 12/30 = 0.4; 1 – 100, 3 or 7 → 33 + 14 − 4 = 43/100; 1 – 99, 9 or 11 → 11 + 9 − 1 = 19/99; 1 – 20, 3 or 5 → 6 + 4 − 1 = 9/20.	PYQ Dec 23 Q80, PYQ Dec 23 Q82, PYQ Jun 24 Q81, PYQ Jan 26 Q91	PYQ 2023-Dec (×2), 2024-Jun, 2026-Jan	15.7 Theorem 3 (15.20), p. 15.15; Example 15.11, p. 15.15
7.3	Cards: P(K ∪ H) = 4/52 + 13/52 − 1/52 = 16/52 = 4/13 (King or Heart; Club or King) — subtract the card counted twice.	PYQ Dec 23 Q79, PYQ May 26 Q93	PYQ 2023-Dec, 2026-May	15.7 Theorem 3 (15.20), p. 15.15; Example 15.4, p. 15.7; Set A Q52, p. 15.44

Ref	One-liner for the student	Scanner Q	Asked in	SM source
7.4	Two items drawn together: n(S) = $^{N}C_2$. Both red or both kings = ($^{26}C_2$ + $^{4}C_2$ − $^{2}C_2$)/$^{52}C_2$ = 330/1326 ≈ 0.2488; both even or both multiples of 5 from 1 − 30 = ($^{15}C_2$ + $^{6}C_2$ − $^{3}C_2$)/$^{30}C_2$ = 117/435; at least one defective of 2 from 20 (4 defective) = ($^{4}C_1$ × $^{16}C_1$ + $^{4}C_2$)/$^{20}C_2$ = 70/190 = 7/19 (or 1 − $^{16}C_2$/$^{20}C_2$).	PYQ Jun 22 Q80, PYQ Dec 23 Q78, PYQ Sep 24 Q14	PYQ 2022-Jun, 2023-Dec, 2024-Sep	15.7 Theorem 3 (15.20), p. 15.15; Example 15.23, p. 15.24; Set B Q3, p. 15.45
7.5	Independent solvers: P(solved) = 1 − P(A′)P(B′)P(C′) = 1 − (2/3)(4/5)(6/7) = 19/35. 'At least two succeed' = Σ P(exactly two) + P(all three) = (2 + 3 + 4 + 1)/60 = 1/6 for 1/5, 1/4, 1/3.	PYQ Jun 24 Q85, PYQ Sep 24 Q10	PYQ 2024-Jun, 2024-Sep	Example 15.21, p. 15.23; Example 15.22, p. 15.24; Set C Q10 − Q11, pp. 15.48 − 15.49
7.6	Theorem 4: P(A ∪ B ∪ C) = P(A) + P(B) + P(C) − P(A ∩ B) − P(A ∩ C) − P(B ∩ C) + P(A ∩ B ∩ C) = 0.8 + 0.6 + 0.5 − 0.46 − 0.32 − 0.48 + 0.26 = 0.90 (survival of three sons).	PYQ May 25 Q82	PYQ 2025-May	15.7 Theorem 4 (15.23), p. 15.17; Example 15.14, p. 15.17
7.7	If P(A) + P(B) = P(A ∪ B) then P(A ∩ B) = 0 → mutually exclusive (⅓ + ½ = 5/6). Only B: P(A′ ∩ B) = P(B) − P(A ∩ B); with P(A) = 1/3, P(B) = 3/4 − 1/3 + 1/4 = 2/3, so P(A′ ∩ B) = 2/3 − 1/4 = 5/12.	MTP Apr 26 S1 Q79, MTP Apr 26 S1 Q80	MTP 2026-Apr S1 (×2)	15.5 (15.9) − (15.10), p. 15.13; Example 15.13 (15.22), p. 15.16

Topic 8 Conditional Probability and Compound Theorem of Probability

24 Scanner questions · ICAI appearances PYQ 20 · RTP − · MTP 4

Ref	One-liner for the student	Scanner Q	Asked in	SM source
8.1	*See Topic 10: V(x) = σ² = E(x − μ)² = E[x − E(x)]² = E(x²) − μ² — both (a) and (b).*	PYQ May 18 Q58	PYQ 2018-May	15.10 (15.44), p. 15.28; Set A Q44, p. 15.43
8.2	Bayes' theorem: P(E_k/A) = P(E_k)P(A/E_k) ÷ Σ P(E_i)P(A/E_i), with E_1, E_2, … mutually exclusive (and exhaustive). Numerator = the joint probability, denominator = total probability: not selected = 0.4(0.3) + 0.45(0.2) + 0.15(0.4) = 0.27 → green = 0.09/0.27 = 1/3; test positive = 0.01(0.9) + 0.99(0.1) = 0.108 → disease = 0.009/0.108 ≈ 0.083.	PYQ Jun 19 Q70, PYQ Sep 26 Q47, PYQ Sep 26 Q49	PYQ 2019-Jun, 2026-Sep (×2)	Not in SM (PYQ-only) — Bayes' theorem is not stated; build it from (15.25), p. 15.18 and Example 15.26, p. 15.26
8.3	Conditional probability: P(B/A) = P(A ∩ B)/P(A), P(A/B) = P(A ∩ B)/P(B) — get P(A ∩ B) first (from P(A ∪ B), or P(A ∩ B) = P(B)P(A/B)). Maths given science = 0.6/0.9 = 2/3; science given maths = 0.5/0.7 = 5/7; P(B/A) = (1/24)/(1/3) = 1/8; P(A ∩ B) = ⅓ + ¾ − 11/12 = 1/6 → P(B/A) = 1/2; P(A ∩ B) = 0.5 × 0.3 = 0.15 → P(A ∪ B) = 0.95.	PYQ Jul 21 Q76, PYQ Jun 22 Q83, PYQ Dec 22 Q79, PYQ Jun 23 Q80, PYQ Jan 26 Q90	PYQ 2021-Jul, 2022-Jun, 2022-Dec, 2023-Jun, 2026-Jan	15.8 (15.24) − (15.25), p. 15.18; Example 15.18, pp. 15.21 − 15.22; Q103 − Q104, p. 15.60
8.4	If P(A/B) = P(A) the events are independent: 10/33 ÷ 6/11 = 5/9 = P(A) and 10/33 ÷ 5/9 = 6/11 = P(B).	PYQ Dec 21 Q78	PYQ 2021-Dec	15.8 (15.26) − (15.28), p. 15.18; Set A Q13, p. 15.40
8.5	Compound theorem (Theorem 5): P(A ∩ B) = P(A) × P(B/A), provided P(A) > 0 — the multiplier is the conditional probability, not P(B).	PYQ Dec 22 Q82	PYQ 2022-Dec	15.8 Theorem 5 (15.31), p. 15.19; Set A Q33, p. 15.42

Ref	One-liner for the student	Scanner Q	Asked in	SM source
8.6	Draws without replacement use Theorem 5: two kings = 4/52 × 3/51 = 1/221; green then yellow from 6 G + 8 Y = 6/14 × 8/13 = 24/91.	MTP Apr 26 S1 Q82, PYQ Sep 26 Q48	PYQ 2026-Sep; MTP 2026-Apr S1	15.8 Theorem 5 (15.31), p. 15.19
8.7	Independent attempts, 'solved/hit/selected at least once' = 1 − Π(1 − p_i): five students → 1 − (½)(⅔)(⅓)(⅛)(⅚) = 25/27 ≈ 0.93; odds 5 : 7 for A (5/12) and 9 : 6 against B (6/15 = 2/5) → 1 − (7/12)(3/5) = 117/180; 5, 12, 15 candidates → 1 − (4/5)(11/12)(14/15) = 71/225; 6/13 and 8/11 → 1 − (7/13)(3/11) = 122/143.	PYQ May 25 Q85, PYQ Jan 26 Q41, PYQ Jan 26 Q40, PYQ May 26 Q95	PYQ 2025-May, 2026-Jan (×2), 2026-May	Example 15.19, p. 15.22; Example 15.21, p. 15.23; Example 15.22, p. 15.24
8.8	Repeated independent trials: success thrice as often as failure → p = 3/4, q = 1/4; no success in 5 trials = q^5 = 1/1024. See Topic 3: alternate H and T in 5 tosses = 2 × $(½)^5$ = 1/16.	PYQ Jun 19 Q71, MTP Jan 25 S2 Q89	PYQ 2019-Jun; MTP 2025-Jan S2	15.8 (15.29), Theorem 6, pp. 15.18 – 15.19
8.9	*See Topic 10: E(x) = Σpx — profit ₹50,000 (0.75) or loss ₹20,000 (0.25) → 37,500 − 5,000 = ₹32,500; 0 × ½ + 1 × ⅓ + 2 × ¼ + 3 × ⅛ ≈ 1.43 (but those probabilities total 77/60).*	PYQ Jan 25 Q5, MTP Jan 25 S2 Q87	PYQ 2025-Jan; MTP 2025-Jan S2	15.10 (15.41), p. 15.28; Example 15.29, p. 15.31
8.10	Binomial (outside Chapter 15): 2P(X = 2) = P(X = 3) gives 6q = (n − 2)p; with np = 10/3 → p = 2/3, n = 5; P(X ≤ 2) = (1 + 10 + 40)/243 = 17/81.	MTP Aug 24 S2 Q84	MTP 2024-Aug S2	Not in SM Chapter 15 (MTP-only) — binomial distribution, SM Chapter 16
8.11	*See Topic 3: digits 1, 3, 5 sum to 9, so all 3! = 6 numbers are divisible by 3 → sure event, P = 1.*	PYQ Jan 26 Q39	PYQ 2026-Jan	15.3(a) (15.3), p. 15.4
8.12	*See Topic 7: one die a multiple of 3 and the other a multiple of 2, either order: 6 + 6 − 1 (the (6, 6) overlap) = 11 → 11/36 (6/36 = 1/6 if the order is fixed); neither is an option, so ICAI gave marks to all.*	PYQ May 26 Q41	PYQ 2026-May	15.7 Theorem 3 (15.20), p. 15.15

Topic 9 Random Variable-Probability Distribution

6 Scanner questions · ICAI appearances PYQ 4 · RTP – · MTP 2

Ref	One-liner for the student	Scanner Q	Asked in	SM source
9.1	A probability distribution must satisfy $p_i \geq 0$ and Σp_i = 1 — add the k-terms and set them to 1: k + 2k + 2k = 5k = 1 → k = 1/5; K(1 + 2 + 4 + 6 + 7 + 8 + 11) = 39K = 1 → K = 1/39.	PYQ Jun 24 Q80, PYQ Sep 26 Q24	PYQ 2024-Jun, 2026-Sep	15.9 (15.33) – (15.34), p. 15.27; Example 15.34, pp. 15.34 – 15.35
9.2	Statistical (relative-frequency) probability = class frequency ÷ total frequency: 4 or more accidents = 24 + 27 + 18 + 9 = 78; the total must include every class (154 with the 0-accident class), giving 78/154 — the options use 118.	PYQ Nov 19 Q76	PYQ 2019-Nov	15.4 (15.7), p. 15.9; Example 15.7, p. 15.9
9.3	Median of a symmetric pmf = its centre of symmetry: p(0) = p(4) = k and p(1) = p(3) = 2k + k^2 → median = 2.	PYQ Sep 25 Q90	PYQ 2025-Sep	Not in SM (PYQ-only); pmf conditions (15.35) – (15.37), p. 15.27

Ref	One-liner for the student	Scanner Q	Asked in	SM source
9.4	Binomial/normal (outside Chapter 15): a binomial variable takes only whole numbers 0, 1, ..., n; for N(μ = 10, σ = 6) (pdf with 72 = 2σ²), Q_1 = μ − 0.675σ = 10 − 4.05 = 5.95.	MTP Aug 24 S2 Q80, MTP Aug 24 S2 Q82	MTP 2024-Aug S2 (×2)	Not in SM Chapter 15 (MTP-only) — binomial and normal distributions, SM Chapter 16

Topic 10 Expected Value of a Random Variable

10 Scanner questions · ICAI appearances PYQ 6 · RTP – · MTP 4

Ref	One-liner for the student	Scanner Q	Asked in	SM source
10.1	The probabilities of a set of mutually exclusive and exhaustive events add up to 1.	PYQ May 18 Q60	PYQ 2018-May	15.5 (15.11), (15.13), p. 15.13; Q21, p. 15.53
10.2	Expected value E(x) = μ = $\Sigma p_i x_i$ (losses negative; check Σp = 1 first). ₹50,000 × 0.75 − ₹20,000 × 0.25 = ₹32,500; (−20)(3/20) + (−10)(1/5) + 30(1/2) + 75(1/10) + 80(1/20) = 21.5; (0 + 5 + 26 + 6 + 12 + 5)/30 = 1.8; (−1)(⅓) + (−2)(⅙) + 0 + 1(⅙) + 2(⅓) = 1/6.	PYQ Jun 23 Q85, PYQ Jun 23 Q86, PYQ Jun 24 Q83, MTP Jun 24 S3 Q88	PYQ 2023-Jun (×2), 2024-Jun; MTP 2024-Jun S3	15.10 (15.41), p. 15.28; Example 15.29, p. 15.31
10.3	Variance $\sigma^2 = E(x^2) - \mu^2$, SD = $\sqrt{\sigma^2}$: μ = 3.55, $E(x^2)$ = 15.45 → σ^2 = 15.45 − 12.6025 = 2.8475, σ ≈ 1.69.	PYQ Dec 21 Q81	PYQ 2021-Dec	15.10 (15.42), (15.44), p. 15.28; Example 15.27, pp. 15.29 – 15.30; Set C Q20, p. 15.50
10.4	Properties: E(k) = k; E(x + y) = E(x) + E(y) (so E(x − y) = 4.5 − 2.5 = 2); E(kx) = kE(x); E(xy) = E(x)E(y) only when x and y are independent. The false statement is 'expectation of a sum is not the sum of expectations'.	MTP Aug 24 S2 Q88, PYQ Sep 26 Q25	PYQ 2026-Sep; MTP 2024-Aug S2	15.10 Properties (15.51) – (15.54), p. 15.29; Set A Q53, p. 15.44
10.5	Normal and Poisson (outside Chapter 15): normal pdf f(x) = [1/(σ√(2π))] e^(−(x − μ)²/2σ²) for −∞ < x < ∞; Poisson with m = np = 10 × 0.012 = 0.12, at most one death = e^(−0.12)(1 + 0.12) = 0.88692 × 1.12 ≈ 0.9934.	MTP Aug 24 S2 Q81, MTP Dec 24 S1 Q86	MTP 2024-Aug S2, 2024-Dec S1	Not in SM Chapter 15 (MTP-only) — normal and Poisson distributions, SM Chapter 16

Part B — Chapter 15 One-liner Revision Sheet

Deduplicated and in Study Material order. Click a 'Part A ref' to jump to the Part A row(s) carrying the full wording, the Scanner questions and the SM page. Refs read Unit.Topic.Row in chapters with several units and Topic.Row otherwise. Weight: ★★★ asked by ICAI 6 or more times · ★★ 3 – 5 times · ★ once or twice. The ★★★ lines alone cover about 71% of ICAI appearances in this chapter.

Probability

#	One-liner	Weight	Part A ref
1	Two divisions: subjective (judgement) and objective (studied); chance = probability.	★	1.1, 3.1
2	Composite event can be split; simple cannot. Mutually exclusive → cannot occur together, P(A ∩ B) = 0.	★★	5.6, 2.1
3	**Classical P(A) = n(A)/n(S); two dice 36, three dice 216; p outcomes repeated q times → p^q.**	★★★	2.3, 3.5, 3.6
4	**Coins: 2ⁿ outcomes; a fixed sequence (½)ⁿ; 'alternately' or 4–0 sweep → 2 × (½)ⁿ.**	★★★	3.2, 3.3, 8.8
5	**Two dice sums: s − 1 ways (s ≤ 7), 13 − s (s ≥ 7); a given face on at least one die = 11/36.**	★★★	3.4, 3.5
6	Leap year 2 odd days → 53 of a given day = 2/7; non-leap 1 odd day → 1/7 each.	★★	2.2, 3.13
7	**Selections: n(S) = $^{N}C_{r}$; different colours = 1 − same colour; 'at least one' = 1 − none.**	★★★	3.8, 3.9, 2.13, 4.1
8	**0 ≤ P ≤ 1; P(A′) = 1 − P(A); odds in favour p : q → p/(p + q); odds against = P(A′) : P(A).**	★★★	2.4, 3.10, 5.7, 8.11
9	**Divisible by 4 → last two digits; multiples of k in 1 … N = ⌊N/k⌋; 'and' → LCM.**	★★★	3.11, 3.12
10	Relative frequency: class frequency ÷ TOTAL frequency (include every class).	★	9.2, 3.19
11	A − B = A ∩ B′: P(A) − P(A ∩ B); only B = P(B) − P(A ∩ B).	★★	2.6, 7.7
12	ME, exhaustive, equally likely → ΣP = 1; P(A) = 2P(B) = 3P(C) → P(B) = 3/11.	★★	5.2, 6.1, 10.1
13	Add directly only if mutually exclusive: P(A ∪ B) = P(A) + P(B); sum 7 or 11 = 2/9.	★★	5.3, 6.2, 7.1
14	**Theorem 3: P(A ∪ B) = P(A) + P(B) − P(A ∩ B) — numbers (subtract LCM count), cards, pairs drawn.**	★★★	5.1, 7.2, 7.3, 7.4, 8.12
15	Theorem 4 (three events): + singles − pairs + triple (survival example = 0.90).	★	7.6
16	**Conditional: P(B/A) = P(A ∩ B)/P(A); reduce the sample space to the given event.**	★★★	8.3, 3.14
17	P(A′/B′) = [1 − P(A ∪ B)]/[1 − P(B)]; find P(A ∩ B) from the addition theorem first.	★	5.5
18	**Independent ⇔ P(A ∩ B) = P(A)P(B) ⇔ P(A/B) = P(A); complements stay independent; independent ≠ exclusive.**	★★★	2.5, 3.17, 8.4, 5.4
19	Compound theorem P(A ∩ B) = P(A) × P(B/A); without replacement 4/52 × 3/51 = 1/221.	★★	8.5, 8.6, 2.9
20	**At least one of independent events = 1 − Π(1 − p_i); defect-free assembly = Π(1 − p_i).**	★★★	2.7, 7.5, 8.7, 3.16
21	**Total probability Σ P(B_i)P(A/B_i) (boxes, companies, product mix); Bayes = one term ÷ total.**	★★★	2.8, 3.15, 4.2, 8.2

#	One-liner	Weight	Part A ref
22	Probability distribution: $p_i \geq 0$, $\Sigma p_i = 1$ → solve for k; symmetric pmf → median at the centre.	★★	9.1, 9.3, 3.18
23	**$E(x) = \Sigma px$ (loss negative); $\sigma^2 = E(x^2) - \mu^2$; $V(x) = E[x - E(x)]^2$.**	★★★	10.2, 10.3, 8.1, 5.8, 8.9
24	$E(k) = k$, $E(x \pm y) = E(x) \pm E(y)$, $E(kx) = kE(x)$, $E(xy) = E(x)E(y)$ if independent; two dice sum → 7; $Y \geq X \Rightarrow E(X) \leq E(Y)$.	★★	10.4, 2.11, 1.2
25	**Outside Chapter 15 (SM Ch 16): binomial ${}^nC_r p^r q^{n-r}$, normal, Poisson; permutations rule (Ch 5) for queues and line-ups.**	★★★	2.10, 2.12, 3.21, 8.10, 9.4, 10.5, 3.20

CHAPTER 16

Theoretical Distributions

121 Scanner questions · 40 one-liners · 23 revision pointers

Part A — One-liners mapped to Scanner questions and Study Material

Theoretical Distributions

SM Chapter 16, pages 16.1 – 16.55

Topic 1 Introduction

1 Scanner question · ICAI appearances PYQ 1 · RTP – · MTP –

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.1	A probability distribution may be discrete (total probability spread over mass points: binomial, Poisson) or continuous (defined by a probability density function: normal) — so the answer is '(a) or (b)', never 'infinite'.	PYQ May 18 Q65	PYQ 2018-May	16.1, p. 16.2; Exercise Set A Q2, p. 16.38

Topic 2 Binomial Distribution

41 Scanner questions · ICAI appearances PYQ 31 · RTP 3 · MTP 7

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.1	Binomial pmf: $f(x) = P(X = x) = {}^{n}C_{x}\, p^{x}\, q^{n-x}$, x = 0, 1, ..., n, q = 1 − p — for n independent trials, each a success or failure, with constant p. 'At least r' = sum of the upper terms (or 1 − lower terms); 'all heads' = p^{n}. Trap: if p = 3q, then p = 3/4, q = 1/4.	PYQ Jul 21 Q83, PYQ Jun 23 Q87, PYQ Dec 23 Q85, PYQ Jun 24 Q90, PYQ Jan 26 Q44, MTP Apr 26 S1 Q83	PYQ 2021-Jul, 2023-Jun, 2023-Dec, 2024-Jun, 2026-Jan; MTP 2026-Apr S1	16.2, (16.1), p. 16.3; Examples 16.1 – 16.3 and 16.8, pp. 16.4 – 16.10
2.2	Binomial is a biparametric discrete distribution (n and p determine it completely); Poisson is uniparametric (m); normal is biparametric but continuous (μ, σ^2).	PYQ May 18 Q64	PYQ 2018-May	16.2 (b), p. 16.3; Exercise Set A Q14, p. 16.39
2.3	Mean of a binomial = np (expected number of successes): B(4, 1/3) → 4/3; four unbiased coins → 4 × ½ = 2 heads.	PYQ Nov 18 Q78, PYQ Dec 21 Q86	PYQ 2018-Nov, 2021-Dec	16.2, (16.3), p. 16.3; Example 16.7, pp. 16.8 – 16.9
2.4	Variance of a binomial σ^2 = npq = np(1 − p) = nq(1 − q); SD = √(npq). Watch for the disguised form nq(1 − q) and for √ on the SD option. Variance is greatest at p = q = ½ (value n/4).	PYQ May 18 Q61, PYQ Jan 21 Q75, PYQ Dec 22 Q87, RTP Sep 24 Q24, PYQ Sep 25 Q88, PYQ May 26 Q44	PYQ 2018-May, 2021-Jan, 2022-Dec, 2025-Sep, 2026-May; RTP 2024-Sep	16.2, (16.5), p. 16.3; Exercise Set A Q13, p. 16.39; Additional QB Q13, Q20, p. 16.49

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.5	Given mean and variance (or SD): q = variance ÷ mean = npq/np, p = 1 − q, n = mean ÷ p. Square the SD first (SD 3 → npq = 9; SD 4 → 16). Compare p and q from q alone (mean 5, variance 3 → q = 3/5 > p).	PYQ Jun 19 Q74, PYQ Dec 23 Q84, PYQ Dec 23 Q87, PYQ Jun 24 Q90, MTP Jun 24 S3 Q81, MTP Dec 24 S1 Q88, PYQ May 26 Q48, PYQ May 26 Q45	PYQ 2019-Jun, 2023-Dec (×2), 2024-Jun, 2026-May (×2); MTP 2024-Jun S3, 2024-Dec S1	Example 16.5, pp. 16.6 – 16.7; Additional QB Q51 – Q53, Q65 – Q66, pp. 16.51 – 16.52
2.6	Validity test: binomial variance npq < mean np (since q < 1). Mean 10, SD 4 → npq = 16 > 10 → q = 1.6 — not a valid binomial distribution.	MTP Apr 26 S1 Q86	MTP 2026-Apr S1	16.2 (e), p. 16.3; Additional QB Q67, p. 16.53
2.7	Ratio condition P(X = r) = k·P(X = s): write both with ${}^{n}C_{x}\, p^{x}\, q^{n-x}$, cancel common powers and solve for p (n = 4, P(2) = 3P(3) → 6q = 12p → q = 2p → p = 1/3).	RTP Jan 25 Q25	RTP 2025-Jan	Example 16.4, p. 16.6
2.8	Mode of a binomial: if (n + 1)p is not an integer, mode = largest integer in (n + 1)p (unimodal); if (n + 1)p is an integer, two modes: (n + 1)p and (n + 1)p − 1. So a binomial may have one or two modes.	PYQ Nov 19 Q79, PYQ Jun 22 Q87, PYQ Jan 25 Q6, PYQ Sep 25 Q86	PYQ 2019-Nov, 2022-Jun, 2025-Jan, 2025-Sep	16.2 (d), (16.4), p. 16.3; Example 16.9, p. 16.10; Exercise Set A Q17, p. 16.40
2.9	Shape of a binomial: symmetrical when p = q = 0.5; positively skewed (skewed to the right) when p < 0.5; negatively skewed when p > 0.5.	PYQ Nov 20 Q74, MTP Jun 24 S3 Q79	PYQ 2020-Nov; MTP 2024-Jun S3	16.4 (b), p. 16.20 (symmetric at p = 0.5); Additional QB Q6, Q7, Q10, p. 16.48
2.10	Additive property: $X \sim B(n_1, p)$, $Y \sim B(n_2, p)$ independent → $X + Y \sim B(n_1 + n_2, p)$; then $P(X + Y \geq 1) = 1 - q^{n1+n2}$ (B(2, ½) + B(3, ½) → 1 − 1/32 = 31/32).	PYQ Sep 26 Q99	PYQ 2026-Sep	16.2 (f), (16.6), p. 16.3; Example 16.10, p. 16.10
2.11	*See Topic 3: rare events in a large batch (n large, p small) follow Poisson with m = np; $P(x) = e^{-m}m^{x}/x!$ (3% defective, n = 100 → m = 3, $P(1) = 3e^{-3} \approx 0.15$; $P(X \geq 2) = 1 - e^{-m}(1 + m)$, × 100 boxes ≈ 9); P(1) = 0.3, P(2) = 0.2 → m/2 = 2/3, m = 4/3, $P(0) = e^{-4/3}$.*	PYQ Jun 24 Q87, MTP Dec 24 S1 Q85, PYQ Jan 25 Q12, PYQ Jan 26 Q95	PYQ 2024-Jun, 2025-Jan, 2026-Jan; MTP 2024-Dec S1	16.3 (vi), p. 16.12; Examples 16.16 – 16.17, pp. 16.15 – 16.17
2.12	*See Topic 4: normal $Q_1 = \mu - 0.675\sigma$, $Q_3 = \mu + 0.675\sigma$ → median = mean = mode = $(Q_1 + Q_3)/2$; standard normal points of inflexion are −1 and +1; MD = 0.8σ, QD = 0.675σ (≈ ⅔σ) give 4 SD = 5 MD = 6 QD, so SD = √(15/8) × √(MD × QD).*	PYQ Jun 19 Q78, MTP Aug 24 S2 Q85, RTP Jan 25 Q24, PYQ Jan 26 Q96	PYQ 2019-Jun, 2026-Jan; RTP 2025-Jan; MTP 2024-Aug S2	16.4, Properties 2, 3 and 5, pp. 16.21 – 16.22; Standard Normal Distribution (iv), p. 16.33
2.13	Continuous random variable: pdf satisfies f(x) ≥ 0 and ∫f(x)dx = 1; mean μ = ∫x f(x)dx over the range — f(x) = 6x(1 − x), 0 < x < 1: $\mu = 6\int(x^2 - x^3)dx = 6(1/3 - 1/4) = ½$.	PYQ Jan 25 Q1	PYQ 2025-Jan	Not in SM (PYQ-only); pdf conditions at 16.4, p. 16.19

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.14	Mixed-concept question: r always lies between −1 and +1 (Correlation chapter), so 'r = 2.6' is the wrong statement; the normal curve is bell-shaped; r = 0 makes the regression lines perpendicular; P(A ∪ B) = P(A) + P(B) − P(A ∩ B).	PYQ Jan 25 Q8	PYQ 2025-Jan	16.4 (b), p. 16.20 (bell shape); r range is Chapter 17

Topic 3 Poisson Distribution

43 Scanner questions · ICAI appearances PYQ 34 · RTP 1 · MTP 8

Ref	One-liner for the student	Scanner Q	Asked in	SM source
3.1	Poisson: $f(x) = e^{-m}m^x/x!$, x = 0, 1, 2, … ; uniparametric (m only); mean = variance = m, so SD = √m. Mean = variance identifies Poisson (binomial: variance < mean).	PYQ Nov 19 Q78, PYQ Jan 21 Q77, RTP May 26 Q27	PYQ 2019-Nov, 2021-Jan; RTP 2026-May	16.3 (ii) – (iv), (16.9), (16.11) – (16.12), p. 16.11; Exercise Set A Q21 – Q22, p. 16.40; Additional QB Q18, p. 16.49
3.2	Poisson model and use: counts of rare events per unit of time or space — misprints per page, defects per metre, deaths from a rare disease, accidents. Height → normal; pass/fail, coin tosses → binomial. Model conditions concern the probability of success (kt in a small interval, more than one success very unlikely, independence) — 'probability of failure constant' is not one.	PYQ Nov 20 Q76, MTP Jun 24 S3 Q82, MTP Jan 25 S2 Q92, PYQ May 25 Q87	PYQ 2020-Nov, 2025-May; MTP 2024-Jun S3, 2025-Jan S2	16.3, Poisson Model, p. 16.11; Application of Poisson distribution, p. 16.12; Exercise Set A Q20, Q40, pp. 16.40, 16.42
3.3	P(X = r) = P(X = r + 1) ⇒ m = r + 1 (ratio m/(r + 1) = 1): P(1) = P(2) → m = 2; P(2) = P(3) → m = 3; P(4) = P(5) → m = 5. Then mean = variance = m; e.g. P(4) = $e^{-2}\cdot 2^4/4! = (2/3)e^{-2}$.	PYQ Jun 19 Q75, PYQ Jan 21 Q76, PYQ Dec 22 Q86, PYQ Sep 24 Q16, MTP Dec 24 S1 Q89, PYQ Jan 25 Q7, MTP Apr 26 S1 Q87	PYQ 2019-Jun, 2021-Jan, 2022-Dec, 2024-Sep, 2025-Jan; MTP 2024-Dec S1, 2026-Apr S1	Example 16.11, pp. 16.12 – 16.13; Exercise Set B Q13, p. 16.43
3.4	P(X = r) = k·P(X = s): write $e^{-m}m^r/r! = k\cdot e^{-m}m^s/s!$, cancel e^{-m} and powers, solve for m: P(2) = 3P(4) → $m^2 = 4$, m = 2 (variance 2, SD √2); P(7) = 8P(9) → $m^2 = 9$, m = 3; P(2) = ½P(3) → m = 6; P(2) = ⅓P(3) → m = 9.	PYQ Nov 18 Q77, PYQ Nov 19 Q80, PYQ Nov 20 Q77, PYQ Dec 21 Q87, PYQ Jun 23 Q89, MTP Jan 25 S2 Q93	PYQ 2018-Nov, 2019-Nov, 2020-Nov, 2021-Dec, 2023-Jun; MTP 2025-Jan S2	Example 16.11 (method), pp. 16.12 – 16.13; Exercise Set B Q15, p. 16.44
3.5	Three-term condition P(2) = 9P(4) + 90P(6): cancel $e^{-m}m^2/2 \rightarrow m^4 + 3m^2 - 4 = 0 \rightarrow (m^2 + 4)(m^2 - 1) = 0$ → m = 1; then $P(X \le 1) = e^{-1}(1 + 1) = 2/e = 0.7358$.	PYQ May 18 Q62	PYQ 2018-May	Example 16.14, p. 16.14; Exercise Set C Q9, p. 16.45
3.6	Two probabilities given: P(2)/P(1) = m/2, so m = 2·P(2)/P(1); then P(0) = e^{-m} (P(1) = 0.7, P(2) = 0.3 → m = 6/7, P(0) = $e^{-6/7}$).	PYQ Jul 21 Q80	PYQ 2021-Jul	16.3, (16.9), p. 16.11 (method of Example 16.11, pp. 16.12 – 16.13)

Ref	One-liner for the student	Scanner Q	Asked in	SM source
3.7	SD given: m = SD^2 (SD 1.732 → m = 3; SD 3 → m = 9, $P(0) = e^{-9}$). For an interval, add f(x) over the whole-number values inside it: $P(-2.48 < X < 3.54) = f(0) + \ldots + f(3) = 13e^{-3} \approx 0.65$. Mean + SD = m + √m (= 6/25 → √m = 1/5, m = 1/25).	PYQ Nov 20 Q79, PYQ Jun 22 Q85, PYQ May 26 Q94	PYQ 2020-Nov, 2022-Jun, 2026-May	Example 16.13, pp. 16.13 – 16.14; Exercise Set B Q9, p. 16.43
3.8	m given directly: $P(0) = e^{-m}$; $P(2) = m^2e^{-m}/2$ (m = 4 → $8/e^4$; m = 3 → $4.5e^{-3} \approx 0.224$); 'either 0 or 2' = P(0) + $P(2) = e^{-4}(1 + 8) \approx 0.165$.	PYQ Dec 21 Q85, PYQ Jun 23 Q88, PYQ Jun 24 Q88, PYQ Sep 26 Q98	PYQ 2021-Dec, 2023-Jun, 2024-Jun, 2026-Sep	Example 16.15, p. 16.15
3.9	Poisson approximation to binomial: n large, p small, m = np finite → B(n, p) ≈ P(m). P(all 4 heads) = 1/16, n = 1600 → m = 100, $P(0) = e^{-100}$; 5% of 100 → m = 5; 5% of 40 → m = 2, $P(X \le 2) = e^{-2}(1 + 2 + 2) = 0.675$.	PYQ Jun 19 Q73, PYQ May 25 Q90, MTP Apr 26 S1 Q84, MTP Apr 26 S2 Q81	PYQ 2019-Jun, 2025-May; MTP 2026-Apr S1, 2026-Apr S2	16.3 (vi), (16.14), p. 16.12; Example 16.16, pp. 16.15 – 16.16
3.10	'More than k' / 'at least k': P(X > k) = 1 − [P(0) + … + P(k)]; 'not more than 2%' of 120 → fail if X ≥ 3: $1 - e^{-2.4}(1 + 2.4 + 2.88) \approx 0.43$; expected number = N × probability (500 × 0.323 ≈ 162).	PYQ Dec 21 Q89, PYQ Dec 21 Q90, PYQ Sep 24 Q19	PYQ 2021-Dec (×2), 2024-Sep	Example 16.17, pp. 16.16 – 16.17; Exercise Set C Q11, Q14, p. 16.46
3.11	*See Topic 2: binomial — P(4 of 5 swimmers) = $^5C_4(4/5)^4(1/5)$, none of the printed options; n = 90, p = 1/3 → SD = √(npq) = √20 = 2√5; 4P(4) = P(2), n = 6 → $4p^2 = q^2$ → p = 1/3; mean 10, SD 3 → q = 0.9, p = 0.1, n = 100.*	PYQ Nov 18 Q81, PYQ Jul 21 Q81, MTP Jan 25 S2 Q88, PYQ Jan 26 Q93	PYQ 2018-Nov, 2021-Jul, 2026-Jan; MTP 2025-Jan S2	16.2, (16.1) and (16.5), p. 16.3; Examples 16.4 – 16.5, pp. 16.6 – 16.7
3.12	*See Topic 4: standardise z = (x − μ)/σ — P(50 < X < 70) = Φ(1.33) − Φ(0) = 0.4082; P(X > 95) = P(Z > 1.28) = 0.1003; symmetry: P(0 < Z < 1.5) = [0.95 − 2 × 0.045]/2 = 0.43.*	PYQ Jul 21 Q82, PYQ Dec 22 Q88, PYQ Sep 25 Q89	PYQ 2021-Jul, 2022-Dec, 2025-Sep	16.4, Property 6, (16.27) – (16.29), p. 16.22

Topic 4 Normal Distribution or Gaussian Distribution

36 Scanner questions · ICAI appearances PYQ 28 · RTP 1 · MTP 7

Ref	One-liner for the student	Scanner Q	Asked in	SM source
4.1	Normal pdf f(x) = [1/(σ√(2π))]·e^(−(x − μ)²/(2σ²)), −∞ < x < ∞: read μ from (x − μ) and σ from the denominator 2σ² — /32 → σ = 4, μ = 10; e^(−2(x − 3)²) → 2σ² = ½, σ = ½, μ = 3.	PYQ Nov 18 Q80, PYQ Nov 19 Q82, MTP Jun 24 S3 Q84	PYQ 2018-Nov, 2019-Nov; MTP 2024-Jun S3	16.4, (16.17), p. 16.20; Examples 16.20 and 16.22, pp. 16.24 – 16.25
4.2	Points of inflexion of the normal curve are μ − σ and μ + σ (standard normal: −1 and +1): mean = midpoint, σ = half the gap (6 and 14 → μ = 10, σ = 4; 40 and 60 → σ = 10, MD = 8).	PYQ Jun 19 Q77, MTP Jun 24 S3 Q84, PYQ May 25 Q88	PYQ 2019-Jun, 2025-May; MTP 2024-Jun S3	16.4, Property 5, p. 16.22; Example 16.22, p. 16.25; Exercise Set B Q20, p. 16.44

Ref	One-liner for the student	Scanner Q	Asked in	SM source
4.3	Normal: mean = median = mode = μ; quartiles are equidistant from the mean, so median = mode = $(Q_1 + Q_3)/2$ and $Q_3 = \mu + 0.675\sigma = \mu + QD$.	PYQ Nov 18 Q79, PYQ Jul 21 Q79, RTP Jan 25 Q30, PYQ May 26 Q47	PYQ 2018-Nov, 2021-Jul, 2026-May; RTP 2025-Jan	16.4, Properties 2 – 3, (16.22) – (16.23), p. 16.21; Example 16.21, p. 16.25
4.4	Normal dispersion: MD = $\sqrt{(2/\pi)}\cdot\sigma \approx 0.8\sigma$, QD = 0.675σ, so 4 SD = 5 MD = 6 QD and SD : MD : QD ≈ 15 : 12 : 10; MD/SD = 0.8. Square-root the variance first (variance 16 → σ = 4 → MD = 3.2; σ = 4 → QD = 2.70).	PYQ Jun 19 Q77, PYQ Nov 19 Q83, PYQ Nov 20 Q78, PYQ Jun 22 Q86, PYQ Jun 24 Q89, PYQ Sep 24 Q17, PYQ Jan 25 Q10, PYQ May 26 Q47	PYQ 2019-Jun, 2019-Nov, 2020-Nov, 2022-Jun, 2024-Jun, 2024-Sep, 2025-Jan, 2026-May	16.4, Property 3, (16.21) – (16.24), p. 16.21; Exercise Set A Q36, p. 16.42
4.5	Normal curve is symmetrical about μ, so skewness = 0 and the third moment about the mean = 0.	PYQ Jan 21 Q78, PYQ Dec 22 Q85, MTP Jun 24 S3 Q80	PYQ 2021-Jan, 2022-Dec; MTP 2024-Jun S3	16.4, Property 4, p. 16.22
4.6	Normal is a biparametric continuous distribution (μ, σ^2); whatever the parameters, the curve keeps the same bell shape — μ only shifts it, σ only stretches it.	PYQ Nov 20 Q75, MTP Dec 24 S1 Q75, MTP Dec 24 S1 Q87	PYQ 2020-Nov; MTP 2024-Dec S1 (×2)	16.4 (d), p. 16.21; Additional QB Q34, p. 16.50
4.7	Standard normal z ~ N(0, 1): mean = median = mode = 0, SD = 1. $\Phi(k) = P(Z \le k) = 0.5 +$ area from 0 to k ($\Phi(1) = 0.5 + 0.3413 = 0.8413$); $\Phi(-k) = 1 - \Phi(k)$.	PYQ May 18 Q66, PYQ Dec 23 Q83	PYQ 2018-May, 2023-Dec	16.4 (c), (16.19) – (16.20), p. 16.21; Property 6, (16.26), p. 16.22; Standard Normal Distribution (i) – (ii), p. 16.33; Exercise Set B Q23, p. 16.44
4.8	Areas: total area = 1; $\mu \pm \sigma = 68.28\%$, $\mu \pm 2\sigma = 95.46\%$, $\mu \pm 3\sigma = 99.73\%$ (all but 0.27%); z = ±1.96 encloses 95% ($z_{0.025} = 1.96$).	PYQ Jun 19 Q76, PYQ Nov 19 Q77, MTP Jun 24 S3 Q85, MTP Aug 24 S2 Q89	PYQ 2019-Jun, 2019-Nov; MTP 2024-Jun S3, 2024-Aug S2	16.4 (b), p. 16.20; Property 7, (16.33), p. 16.23; (16.38), p. 16.33; Exercise Set A Q29, Q39, pp. 16.41 – 16.42
4.9	Probabilities by standardising $z = (x - \mu)/\sigma$: $P(X > b) = 1 - \Phi(z_b)$; $P(a < X < b) = \Phi(z_b) - \Phi(z_a)$; expected number = N × probability. Trap: σ = √variance (variance 100 → σ = 10, $P(X \ge 60) = 1 - \Phi(1) \approx 0.16$).	PYQ Dec 21 Q88, PYQ Sep 24 Q15, MTP Jan 25 S2 Q91, PYQ Sep 26 Q100	PYQ 2021-Dec, 2024-Sep, 2026-Sep; MTP 2025-Jan S2	16.4, Property 6, (16.27) – (16.29), p. 16.22; Examples 16.24, 16.26 and 16.27, pp. 16.26 – 16.29

Ref	One-liner for the student	Scanner Q	Asked in	SM source
4.10	Sum of independent normals: $X + Y \sim N(\mu_1 + \mu_2, \sigma_1^2 + \sigma_2^2)$ — add variances, not SDs: $SD = \sqrt{(\sigma_1^2 + \sigma_2^2)}$ (3 and 4 → 5).	PYQ Dec 23 Q86, PYQ Sep 24 Q18	PYQ 2023-Dec, 2024-Sep	16.4, Property 8, (16.34), p. 16.24; Example 16.32, pp. 16.32 – 16.33; Exercise Set B Q24, p. 16.44
4.11	Unknown constant in a pdf: set the total area $\int f(x)dx = 1$ over the range — kx^2, $0 \le x \le 1 \rightarrow k/3 = 1 \rightarrow k = 3$.	PYQ May 26 Q43	PYQ 2026-May	16.4, p. 16.19; Additional QB Q61, Q62, Q84, pp. 16.52, 16.54
4.12	*See Topic 3: Poisson with $m = 3$ — $P(2) = 3^2e^{-3}/2! = 0.049 \times 4.5 \approx 0.22$.*	PYQ Sep 25 Q87	PYQ 2025-Sep	16.3, (16.9), p. 16.11; Example 16.15, p. 16.15
4.13	*See Topic 2: binomial mean = $np = 25 \times 0.2 = 5$.*	PYQ Jan 26 Q94	PYQ 2026-Jan	16.2, (16.3), p. 16.3

Part B — Chapter 16 One-liner Revision Sheet

Deduplicated and in Study Material order. Click a 'Part A ref' to jump to the Part A row(s) carrying the full wording, the Scanner questions and the SM page. Refs read Unit.Topic.Row in chapters with several units and Topic.Row otherwise. Weight: ★★★ asked by ICAI 6 or more times · ★★ 3 – 5 times · ★ once or twice. The ★★★ lines alone cover about 74% of ICAI appearances in this chapter.

Theoretical Distributions

#	One-liner	Weight	Part A ref
1	Probability distribution: discrete (binomial, Poisson) or continuous (normal, via pdf)	★	1.1
2	**Binomial f(x) = $^nC_x p^x q^{n-x}$ · n independent two-outcome trials, constant p · biparametric (n, p)**	★★★	2.1, 2.2
3	**Mean np · variance npq = nq(1 − q) · SD √(npq) · max variance n/4 at p = ½**	★★★	2.3, 2.4
4	**From mean & variance: q = var/mean, p = 1 − q, n = mean/p · variance must be < mean**	★★★	2.5, 2.6
5	P(X = r) = k·P(X = s): write both terms, cancel, solve for p	★	2.7
6	Mode: largest integer in (n + 1)p; if (n + 1)p integer → two modes (n + 1)p and (n + 1)p − 1	★★	2.8
7	p = ½ symmetrical · p < ½ skewed right · p > ½ skewed left	★	2.9
8	Additive: $B(n_1, p) + B(n_2, p) = B(n_1 + n_2, p)$ · $P(\geq 1) = 1 - q^n$	★	2.10
9	**Poisson $f(x) = e^{-m}m^x/x!$ · uniparametric · mean = variance = m · SD = √m**	★★★	3.1, 3.7
10	Poisson model: rare events per unit time/space (misprints, defects, rare deaths, accidents)	★★	3.2
11	**P(r) = P(r + 1) ⇒ m = r + 1 · P(r) = k·P(s): cancel e^{-m}, solve m · P(2)/P(1) = m/2**	★★★	3.3, 3.4, 3.6
12	9P(4) + 90P(6) = P(2) ⇒ m = 1 · P(X ≤ 1) = 2/e = 0.7358	★	3.5
13	**m given: $P(0) = e^{-m}$, $P(2) = m^2e^{-m}/2$ · interval = sum over whole numbers inside it**	★★★	3.7, 3.8
14	**n large, p small ⇒ Poisson with m = np · 'more than k' = 1 − Σ_0^k · expected number = N × P**	★★★	3.9, 3.10, 2.11
15	Continuous pdf: f(x) ≥ 0, ∫f(x)dx = 1 (find k) · mean = ∫x f(x)dx	★	4.11, 2.13
16	**Normal pdf $1/(\sigma\sqrt{2\pi})\cdot e^{-(x-\mu)^2/2\sigma^2}$: read μ, σ by comparison · bell-shaped, biparametric, same shape for any μ, σ**	★★★	4.1, 4.6
17	Standard normal N(0, 1) · Φ(k) = 0.5 + area 0 to k · Φ(−k) = 1 − Φ(k)	★	4.7
18	**Mean = median = mode = $(Q_1 + Q_3)/2$ · $Q_{1,3} = \mu \mp 0.675\sigma$**	★★★	4.3, 2.12
19	**MD ≈ 0.8σ · QD = 0.675σ · 4 SD = 5 MD = 6 QD · SD : MD : QD = 15 : 12 : 10**	★★★	4.4
20	**Skewness 0, third central moment 0 · inflexion at μ ± σ (standard: ±1)**	★★★	4.5, 4.2
21	Areas: ±1σ 68.28% · ±2σ 95.46% · ±3σ 99.73% · ±1.96 → 95% · total area 1	★★	4.8

#	One-liner	Weight	Part A ref
22	**$z = (x - \mu)/\sigma$ · $P(X > b) = 1 - \Phi(z)$ · $P(a < X < b) = \Phi(z_b) - \Phi(z_a)$ · number = N × P**	★★★	4.9, 3.12
23	X + Y independent normals: mean $\mu_1 + \mu_2$, SD $\sqrt{(\sigma_1^2 + \sigma_2^2)}$	★	4.10

CHAPTER 17

Correlation and Regression

124 Scanner questions · 59 one-liners · 30 revision pointers

Part A — One-liners mapped to Scanner questions and Study Material

Correlation and Regression

SM Chapter 17, pages 17.1 – 17.60

Topic 1 Correlation Analysis

13 Scanner questions · ICAI appearances PYQ 8 · RTP 1 · MTP 4

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.1	Bivariate frequency table with m classes of x and n classes of y: it yields exactly 2 marginal distributions (one for x, one for y, from the row and column totals) and m + n conditional distributions (one for each class of the other variable); a p × q table has pq cells.	MTP Apr 26 S1 Q93, MTP Apr 26 S2 Q91	MTP 2026-Apr S1, 2026-Apr S2	17.2, pp. 17.4 – 17.5; Exercise Set A Q4 – Q5, p. 17.41
1.2	Positive correlation: both variables move in the same direction (height–weight, rainfall–yield, profit–investment, speed of a car–distance needed to stop it). Negative correlation: they move in opposite directions (price–demand, an insurance company's profits–number of claims it pays). Uncorrelated: no movement in a particular direction (shoe-size–intelligence).	PYQ May 18 Q72, PYQ Sep 24 Q22, PYQ Sep 25 Q92	PYQ 2018-May, 2024-Sep, 2025-Sep	17.3, p. 17.5; Additional Question Bank Q60, Q86, pp. 17.57 – 17.59
1.3	*See Topic 2: scatter points running from upper left to lower right show negative correlation (lower left to upper right = positive).*	PYQ Nov 19 Q87	PYQ 2019-Nov	17.4(a), p. 17.6
1.4	Spurious (non-sense) correlation = correlation between two variables that have no causal relationship, caused by a third variable linked to both (e.g. rice and iron output both rising with time) — not 'bad', 'negative' or 'very low' correlation.	PYQ Nov 20 Q80	PYQ 2020-Nov	17.7, pp. 17.37 – 17.38; Exercise Set A Q8, p. 17.42
1.5	Cov(x, y) = $\Sigma(x - \bar{x})(y - \bar{y})/n = \Sigma xy/n - \bar{x}\bar{y}$ (17.2); it can be positive, negative or zero (only variance cannot be negative). Trap: if $\Sigma(x + y)^2$ is given, first recover $\Sigma xy = [\Sigma(x + y)^2 - \Sigma x^2 - \Sigma y^2] \div 2 = (1372 - 652)/2 = 360$, so Cov = 36 − 5 × 6 = 6.	PYQ Nov 20 Q82, PYQ Jan 25 Q11	PYQ 2020-Nov, 2025-Jan	17.4(b), (17.2), p. 17.8; Exercise Set A Q21, p. 17.43
1.6	*See Topic 2: r is a unit-free (pure) number, independent of the units of measurement, and unchanged by a change of origin — adding 10 to X and subtracting 20 from Y leaves r = 0.8.*	MTP Jun 24 S3 Q69, PYQ May 25 Q91	PYQ 2025-May; MTP 2024-Jun S3	17.4(b) properties (i) – (ii), p. 17.9
1.7	*See Topic 4: r is the simple geometric mean of the two regression coefficients, $r = \pm\sqrt{byx \times bxy}$ — not the AM or HM.*	RTP Jan 25 Q22	RTP 2025-Jan	17.6 (iii), (17.30), p. 17.35

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.8	*See Topic 5: variation unaccounted for = coefficient of non-determination = 1 − r^2; r = 0.8 → 1 − 0.64 = 36% (64% is the part explained).*	MTP Jan 25 S2 Q78	MTP 2025-Jan S2	17.7, p. 17.38

Topic 2 Measures of Correlation

52 Scanner questions · ICAI appearances PYQ 43 · RTP 2 · MTP 7

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.1	Scatter diagram: points from lower left to upper right → positive correlation; from upper left to lower right → negative (X rising while Y falls); on a straight line going downwards → perfect negative ('indirect') correlation; evenly spread with no pattern → zero correlation.	PYQ May 18 Q67, PYQ Dec 21 Q91, PYQ Jun 22 Q90, MTP Dec 24 S1 Q91	PYQ 2018-May, 2021-Dec, 2022-Jun; MTP 2024-Dec S1	17.4(a), p. 17.6; Figures 17.1 – 17.5, pp. 17.6 – 17.7
2.2	Scatter diagram plots paired quantitative data and suits any relation, linear or curvilinear; it shows whether and how the variables are correlated but fails to measure the extent — it gives no numerical value of r.	PYQ Nov 20 Q81, PYQ Jun 22 Q93	PYQ 2020-Nov, 2022-Jun	17.4(a), p. 17.6
2.3	Karl Pearson's product moment correlation coefficient = ratio of the covariance to the product of the two standard deviations: r = Cov(x, y) ÷ (Sx × Sy) (17.1) — SDs, not variances, in the denominator. If $\Sigma(x - \bar{X})(y - \bar{y}) = 0$, Cov = 0 and r = 0.	PYQ Jul 21 Q87, PYQ Dec 22 Q93, PYQ Dec 23 Q89	PYQ 2021-Jul, 2022-Dec, 2023-Dec	17.4(b), (17.1) – (17.2), pp. 17.7 – 17.8
2.4	r = Cov/(Sx·Sy) and its rearrangement Sy = Cov/(r·Sx). Take √variance first: 40/(4 × 16) = 0.625, 8.4/(5 × 6) = 0.28; −2.15/(1.30 × 2.50) = −0.66; Sy = 16/(0.5 × 4) = 8; Sy = 4/(0.4 × 10) = 1.	PYQ Jan 21 Q80, PYQ Jun 24 Q91, MTP Jan 25 S2 Q79, RTP May 26 Q20, PYQ May 26 Q46	PYQ 2021-Jan, 2024-Jun, 2026-May; RTP 2026-May; MTP 2025-Jan S2	17.4(b), (17.1), p. 17.8; Exercise Set B Q1, p. 17.46
2.5	From raw pairs: $r = [n\Sigma xy - \Sigma x \cdot \Sigma y] \div \sqrt{[n\Sigma x^2 - (\Sigma x)^2][n\Sigma y^2 - (\Sigma y)^2]}$ (17.5); shifting the origin (dx = x − 3, dy = y − 7) cuts the arithmetic: {(1,2), (2,5), (3,7), (4,8), (5,10)} → 95/√(50 × 186) = 0.985. If $\Sigma xy/n = \bar{x}\bar{y}$ (x = 1...5, y = 5, 4, 3, 2, 6: 60/5 = 3 × 4) then Cov = 0 and r = 0.	PYQ Nov 19 Q86, PYQ Jan 21 Q79	PYQ 2019-Nov, 2021-Jan	17.4(b), (17.5), p. 17.8; Example 17.4, p. 17.13
2.6	Pearson's r measures only linear relationship: for values symmetric about 0 with $y = x^2$ (x = −3, −3/2, 0, 3/2, 3), Cov = 0 so r = 0 although y depends exactly on x — r = 0 does not mean independence.	PYQ Jun 19 Q80	PYQ 2019-Jun	17.7, p. 17.37
2.7	r is a unit-free measure (independent of the units of measurement) and lies between −1 and +1 inclusive ($-1 \le r \le 1$): maximum +1, minimum −1. Spearman's rank correlation coefficient and the coefficient of concurrent deviations have the same range.	PYQ May 18 Q71, PYQ May 18 Q74, PYQ Jun 24 Q94, MTP Jun 24 S3 Q97	PYQ 2018-May (×2), 2024-Jun; MTP 2024-Jun S3	17.4(b) properties (i), (iii), p. 17.9; 17.4(c), p. 17.18

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.8	Change of origin and scale: if u = (x − a)/b and v = (y − c)/d, r_uv = r_xy when the scale factors b and d have the same sign and r_uv = −r_xy when they differ (17.10). Solve each relation for u (or v) and read only the sign of the x (or y) term: u = (x − 3)/2, v = (y − 2)/3 → 0.925 unchanged; 2u − x + 3 = 0 (+) with 3v + y − 2 = 0 (−) → −0.6; 3x + 4u + 7 = 0 (u falls as x rises) → r_uy = −(−0.6) = 0.6.	PYQ Jun 22 Q88, PYQ Sep 24 Q23, MTP Jan 25 S2 Q80, PYQ Jan 26 Q99	PYQ 2022-Jun, 2024-Sep, 2026-Jan; MTP 2025-Jan S2	17.4(b) property (ii), (17.10), p. 17.9; Example 17.8, p. 17.18; Exercise Set B Q7, p. 17.47
2.9	An exact linear relation y = a + bx gives perfect correlation: r = +1 if b > 0, r = −1 if b < 0. 4x + 3y = 7 → y = (7 − 4x)/3, slope negative → perfect negative.	MTP Dec 24 S1 Q92	MTP 2024-Dec S1	17.4(a), Figures 17.2 and 17.4, pp. 17.6 – 17.7; Exercise Set B Q4, p. 17.46
2.10	Karl Pearson's coefficient needs numerical measurements and a linear relationship; the SM gives a single formula for ungrouped data (17.5) and separate formulas for a bivariate frequency (grouped) distribution (17.6) – (17.9). The keyed answer is 'ungrouped data' — see editorial note.	PYQ Jun 22 Q89	PYQ 2022-Jun	17.4(b), (17.5) – (17.9), pp. 17.8 – 17.9; Additional Question Bank Q19, p. 17.54
2.11	Spearman's rank correlation is used to find correlation between two qualitative characteristics (e.g. beauty and intelligence) or agreement between two judges — it checks the relationship between the variables, not scatter, median or range.	PYQ Jun 22 Q92, PYQ Jun 24 Q93	PYQ 2022-Jun, 2024-Jun	17.4(c), p. 17.18
2.12	Spearman's rR = 1 − 6Σd² ÷ [n(n² − 1)] (17.11) — the denominator is n(n² − 1), not n(n² + 1). Σd² = 30, n = 10 → 1 − 180/990 = 0.82; Σd² = 60 → 0.636. For marks, rank each series (highest = 1) before taking d = Rx − Ry: 6 students → Σd² = 44 → 1 − 264/210 = −0.257.	PYQ Jun 19 Q83, PYQ Dec 22 Q92, PYQ Jun 23 Q91, PYQ Jun 24 Q92	PYQ 2019-Jun, 2022-Dec, 2023-Jun, 2024-Jun	17.4(c), (17.11), p. 17.18; Example 17.12, p. 17.22
2.13	Tied ranks: rR = 1 − 6[Σd² + Σ(t³ − t)/12] ÷ [n(n² − 1)] (17.12), adding one t(t² − 1)/12 term for every tie in either series (X has one tie of 15s, Y two ties, 16s and 18s).	PYQ Jun 19 Q82	PYQ 2019-Jun	17.4(c), (17.12), p. 17.19; Example 17.11, pp. 17.21 – 17.22
2.14	Reversing Spearman: n(n² − 1) = 6Σd² ÷ (1 − rR), then match n: 6 × 66/0.4 = 990 = 10 × 99 → n = 10; 240 ÷ (24/99) = 990 → n = 10. Σd² = (1 − rR) × n(n² − 1)/6 = 0.30 × 990/6 = 49.5.	MTP Dec 24 S1 Q90, PYQ May 26 Q99, PYQ Sep 26 Q74	PYQ 2026-May, 2026-Sep; MTP 2024-Dec S1	Example 17.13, pp. 17.22 – 17.23; Exercise Set B Q11, p. 17.47
2.15	Wrongly taken rank difference: back out Σd² from the reported rR, then corrected Σd² = Σd² − (wrong d)² + (correct d)²: 0.5 → Σd² = 82.5; 82.5 − 3² + 7² = 122.5 → rR = 1 − 735/990 = 0.26.	PYQ Jan 26 Q97	PYQ 2026-Jan	Example 17.14, p. 17.23
2.16	Coefficient of concurrent deviations uses only the direction (+/−) of change: rC = ±√[±(2c − m)/m] (17.13), m = number of pairs − 1, c = concurrent deviations, sign taken from (2c − m). rC = 1/√3, c = 6 → (12 − m)/m = 1/3 → m = 9 → n = 10 pairs.	PYQ May 18 Q70, PYQ Jun 22 Q91	PYQ 2018-May, 2022-Jun	17.4(d), (17.13), pp. 17.23 – 17.24; Exercise Set B Q14, p. 17.47

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.17	Limits for the population correlation coefficient = r ± P.E., where probable error P.E. = 0.6745(1 − r²)/√n (Scanner rounds 0.6745 to ⅔): r = 0.4, n = 81 → 0.6745 × 0.84/9 = 0.063 → (0.337, 0.463).	PYQ Jun 23 Q90	PYQ 2023-Jun	Not in SM (PYQ-only)
2.18	*See Topic 4: r = ±√(byx × bxy) with the common sign: √(0.5 × 0.46) = 0.48; √(0.7 × 0.8) = 0.75; reversed, byx = r²/bxy = 0.64/0.32 = 2.*	PYQ Dec 22 Q91, PYQ Dec 23 Q90, PYQ May 25 Q92	PYQ 2022-Dec, 2023-Dec, 2025-May	17.6 (iii), (17.30), p. 17.35
2.19	*See Topic 3: treat one line as y on x and the other as x on y and keep the choice only if byx × bxy ≤ 1: 2x + 3y = 2 (byx = −2/3) with 4x + 3y = 4 (bxy = −3/4) → r = −√0.5 = −0.71; 3x − 4y + 8 = 0 (byx = 3/4) with 4x − 3y = 1 (bxy = 3/4) → r = 3/4.*	PYQ Nov 19 Q85, PYQ Jun 24 Q95	PYQ 2019-Nov, 2024-Jun	Example 17.20, pp. 17.35 – 17.36
2.20	*See Topic 4: byx = r·σy/σx — y = x + 2 gives byx = 1 = 0.5 × σy/σx, so σy/σx = 2 and σy²/σx² = 4.*	PYQ Jun 19 Q84	PYQ 2019-Jun	17.5, (17.18), p. 17.27
2.21	*See Topic 4: regression coefficients change with scale: m = 10 − 3x, n = 5 − (2/5)y → b_nm = [(−2/5) ÷ (−3)] × 0.80 = 0.1067.*	PYQ Sep 25 Q93	PYQ 2025-Sep	17.6 (i), (17.28), p. 17.34; Example 17.19, p. 17.35
2.22	*See Topic 3: byx × bxy = r² ≤ 1, so if byx > 1 then bxy cannot be greater than one.*	PYQ Sep 25 Q94	PYQ 2025-Sep	17.6 (iii), p. 17.35; Exercise Set A Q39, p. 17.45
2.23	*See Topic 5: coefficient of determination = r² (r = −0.9 → 0.81, sign irrelevant); non-determination = 1 − r² (r = 0.7 → 0.51; r = 0.6 → 0.64).*	RTP Sep 24 Q29, PYQ May 25 Q94, MTP Jan 25 S2 Q97	PYQ 2025-May; RTP 2024-Sep; MTP 2025-Jan S2	17.7, p. 17.38

Topic 3 Regression Analysis

33 Scanner questions · ICAI appearances PYQ 29 · RTP – · MTP 4

Ref	One-liner for the student	Scanner Q	Asked in	SM source
3.1	Regression line of y on x: y = a + bx (17.14) — a is the intercept, b = byx the slope (regression coefficient of y on x). Estimate by substitution: 15 + 5.5 × 6 = 48. A horizontal line has slope b = 0.	PYQ Jul 21 Q85, PYQ Jul 21 Q88	PYQ 2021-Jul (×2)	17.5, (17.14), p. 17.25; Additional Question Bank Q28 – Q29, p. 17.55
3.2	Least squares from sums: byx = [nΣxy − Σx·Σy] ÷ [nΣx² − (Σx)²] (17.25) and a = ȳ − b·x̄ (17.19). n = 5, Σx = 10, Σy = 25, Σxy = 70, Σx² = 30 → b = 100/50 = 2; n = 4, Σx = 10, Σy = 14, Σxy = 3, Σx² = 65 → byx = −128/160 = −0.8, a = 3.5 + 0.8 × 2.5 = 5.5 → y = −0.8x + 5.5.	PYQ Jun 23 Q94, PYQ May 26 Q97	PYQ 2023-Jun, 2026-May	17.5, (17.19), (17.25), p. 17.27; Example 17.18, pp. 17.33 – 17.34
3.3	Point-slope forms: y − ȳ = byx(x − x̄) and x − x̄ = bxy(y − ȳ). x̄ = 5, ȳ = 3, byx = 0.6 → y = 0.6x. With r = 1, byx·bxy = 1, so byx = 0.5 gives bxy = 2 and the x-on-y line is x = 30 + 2(y − 40) — it must be written as x = …	PYQ Jan 21 Q82, PYQ Jan 25 Q15	PYQ 2021-Jan, 2025-Jan	17.5, (17.20), (17.27), pp. 17.27 – 17.28

Ref	One-liner for the student	Scanner Q	Asked in	SM source
3.4	Unlabelled regression lines: assume one is y on x (solve for y → byx) and the other x on y (solve for x → bxy); the assumption stands only if byx × bxy ≤ 1, otherwise swap. 8Y = 6X (byx = 3/4) with 3X = Y (bxy = 1/3) → r = 0.5; y = 9x, x = 0.01y → r = √0.09 = 0.3; x + 2y − 5 = 0 is y on x (−½ × −3/2 = ¾); 2x + 5y = 20 is y on x (byx = −0.4, bxy = −1/3).	PYQ Nov 18 Q83, PYQ Nov 19 Q84, PYQ Jul 21 Q84, MTP Dec 24 S1 Q93	PYQ 2018-Nov, 2019-Nov, 2021-Jul; MTP 2024-Dec S1	Example 17.20 (ii), p. 17.36; Exercise Set B Q18, p. 17.48
3.5	Same test when the coefficients are negative — r takes their common (negative) sign: 4x + 3y + 7 = 0 (x on y, bxy = −3/4) with 3x + 4y + 8 = 0 (y on x, byx = −3/4) → r = −0.75; 9X + 12Y = 36 as y on x gives 0.75 × 2 = 1.5 > 1, so it is x on y (bxy = −4/3) and 3X + 6Y = 12 is y on x (byx = −½) → r = −√(2/3) ≈ −0.82.	PYQ Dec 22 Q89, PYQ Sep 26 Q50	PYQ 2022-Dec, 2026-Sep	17.6 (iii), p. 17.35; Example 17.20, pp. 17.35 – 17.36
3.6	byx × bxy = r^2 ≤ 1, so the product of the regression coefficients must be numerically less than (or equal to) unity: if one exceeds 1 the other must be less than 1, and both > 1 is impossible (S2 false). S1 is true — correlation does not imply causation (spurious correlation).	PYQ Dec 23 Q91, PYQ Sep 24 Q21, MTP Dec 24 S1 Q95, PYQ Sep 26 Q71	PYQ 2023-Dec, 2024-Sep, 2026-Sep; MTP 2024-Dec S1	17.6 (iii), (17.30), p. 17.35; 17.7, p. 17.38; Exercise Set A Q39, p. 17.45
3.7	One regression line plus r: read byx from the y-on-x line, then bxy = r^2 ÷ byx. 4y − 6x = 18 → byx = 1.5 → bxy = 0.64/1.5 = 0.4267; 4y − 5x = 15 → byx = 1.25 → bxy = 0.5625/1.25 = 0.45.	PYQ Dec 23 Q92, MTP Apr 26 S1 Q91	PYQ 2023-Dec; MTP 2026-Apr S1	17.6 (iii), (17.30), p. 17.35; Exercise Set B Q21, p. 17.48
3.8	r = √(byx × bxy) is the GM of the regression coefficients and AM ≥ GM, so (byx + bxy)/2 ≥ r (for positive coefficients).	PYQ Jun 19 Q79	PYQ 2019-Jun	Not in SM (PYQ-only)
3.9	*See Topic 4: r = ±√(byx × bxy) = √(1.6 × 0.4) = 0.8, positive because both coefficients are positive.*	PYQ Jan 26 Q45	PYQ 2026-Jan	17.6 (iii), (17.30), p. 17.35
3.10	*See Topic 4: the regression lines intersect at ($\bar{x}$, $\bar{y}$) — solve them simultaneously: 2x + 5y = 9 & 3x − y = 5 → (2, 1); 2x + 3y = −1 & 5x + 6y = −1 → (1, −1); x + 2y = 5 & 2x + 3y = 8 → (1, 2); 10x + 20y = 290 & 4x + 7y = 104 → (5, 12); 2X + 3Y = 10 & 4X + Y = 12 → (2.6, 1.6).*	PYQ Dec 21 Q92, PYQ Dec 22 Q90, PYQ Jun 23 Q92, PYQ Dec 23 Q88, PYQ Sep 26 Q73	PYQ 2021-Dec, 2022-Dec, 2023-Jun, 2023-Dec, 2026-Sep	17.6 (ii), p. 17.34; Example 17.20 (i), p. 17.36
3.11	*See Topic 4: regression coefficients are independent of change of origin but not of scale.*	PYQ Sep 24 Q20, MTP Dec 24 S1 Q94	PYQ 2024-Sep; MTP 2024-Dec S1	17.6 (i), p. 17.34
3.12	*See Topic 2: rR = 1 − 6Σd^2/[n(n^2 − 1)]: n = 10, Σd^2 = 5 → 0.97; n = 9, Σd^2 = 62 → 1 − 372/720 = 0.48; rR = 0.8, n = 10 → Σd^2 = 0.2 × 990/6 = 33; Σd^2 = 60 = 120rR → rR = 0.5 → n(n^2 − 1) = 720 → n = 9.*	PYQ Jan 25 Q19, PYQ May 25 Q93, PYQ Sep 25 Q95, PYQ Sep 25 Q91	PYQ 2025-Jan, 2025-May, 2025-Sep (×2)	17.4(c), (17.11), p. 17.18; Example 17.13, pp. 17.22 – 17.23
3.13	*See Topic 5: r^2 = 1 − 500/300 would be negative, so the relationship is not possible (True); non-determination = 1 − r^2 = 1 − 0.64 = 0.36.*	PYQ May 18 Q73, PYQ Jan 25 Q23	PYQ 2018-May, 2025-Jan	17.7, p. 17.38; Additional Question Bank Q45, p. 17.56

Topic 4 Properties of Regression Lines

22 Scanner questions · ICAI appearances PYQ 13 · RTP 1 · MTP 8

Ref	One-liner for the student	Scanner Q	Asked in	SM source
4.1	Regression coefficients remain unchanged by a shift of origin but change with a shift of scale: for u = (x − a)/p, v = (y − c)/q, byx = (q/p)·bvu (17.28) and bxy = (p/q)·buv (17.29).	PYQ Jan 21 Q83, PYQ Dec 21 Q94	PYQ 2021-Jan, 2021-Dec	17.6 (i), p. 17.34; Exercise Set A Q40, p. 17.46
4.2	The two regression lines intersect at the point of means ($\bar{x}$, $\bar{y}$) — not mode or median, not (0, 0) or (byx, bxy). If the intersection falls on the X-axis, $\bar{y}$ = 0.	PYQ Nov 18 Q82, PYQ Jan 21 Q81, PYQ Dec 21 Q93	PYQ 2018-Nov, 2021-Jan, 2021-Dec	17.6 (ii), p. 17.34
4.3	Means from the lines: solve both simultaneously, or put a known mean into either line. 4x + 3y = −7 & 3x + 4y = −8 → (−4/7, −11/7); 2x + 3y = −1 & 5x + 6y = −1 → (1, −1); y = 3x + 4 with $\bar{x}$ = −1 → $\bar{y}$ = 1; 2$\bar{x}$ + 3(−2) + 2 = 0 → $\bar{x}$ = 2.	MTP Jun 24 S3 Q68, MTP Aug 24 S2 Q93, MTP Aug 24 S2 Q94, PYQ May 26 Q49	PYQ 2026-May; MTP 2024-Jun S3, 2024-Aug S2 (×2)	17.6 (ii), p. 17.34; Example 17.20 (i), p. 17.36; Exercise Set B Q17, Q24, p. 17.48
4.4	r = ±√(byx × bxy) (17.30): the simple geometric mean of the two regression coefficients, with their common sign. √(0.6 × 0.9) = 0.73; byx = −0.72, bxy = −0.50 → r = −√0.36 = −0.60; x = 2y + 4 (bxy = 2) and y = kx + 6 (byx = k) with r = 0.5 → 0.25 = 2k → k = 1/8.	PYQ May 25 Q95, PYQ May 26 Q100, PYQ Sep 26 Q72	PYQ 2025-May, 2026-May, 2026-Sep	17.6 (iii), (17.30), p. 17.35
4.5	byx = r·Sy/Sx (17.18) and bxy = r·Sx/Sy (17.23). 8x + 10y = 25 (y on x, byx = −0.8) and 16x + 5y = 12 (x on y, bxy = −5/16) → r = −0.5; −0.8 = −0.5 × Sy/5 → Sy = 8.	MTP Aug 24 S2 Q92	MTP 2024-Aug S2	17.5, (17.18), (17.23), p. 17.27; Example 17.20 (iv), p. 17.37; Exercise Set C Q17, p. 17.51
4.6	The two regression lines coincide (become identical) when r = ±1 (perfect correlation) and are perpendicular when r = 0 (uncorrelated variables) — never parallel.	PYQ Jun 23 Q93, MTP Jun 24 S3 Q78, MTP Aug 24 S2 Q91, RTP Jan 25 Q23	PYQ 2023-Jun; RTP 2025-Jan; MTP 2024-Jun S3, 2024-Aug S2	17.7, p. 17.38
4.7	*See Topic 3: byx × bxy = r^2 ≤ 1, so if one regression coefficient is greater than one the other is less than one.*	MTP Jun 24 S3 Q96	MTP 2024-Jun S3	17.6 (iii), p. 17.35; Exercise Set A Q39, p. 17.45
4.8	*See Topic 2: r keeps its value under change of origin and scale but changes sign when the scale factors differ in sign: 2x − 4 (+) and 3 − 2y (−) → r = −0.5.*	PYQ Nov 18 Q85	PYQ 2018-Nov	17.4(b) property (ii), (17.10), p. 17.9
4.9	*See Topic 2: r = 1 means all points lie on a straight line rising from lower left to upper right (r = −1: falling from upper left to lower right).*	MTP Jan 25 S2 Q77	MTP 2025-Jan S2	17.4(a), Figure 17.2, p. 17.6; Exercise Set A Q19, p. 17.43
4.10	*See Topic 3: Y = a + bX with intercept 14 and slope 3.5 → Y = 14 + 3.5 × 6 = 35.*	PYQ Jan 26 Q42	PYQ 2026-Jan	17.5, (17.14), p. 17.25

Ref	One-liner for the student	Scanner Q	Asked in	SM source
4.11	*See Topic 3: x + 2y − 5 = 0 as y on x (byx = −0.5) and 2x + 3y − 8 = 0 as x on y (bxy = −1.5) → product 0.75 ≤ 1 → r = −√0.75 = −0.87.*	PYQ Jan 26 Q43	PYQ 2026-Jan	Example 17.20, pp. 17.35 – 17.36

Topic 5 Review of Correlation and Regression Analysis

4 Scanner questions · ICAI appearances PYQ 4 · RTP – · MTP –

Ref	One-liner for the student	Scanner Q	Asked in	SM source
5.1	Coefficient of determination r^2 = explained variance ÷ total variance = 1 − (unexplained variance ÷ total variance), so both forms are correct; coefficient of non-determination = 1 − r^2 = unexplained ÷ total variance.	PYQ May 18 Q69	PYQ 2018-May	17.7, p. 17.38; Additional Question Bank Q39, p. 17.55
5.2	*See Topic 4: the regression coefficient is independent of change of origin (but not of scale).*	PYQ Nov 18 Q84	PYQ 2018-Nov	17.6 (i), p. 17.34
5.3	*See Topic 2: P.E. = 0.6745(1 − r^2)/√n; r = 2/√10 (r^2 = 0.4), n = 36 → 0.6745 × 0.6/6 = 0.067.*	PYQ Jun 19 Q81	PYQ 2019-Jun	Not in SM (PYQ-only)
5.4	bxy = r·Sx/Sy (17.23): Var(X) = 5Var(Y) → Sx/Sy = √5 → bxy = 0.2 × √5 = 1/√5 ≈ 0.447.	PYQ Jan 25 Q18	PYQ 2025-Jan	17.5, (17.23), p. 17.27

Part B — Chapter 17 One-liner Revision Sheet

Deduplicated and in Study Material order. Click a 'Part A ref' to jump to the Part A row(s) carrying the full wording, the Scanner questions and the SM page. Refs read Unit.Topic.Row in chapters with several units and Topic.Row otherwise. Weight: ★★★ asked by ICAI 6 or more times · ★★ 3 – 5 times · ★ once or twice. The ★★★ lines alone cover about 59% of ICAI appearances in this chapter.

Correlation and Regression

#	One-liner	Weight	Part A ref
1	Bivariate table: 2 marginal distributions · m + n conditional distributions · p × q table = pq cells	★	1.1
2	Positive = same direction (speed–stopping distance) · negative = opposite (insurance profits–claims) · shoe-size–intelligence = zero	★★	1.2
3	**Scatter: lower-left→upper-right + · upper-left→lower-right − · even spread 0 · r = 1 straight rising line**	★★★	2.1, 1.3, 4.9
4	Scatter diagram: quantitative data, linear or curvilinear, no numerical value of r	★	2.2
5	r = Cov/(Sx·Sy) · Cov = Σxy/n − $\bar{X}\bar{y}$ (+, − or 0) · Σxy = [Σ(x+y)² − Σx² − Σy²]/2	★★	2.3, 1.5
6	r numericals: √variance first · Sy = Cov/(r·Sx)	★★	2.4
7	r = [nΣxy − ΣxΣy]/√{[nΣx² − (Σx)²][nΣy² − (Σy)²]} · Cov = 0 ⇒ r = 0	★	2.5
8	**r unit-free · −1 ≤ r ≤ 1 (also rR, rC)**	★★★	2.7, 1.6
9	u = (x−a)/b, v = (y−c)/d: |r| unchanged · sign flips if b, d differ in sign	★★	2.8, 4.8
10	Exact line y = a + bx: r = +1 (b > 0) / −1 (b < 0)	★	2.9
11	Pearson: numerical data, linear relation only · y = x² symmetric ⇒ r = 0 but not independent	★	2.10, 2.6
12	Spearman: qualitative characteristics / two judges	★	2.11
13	**rR = 1 − 6Σd²/[n(n² − 1)] · rank highest = 1 first**	★★★	2.12, 3.12
14	Ties: add Σ(t³ − t)/12, one term per tie in either series	★	2.13
15	**Reverse: n(n² − 1) = 6Σd²/(1 − rR) · Σd² = (1 − rR)n(n² − 1)/6**	★★★	2.14, 3.12
16	Wrong rank difference: Σd² − (wrong)² + (correct)²	★	2.15
17	Concurrent deviations: rC = ±√[±(2c − m)/m], m = pairs − 1 · direction of change only	★	2.16
18	P.E. = 0.6745(1 − r²)/√n · limits r ± P.E. (not in SM)	★	2.17, 5.3
19	y = a + bx: a intercept, b = byx slope · horizontal ⇒ b = 0	★★	3.1, 4.10
20	byx = [nΣxy − ΣxΣy]/[nΣx² − (Σx)²] · a = $\bar{y}$ − b·$\bar{X}$	★	3.2
21	y − $\bar{y}$ = byx(x − $\bar{X}$) · x − $\bar{X}$ = bxy(y − $\bar{y}$)	★	3.3
22	byx = r·Sy/Sx · bxy = r·Sx/Sy	★★	4.5, 5.4, 2.20

#	One-liner	Weight	Part A ref
23	**Origin: no effect · scale: byx = (q/p)bvu, bxy = (p/q)buv**	★★★	4.1, 2.21, 3.11, 5.2
24	**Lines meet at (x̄, ȳ): solve simultaneously or substitute a known mean**	★★★	4.2, 4.3, 3.10
25	**r = ±√(byx·bxy), common sign · byx = r^2/bxy**	★★★	4.4, 2.18, 3.9
26	**Unlabelled lines: assume, test byx·bxy ≤ 1, else swap**	★★★	3.4, 3.5, 2.19, 4.11
27	**byx·bxy ≤ 1: one > 1 ⇒ other < 1 · bxy = r^2/byx · AM of b's ≥ r**	★★★	3.6, 3.7, 3.8, 4.7, 2.22
28	Spurious correlation: no causal link, third variable	★★	1.4, 3.6
29	**r^2 = explained/total = 1 − unexplained/total · non-determination 1 − r^2**	★★★	5.1, 1.8, 2.23, 3.13
30	Lines coincide at r = ±1 · perpendicular at r = 0	★★	4.6

CHAPTER 18

Index Numbers

117 Scanner questions · 47 one-liners · 27 revision pointers

Part A — One-liners mapped to Scanner questions and Study Material

Index Numbers

SM Chapter 18, pages 18.1 – 18.39

Topic 1 Introduction

3 Scanner questions · ICAI appearances PYQ 3 · RTP – · MTP –

Ref	One-liner for the student	Scanner Q	Asked in	SM source
1.1	Index number = a ratio (or an average of ratios) expressed as a percentage, comparing a period with a base period whose value is the standard point of comparison; 'a series of numerical figures which show the relative position' = index number.	PYQ May 18 Q76	PYQ 2018-May	18.1, p. 18.2; Exercise Q1, p. 18.19
1.2	*See Topic 3: Fisher F = √(L × P), so P = F^2 ÷ L = 109^2 ÷ 110 = 108.01 ≈ 108 — square Fisher's index, do not take a simple difference.*	PYQ Nov 20 Q84	PYQ 2020-Nov	18.3.3, p. 18.6
1.3	*See Topic 3: Cost of living index uses base-year quantities (Laspeyres form) — CLI = $\Sigma p_1q_0 \div \Sigma p_0q_0 \times 100$ = 178.6 ÷ 160.7 × 100 = 111.14.*	PYQ Sep 25 Q97	PYQ 2025-Sep	18.3.3, p. 18.6; Additional Question Bank Q13, p. 18.25

Topic 2 Issues Involved

10 Scanner questions · ICAI appearances PYQ 1 · RTP – · MTP 9

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.1	*See Topic 4: Index numbers are useful for framing economic and business policies, revealing trends, forecasting, deflating (nominal → real wages) and measuring cost of living — they are NOT a tool for identifying errors.*	PYQ Dec 21 Q98	PYQ 2021-Dec	18.4, p. 18.10
2.2	*See Topic 7: There are 4 tests of adequacy (unit, time reversal, factor reversal, circular); Pab × Pbc × Pca = 1 is the circular test, i.e. the test of shifting the base.*	MTP Jun 24 S3 Q61, MTP Jun 24 S3 Q63, MTP Jun 24 S3 Q89	MTP 2024-Jun S3 (×3)	18.7, pp. 18.12 – 18.13; Exercise Q39, Q42, p. 18.22
2.3	*See Topic 5: Rightly compensated salary = old salary × new CPI ÷ old CPI; additional DA = compensated salary − salary actually paid: 800 × 200/160 = 1,000 → DA ₹200; 325 × 200/110 = 590.91 − 500 = ₹90.91; 10,000 × 240/100 = ₹24,000; 24,000 × 224/140 = 38,400 → extra ₹14,400 (trap: 38,400 is the total, not the addition).*	MTP Aug 24 S2 Q98, MTP Aug 24 S2 Q99, MTP Dec 24 S1 Q98, MTP Dec 24 S1 Q100	MTP 2024-Aug S2 (×2), 2024-Dec S1 (×2)	18.5, p. 18.10; Additional Question Bank Q30, p. 18.28 and Q76, p. 18.35
2.4	*See Topic 3: Price relative = $P_n \div P_0 \times 100$ with the BASE year in the denominator — 1975 on base 1980 = 25 ÷ 30 × 100 = 83.33.*	MTP Aug 24 S2 Q100	MTP 2024-Aug S2	18.3, p. 18.4; Additional Question Bank Q77, p. 18.35

Ref	One-liner for the student	Scanner Q	Asked in	SM source
2.5	*See Topic 3: % rise in prices over the base = index − 100; wholesale price index 280 → 180% increase (not 280% or 380%).*	MTP Jan 25 S2 Q100	MTP 2025-Jan S2	Additional Question Bank Q48, p. 18.30

Topic 3 Construction of Index Number

62 Scanner questions · ICAI appearances PYQ 50 · RTP – · MTP 12

Ref	One-liner for the student	Scanner Q	Asked in	SM source
3.1	Index numbers are usually built from a sample, which must be representative — random (if need be, stratified random) sampling ensures this.	PYQ Sep 25 Q98	PYQ 2025-Sep	18.2, p. 18.2
3.2	True/false theory: unweighted (simple) index numbers DO exist, so 'there is no such thing as unweighted index numbers' is FALSE; the index number is a special type of average (true); GM is theoretically the best average but AM is mostly used in practice (true); the base period should be normal and relatively recent (true).	PYQ Sep 26 Q28	PYQ 2026-Sep	18.2, p. 18.3; Exercise Q29, Q35, Q36, p. 18.21
3.3	Notation: P_{01} = index for period 1 on base 0 (P_{10} = 0 on 1). Price relative = $P_n \div P_0 \times 100$ ($P_1/P_0 \times 100$) — base-year price always in the denominator: '2015 on 2020' = 50 ÷ 60 × 100 = 83.33.	PYQ May 18 Q78, PYQ May 18 Q81, PYQ Jun 22 Q98, PYQ May 25 Q99	PYQ 2018-May (×2), 2022-Jun, 2025-May	18.3, p. 18.4; 18.7, p. 18.12
3.4	Reading an index: % change over base = index − 100 — 355 → 255% rise; 280 → 180% rise; 250 → prices have risen by 1.5 times (to 2.5 times) the base-period level.	PYQ Jun 23 Q97, MTP Jun 24 S3 Q62, MTP Aug 24 S2 Q97	PYQ 2023-Jun; MTP 2024-Jun S3, 2024-Aug S2	Additional Question Bank Q16, p. 18.25 and Q46, Q48, p. 18.30
3.5	Simple aggregative price index = $\Sigma P_n \div \Sigma P_0 \times 100$: (120 + 200 + 400) ÷ (80 + 220 + 300) × 100 = 720 ÷ 600 × 100 = 120. Defect: high-priced items dominate and the result changes with units.	PYQ May 25 Q97	PYQ 2025-May	18.3.1, pp. 18.4 – 18.5
3.6	Laspeyres = $\Sigma P_n Q_0 \div \Sigma P_0 Q_0 \times 100$ — base-year (last-year) quantities as weights; use only the q_0 totals and ignore $p_n q_n$ and $p_0 q_n$ given as distractors: 600/240 = 250; 96/73 = 131.51; 440/265 = 166.04; 1900/1360 = 1.397 (keyed 1.39 in ratio form).	PYQ May 18 Q80, PYQ Nov 18 Q88, PYQ Jun 22 Q97, PYQ Dec 22 Q94, PYQ Jun 23 Q95, MTP Apr 26 S1 Q99	PYQ 2018-May, 2018-Nov, 2022-Jun, 2022-Dec, 2023-Jun; MTP 2026-Apr S1	18.3.3, p. 18.6
3.7	Paasche = $\Sigma P_n Q_n \div \Sigma P_0 Q_n \times 100$ — current-year quantities as weights: 506/451 × 100 = 112.20; reverse it to find a missing total, $p_0 q_n$ = 300 × 100 ÷ 200 = 150 ($p_0 q_0$ is a distractor). It equals the weighted average of price relatives with current-year quantity weights ($p_0 q_n$).	PYQ Jul 21 Q89, PYQ Dec 21 Q96, PYQ Jan 25 Q22, MTP Apr 26 S1 Q100	PYQ 2021-Jul, 2021-Dec, 2025-Jan; MTP 2026-Apr S1	18.3.3, p. 18.6

Ref	One-liner for the student	Scanner Q	Asked in	SM source
3.8	Marshall–Edgeworth = $\Sigma P_n(Q_0 + Q_n) \div \Sigma P_0(Q_0 + Q_n) \times 100$ — weights are the average (sum) of base- and current-year quantities: (456 + 506) ÷ (406 + 451) × 100 = 112.25 (keyed 112.26).	PYQ Jul 21 Q91, PYQ Jun 23 Q96, PYQ Jun 24 Q96, PYQ Jan 25 Q16	PYQ 2021-Jul, 2023-Jun, 2024-Jun, 2025-Jan	18.3.3, p. 18.6
3.9	Fisher's ideal index = $\sqrt{[(\Sigma P_n Q_0/\Sigma P_0 Q_0) \times (\Sigma P_n Q_n/\Sigma P_0 Q_n)]} \times 100$ = GEOMETRIC mean of Laspeyres and Paasche (not AM, not median); 'ideal' because it satisfies both time reversal and factor reversal tests.	PYQ Nov 18 Q86, PYQ Jun 19 Q85, PYQ Jun 22 Q94, MTP Jan 25 S2 Q96, MTP Apr 26 S2 Q97, PYQ May 26 Q51	PYQ 2018-Nov, 2019-Jun, 2022-Jun, 2026-May; MTP 2025-Jan S2, 2026-Apr S2	18.3.3, p. 18.6; 18.7, p. 18.13
3.10	Fisher from L and P: $F = \sqrt{(L \times P)}$; reverse with $L = F^2 \div P$ or $P = F^2 \div L$ — $\sqrt{(250 \times 160)} = 200$; $\sqrt{(119 \times 112)} = 115.45$; $160^2 \div 140 = 182.86$; $156^2 \div 169 = 144$. When totals are given, find L first: 720/400 × 100 = 180 → $\sqrt{(180 \times 125)} = 150$; 145/150 × 100 = 96.67 → $\sqrt{(96.67 \times 150)} = 120.42$.	PYQ Nov 18 Q87, PYQ Dec 22 Q97, PYQ Jun 23 Q98, PYQ May 25 Q96, MTP Jan 25 S2 Q99, PYQ May 26 Q52	PYQ 2018-Nov, 2022-Dec, 2023-Jun, 2025-May, 2026-May; MTP 2025-Jan S2	18.3.3, p. 18.6
3.11	Fisher from a table: build the four columns p_0q_0, p_1q_0, p_0q_1, p_1q_1, total them, then $\sqrt{(\Sigma p_1q_0/\Sigma p_0q_0 \times \Sigma p_1q_1/\Sigma p_0q_1)} \times 100$ — 63/52 × 59/52 → 117.3 (SM example); 456/406 × 506/451 → 112.26 (112.255).	PYQ Jul 21 Q90, PYQ Dec 21 Q97, PYQ Sep 26 Q51	PYQ 2021-Jul, 2021-Dec, 2026-Sep	Example, p. 18.14
3.12	If all prices change in the same ratio k, Laspeyres = Paasche = 100k (the weighting is irrelevant); base-year prices twice the current prices → every index, including Fisher's, = 50.	PYQ Jan 21 Q86, PYQ Jun 24 Q99	PYQ 2021-Jan, 2024-Jun	Additional Question Bank Q53, p. 18.31
3.13	Bowley's index = (Laspeyres + Paasche) ÷ 2 (arithmetic mean), so Paasche = 2 × Bowley − Laspeyres = 300 − 180 = 120.	MTP Apr 26 S1 Q98	MTP 2026-Apr S1	Additional Question Bank Q51, p. 18.30
3.14	Chain index = (link relative of current year × chain index of previous year) ÷ 100; chaining = successive multiplication of links: 100 × 1.08 × 1.15 × 1.25 = 155.25.	PYQ May 25 Q100, PYQ Sep 26 Q27	PYQ 2025-May, 2026-Sep	18.3.4, pp. 18.7 – 18.8
3.15	Price index measures the relative change in the price of an item or group of items; value index = $\Sigma P_n Q_n \div \Sigma P_0 Q_0$ = total value of the given year DIVIDED by total value of the base year.	PYQ Dec 23 Q94, PYQ Sep 24 Q26	PYQ 2023-Dec, 2024-Sep	18.3.5 – 18.3.6, p. 18.9
3.16	CPI = cost of living index = retail price index: it measures month-to-month change in the cost of a representative basket bought by a typical household; the cost of living index is always a weighted index.	PYQ Jan 21 Q84, PYQ Dec 22 Q95, MTP Apr 26 S2 Q98	PYQ 2021-Jan, 2022-Dec; MTP 2026-Apr S2	Concept box, p. 18.16; Additional Question Bank Q56, p. 18.31

Ref	One-liner for the student	Scanner Q	Asked in	SM source
3.17	Rise in cost of living = item's budget share × item's price rise: 8% = w × 40% → w = 20%.	PYQ Jan 25 Q20	PYQ 2025-Jan	Additional Question Bank Q91, p. 18.37
3.18	Purchasing power of money = reciprocal of the price index: value of ₹1 = 100 ÷ CPI = 100 ÷ 750 = ₹0.1333 = 13.3 paise.	MTP Jun 24 S3 Q90, PYQ Sep 25 Q100	PYQ 2025-Sep; MTP 2024-Jun S3	Additional Question Bank Q44, p. 18.29 and Q92, p. 18.37
3.19	*See Topic 5: Salary needed = old salary × new CPI ÷ old CPI; additional amount = needed − actual: 19,500 × 115/97.5 = 23,000 (+3,500); 15,000 × 155/100 = 23,250 (DA 8,250); 23,000 × 180/135 = 30,667 − 29,500 = 1,167; 25,000 × 196/125 = 39,200 − 37,250 = 1,950; 60,000 × 180/100 = 1,08,000.*	PYQ Jun 19 Q87, PYQ Dec 23 Q93, PYQ Dec 23 Q96, PYQ Sep 25 Q99, MTP Apr 26 S2 Q100	PYQ 2019-Jun, 2023-Dec (×2), 2025-Sep; MTP 2026-Apr S2	18.5, p. 18.10; Additional Question Bank Q30, p. 18.28
3.20	*See Topic 5: Real wage = money wage ÷ CPI × 100 — 8,190 ÷ 273 × 100 = ₹3,000; 500 ÷ 200 × 100 = 250.*	PYQ Sep 24 Q24, MTP Apr 26 S1 Q96	PYQ 2024-Sep; MTP 2026-Apr S1	18.5, p. 18.10; Additional Question Bank Q23, p. 18.26
3.21	*See Topic 7: Circular test $P_{01} \times P_{12} \times P_{20} = 1$ lets the base be shifted without returning to the original base — 1970 on 1960 = 150 × 200 ÷ 100 = 300. Time reversal test fails for Laspeyres, Paasche and Bowley but holds for Fisher and Marshall–Edgeworth.*	PYQ May 18 Q83, PYQ Jan 26 Q48, PYQ Jan 26 Q47	PYQ 2018-May, 2026-Jan (×2)	18.7, p. 18.13; Additional Question Bank Q12, p. 18.25

Topic 4 Usefulness of Index Numbers

5 Scanner questions · ICAI appearances PYQ 2 · RTP – · MTP 3

Ref	One-liner for the student	Scanner Q	Asked in	SM source
4.1	*See Topic 5: Compare REAL wages (money wage ÷ CPI × 100), not money wages: 330/110 × 100 = 300 vs 500/200 × 100 = 250 → loss of ₹50; 12,500 ÷ 250 × 100 = ₹5,000.*	PYQ Sep 24 Q27, PYQ May 26 Q53	PYQ 2024-Sep, 2026-May	18.4, p. 18.10; Additional Question Bank Q96, p. 18.37
4.2	*See Topic 6: Splicing = constructing one continuous series from two index series with different bases, on a common base. Distractors are false: Paasche uses current-year quantities; Fisher fails the circular test; GM, not AM, is the theoretically best average.*	MTP Dec 24 S1 Q97	MTP 2024-Dec S1	18.6, pp. 18.11 – 18.12
4.3	*See Topic 3: Purchasing power of money = reciprocal of the price index number.*	MTP Dec 24 S1 Q99	MTP 2024-Dec S1	Additional Question Bank Q44, p. 18.29
4.4	*See Topic 7: Fisher's index satisfies both the time reversal and factor reversal tests (and the unit test), but not the circular test.*	MTP Jan 25 S2 Q95	MTP 2025-Jan S2	18.7, p. 18.13; Exercise Q31, p. 18.21

Topic 5 Deflating Times Series using Index Numbers

1 Scanner question · ICAI appearances PYQ 1 · RTP – · MTP –

Ref	One-liner for the student	Scanner Q	Asked in	SM source
5.1	Deflated (real) value = current value ÷ price index of the current year × 100; real wage = money wage ÷ CPI × 100 — increase in real terms = 540/180 × 100 − 240/120 × 100 = 300 − 200 = 100.	PYQ Jul 21 Q92	PYQ 2021-Jul	18.5, pp. 18.10 – 18.11; Additional Question Bank Q96, p. 18.37

Topic 6 Shifting and Splicing of Index Numbers

6 Scanner questions · ICAI appearances PYQ 4 · RTP – · MTP 2

Ref	One-liner for the student	Scanner Q	Asked in	SM source
6.1	Shifted price index = original index ÷ index of the new base year × 100: 2022 on 2019 = 150/120 × 100 = 125; 2010 on 2020 = 140/210 × 100 = 66.67 (dividing the other way gives 133.33); 1981 on 1984 = 104/112 × 100 = 92.86.	PYQ May 25 Q98, PYQ May 26 Q50, PYQ Sep 26 Q52	PYQ 2025-May, 2026-May, 2026-Sep	18.6, p. 18.11
6.2	Splicing joins two index series with different bases into one continuous series — needed when quantity weights change, the method of calculation changes or a new commodity is included.	PYQ Dec 22 Q98	PYQ 2022-Dec	18.6, pp. 18.11 – 18.12
6.3	*See Topic 5: Deflated value = Current value ÷ Price index of the current year (equivalently, current value × P_0/P_n).*	MTP Aug 24 S2 Q96	MTP 2024-Aug S2	18.5, pp. 18.10 – 18.11; Exercise Q40, p. 18.22
6.4	*See Topic 3: The cost of living index is always a weighted index.*	MTP Jan 25 S2 Q98	MTP 2025-Jan S2	Additional Question Bank Q56, p. 18.31

Topic 7 Test of Adequacy

30 Scanner questions · ICAI appearances PYQ 28 · RTP – · MTP 2

Ref	One-liner for the student	Scanner Q	Asked in	SM source
7.1	There are 4 tests of adequacy: unit, time reversal, factor reversal and circular — 'square test' and 'price relative test' are not tests; time reversal and factor reversal are the tests of consistency.	PYQ May 18 Q75, PYQ Jun 22 Q99, PYQ Jun 24 Q98	PYQ 2018-May, 2022-Jun, 2024-Jun	18.7, p. 18.12
7.2	Time reversal test: $P_{01} \times P_{10} = 1$ — the current-on-base and base-on-current indices must be reciprocals; Laspeyres and Paasche fail it, Fisher satisfies it.	PYQ Dec 21 Q100, PYQ Jun 22 Q96, PYQ Jun 24 Q100, PYQ Sep 24 Q25, PYQ Sep 25 Q96	PYQ 2021-Dec, 2022-Jun, 2024-Jun, 2024-Sep, 2025-Sep	18.7, pp. 18.12 – 18.13
7.3	Factor reversal test: $P_{01} \times Q_{01} = V_{01} = \Sigma P_1Q_1 \div \Sigma P_0Q_0$ (price index × quantity index = value index); only Fisher satisfies it, and passing both TRT and FRT makes Fisher the 'ideal' index.	PYQ Dec 22 Q96, PYQ Jun 23 Q99, PYQ Jun 24 Q97, MTP Aug 24 S2 Q95, PYQ May 26 Q98	PYQ 2022-Dec, 2023-Jun, 2024-Jun, 2026-May; MTP 2024-Aug S2	18.7, p. 18.13

Ref	One-liner for the student	Scanner Q	Asked in	SM source
7.4	Circular test: $P_{01} \times P_{12} \times P_{20} = 1$ — an extension of the time reversal test to three or more periods; it is the test of shiftability of the base (shifting the base without referring back to the original base).	PYQ May 18 Q79, PYQ Jun 22 Q95, PYQ Sep 24 Q28, PYQ Jan 26 Q46, MTP Apr 26 S1 Q97	PYQ 2018-May, 2022-Jun, 2024-Sep, 2026-Jan; MTP 2026-Apr S1	18.7, p. 18.13
7.5	Circular test is met only by the simple GM of price relatives and the weighted aggregative with fixed weights — NOT by Laspeyres, Paasche or Fisher (Fisher's one failure).	PYQ May 18 Q82, PYQ Jan 21 Q85, PYQ Dec 21 Q99, PYQ Sep 26 Q26	PYQ 2018-May, 2021-Jan, 2021-Dec, 2026-Sep	18.7, p. 18.13
7.6	*See Topic 3: Laspeyres = $\Sigma p_1q_0 \div \Sigma p_0q_0 \times 100$ = 600/560 × 100 = 107.14 (base-year quantities); Paasche uses current-year quantities as weights.*	PYQ Jun 19 Q86, PYQ Jan 26 Q100	PYQ 2019-Jun, 2026-Jan	18.3.3, p. 18.6
7.7	*See Topic 3: Fisher = $\sqrt{(L \times P)}$, the geometric mean: $\sqrt{(110 \times 108)} = 108.99$; $\sqrt{(125 \times 500)} = 250$.*	PYQ Dec 23 Q95, PYQ Jan 25 Q23, PYQ Jan 26 Q98	PYQ 2023-Dec, 2025-Jan, 2026-Jan	18.3.3, p. 18.6
7.8	*See Topic 3: Prices of all goods changing in the same ratio → Laspeyres = Paasche.*	PYQ Jan 25 Q21	PYQ 2025-Jan	Additional Question Bank Q53, p. 18.31
7.9	*See Topic 3: Index numbers are expressed as percentages; index 225 on base 100 → 225 − 100 = 125% increase.*	PYQ Nov 19 Q88, PYQ Nov 20 Q83	PYQ 2019-Nov, 2020-Nov	18.1, p. 18.2; Additional Question Bank Q16, p. 18.25

Part B — Chapter 18 One-liner Revision Sheet

Deduplicated and in Study Material order. Click a 'Part A ref' to jump to the Part A row(s) carrying the full wording, the Scanner questions and the SM page. Refs read Unit.Topic.Row in chapters with several units and Topic.Row otherwise. Weight: ★★★ asked by ICAI 6 or more times · ★★ 3 – 5 times · ★ once or twice. The ★★★ lines alone cover about 56% of ICAI appearances in this chapter.

Index Numbers

#	One-liner	Weight	Part A ref
1	Index number = ratio/average of ratios as %; built from a representative (random) sample; base period normal and recent	★★	1.1, 3.1, 3.2
2	Uses: policy, trends, forecasting, deflating, cost of living — not error-finding	★	2.1
3	P_{01} = 1 on 0 · price relative $P_n/P_0 \times 100$ (base year in denominator)	★★	3.3, 2.4
4	**Index − 100 = % rise (280 → 180%)**	★★★	3.4, 2.5, 7.9
5	Simple aggregative $\Sigma P_n/\Sigma P_0 \times 100$ — fails the unit test	★	3.5
6	**Laspeyres $\Sigma P_nQ_0/\Sigma P_0Q_0 \times 100$ — base-year quantities; CLI uses this form**	★★★	3.6, 1.3, 7.6
7	Paasche $\Sigma P_nQ_n/\Sigma P_0Q_n \times 100$ — current-year quantities	★★	3.7
8	Marshall–Edgeworth $\Sigma P_n(Q_0+Q_n)/\Sigma P_0(Q_0+Q_n) \times 100$ — average of both years' quantities	★★	3.8
9	**Fisher = $\sqrt{(L \times P)} \times 100$ = GM of L and P; $L = F^2/P$, $P = F^2/L$**	★★★	3.9, 3.10, 1.2, 7.7
10	Fisher from a table: four Σ columns, then $\sqrt{(\Sigma p_1q_0/\Sigma p_0q_0 \times \Sigma p_1q_1/\Sigma p_0q_1)}$	★★	3.11
11	Prices all change in same ratio → L = P	★★	3.12, 7.8
12	Bowley = (L + P)/2	★	3.13
13	Chain index = LR(current) × CI(previous) ÷ 100	★	3.14
14	Value index $\Sigma P_nQ_n/\Sigma P_0Q_0$ (given-year value ÷ base-year value)	★	3.15
15	CPI = cost of living = retail price index; CLI always weighted	★★	3.16, 6.4
16	Budget share × price rise = CoL rise (8% = w × 40% → 20%)	★	3.17
17	Purchasing power = 1/price index; ₹1 = 100/CPI	★★	3.18, 4.3
18	**Compensation: old salary × new CPI/old CPI; extra = needed − actual**	★★★	3.19, 2.3
19	Real wage = money wage/CPI × 100; compare real, not money, wages	★★	3.20, 4.1, 5.1
20	Deflated value = current value ÷ current price index	★	5.1, 6.3
21	Shifted index = original ÷ new-base-year index × 100	★★	6.1
22	Splicing: join two series with different bases (new weights, method or commodity)	★	6.2, 4.2
23	**4 tests: unit, TRT, FRT, circular; TRT + FRT = tests of consistency**	★★★	7.1, 2.2

#	One-liner	Weight	Part A ref
24	**TRT $P_{01} \times P_{10} = 1$ — L and P fail; Fisher and M–E pass**	★★★	7.2, 3.21
25	**FRT $P_{01} \times Q_{01} = \Sigma P_1Q_1/\Sigma P_0Q_0$ — Fisher only; TRT + FRT → 'ideal'**	★★★	7.3, 4.4
26	**Circular $P_{01} \times P_{12} \times P_{20} = 1$ — shiftability of base; extension of TRT**	★★★	7.4, 3.21
27	Circular met by simple GM of relatives and fixed-weight aggregative — not L, P or Fisher	★★	7.5