



CMA INTERMEDIATE • PAPER 9 • OPERATIONS MANAGEMENT AND
STRATEGIC MANAGEMENT

Student Notes

Chapter 5 • Productivity Management and Quality Management



4 Topics • 4 Examined • 81 Classified Questions

ICMAI Study Material, Syllabus 2022 • Shuchita Scanner, 2026 July Edition

How to use this booklet

For each topic, first read the Study Material paragraphs named in the “Read first” line. Then prepare level by level — each level tells you what kind of mastery the examiner expects, and lists the exact Scanner questions to practise at that level.

Question lines show: **label • source & exam • question reference • category • marks • Scanner page**, then the **category** again in the column beside it and the **difficulty** of the question.

The category — **OQ** objective, **SN** short note, **DB** distinguish between, **DESC** descriptive, **CSQ** case scenario — is the **Scanner’s own**, printed in the book. A **{C}** after the exam reference means the question was **compulsory** in that paper.

The heading above each group names the **skill the question calls for** — **OBJECTIVE, REMEMBERING, UNDERSTANDING, APPLYING, ANALYSING, EVALUATING, CREATING**, and **PRACTICE** for a model question set by the Scanner rather than taken from a past paper. It is assigned by the SITS rubric from the directive verb and the question type. **ICMAI publishes no skill-assessment grid** for the Intermediate papers, so no weighting is implied here on the Institute’s behalf.

STUDY PRIORITY GUIDE

Chapter 5 at a Glance

This chapter carries 81 classified Scanner questions across 4 declared topics, 4 of which the examiner has actually asked. The table below breaks the chapter down by the skill each question calls for, and by the marks that skill is worth.

SKILL REQUIRED Chapter 5 • share of the chapter's 229 marks

Recall — objective questions	29.7%	68 of 229 marks • 48 questions
Remembering	27.1%	62 of 229 marks • 14 questions
Understanding	21.8%	50 of 229 marks • 9 questions
Applying	13.1%	30 of 229 marks • 7 questions
Analysing	5.2%	12 of 229 marks • 2 questions
Evaluating	3.1%	7 of 229 marks • 1 question

Recalling and explaining **78.6%** • applying, analysing and judging **21.4%** — this chapter reads **weighted towards recall and explanation**

79% of this chapter's marks are earned by recalling and explaining, and 21% by applying, analysing and judging. Across Paper 9 as a whole the split is 66% and 34%. More of this chapter's marks are earned by recalling and explaining than the paper's own balance would suggest. Reading carries further here than in most of the paper, but do not stop at reading — the application marks that remain are the ones students lose.

Every band is assigned by the SITS rubric v1-CMA and weighted on the marks printed in the Scanner. ICAI publishes no skill-assessment grid for the Intermediate papers, so the comparison is against this paper's own profile drawn from the Scanner, and no weighting is implied on the Institute's behalf.

SKILL REQUIRED	WHAT THE EXAMINER ASKS FOR	QUESTIONS
Recall — objective questions	recognise the right answer — Section A of the Scanner, 1 and 2 marks	48
Remembering	recall and reproduce	14
Understanding	explain with reasons	9
Applying	take the provision to the facts	7
Analysing	break down and compare	2
Evaluating	judge and justify	1

The Scanner's own categories for this chapter: 48 objective, 22 descriptive, 10 practical, 1 distinguish.

The band on each question line is SITS-assigned by written rubric. ICMAI publishes no skill-assessment grid for the Intermediate papers, so no institute weighting is implied. The category beside it — OQ, SN, DB, DESC, PRAC — is the Scanner's own: OQ, SN, DB and DESC are printed in the book, and PRAC marks a question the Scanner sets under PRACTICAL QUESTIONS.

CHAPTER 5

Productivity Management and Quality Management

Topic 1: Measurement Techniques of Productivity Index

CMAL2P9-C5-T01

Read first Read §5.1 Measurement Techniques of Productivity Index, ICAI Study Material Module 5, pages 255–264 — the definition and the symbols on pages 255 and 256, the seven heads of importance on pages 256 and 257, the indices of productivity on pages 257 and 258, the tools of productivity on pages 258 and 259, production against productivity on page 260, and then work Illustrations 1 to 5 on pages 261 to 264 before reading anything else in the module.

NOTES

Productivity: some relationship of outputs to inputs — the quality that indicates **how well labour, capital, materials and energy are utilised**. Symbolically $P = O \div I$, where **P** is productivity, a pure ratio (or a percentage when the input is a standard), **O** is output measured in **units of goods produced or the value of goods and services produced**, and **I** is input, the combination of raw materials, machinery, worker's time, power, effort and the imagination of the entrepreneur. A unit of input may be **one worker, one hour of labour time, one tonne of raw material or one kW of electricity**, so productivity can be computed for **each factor separately or for all the factors together**. The higher the ratio, the greater the productivity, and **productivity is a measure of how much input is required to achieve a given output**.

The productivity index: a device of numerically expressing the ratio between outputs and the inputs of the resources. Indices are prepared by **comparing the volume of output of goods with the labour employed on that job, or the profits of the firm with the capital employed**, and if the comparison shows an upward trend in the indices it is a **sign of improved productivity**, and vice versa. In index form the base period is set at **100** and the index for any later period is **current-period productivity ÷ base-period productivity × 100**; a material productivity index **below 100** means low productivity and above 100 means improvement over the base year.

The two criteria of productivity measurement: (i) **change in output per unit of input** indicates the change in the performance of that input — output per worker or per man-hour signifies the change in the performance of labour; (ii) **change in input per unit of output** signifies the same thing read the other way, man-hours per unit of output being the labour measure. Productivity measurement **implies the use of standards set for each input factor in terms of output**; where standards are not in use, output is converted into **units of work**, defined as **the amount of work that can be performed by one unit of input**. The three models of productivity measurement,

classified on the type and coverage of the output and input variables, are the **ratio method**, the **production function method** and the **P-O-P method**.

The indices of productivity, with the unit of each:

Index	Formula
Man-hour output — the most widely used index	Units of output ÷ Total man-hours
Productivity ratio	Net profit ÷ Capital employed
Financial ratio of the labour force	Added value ÷ Labour costs, where Added value = Output – Inputs
Financial ratio of all resources together	Added value ÷ Conversion costs
Manpower productivity	Value of output of goods or services ÷ Number of workers or man-hours used
Materials productivity	Value of output of goods or services ÷ Units (or cost) of materials used
Capital productivity	Value of output of goods or services ÷ Capital assets employed
Energy productivity	Value of output of goods or services ÷ Units (or cost) of energy used
Combined measure — all inputs together	Value of output of goods or services ÷ Value of (labour + capital + materials + other inputs)
Input efficiency	Actual consumption ÷ Desired or standard consumption
Effectiveness	Target achieved ÷ Target achievable

Partial productivity against the combined measure: partial productivity measures the productivity of one factor or input, keeping the other factors or inputs constant or unchanged; the **combined measure** divides the value of output by the value of all the inputs taken together. In a partial measure the other input data are **not used**: a firm employing ₹20,00,000 of capital and 20,000 labour hours to produce ₹2,00,00,000 of product has a partial productivity of labour of $\text{₹}2,00,00,000 \div 20,000 = \text{₹}1,000$ per labour hour, and the capital figure plays no part in it. Name the factor with the figure — 'partial productivity of labour' — because the ratio means nothing without it.

Productivity as the ratio of actual to standard production: Standard production per shift = Shift

minutes ÷ **Standard time per unit**, and **Productivity = Actual production ÷ Standard production**, expressed as a percentage. With a standard time of **15 minutes** a piece and an eight-hour shift, standard production is $(8 \times 60) \div 15 = 32$ pieces; an output of 30 gives $30 \div 32 = 93.75\%$ and an output of 20 gives $20 \div 32 = 62.5\%$. The related measure without a standard is **productivity per worker = units of output ÷ number of workers** — 2,500 tonnes a month from 100 workers is **25 tonnes per worker**, and 450 units a month from 15 workers is **30 units**; the number of working days in the month is not used in either.

Time study, from observed time to standard production: **Average observed time** is the mean of the cycle times recorded, ignoring any cycle spoilt by a broken element. **Normal time = Average observed time × Rating factor ÷ 100**. Standard time is then found in one of two ways, and the data tell you which: where the allowance is quoted as a **percentage of normal time**, **Standard time = Normal time + Allowance**, so a normal time of 6 minutes with a 30% allowance gives **7.8 minutes**; where it is quoted as an **allowance fraction**, **Standard time = Normal time ÷ (1 – Allowance fraction)**, so cycle times of 7.0, 9.0, 10.0 and 10.0 average 9.0, at a 90% rating give a normal time of **8.1**, and with a 0.15 allowance fraction a standard time of $8.1 \div 0.85 = 9.53$ minutes. **Standard production in a shift = Shift minutes ÷ Standard time per unit**. All times are in minutes per unit; production is in units per shift.

Productivity per machine hour: **Machine hours = Number of machines employed × Working hours**, and **Productivity per machine hour = Number of units produced ÷ Machine hours**, in units per machine hour. Insert the machine-hour column before computing anything, and close with the interpretation: **though the total production in number of units is increasing, the productivity is declining**.

Month	No. of machines employed	Working hours	Machine hours = machines × hours	Production units	Productivity = units ÷ machine hours
January	400	220	88,000	99,000	1.125
February	550	180	99,000	1,00,000	1.010
March	580	220	1,27,600	1,25,000	0.980

The four labour measures: **Percent absenteeism = Hours lost in absenteeism ÷ Total working hours per month × 100**, where hours lost = man-days lost × daily hours and total working hours = operators × days × daily hours. **Efficiency of utilisation of labour = Standard labour hours to produce the actual output ÷ Total labour hours available × 100**. **Productive efficiency of labour = Standard labour hours ÷ Actual labour hours worked × 100**, where **actual labour hours = total available hours – absenteeism hours – idle time**. **Overall productivity of labour = Units produced ÷ Number of men**, compared with the standard of **standard production ÷ number of men**, and the

fall is expressed as a percentage of the standard. Every figure is in labour hours except the last, which is in units per man per month.

Step	Working
Total working hours per month	Operators $\times$ days $\times$ daily hours
Hours lost in absenteeism	Man-days lost $\times$ daily hours
Percent absenteeism	Hours lost $\div$ total working hours $\times$ 100
Efficiency of utilisation of labour	Standard hours for actual output $\div$ total hours $\times$ 100
Actual labour hours	Total hours – absenteeism hours – idle time
Productive efficiency of labour	Standard hours $\div$ actual hours $\times$ 100
Overall productivity	Units $\div$ men, against standard units $\div$ men

The plant-and-operator output model: the monthly capacity in units is **(Working days $\times$ Hours per day $\times$ 60) $\div$ Total time per unit in minutes**, where **total time per unit = machine time + operator time**; that figure is then multiplied by the **plant efficiency** and, where relevant, by the operator's efficiency. Where **machine productivity is increased by x%**, the new machine time is **old machine time $\times$ 100 $\div$ (100 + x)** — 22 minutes at 10% becomes 20. Where **operator efficiency is reduced by y%**, the new operator time is **old operator time $\times$ (100 + y) $\div$ 100** — 8 minutes at 20% becomes 9.6, because only 80% of the job is now completed in the 8 minutes. Recompute the total time per unit after the change and rework the output; never scale the output figure directly.

Number of machines required: **Processing time needed = Annual demand of each product $\times$ Standard processing time per unit**, summed over the products, in hours a year. **Annual production capacity of one machine = Hours per shift $\times$ Working days a year**, in standard hours. **Number of machines = Total work load per year $\div$ Capacity per machine**, and the result is **always rounded up to the next whole machine** — 8,115 $\div$ 2,280 = 3.5592 machines means **4 machines**, and 6,725 $\div$ 2,304 = 2.90 means **3**. Show the workload table product by product.

Work sampling: **Percentage of working time = (Total observations – observations showing no activity) $\div$ Total observations $\times$ 100**. **Actual working time = Study hours $\times$ that percentage**, converted to minutes. **Time per article = Actual working minutes $\div$ Articles produced**. Split that time in the given **manual to machine ratio**. **Normal time of the man = Manual time $\times$ Rating factor $\div$ 100**; the machine time is **not rated**. **Allowances apply to the man's normal time only**, so the **standard time per article = machine time + (normal time of man + allowance)**. Then **standard time for the month's output $\div$ total available hours** is the **efficiency of utilisation of labour** and **standard time $\div$ actual working hours after absenteeism** is the **productive efficiency of labour**.

Incentive performance and net labour productivity: $\text{Performance} = \frac{\text{Standard minutes produced}}{\text{Working minutes on measured work}} \times 100$; where an incentive scheme allows a **proportionate production bonus beyond the 100% performance level**, the bonus is payable on the excess only — 15 sets at 30 standard minutes is 450 standard minutes against 360 minutes worked, a performance of 125%, so the bonus is $0.25 \times 6 \text{ hours} \times ₹4 = ₹6$, the guaranteed wage is $8 \times ₹4 = ₹32$ and the total is ₹38. **Net labour productivity** = $\frac{\text{Output in units}}{\text{Net man-hours}}$ — 15 sets in 6 measured hours is 2.5 sets an hour. The guaranteed wage runs on **attended time**, productivity on **measured working time**.

The three tools of productivity: human aspects — more worker participation in management and decision making through joint consultation, improved communication services, mutual trust and cooperation through better job procedures, better training, incentive schemes and labour welfare programmes, and better planning of work with more democracy in administration. **Supply of inputs** — improvement in the nature and quality of raw materials, proper provision of plant and equipment and their maintenance, more machines in place of physical work, and **fuller utilisation of manpower and of plant capacity**. **Technological aspects** — **work, time and motion studies, simplification, specialisation and standardisation** programmes, control techniques for production planning and control, cost control and quality control, improved **layout and material handling**, and improved **inspection techniques to minimise wastage and defective work**.

The importance of productivity — seven heads: **to beat the competition;** **guide to management**, where productivity indices are used for **strategic** purposes (comparing the efficiency of different firms), **tactical** purposes (comparing units or sectors within the firm), **planning** (comparing the relative benefit of different inputs) and **administration** (measuring progress over years and supporting bargaining with labour leaders, trade unions and Government); **an indicator of progress;** **maximum utilisation of scarce resources;** **key to national prosperity;** **prosperity to the work force;** and other uses — higher profits and reserves for expansion and modernisation, greater goodwill, and improved **competitive strength in export markets**.

Production and productivity are not synonymous: **production** refers to the **volume, value or quantity of goods and services produced during a given period by a worker, plant, firm or economy** and is the sum total of the results achieved by the factors used together; **productivity** is **not concerned with the volume of production** but is the **ratio of output to the input factors**, and it shows the **efficiency of production**. Production is used in an **absolute** sense, productivity is **relative to the resources used**. Hence **an increase in production does not necessarily mean an increase in productivity**: if production has risen because the inputs rose in the same proportion, **production has increased while productivity has declined or stayed constant**.

The advantages of higher productivity, under three heads: **to the individual concern** — more wages directly to piece-workers and more production bonus to all workers, hence satisfied staff and harmonious staff relations; more profit for the factory because of the reduction in costs; and the possibility of **reducing selling prices** so that sales and production increase. **To the industry** — higher productivity in some concerns compels less efficient firms to follow for their own survival. **To the Government** — higher profits bring more revenue by taxation, export trade may develop

and bring foreign exchange, and the overall **standard of labour** is raised.

Low productivity in the Indian context, and the three approaches to the hurdles: the causes have their origin in **two distinct sources** — the **exogenous or external factors** such as shortages of essential inputs, power, raw materials and transport facilities, **over which the management of an enterprise has little or no control**; and the **endogenous or internal factors**, mainly **system deficiencies preventing the optimum utilisation of resources**. The three approaches to overcoming the hurdles in managing productivity improvement are **management by internal motivation**, that is **KAIZEN**; **management by incentives**; and **management by fear**.

Seven properties of a good productivity measure: **validity** — it reflects accurately the changes in productivity; **completeness** — it takes into consideration all components of both the output and the input for a given ratio; **compatibility** — it enables the accurate measurement of a productivity change **between periods**; **inclusiveness** — it takes into account and measures **separately** the productivity of all activities; **timeliness** — data is provided **soon enough for managerial action** when problems arise; **cost effectiveness** — measurement is obtained with the **least interruption** to the ongoing productive effort; and **partial productivity** — it measures the productivity of one factor keeping the others unchanged. The more closely a measure meets these criteria, the more useful it is.

Technology, research and development, and information technology: the **four generic components of technological innovation** are **basic research** (advancement of scientific knowledge with no specific commercial use), **applied research** (advancement of knowledge with specific potential commercial uses), **development** (translating basic or applied research results into products or processes) and **implementation** (designing and building pilot models, equipment and facilities, and initiating the marketing channels). The variables determining **R&D success** are the **size of the operation**, the presence of **technological opportunities** in the industry, the **philosophy and genuine effort of management**, the contribution of **individual researchers**, good **growth prospects and profits**, **diversification**, and above all **marketing opportunity**, which contributes **three times more than technical opportunity** as a source of innovation. **Information technology** is crucial to operations everywhere along the supply chain and to every functional area: it makes **cross-functional coordination easier**, **links the firm's basic processes** and links people with work centres, databases and computers.

Managing a change of technology — seven suggestions: make a **master plan for automation**; find out the **risks** in going for automation; establish a new **production technology or technology development department**; allow **plenty of time** for the completion of automation projects; **do not try to automate everything at once**; remember that **people are the key** to successful implementation of automation projects; and note the risk on the other side, that **companies moving too slowly in adopting new production technology may be left behind**.

OBJECTIVE recognise the right answer — Section A of the Scanner, 1 and 2 marks • 23 questions

- Twenty-three objectives are placed on this topic, close to half the chapter's Section A, and eight of them are one small computation. Four ask for **productivity as actual over standard** — 24 units against a 15-

minute standard in an 8-hour shift is $24 \div 32 = 75\%$, 30 units against a 12-minute standard is $30 \div 40 = 75\%$, and the pair of hose-coupling industries is **93.75% and 62.50%**. Two ask for **productivity per worker** — $2,500 \text{ tonnes} \div 100 \text{ workers} = 25 \text{ tonnes}$, $450 \text{ units} \div 15 \text{ workers} = 30 \text{ units}$, and in both the number of days and shifts in the stem is surplus data.

- The two capacity computations are worth separating in your mind because the denominators differ. **Efficiency = actual output $\div$ effective capacity**, so 36,000 against an effective capacity of 40,000 is **90%**; utilisation would have used the design capacity of 50,000 and given 72%, which is the distractor. The **time study** objective is decided by the allowance convention: 9.0 average, rated at 90%, is a normal time of 8.1, and an **allowance fraction** of 0.15 divides rather than adds — **9.53**, not 9.315.
- Seven are sentences taken from the Study Material almost word for word. **A productivity index is a device of expressing the ratio between outputs and the inputs** — true. **Productivity is a measure of how much input is required to achieve a given output** — true. **The most widely used index of productivity is output per machine-hour** — false, it is output per **man-hour**. **Increase in production does not necessarily mean an increase in productivity** — correct. The indices are **man-hour output**, the **productivity ratio** and **financial ratios**, so **TQM** is the item that is not one; **efficiency** is the ratio of units of input required per unit of output, and **operation time** is setup time plus run time.
- The rest are recall from the wider operations vocabulary and are answered in a word. **Work study** finds the best and most efficient way of using men, materials, money and machinery; cost reduction is achieved through **value analysis**; the productivity of capital is best improved by **effective materials management**; a **work stoppage** does not reduce the cost of production, so that statement is false; the **Z chart** is used in **programme control**, not quality control; and the trend using a minimal amount of resources for high volumes of high-quality goods with some variety is **lean production**.
- One objective printed here has nothing to do with productivity — a ₹40,000 loss at 7,000 units against a ₹20,000 profit at 10,000 units, giving a fixed cost of **₹1,80,000**. It is a cost-volume-profit sum: the 3,000 extra units swing the result by ₹60,000, so contribution is **₹20 a unit**, and fixed cost is $7,000 \times ₹20 + ₹40,000$. Do not go looking for a productivity formula.

OQ • PYQ 2014-Jun [1] (d) {C} • 2M • Pg 233	OQ Objective	Easy
OQ • PYQ 2014-Jun [1] (e) {C} • 2M • Pg 233	OQ Objective	Easy
OQ • PYQ 2016-Jun [I] (c) • 2M • Pg 233	OQ Objective	Easy
OQ • PYQ 2017-Jun [1] (a) (v) • 1M • Pg 234	OQ Objective	Easy
OQ • PYQ 2017-Jun [1] (c) (v) • 1M • Pg 234	OQ Objective	Easy
OQ • PYQ 2018-Jun [1] (a) (i) • 1M • Pg 235	OQ Objective	Easy
OQ • PYQ 2018-Jun [1] (c) (iv) • 1M • Pg 235	OQ Objective	Easy
OQ • PYQ 2018-Dec [1] (a) (iv) • 1M • Pg 235	OQ Objective	Easy

OQ • PYQ 2018-Dec [1] (c) (iv) • 1M • Pg 236	OQ Objective	Easy
OQ • PYQ 2019-Jun [1] (a) (iv) • 1M • Pg 236	OQ Objective	Easy
OQ • PYQ 2019-Jun [1] (c) (i) • 1M • Pg 236	OQ Objective	Easy
OQ • PYQ 2021-Dec [1] • 1M • Pg 237	OQ Objective	Easy
OQ • PYQ 2021-Dec [8] • 1M • Pg 237	OQ Objective	Easy
OQ • PYQ 2022-Dec [1] (a) (viii) {C} • 1M • Pg 237	OQ Objective	Easy
OQ • PYQ 2023-Jun [1] (a) (v) {C} • 1M • Pg 238	OQ Objective	Easy
OQ • MQP 2023-Jun S1 [6] (c) (iii) • 1M • Pg 238	OQ Objective	Easy
OQ • PYQ 2024-Jun [1] (vi) {C} • 2M • Pg 239	OQ Objective	Easy
OQ • PYQ 2024-Dec [1] (vi) {C} • 2M • Pg 239	OQ Objective	Easy
OQ • MQP 2024-Dec S2 [1] (a) (iv) • 2M • Pg 240	OQ Objective	Easy
OQ • MQP 2024-Dec S2 [1] (a) (ix) • 2M • Pg 240	OQ Objective	Easy
OQ • PYQ 2025-Jun [1] (iv) {C} • 2M • Pg 241	OQ Objective	Easy
OQ • PYQ 2025-Dec [1] (iii) {C} • 2M • Pg 242	OQ Objective	Easy
OQ • PYQ 2026-Jun [1] (iii) {C} • 2M • Pg 243	OQ Objective	Easy

REMEMBERING recall and reproduce • 6 questions

- Six questions sit here and five of them are pure lists, so number the points and stop. The **three models of productivity measurement** are the ratio method, the production function method and the P-O-P method, at three marks a point each. The **four generic components of technological innovation** are basic research, applied research, development and implementation, and the four-mark question expects the one-line description that goes with each name.
- The two-mark question on the **approaches to overcome hurdles in the management of productivity improvement** has exactly three answers — management by **internal motivation (KAIZEN)**, by **incentives** and by **fear** — and nothing else is wanted at two marks. The causes of **low productivity in the Indian context** are answered by the two-source structure, exogenous and endogenous, with two or three examples of each.
- The six-mark question on the **manifold advantages of higher productivity** is marked on its three headings. Write **to the individual concern**, **to the industry** and **to the Government** as headings and put

the points under them; an unheaded list of advantages loses the structure that the question's own answer is built on. The one-mark practical asks only for the **partial productivity of labour** — one division, ₹1,000, and the capital figure is not used.

TQ 1.2 • PYQ 2013-Dec [6] (b) • 3M • Pg 245	DESC Descriptive	Easy
TQ 1.5 • PYQ 2014-Dec [2] (a) (iii) • 4M • Pg 245	DESC Descriptive	Easy
TQ 1.6 • PYQ 2015-Jun [1] (d) • 2M • Pg 246	DESC Descriptive	Easy
TQ 1.11 • PYQ 2016-Dec [1] (e) • 2M • Pg 249	DESC Descriptive	Easy
PQ 1.1 • PYQ 2013-Dec [1] (f) {C} • 1M • Pg 251	PRAC Practical	Easy
TQ 1.9 • PYQ 2015-Dec [2] (a) (i) • 6M • Pg 248	DESC Descriptive	Medium

UNDERSTANDING explain with reasons • 5 questions

- Two of the five questions here are two-mark formula questions, and they are answered by writing the formula and defining the terms. **Input efficiency = actual consumption ÷ desired or standard consumption; effectiveness = target achieved ÷ target achievable.** Where the question asks for both, give both, each on its own line; at two marks there is one mark in each formula and none in prose about them.
- The three-mark question on the **role of information technology in production and operations management** wants four or five sentences: that IT is crucial to operations everywhere along the supply chain and to every functional area, that computer-based IT has changed how operations are managed and how offices work, that it makes **cross-functional coordination easier** and **links the firm's basic processes**, and that in a plant it links people with work centres, databases and computers.
- The five-mark question asks what you would **suggest to a production manager for managing technological changes**, and the keyed answer is a numbered list of seven: **make a master plan for automation; find out the risks in going for automation; establish a new production technology or technology development department; allow plenty of time; do not try to automate everything at once; people are the key to successful implementation**; and companies moving too slowly are left behind. Number the points; prose loses the marks the numbering carries.
- The eight-mark labour question asks for four separate figures — **percent absenteeism, efficiency of utilisation of labour, productive efficiency of labour and overall productivity** — and each carries two marks. Write the formula, then the substitution, then the figure, for each of the four in turn. The step candidates miss is the third: **actual labour hours are the total available hours less both the absenteeism hours and the idle time**, and using the total hours there turns a 90.50% answer into 75%.

TQ 1.3 • PYQ 2014-Jun [3] (b) • 3M • Pg 245	DESC Descriptive	Easy
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TQ 1.4 • PYQ 2014-Dec [1] (b) • 2M • Pg 245	DESC Descriptive	Easy
TQ 1.10 • PYQ 2016-Jun [I] (d) • 2M • Pg 249	DESC Descriptive	Easy
TQ 1.7 • PYQ 2015-Jun [2] (c) (iii) • 5M • Pg 247	DESC Descriptive	Medium
PQ 1.7 • PYQ 2019-Dec [3] (b) • 8M • Pg 254	PRAC Practical	Hard

APPLYING take the provision to the facts • 6 questions

- Six practical questions sit here and five of them are the **same question** under different months and figures: compute the productivity per machine hour and interpret it. Work it once as a table with a **machine-hours column** inserted between the working hours and the production units, and the other four fall out in three minutes each.
- The **interpretation is a marked part of the answer**, not a courtesy. One sentence does it — though the total production in units is rising, the productivity per machine hour is falling — and it is the sentence the printed answer ends on every time. An answer that stops at three ratios is unfinished.
- The four-mark SONIX question is the plant-efficiency model and it turns on two conversions. Total time per unit is **operator time plus machine time**, 48 minutes; the month has $25 \times 8 \times 60 = 12,000$ minutes; at 80% plant efficiency that is 9,600 effective minutes and **200 units**. When **machine productivity falls by 10%**, machine time becomes $36 \times 100 \div 90 = 40$ minutes, so the total is 52 and the output **184 units**. Round to the nearest whole unit as the question directs, and never scale the 200 units by 10% directly.

PQ 1.2 • PYQ 2014-Jun [2] (c) • 2M • Pg 251	PRAC Practical	Medium
PQ 1.3 • PYQ 2014-Dec [1] (d) • 2M • Pg 252	PRAC Practical	Medium
PQ 1.4 • PYQ 2015-Dec [2] (c) (iii) • 5M • Pg 252	PRAC Practical	Medium
PQ 1.5 • PYQ 2016-Jun • 4M • Pg 253	PRAC Practical	Medium
PQ 1.6 • PYQ 2016-Dec [3] (b) • 7M • Pg 253	PRAC Practical	Medium
PQ 1.8 • PYQ 2023-Jun [4] (b) (ii) • 4M • Pg 256	PRAC Practical	Medium

ANALYSING break down and compare • 2 questions

- The seven-mark question asks you to **analyse the three important tools used for increasing productivity**, and the three headings are the answer's skeleton — **human aspects**, **supply of inputs** and **technological aspects**. Give each heading four sub-points; the marks are distributed across the three, so an answer that is strong on the human aspects and silent on the technological ones cannot pass the middle band.

- Analysis, as against a list, is shown by saying **why** each tool raises the ratio: the human aspects raise the willingness to work, the supply of inputs raises the quality and availability of what is converted, and the technological aspects reduce the input needed per unit of output. One such sentence under each heading is enough.
- The five-mark question on the **relationship between R&D inputs and output** is a distinguish-and-relate question, and it is answered by the seven determining variables — size of operation, technological opportunity, management philosophy, individual researchers, growth prospects and profits, diversification and marketing opportunity. Close on the point the printed answer closes on, that **market opportunities contribute three times more than technical opportunities** as a source of innovation.

TQ 1.1 • PYQ 2013-Dec [6] (c) • 5M • Pg 244

DB
Distinguish

Medium

TQ 1.12 • PYQ 2025-Jun [2] (b) • 7M • Pg 249

DESC
Descriptive

Medium

EVALUATING judge and justify • 1 question

- The single seven-mark question asks you to **write a line to define** seven terms used in measuring productivity — validity, completeness, compatibility, inclusiveness, timeliness, cost effectiveness and partial productivity. 'A line' is an instruction about length, and seven items at seven marks means one mark each; a paragraph on any one of them costs the marks that the last two items needed.
- Open with the sentence that gives the seven their standing — that a good productivity measure should possess these properties, and the more closely a measurement meets them the more useful it is for improving productivity. Then take them in the order the question prints them, and keep the distinguishing word in each definition: **between periods** for compatibility, **separately** for inclusiveness, **soon enough for managerial action** for timeliness, and **least interruption** for cost effectiveness.

TQ 1.8 • PYQ 2015-Jun [2] (d) (iii) • 7M • Pg 247

DESC
Descriptive

Hard

Topic 2: Five Key Aspects of Productivity

CMAL2P9-C5-T02

FREQUENCY TABLE CORRECTED — the Scanner's table at page 230 counts 2 against this topic; the book carries 1 appearance — the questions printed under it and the earlier sittings listed against them. These notes follow the book.

Read first Read §5.2 Five Key Aspects of Productivity, ICMAI Study Material Module 5, pages 265–267 — the system concept of productivity on page 265, then the five bulleted aspects that follow it in order, and read the factors affecting industrial productivity on pages 259 and 260 with them, because that list is what this topic is examined on.

NOTES

Productivity as a system: a ratio between the output volume and the volume of inputs; it measures how efficiently production inputs are being used in an economy to produce a given level of output, and it is a key source of economic growth and competitiveness. Because output is ambiguous and the inputs are diverse — people, capital, land, facilities, machine tools, mineral deposits, energy, ingenuity, climate, organisation and much else — it is restated as **the relationship between achieving a result and the time it takes to accomplish it**, that is **productivity = results ÷ time**. If one carpenter completes a job in 5 hours and another in 10, **the former's productivity is double the latter's**.

The system concept: the inputs — **land, workforce, material, facilities, capital, technology, equipment and tools** — enter the **production system**, where the **transformation process or value addition** takes place, and emerge as **goods and services** for the **end customer**; productivity is the **output ÷ input** measured across that system. The measure is used to **determine capacity utilisation**, which in turn allows the position of an economy in the business cycle to be gauged and its growth forecast.

Aspect one, employee productivity: it is **the amount of work, or output, produced by an employee in a specific period of time**, and the manager's task is to understand **how long it takes teammates to complete specific tasks and what roadblocks or distractions stand in the way**. Productivity is **getting important things done consistently** rather than getting more things done each day — **maintaining a steady average speed on a few things, not maximum speed on everything**. It is measured in three ways: **measure goals, measure quality of work, and measure the amount of work completed**. It is improved by **improving workplace conditions, allowing flexible schedules, setting clear deadlines and expectations, encouraging self-care and time off, optimising meetings, coaching employees on their priorities, learning time management skills, and boosting morale by celebrating accomplishments**.

Aspect two, material productivity: materials are **one of the basic inputs, constituting 50 to 70 per cent of the total value of the output**, so the performance of an organisation cannot be improved without improving material productivity. **Material productivity ratio = material output (net sales) ÷ material input**, and it **reveals the output received in constant prices per rupee of material input**. Set the **base year ratio at 100**: an index **below 100 means low productivity** and **above 100 an improvement** over the base year. That base-and-current comparison is the form in which any productivity ratio is turned into an index.

Aspect three, the three basic inputs and the catalyst: **land, labour and capital** are the three basic inputs of the production process, but **they do not contribute to total output separately or independently** — they produce goods and services **only when brought together in the presence of an organising authority or catalyst**, and that catalyst is **management**. Productivity is low in many organisations **despite the latest technology and trained manpower**, because of **inefficient and indifferent management**; job performance depends on the employee's **ability and willingness to work**, and management is the catalyst that creates both. Drucker: **without the manager's leadership the resources of production remain resources and never become production**.

Aspect four, the other factors that bear on productivity, by class: technological factors —

product design, plant layout, size and capacity of the plant, location of plant, timely supply of raw material, repairs and maintenance, material handling system, research and development, and inventory control. **Natural factors** — the physical, geographical, geological and climatic conditions, which are under no one's control and weigh most on extraction industries. **Social factors** — culture, traditions, customs, rules and norms, which **differ from place to place**. **Political factors** — law and order, peace and stability of government, with industrial, tariff and taxation policy. **Economic factors** — market size, banking and credit facilities, and the transport and communication system.

Aspect five, improving productivity — six steps and eight techniques: the steps are (a) **develop productivity measures for all operations**, measurement being the first step in managing and controlling; (b) **look at the system as a whole** in deciding which operations are most critical, because it is **overall productivity that matters**; (c) develop methods of improvement — soliciting ideas from workers, organising teams of workers, engineers and managers, studying how other firms have improved, and re-examining the way work is done; (d) **establish reasonable goals**; (e) make it clear that **management supports and encourages** improvement, with incentives to reward contributions; (f) **measure improvements and publicise them**. The individual techniques are **time your time, initiate regular breaks, self-imposed deadlines, quit multitasking, the two-minute rule, avoid unnecessary meetings, use unexpected bonus time, and be proactive not reactive**.

Factors affecting industrial productivity — five heads: **technological development** — the size of the plant and its capacity utilisation, production below or above the optimum being uneconomical; **research and development**; **plant and job layout**; **machine and equipment design**; **production processes**; **power and raw materials**; and **scientific management techniques** such as better planning, simplification of methods, time and motion study and reduced wastage. **Individual factors** — **knowledge**, acquired through training and education, **skill**, affected by aptitude, personality, education, experience and training, and **attitude**, the willingness of the employee to work, without which knowledge and skill are futile. **Organisation factors** — delegation and decentralisation of authority, participative management, personnel policies on selection, placement, promotion, wage and salary levels, **incentives, merit rating, job evaluation**, training, two-way communication and supervision, the Hawthorne experiments being the authority cited. **Work environment** — ventilation and lighting, safety devices, reduction in noise, suitable rest pauses. **Other factors** — **natural, managerial and Government policy**.

OBJECTIVE recognise the right answer — Section A of the Scanner, 1 and 2 marks • 3 questions

- Three objectives are placed on this topic and each turns on one word of a factor list. **Merit rating** appears among the organisation factors affecting productivity as a personnel policy; it is not a costing device, so the statement that merit rating is used to determine the cost of a product is **false**.
- The statement that a **piece wage system is a substitute for proper supervision** is **false** for the same reason — incentives and supervision are two separate organisation factors, and the Study Material lists them side by side rather than treating one as a replacement for the other.

- **Aesthetics** — style, colour, look and feel — **does add value to the product**, so the statement that it does not is false. Product design sits among the technological factors affecting productivity, which is why a design point can be set under this chapter as easily as under Chapter 3.

OQ • PYQ 2017-Jun [1] (c) (i) • 1M • Pg 234

OQ
Objective

Easy

OQ • PYQ 2017-Dec [1] (c) (vi) • 1M • Pg 234

OQ
Objective

Easy

OQ • PYQ 2019-Jun [1] (c) (iii) • 1M • Pg 236

OQ
Objective

Easy

UNDERSTANDING explain with reasons • 1 question

- The single seven-mark question asks you to **discuss the factors that will affect industrial productivity**, and the answer has a fixed shape: open with the sentence that productivity is a ratio between output and input, so that **all factors which affect output and input will also affect productivity**, and then take the five heads in order.
- Weight the answer as the material does. **Technological development** carries seven sub-heads and deserves half the space; **individual factors** are three words — knowledge, skill and attitude — each with a line; **organisation factors**, **work environment** and **other factors** take two or three lines each. Naming all five heads earns more than describing two of them well.
- Do not confuse this list with the **five key aspects** of the section's own title. The aspects are employee productivity, material productivity, the three basic inputs with management as the catalyst, the other classes of factor, and productivity improvement; the factors affecting industrial productivity are the five-head list above. A question that asks for factors wants the second.

TQ 2.1 • MQP 2024-Dec S2 [2] (b) • 7M • Pg 258

DESC
Descriptive

Medium

Topic 3: TQM Basic Tools and Certification

CMAL2P9-C5-T03

Read first Read §5.3 TQM Basic Tools and Certification, ICMAI Study Material Module 5, pages 268–269 — the definition of total quality management, then the basic concepts, the essentials of TQM focus, the underlying principles and the scope, which are four separate lists and are examined separately.

NOTES

Total quality management (TQM): a philosophy that involves everyone in an organisation in a continual effort to improve quality and achieve customer satisfaction. It is the **Japanese approach to quality** and it underlines **three philosophies** — a **never-ending push to improve**, called **continuous improvement**; the **involvement of every employee** in the organisation; and the

goal of customer satisfaction, which means **meeting or exceeding customer expectations**. **Static improvement** is a contradiction in terms and forms no part of the philosophy.

The six basic concepts in TQM: **top management commitment and support**; **focus on both internal and external customers**; **employee involvement and empowerment**; **continuous improvement (KAIZEN)**; **partnership with suppliers**; and **establishing performance measures for processes**.

The eight essentials of TQM focus: **customer satisfaction**, **leadership**, **quality policy**, **organisation structure**, **employee involvement**, **quality costs**, **supplier selection and development**, and **recognition and reward**.

The seven underlying principles in TQM: **strive for quality in all things** (total quality); **the customer is the creation of quality**; **improve the process or systems by which products are produced**; **quality improvement is a continuous, never-ending activity** (continuous improvement, kaizen); **worker involvement is essential**; **ground decisions and actions on knowledge**; and **encourage team work and cooperation**. A separate six-item statement of the **principles of total quality** is also in use — **quality oriented management**, **focus on customer**, **involving the entire work force**, **continuous improvement**, **supplier partnership** and **measuring performance**.

The scope of TQM: **an integrated organisational infrastructure**, **a set of management practices** and **a wide variety of tools and techniques**. TQM often focuses on **benchmarking world-class standards**, **product and service design and purchasing**, and involves the **team approach**, **employee empowerment**, **decisions based on facts rather than opinions**, **knowledge of quality tools** — **flow charts**, **check sheets**, **histograms**, **pareto analysis** and **scatter diagrams**, **quality at the source**, and the **inclusion of suppliers as part of the quality improvement programme**. TQM **seeks to break down communication barriers** among employees and between the organisation and its external stakeholders; it is **not merely a collection of techniques** but a **culture**, and to reap its benefits **the culture of the organisation must change**.

Kaizen: in simple terms kaizen is Japanese for **a change for better**, which results in **continuous improvement**, and it is **focused on making small improvements on a continuous basis**. Its advantages are five: it **involves every employee** in the process of change through small incremental changes, **identifying problems at their source**, **solving them at their source** and **changing standards so that the problem stays solved**; involving employees **improves morale** as work becomes more enjoyable and easier; it **reduces waste** in employee skills, waiting time, transportation, worker motion, over-production, excess inventory, quality and process; it **improves product quality**, **use of capital**, **production capacity**, **communications**, **space utilisation** and **employee retention**; and it incorporates **visual, action-oriented tasks**.

Total Quality Control (TQC): **quality control and improvement from shop floors to board rooms**, and an effective system for **integrating the quality development**, **quality maintenance** and **quality improvement efforts of the various groups in an organisation**. Its six principles are **top management policies** (zero defects, continuous improvement), **quality control training for everyone**, **quality at the product or service design stage**, **quality materials from suppliers**, **quality**

control in production (SQC), and quality control in distribution, installation and usage.

The three levels of quality: **organisation level**, satisfying the requirements of **external customers**; **process level**, meeting the needs of **internal customers**; and **performer level**, also called the job level or task design level, **meeting and maintaining the requirements of accuracy, completeness, innovation, timeliness and cost.**

The quality trilogy: under total quality management, **Juran** takes a holistic approach to quality, and his concept revolves around a **quality trilogy** composed of **quality planning, quality control and quality improvement.**

Benchmarking: the search for the industry's best practices that lead to superior performance. The process is: **select the benchmarking subject and the appropriate team; identify performance indicators and drivers; select benchmark partners; determine the data collection method and collect the data; analyse performance gaps; communicate findings and identify projects to close the gaps; implement plans and monitor results; and recalibrate benchmarks.**

The benefits of benchmarking: it is **particularly helpful in validating proposals for change; it often results in creative imitation and the adoption of new practices that overcome previous industry barriers**, and this search for diversity and for innovative breakthroughs applied elsewhere is **at the core of the benefits; by sharing information all parties benefit**, because it is difficult to excel in all activities, though sharing information and data is **the first hurdle to be overcome.** The caution: **do not attempt benchmarking in areas in which trade secrets or sensitive information determine the outcome.** Used with other quality techniques or alone, benchmarking **can influence how an organisation operates**, and if the search for best or better practice is performed correctly the likelihood of a successful outcome is high.

The eight most common benchmarking errors: **lack of self-knowledge** — until you have analysed your own operations the effort will not pay off, which is why **internal benchmarking is an important first step; benchmarking everything** — be selective; **benchmarking projects that are broad instead of focused** — benchmark a company's hiring procedures, not its entire human resources operation; **benchmarking produces reports, not action** — studies indicate that **50% of benchmarking projects result in no specific change; benchmarking is not continuous; setting too many goals**, when time and energy are fixed; **participants are not motivated**, benchmarking being treated as busy work for low-level employees; and **too much data**, success being measured by the quantity of information rather than by the action taken.

The quality vocabulary of the operating system: **inspection** is the **conducting of occasional check-ups of the products manufactured or assembled to ensure high quality of production** — a check on output, distinct from planning, scheduling and routing. **Quality circles**, and the use of **work teams or quality improvement teams**, are examples of **worker involvement** as a recent trend in production and operations management. And the operational question **are we producing the right things** belongs to **quality management**, as against inventory, maintenance and delivery planning, each of which answers a different question about the operating system.

OBJECTIVE recognise the right answer — Section A of the Scanner, 1 and 2 marks • 10 questions

- Ten objectives sit here and four of them are answered by the word **continuous**. TQM focuses on **continuous improvement**; **static improvement** is the item that is not part of the TQM philosophy; **KAIZEN is concerned with continuous improvement**, which is correct; and continuous improvement is the fourth of the six basic concepts. Where an option offers a business outcome — reducing production costs, expanding market share — it is a consequence of TQM, not its focus.
- Two are expansions or definitions. **TQC is Total Quality Control**, not total quality management, and the two are examined against each other. **Benchmarking is the search for the industry's best practices that lead to superior performance**; the option describing an analytical tool based on Pareto analysis and the one describing the redesign of the way a company works belong to other techniques.
- The remaining four are placement questions — which name goes with which activity. **Inspection** is the occasional check-up of what has been made; **quality circles** and work teams are **worker involvement**; and the operational question about whether the right things are being produced is **quality management**. Learn these as pairs, because the distractors are always the other three management functions of the operating system.

OQ • PYQ 2016-Dec [1] (d) (v) • 1M • Pg 233	OQ Objective	Easy
OQ • PYQ 2016-Dec [2] (c) (iv) • 1M • Pg 234	OQ Objective	Easy
OQ • PYQ 2017-Dec [1] (a) (iii) • 1M • Pg 234	OQ Objective	Easy
OQ • PYQ 2018-Jun [1] (a) (iv) • 1M • Pg 235	OQ Objective	Easy
OQ • PYQ 2019-Jun [6] (iv) • 1M • Pg 236	OQ Objective	Easy
OQ • PYQ 2021-Dec [18] • 1M • Pg 237	OQ Objective	Easy
OQ • MQP 2024-Dec S1 [1] (v) • 2M • Pg 240	OQ Objective	Easy
OQ • PYQ 2025-Jun [1] (i) {C} • 2M • Pg 241	OQ Objective	Easy
OQ • PYQ 2025-Jun [1] (vi) {C} • 2M • Pg 241	OQ Objective	Easy
OQ • PYQ 2026-Jun [1] (i) {C} • 2M • Pg 242	OQ Objective	Easy

REMEMBERING recall and reproduce • 7 questions

- Seven of the nine Section B questions on this topic sit here and every one of them is a list to be reproduced. The pairing that decides the marks is knowing **which** list is asked for: the **principles of total quality** (six), the **basic concepts in TQM** (six), the **essentials of TQM focus** (eight) and the **underlying principles** (seven) are four different lists, and a question asking for one is not answered by another.

- The two benchmarking questions at this level are the longest in the topic. The eight-mark **benefits of benchmarking** wants the benefit statements and the caution about trade secrets; the eight-mark **eight most common errors** wants all eight **named**, each with the clause that explains it — the name alone carries only half the mark, and the 50% figure on projects producing no change is worth quoting.
- The short ones are answered in three lines. **Kaizen** at four marks is the definition — Japanese for a change for better, resulting in continuous improvement through small improvements made continuously — and then the five advantages. The **three levels of quality** at three marks are organisation, process and performer, with the customer each level serves. The **quality trilogy** at two marks is Juran's three words and nothing more.

TQ 3.1 • PYQ 2013-Dec [5] (c) • 2M • Pg 260	DESC Descriptive	Easy
TQ 3.2 • PYQ 2013-Dec [6] (a) • 4M • Pg 260	DESC Descriptive	Easy
TQ 3.3 • PYQ 2014-Jun [5] (b) • 3M • Pg 261	DESC Descriptive	Easy
TQ 3.6 • PYQ 2015-Dec [1] (d) • 2M • Pg 263	DESC Descriptive	Easy
TQ 3.5 • PYQ 2015-Jun [2] (a) (iii) • 5M • Pg 263	DESC Descriptive	Medium
TQ 3.4 • PYQ 2014-Dec [2] (d) (ii) • 8M • Pg 261	DESC Descriptive	Hard
TQ 3.8 • PYQ 2016-Jun [II] (2) (c) • 8M • Pg 264	DESC Descriptive	Hard

UNDERSTANDING explain with reasons • 2 questions

- The seven-mark question on the **scope of TQM** is wider than its name suggests. Open with the three-item scope — integrated organisational infrastructure, a set of management practices, a wide variety of tools and techniques — then give the **three philosophies** of continuous improvement, employee involvement and customer satisfaction, then the **elements** including the named quality tools, and close on the culture point: TQM is not a collection of techniques, and to reap its benefits the culture of the organisation must change.
- The six-mark **eight steps benchmarking process** is marked step by step, so number the eight and keep each to one line. Do not describe benchmarking before starting — the question asks for the process — and do not stop at seven: **recalibrate benchmarks** is the step that closes the loop and it is the one most often left off.
- Where a question at this level names a technique in its stem, use the Study Material's own words for the definition and spend the space on the list that follows. The definitions in this topic are short and exact, and a paraphrase of a one-sentence definition reads as an approximation.

TQ 3.7 • PYQ 2015-Dec [2] (c) (ii) • 6M • Pg 264	DESC Descriptive	Medium
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Topic 4: ISO Standard Basics

CMAL2P9-C5-T04

FREQUENCY TABLE CORRECTED — the Scanner's table at page 230 counts 4 against this topic; the book carries 5 appearances — the questions printed under it and the earlier sittings listed against them. These notes follow the book.

Read first Read §5.4 ISO Standard Basics, ICMAI Study Material Module 5, pages 270–271 — what quality certification is and what ISO 9000 and ISO 14000 each cover, the five standards of the ISO 9000 series with the figure showing where each applies in the production flow, the eight quality management principles, and the review cycle.

NOTES

Quality certification and the two families: the EU, in 1987, established ISO — the International Organisation for Standardisation — 9000 certification. The two best known are ISO 9000, which pertains to quality management and concerns what an organisation does to ensure that its products or services are suitable to customers' expectations, and ISO 14000, which concerns the minimisation of harmful effects to the environment caused by an organisation's operations. Both are related to an organisation's processes rather than to its products and services, and both stress continual improvement. ISO 9000 is composed of the national standard bodies of 91 countries, and about 90 countries have adopted it as a national standard; the certification is intended to promote the idea of quality at every level in the organisation.

What certification does and does not certify: ISO certification is an elaborate and expensive process. A firm seeking it must document how its workers perform every function that affects quality and install mechanisms to ensure that they follow on expected lines. Certification entails a complex analysis of management systems and procedures; rather than judging the quality of a particular product, ISO 9000 evaluates the management of the entire manufacturing process, from purchasing to design to training. The firm must fill out a report and then be certified by a team of independent auditors, and with certification comes registration in an ISO directory that firms seeking suppliers can consult, registered companies generally being given preference over unregistered ones.

The five standards of the ISO 9000 series: placed on a continuum they range from design and development through procurement, production, installation and servicing. ISO 9004 only establishes guidelines for operation, while ISO 9001, 9002 and 9003 are well-defined standards; ISO 9000 itself is a guideline for selection and use.

Standard	Title
ISO 9000	Quality Management and Quality Assurance

	Standards — Guidelines for Selection and Use
ISO 9001	Model for Quality Assurance in Design, Production, Installation and Servicing
ISO 9002	Model for Quality Assurance in Production and Installation
ISO 9003	Model for Quality Assurance in Final Inspection Test
ISO 9004	Quality Management and Quality System Elements — Guidelines
ISO 14000	Environmental management

The eight quality management principles of the latest version of ISO 9000: a system approach to management; continual improvement; a factual approach to decision making; mutually beneficial supplier relationships; customer focus; leadership; people involvement; and the process approach.

When certification is a must, and when it is reviewed: ISO certification is a must for doing business with any member of the EU, and in addition to the benefit of access to that market it is particularly helpful for companies that do not currently have a quality management system, because it provides guidelines for establishing the system and making it effective. ISO standards are reviewed every five years and revised if needed, so that they remain useful tools for the market place; the last version was ISO 9001: 2008, replaced by ISO 9001: 2015 on and from September 2018. A certificate, once awarded, is valid for three years only, after which the certification body carries out periodic surveillance audits.

Implementing ISO 9000 — the fourteen steps: (1) **commitment from top management**, without which no quality initiative can succeed; (2) **establishing an implementation team** headed by a Service Provider and a **Management Representative**, who are the coordinators and the link between top management and the ISO 9000 registrar, with every department represented; (3) **conducting ISO 9000 awareness programmes**; (4) **providing training** to all employees; (5) **conducting an initial status survey**, comparing the existing quality management system with the requirements of the standard; (6) **creating a documented implementation plan** to address any non-conformance; (7) **developing quality management system documentation**; (8) **control of documents**; (9) **implementation**, phased in a large organisation and all at once in a small one; (10) **internal quality audit**; (11) **reviewing by management**, three to six months after implementation; (12) **pre-assessment audit** by a qualified but independent auditor; (13) **certification and registration**, an adequacy audit of the documents followed by an on-site audit; and (14) **continual improvement**, because **certification should not be an end**.

What the documented implementation plan and the documentation must contain: the plan is thorough and specific, detailing the quality documentation to be developed, the objective of the system, the pertinent section of the standard, the person or team responsible, the approval required, the training required, the resources required and the estimated completion date. The documentation itself must include documented statements of a quality policy and quality objectives, a quality manual, the documented procedures and records required by the standard, and the documents needed to ensure effective planning, operation and control of the processes. Continual improvement after certification is pursued through the quality policy, quality objectives, audit results, analysis of data, corrective and preventive actions, and management review.

The capacity computation: Processing time needed = Annual demand $\times$ Standard processing time per unit, summed over the products, in hours a year; Annual production capacity of one machine = Hours per shift $\times$ Working days a year, in standard hours; Number of machines required = Total work load $\div$ Capacity per machine, rounded up to the next whole machine. With 360 units at 7 hours, 435 at 5 and 570 at 6 the workload is **8,115 hours**; a machine working an 8-hour shift for 285 days gives **2,280 hours**; and $8,115 \div 2,280 = 3.5592$, so **4 machines** are required.

OBJECTIVE recognise the right answer — Section A of the Scanner, 1 and 2 marks • 12 questions

- Twelve objectives sit on this topic, a quarter of the chapter's Section A, and eight of them ask which number goes with which title. Learn the four phrases as four numbers: **design, production, installation and servicing = 9001; production and installation = 9002; final inspection test = 9003; quality management and quality system elements, guidelines = 9004**. Each of those four has been set at least twice, and the distractor is always one of the other three.
- Three are facts about the family rather than about a number. **ISO 14000** concerns the minimisation of harmful effects to the environment. There are **five** standards in the ISO 9000 series, so the statement that there are essentially four is **false**. And **ISO 9000** is the standard that evaluates the management of the entire manufacturing process from purchasing to design to training, which is the sentence the Study Material uses.
- Two turn on the review cycle and they are set as a matched pair. **ISO standards are reviewed every five years**, so the statement that they are reviewed every ten years is **false** and the multiple choice answer is **5 years**. The question asking on which area **ISO 9003** is applicable is keyed **installation**, read off the production-flow figure rather than from the title; keep it apart from the title question, which is answered by final inspection and test.

OQ • PYQ 2018-Jun [1] (a) (v) • 1M • Pg 235

OQ
Objective

Easy

OQ • PYQ 2019-Dec [1] (a) (v) • 1M • Pg 237

OQ
Objective

Easy

OQ • PYQ 2022-Dec [1] (a) (ix) {C} • 1M • Pg 238

OQ
Objective

Easy

OQ • PYQ 2022-Dec [1] (c) (iv) {C} • 1M • Pg 238

OQ
Objective

Easy

OQ • PYQ 2023-Jun [1] (b) (iv) {C} • 1M • Pg 238	OQ Objective	Easy
OQ • MQP 2023-Jun S2 [1] (a) (iii) • 1M • Pg 239	OQ Objective	Easy
OQ • PYQ 2023-Dec [1] (v) {C} • 2M • Pg 239	OQ Objective	Easy
OQ • PYQ 2024-Jun [1] (v) {C} • 2M • Pg 239	OQ Objective	Easy
OQ • PYQ 2024-Dec [1] (vii) {C} • 2M • Pg 240	OQ Objective	Easy
OQ • PYQ 2025-Jun [1] (xiii) {C} • 2M • Pg 241	OQ Objective	Easy
OQ • PYQ 2025-Dec [1] (ii) {C} • 2M • Pg 242	OQ Objective	Easy
OQ • PYQ 2026-Jun [1] (ii) {C} • 2M • Pg 243	OQ Objective	Easy

REMEMBERING recall and reproduce • 1 question

- The twelve-mark question puts you in the position of the **Management Representative** and asks four things in turn — the broad activities of the role, the five standards, when certification is a must and particularly helpful, and when it is reviewed. Answer under four headings in the order asked; the marks are split across the four and the last two are each worth two or three despite being a sentence long.
- The first part is answered from the certification passage: document how workers perform every function that affects quality, install mechanisms to ensure they follow on expected lines, submit to a complex analysis of management systems and procedures rather than a judgement of a particular product, file a report, be certified by **independent auditors**, and take registration in the ISO directory.
- The second part is the five-standard table and it should be written as a table. The third is answered in two clauses — a must for doing business with any member of the **EU**, and particularly helpful for companies with no quality management system already. The fourth is one line: **reviewed every five years and revised if needed**.

PQ 4.2 • PYQ 2021-Dec [1] • 12M • Pg 272	PRAC Practical	Hard
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UNDERSTANDING explain with reasons • 1 question

- The ten-mark question makes you a consultant appointed to **implement ISO 9000** and asks for the steps. It is a sequence question, so number the steps and give each a single sentence; fourteen steps at ten marks means the marks are for **coverage and order**, not for depth on any one of them.
- Open with the sentence the printed answer opens with — that implementation affects the entire organisation from the start and, if pursued with total dedication, results in a **cultural transition to an atmosphere of continuous improvement**. Close on step fourteen, that certification **should not be an end** and improvement continues through the quality policy, objectives, audit results, analysis of data, corrective and preventive actions and management review.

- The steps most often missed are the middle ones — the **initial status survey** that compares the existing system with the standard, and the **documented implementation plan** that addresses the non-conformances the survey finds. Without those two the answer jumps from training to documentation and loses the logic that the marker is following.

TQ 4.1 • PYQ 2014-Jun [4] (a) • 10M • Pg 266

DESC
Descriptive**Hard****APPLYING** take the provision to the facts • 1 question

- The six-mark question printed here is a **machines required** computation and it is marked in three parts of two marks each: the processing time needed for each product, the annual capacity of one machine, and the number of machines. Lay the first part out as a table with a product per row and the multiplication shown.
- The third part is where marks are lost. **Round up:** 3.5592 machines is **4 machines**, never 3.56 and never 3. Write the division, the decimal answer and then the rounded figure with the word 'machines' against it, and say in a clause why it is rounded up — a fraction of a machine cannot meet the load.

PQ 4.1 • PYQ 2017-Dec [4] (b) • 6M • Pg 271

PRAC
Practical**Medium**