P16 Paper Map Strategic Cost Management

Q1 = 15 MCQs × 2 = 30, compulsory. Q2–Q8 = seven questions of 14; answer any five. The paper prints 128 marks; about 84% of past marks are sums. Since Dec'23 the frame has not moved: Q2 decision sum · Q3 transfer pricing + target / life-cycle · Q4 ABC or throughput + a theory half · Q5 variances · Q6–Q7 four rotating quantitative halves · Q8 maxima / minima + forecasting. **The exam copies SM illustrations** — Jun'26 Q3 was two of them word for word.

Module	Marks per paper (J26 · D25 · J25 · D24 · J24 · D23)	Dec'26 ≈	Where it sits
3 Decision making (two packs)	36 · 36 · 34 · 32 · 34 · 34	**34.9**	Q2, Q3, MCQs (i)–(iii), (xv)
5 Variances	20 · 18 · 16 · 16 · 16 · 16	**17.8**	Q5, MCQs (v), (xi), (xiii)
4 ABC, JIT, throughput	11 · 11 · 11 · 11 · 9 · 9	**11.5**	Q4(a), MCQs (iv), (xii)
11 PERT, CPM	7 · 0 · 16 · 18 · 16 · 9	8.0	Q6–Q7
14 Forecasting	7 · 7 · 7 · 9 · 7 · 9	7.5	Q8(b)
10 Simulation	2 · 7 · 7 · 9 · 9 · 9	7.1	Q6–Q7, MCQ (vii)
13 Maxima, minima	7 · 7 · 9 · 2 · 9 · 7	6.6	Q8(a)
1 SCM, value analysis, BPR	4 · 4 · 2 · 9 · 2 · 9	6.1	Q4(b) theory, MCQs (x), (xiv)
12 Learning curve	2 · 9 · 2 · 2 · 2 · 9	6.1	Q7 (Decembers), MCQ (viii)
8 Assignment	2 · 7 · 2 · 7 · 2 · 7	5.8	Q6 (every December)
2 Quality	7 · 7 · 9 · 2 · 9 · 2	4.1	Q4(b) theory, MCQs
6 Linear programming	7 · 11 · 0 · 0 · 7 · 0	4.1	Q6 formulation, MCQs
9 Game theory	7 · 2 · 2 · 7 · 2 · 2	3.9	Q7 / Q8 half, MCQ (vii)
15 Data analytics	2 · 2 · 4 · 4 · 4 · 4	2.6	MCQ (ix)
7 Transportation	7 · 0 · 7 · 0 · 0 · 2	1.8	Q6 (Junes)

Marks are per paper (the rule: never added up). Dec'26 ≈ = expected printed marks from the slot model (sums to 128). Jun'23 used an older layout and is left out of this table.

A Dec'26, question by question — the most likely topic per place

Place	Most likely (chance)	Practise first
Q2 (14)	3.1 + 3.4 decision sum: contract / spare capacity (December habit)	D25, D23 Q2, SM Illus. 34
Q3(a)	3.3 transfer pricing (95%)	SM Illus. 26, 20–23 (not yet asked)
Q3(b)	3.5 target costing (35%), 3.8 probability (25%)	SM Illus. 41, 45, 56
Q4(a)	4.1 ABC (50%), 4.3 throughput (38%)	J26 Q4(a), SM Illus. 15
Q4(b)	1.3 value-analysis phases (35%), 2.2 cost of quality (20%)	Module 1 and 2 model answers
Q5 (14)	5.1 variances: mix / yield or overheads	J26, D25 Q5, SM Illus. 8, 19
Q6 + Q7	four of: PERT (11.0) · simulation (10.0) · assignment (8.0) · learning curve (12.0)	D25, D24, D23 Q6–Q7
Q8(a)	13.0 maxima / minima (85%)	J26, D25 Q8(a)
Q8(b)	14.0 forecasting — seasonal indices in Decembers	D25, D24 Q8(b)

MCQ	Most likely topic
(i)	3.8 probability / expected profit
(ii), (iii)	3.1 CVP one-liners
(iv)	4.1 ABC rate
(v)	5.1 variance back-solve
(vi)	6.0 LP or 8.0 assignment
(vii)	9.0 game value or 10.0 simulation
(viii)	12.0 learning curve
(ix)	15.0 data-analytics tool
(x)	1.1 / 1.3 value chain, blue ocean, value engineering
(xi)	5.1 variance theory or 6.0 shadow price
(xii)	4.2 Kanban / JIT
(xiii)	5.1 / 5.2 standard v budget, uniform costing
(xiv)	1.3 BPR / value analysis
(xv)	3.5 target cost with an ROI

YOUR 5 OF 7

- **Core**: Q2, Q3, Q5, Q8 — the same areas in every paper since Dec'23.
- **Fifth**: Q4 (ABC / throughput + one short theory list).
- **Spare**: Q6 or Q7 — prepare PERT, simulation, assignment and learning curve so one of them is all-familiar.
- Use the site's **Question numbers** view (Analytics tab) to see each question's module in every past paper.

B Formula card — the sums of this paper

Formula	Question	SM
BEP = fixed cost ÷ PV ratio; MOS × PV ratio = profit; target sales = (fixed + profit) ÷ PV ratio	MCQs (ii)–(iii), Q2	[SM 80–83]
Key factor: contribution ÷ scarce unit; shadow price = contribution of one more unit	Q2	[SM 88–89]
Relevant cost: replacement / realisable / opportunity; sunk and absorbed fixed out	Q2	[SM 160–174]
Minimum TP = VC + contribution given up; company view = outside price v VC saved	Q3(a)	[SM 139, 154]
Target cost = target price − target profit	Q3(b), MCQ (xv)	[SM 176]
Equivalent annual cost = PV of costs ÷ annuity factor	Q3(b)	[SM 215]
Cost driver rate = activity cost ÷ driver volume	Q4(a), MCQ (iv)	[SM 266–269]
Throughput = sales − material; TA ratio = return per hour ÷ cost per hour	Q4(a)	[SM 292]
Usage = mix + yield; price on AQ; rate on hours paid, efficiency on hours worked	Q5	[SM 334–337]
FOH volume = efficiency + capacity (+ calendar); expenditure = budget − actual	Q5	[SM 356–357]
$t_e = (a + 4m + b) \div 6$; σ = √Σ variances; $Z = (T - T_E) \div \sigma$; cost slope	Q7	[SM 612–618]
Learning: average falls to r each doubling; $Y = aX^b$, $b = \log r \div \log 2$	Q7, MCQ (viii)	[SM 639–640]
Simulation ranges from 00; idle share = idle ÷ total time	Q6–Q7	[SM 581, 586]
Profit maximum: $d\pi/dx = 0$, $d^2\pi/dx^2 < 0$; discrimination MC = $MR_1 = MR_2$	Q8(a)	[SM 663, 669]
Trend y = a + bx (centred x); forecast = trend × index; $u_t = u_{t-1} + \alpha(y_t - u_{t-1})$	Q8(b)	[SM 701–708]
2 × 2 game value = $(a_{11}a_{22} - a_{12}a_{21}) \div (a_{11} + a_{22} - a_{12} - a_{21})$	MCQ (vii), Q7	[SM 555]

WHAT COULD GO WRONG

- The Q6–Q7 mix can drop any one module (PERT was absent in Dec'25) — prepare four, not two.
- A whole December question can come back with the same numbers (Jun'26 repeated three June ones) — practise Dec'23, Dec'24 and Dec'25 in full.
- A never-asked theory in Q4(b) (JIT, Six Sigma, supply chain) — Q4 is the fifth question, Q6 / Q7 the fallback.

Module 3 · Part 1 · Decision sums and CVP P16 · 3.1, 3.4

SM pp. 77–116 (3.1 alternative choices) and 160–174 (3.4 relevant cost). Module 3 is the heaviest module — marks per paper: **J26-36 · D25-36 · J25-34 · D24-32 · J24-34 · D23-34** (J23-19, old layout); Dec'26 expected ≈ 35. Part 1 = **Q2, one 14-mark decision sum in every paper since Dec'23**, plus **MCQs (ii)–(iii) on CVP** and an opportunity-cost MCQ. Part 2 = Q3 (transfer pricing, target / life-cycle costing, probability).

Paper	Q2 (14)	MCQs
Jun'23*	old layout: leave a job for a venture — profit and BEP at each price (Q6); minimum price of a modified job (Q4(a))	–
Dec'23	**builder's contract: relevant v irrelevant costs, accept?** (= SM Illus. 34 type)	opportunity cost · price for a target profit
Jun'24	**make or buy + an alternative product per machine hour, best mix**	profit from BEP and MOS · relevant cost of stock
Dec'24	budget profit, **export order at idle capacity**, make or buy a component (= PTP Q2)	price from BEP, fixed cost, MOS
Jun'25	airline: profit and BEP per flight, stop-over offer — accept?	PV ratio · opportunity cost · price for a target profit
Dec'25	**spare hours in two departments**: relevant cost, best price, weekly programme, gain	units for a target profit · fixed cost
Jun'26	**= Jun'24 Q2 word for word** (same numbers)	change in PV ratio · profit at given sales

HOW IT IS ASKED

- **Q2**: one case, three or four asks: contribution / relevant cost per unit → which alternative / what price / what mix → the gain → advise "accept / make / buy" with a reason.
- **December habit**: relevant cost of a contract (D23) or of spare capacity (D25); an export order + make or buy (D24). **June**: the machine-hour mix (J24 = J26), the airline offer (J25).
- **MCQs (ii)–(iii)**: one-line CVP — BEP, MOS, PV ratio, sales or price for a target profit.

A Formula sheet — when to use

Formula	When to use · notes	SM
Contribution = sales − variable cost; profit = contribution − fixed cost	Every decision sum starts here; fixed costs that do not change are left out of the comparison.	[SM 80]
PV ratio = contribution ÷ sales × 100; sales = contribution ÷ PV ratio	MCQs give two of BEP, fixed cost, PV ratio, sales — find the third.	[SM 80]
BEP = fixed cost ÷ PV ratio (₹) or ÷ contribution per unit (units)	"Break-even passengers / units".	[SM 82]
MOS = sales − BEP sales; profit = MOS × PV ratio	Profit straight from BEP data (J24, J26 MCQs).	[SM 82]
Target sales = (fixed cost + target profit) ÷ PV ratio	Units for a target profit: ÷ contribution per unit; price for a target profit: required contribution per unit + variable cost.	[SM 82–83]
Key factor: contribution ÷ units of the scarce factor; rank; fill demand in rank order	Machine / labour / material hours short (J24, J26, D25).	[SM 83, 88]
Shadow price = contribution from one more unit of the scarce factor	The contribution per hour of the product that gets the last hour.	[SM 89]
Relevant cost = future, incremental, cash cost of this decision	Sunk, committed and absorbed fixed costs and depreciation are irrelevant; opportunity costs are relevant.	[SM 160, 162–163]

B Relevant cost of a contract or of spare capacity · Q2 3.4

Item	Relevant amount	SM
Material not in stock, or in regular use	**replacement cost**	[SM 165]
Material in stock, no other use	**realisable value** (what it would sell for)	[SM 165]
Stock that can replace another material	the **cost saved** there (substitution)	[SM 165]
Material on order, no longer needed	its **residual value**	[SM 173]
Labour paid anyway, no other work	**nil**	[SM 169]
Labour that can take over other paid work	the **cost saved** there (lower of the two)	[SM 173]
Scarce skilled labour	**wages + contribution forgone**	[SM 169]
Machine used regularly	**fall in replacement cost** over the period	[SM 170]
Machine with no other use	**fall in resale value** (+ extra maintenance)	[SM 164, 170]
Fixed overheads absorbed	**irrelevant**; only the avoidable part counts	[SM 163, 173]
Work given up for this one	**profit / contribution forgone** (opportunity cost)	[SM 161]

1 · List every cost line
as the question gives it (estimate / cost sheet)

↓

2 · Relevant amount + reason
one line each: replacement, realisable, opportunity, nil (sunk / committed / absorbed)

↓

3 · Total relevant cost
add the opportunity cost of work given up

↓

4 · Compare and advise
price − relevant cost = gain (accept) or loss; minimum price = relevant cost

- Relevant costs must be **futuristic, incremental and cash flows**; depreciation and book values are not. [SM 160]
- Relevant: differential, incremental, opportunity, avoidable, replacement, imputed, out-of-pocket costs. Irrelevant: **sunk, committed, unavoidable, absorbed** costs. [SM 161–162]

PROBLEMS BOX · CONTRACT / SPARE CAPACITY (D23, D25 — RECOMPUTED BY SCRIPT m03p1_patterns.py)

WORKED PATTERN · SM ILLUSTRATION 34 (XYZ CONTRACT = D23 Q2 TYPE)

Element	Relevant ₹	Why
Material X (obsolete; replaces W)	1,08,000	1,35,000 − 15,000 − 12,000 saved
Material Y (on order, not needed)	1,55,000	residual value
Material Z (to be ordered)	3,00,000	current price
Skilled labour	4,00,000	lower of 5,40,000 and 4,00,000 saved
Unskilled (hired for it) · supervisory · avoidable overheads	3,00,000 · 50,000 · 1,25,000	
Total v price 14,00,000	**14,38,000**	profit falls by **38,000**

DEC'25 Q2 BNR (OUR WORKING): SPARE HOURS, SELL TIME AT ₹70 OR MAKE

- Labour is paid anyway → out. Overhead at 90% capacity = 1,800 h a year: fixed ₹20 / ₹28 per hour → variable ₹20 / ₹12.
- Variable cost per hour: Dept 4 = 40 + 20 = **₹60**; Dept 5 = 60 + 12 = **₹72**. Selling Dept 4 time earns ₹10 / h (opportunity cost); Dept 5 time at ₹70 loses ₹2 / h (no opportunity cost).
- **Relevant cost per unit** = 0.75 h × 70 + 20/60 h × 72 + material 10 = **₹86.50**.
- Price: (100 − 86.50) × 1,500 = 20,250 but Dept 4 has only 800 spare hours (max 1,066 units); 110 → 23.5 × 1,000 = **23,500**; 120 → 16,750 → **price ₹110**.
- Week: 20 units; Dept 4 15 h + 1 h sold; Dept 5 6⅔ h, rest left idle (not sold at a loss). Weekly contribution **₹630** v ₹128 now (all 32 h sold) → **gain ₹502 a week**.

PRACTISE THESE (MOST LIKELY FIRST)

D25 Q2, D23 Q2 · J23 Q4(a) (minimum price of a job) · MCQs D23 Q1(iii), J25 Q1(xii) (opportunity cost), J24 Q1(xi) (stock) · postal Q1(vi) · SM Illus. 27–34 (SM 160–174), exercise essay 10 (SM 248) · **ICMAI Practice Workbook Ch1 illus. 6, 7** · MCQ bank Q24–Q30, Q34, Q219, Q268.

[SM 171–174] Then advise: reject on cost (or accept only for strategic reasons).

⚠ SM SLIP · ILLUSTRATION 34

The solution writes Material Y "on order at contract price ₹1,50,000"; the question says ₹1,80,000. The answer (residual value ₹1,55,000) is not affected. [SM 171–173]

DEC'23 Q2 RONTEX (OUR WORKING, SM ILLUS. 34 RULES), ₹ LAKH

Land 1 ground 20 (2 free) · design 3.5 (half sunk) · registration 10 · cement 8 (replacement) · bricks 5 (realisable) · others 8 + 1 = 9 · skilled 2 (profit lost elsewhere; wages paid anyway) · unskilled 8 · supervisor 0 · overheads 4 (avoidable) · equipment 32 − 25 = 7 (fall in replacement cost; depreciation out) · other project's profit 10 → **relevant cost 86.5 v offer 100: accept, gain 13.5**. If the skilled wages are read as extra cost: 98.5 — still accept. State the assumption.

C Make or buy, export order, best mix · Q2 3.1

PROBLEMS BOX · ALTERNATIVE CHOICES (J24 = J26, D24, J25 — RECOMPUTED BY SCRIPT)

WORKED PATTERN · SM ILLUSTRATION 3 (KEY FACTOR AND SHADOW PRICE)

	A	B	C
Contribution per unit (variable = ⅓ of unit cost)	14	23	29
Per processing hour · rank	14 · III	23 · I	14.50 · II
Hours given (13,500)	1,500	8,000	4,000

Profit ₹60,750 → **₹80,000** (+₹19,250); **shadow price ₹14** per hour (one more hour = one more A). [SM 87–89]

EXPORT ORDER · SM ILLUSTRATION 2 (₹ LAKH)

Reject: profit 2.00 · accept and starve the home market: 3.00 · add capacity + overtime: **4.00** → **best**. Variable costs scale with capacity; overtime premium on the extra 10%. [SM 85–87]

JUN'26 Q2 = JUN'24 Q2 MHT (OUR WORKING) — LEARN THIS ONE

Per unit (₹)	MH 100 made	MH 100 bought	MH 200 made
Selling price	900	900	600
Material + machine + **variable** mfg OH + variable selling	200 + 150 + 120 + 80	650 + 40	200 + 50 + 40 + 60
Contribution · per machine hour	**350** · 233.33	**210**	**250** · 500

Fixed mfg OH ₹3,00,000 ÷ 7,500 machine hours (5,000 × 1.5 h) = ₹40 / h, so MH 100 carries 60 fixed (180 − 60 = 120 variable), MH 200 carries 20 (60 − 20 = 40). Plan: MH 200 12,000 (6,000 h) → MH 100 made 1,000 (1,500 h) → MH 100 bought 6,000 (Rex's limit). Operating income = 30,00,000 + 3,50,000 + 12,60,000 − 3,00,000 − 6,00,000 = **₹37,10,000**.

DEC'24 Q2 GREEN SINE (OUR WORKING)

- Variable per unit 30 + 9.40 + 28 + 12 + 12 = 91.40 → contribution 38.60; budget profit = 1,80,000 × 38.60 − fixed 37,80,000 = **₹31,68,000**.
- Export: wages 28 ÷ ₹7 = 4 h a unit, so variable factory OH = 12 ÷ 4 = ₹3 / h. Cost 56 + 70 + 30 + 14 = 170 v price 175 → **₹5 × 6,000 = ₹30,000**; needs 60,000 h of the 80,000 idle h → accept.
- Component EX: make at (30,000 + 52,500 + 25,500) ÷ 15,000 = **₹7.20** v buy ₹7.90 → **make** (fixed OH stays either way).

JUN'25 Q2 AIRWAY (OUR WORKING)

Contribution per passenger 5,000 − 300 − 500 = 4,200; fixed per flight 3,78,000 → profit **₹6,30,000**, BEP **90 passengers**. Stop-over: ZOMB 50 × 2,500 + A–D 60 × 2,400 − 25 lost × 4,200 − snacks 215 × 200 − fuel 45,000 − landing 19,000 = **+₹57,000** → **accept**. ⚠ The question's seats do not fit 260 (A–D 275, D–B 265); answer on its figures and say so.

PRACTISE THESE (MOST LIKELY FIRST)

J26 = J24 Q2, D24 Q2 (= PTP Q2 word for word), J25 Q2 · MQP Q2 (adds the use of the released capacity) · J23 Q6 · SM Illus. 2, 3, 6, 7, 11, 12 (make or buy), 4, 9 (mix), 10 (shut down), 13–16 (SM 84–116), exercise essays 1–3 (SM 247) · **ICMAI Practice Workbook Ch1 illus. 1–5**.

D CVP one-liners · MCQs (ii)–(iii) 3.1

WORKED PATTERN · SM ILLUSTRATION 1 (BEP AND TARGET SALES)

- Revenue ₹80,00,000; variable ₹48,00,000 → contribution ₹32,00,000, **PV ratio 40%**; fixed cost after advertising ₹60,00,000. [SM 84–85]
- BEP = 60,00,000 ÷ 40% = **₹1,50,00,000**; sales for a ₹4,00,000 profit = 64,00,000 ÷ 40% = **₹1,60,00,000**. [SM 85]

OPPORTUNITY COST MCQ · SM ILLUSTRATION 33

One product per period, 1,000 hours: C can make 800 of 900 demanded → 100 × ₹40 = **₹4,000** lost; D 500 of 600 → **₹4,000**; A and B nil. [SM 171]

MCQ asks	Do this
Price for a target profit (D23, D24, J25)	contribution needed = fixed + profit; ÷ units; + variable cost
Profit from BEP and MOS (J24, J26)	(sales − BEP sales) × PV ratio
PV ratio from BEP and fixed cost (J25)	fixed cost ÷ BEP sales
Units for a target profit (D25)	(fixed + profit) ÷ contribution per unit
Change in PV ratio (J26)	new (price − variable) ÷ price, less the old ratio

Practise: D23 Q1(iv), J24 Q1(iv), D24 Q1(ii), J25 Q1(ix), (xv), D25 Q1(ii), (iii), J26 Q1(ii), (iii) · MQP Q1(ii), (iii) · PTP Q1(ii), (iii), (xi) · postal Q1(iv), (v) · MCQ bank Q15, Q17, Q19–Q21, Q31, Q185, Q191, Q194, Q210, Q214, Q217, Q245, Q247, Q248, Q256, Q259, Q271, Q274, Q276, Q279.

TRAPS

- Split each overhead into fixed and variable first (absorption rates hide the fixed part: D25, J26, D24).
- Rank by contribution **per unit of the scarce factor**, never per unit of product.
- Sunk costs, depreciation and staff paid anyway are left out — say why in one line each.
- End with a clear advice sentence ("accept", "make", "price ₹110"): the marks sit there.

Module 3 · Part 2 · Q3 sums P16 · 3.2, 3.3, 3.5–3.8

SM pp. 117–236. **Q3 = 7 + 7 in every paper since Dec'23**: (a) **transfer pricing — every paper**; (b) target costing (D23, J25, J26), life-cycle costing (J24, D25) or CVP with probability (D24). MCQs: (i) probability / expected value, (xv) target cost with an ROI. Module 3 per paper: J26-36 · D25-36 · J25-34 · D24-32 · J24-34 · D23-34.

Paper	Q3(a) transfer pricing	Q3(b)
Dec'23	sell to B at 2.25 or cut back? (ROI)	target cost after value engineering
Jun'24	best external price, minimum TP, share the gain (= SM Illus. 24 type)	life-cycle cost of two machines (= SM Illus. 50 × 200)
Dec'24	transfer at 22 under ROI; lowest price	BEP + probability of reaching it (= SM Illus. 56 type)
Jun'25	buy outside at 270, then at 249.75?	**= SM Illus. 41, same numbers**
Dec'25	**= SM Illus. 19, every figure × 10**	product life-cycle cost (= SM Illus. 49 type)
Jun'26	**= SM Illus. 25 word for word**	**= SM Illus. 45 word for word**

THE EXAM COPIES THE SM HERE

- Jun'26 Q3 was **two SM illustrations with the same numbers**; Jun'25 Q3(b) and Dec'25 Q3(a) too. Learn **SM Illus. 19, 24, 25, 41, 45, 49, 50, 56** exactly — layout and figures.
- Dec'26 most likely: (a) a transfer-pricing case from Illus. 17–26 not yet asked word for word (19, 24 and 25 came; **Illus. 26**, 20, 21, 22, 23 have not); (b) target costing or a life-cycle cost.
- Old layout Jun'23: variance investigation by probability (J23 Q5(b)) and MCQs only.

A Formula sheet — when to use

Formula	When to use · notes	SM
Minimum TP = variable cost + contribution given up per unit; maximum = what the buyer pays outside	Opportunity-cost pricing: the seller's floor and the buyer's ceiling; with spare capacity the floor is variable cost.	[SM 139]
Company view: buy outside only if outside price < variable cost saved + any other saving	Fixed costs of the selling division stay; ignore the transfer price itself (it cancels out).	[SM 154–155]
Cost-plus TP = variable + fixed per unit + (assets × ROI) ÷ units	Division priced on a return on its investment (D23, D24 ROI cases).	[SM 140]
Target cost = target price − target profit ("price-led costing")	Profit as % of sales, or ROI × investment ÷ units (MCQ xv).	[SM 176]
Life-cycle cost = all costs from design to after-sales, over the whole life	R&D once + variable × units + fixed per year × years + warranty.	[SM 199]
Equivalent annual cost = PV of all costs ÷ annuity factor for that life	Machines with different lives (J24 type).	[SM 215]
Expected value = Σ probability × outcome; P(break-even) = P(sales ≥ BEP)	MCQ (i) and the Q3(b) probability case.	[SM 230, 232]

B Transfer pricing · Q3(a) every paper 3.3

1 · Each division's statement
at the asked price / output: sales or transfer revenue − its own costs

↓

2 · Company as a whole
external revenue − variable costs actually saved or incurred (transfer price cancels)

↓

3 · Range
minimum = VC + contribution lost; maximum = outside price (+ costs it saves)

↓

4 · Advise
goal congruence: what is best for the company, and the TP that makes each manager agree

- Methods: market price, cost based, **negotiated**, **opportunity cost** (the minimum the seller accepts, the maximum the buyer pays). [SM 139]
- Illus. 17: cost-plus ROI transfer price ₹12.70 = 10 + 2 + 0.70 (28% on ₹10,00,000 of assets ÷ 4,00,000 units). [SM 140]
- Illus. 18: effect on profit of six transfer bases (marginal cost, + 25%, + ROI, full cost, full cost + share of profit, market price). [SM 140–142]

TRAPS

- The division's fixed costs and the old transfer price are **not** savings for the company.
- Check capacity: a transfer that pushes external sales down costs the contribution lost.
- ROI cases: compare ROI with and without the transfer — assets and fixed costs saved count.

PROBLEMS BOX · TRANSFER PRICING (RECOMPUTED BY SCRIPT m03p2_patterns.py)

WORKED PATTERN · SM ILLUSTRATION 25 (= JUN'26 Q3(a) WORD FOR WORD)

Situation (1,000 units)	Outside	Saved	Company
(i) buy at ₹135	1,35,000	1,20,000	**loss 15,000**
(ii) + ₹18,000 other use of A's plant	1,35,000	1,38,000	**gain 3,000**
(iii) price drops by ₹20 (₹115)	1,15,000	1,20,000	**gain 5,000**

Saved = A's variable cost ₹120 per unit (its ₹20 fixed stays). [SM 154–155]

SM ILLUSTRATION 24 (= JUN'24 Q3(a) TYPE)

X alone: best 64,000 at ₹24 = ₹7,68,000. Forced 50,000 to Y: external 50,000 × 14 = 7,00,000, shortfall 68,000 → **minimum TP 12 + 1.36 = ₹13.36**; Y's ceiling 22 + 3 transport = ₹25. Partial: X sells 64,000 outside and offers 36,000 at a **shared ₹17** (12 + half of 22 − 12). Company best: transfer 50,000, net gain **₹5,82,000**. [SM 152–154]

SM ILLUSTRATION 19 (= DEC'25 Q3(a), EVERY FIGURE × 10)

At TP 1.20: A's profit rises to 1,200 at 6,000 units; B peaks at 1,060 (2,000 units). [SM 142–144] Company = A + B: 0, 1,060, **1,350 (3,000 units)**, 920, 150, −1,440. Dec'25 = ×10: company ₹13,500 at 3,000 a day; at A's best (6,000) − ₹14,400; at B's best (2,000) ₹10,600.

OUR WORKINGS · THE OTHER Q3(a)s

- **D24 Roxin** (ROI): now 25%; at ₹22 to N 22.5%; without N (assets −2 lakh, fixed −40,000) 24% → M will refuse 22; **lowest price ₹23.80** keeps 24%.
- **J25 Regal**: inside, company contribution (540 − 256.50 − 202.50) × 2,500 = 2,02,500; Y buys at 270 → 1,68,750 → company loses **33,750**; at 249.75 buying outside gains **16,875**. TP: 270 (market) in (i); in (ii) buy outside (X cannot go below 256.50).
- **D23 Doxin**: price for 25% on ₹12 lakh assets = **₹4.50**. A sells 1,40,000 only: profit 1,30,000, ROI 13%; also sells 60,000 to B at 2.25: profit 1,65,000, ROI 13.75% → sell (+35,000).
- **J24 MN Co**: EXE alone ₹40 × 1,25,000 → ₹31,25,000; forced 1,00,000 to WYE: minimum TP **₹16.25**; partial: 75,000 units at a shared **₹25**.

PRACTISE THESE (MOST LIKELY FIRST)

SM Illus. 26, 20, 21, 22, 23 (not yet asked), 19, 24, 25 (SM 140–159) · J26, D25, J25, D24, J24, D23 Q3(a) · MQP Q3(a), PTP Q3(a), postal Q4(b), Q5(a) · SM exercise MCQ 2 (SM 237), essay 9 (SM 248) · **ICMAI Practice Workbook Ch1 illus. 11, 12** · MCQ bank Q22, Q23, Q186, Q223.

C Target costing · Q3(b) and MCQ (xv) 3.5

PROBLEMS BOX · TARGET COSTING (RECOMPUTED BY SCRIPT)

WORKED PATTERN · SM ILLUSTRATION 45 (= JUN'26 Q3(b) WORD FOR WORD)

Per unit (2,00,000 units)	₹
Target price 1,000 less 20% · less 10% profit	800 − 80 = **720**
Direct: materials 385 + labour 50 + machining 60	495
Overheads: orders 21,250 × 80 · testing 30,00,000 × 2 · rework 13,000 × 100, ÷ 2,00,000	8.50 + 30 + 6.50 = 45
Manufacturing cost · + research and design 50 + marketing 130	540 + 180 = **720**
Profitability: sales 16,00,00,000 − manufacturing 10,80,00,000 = gross margin 5,20,00,000 − other 3,60,00,000	**1,60,00,000**

[SM 193–195] D23 Q3(b) Tecon, same layout: 1,200 less 25% = 900 − 15% = **765**; direct 530 + overheads (22,000 × 80 + 35,00,000 × 2 + 14,400 × 100) ÷ 2,00,000 = 51 → 581 + 184 = 765.

SM ILLUSTRATION 41 (= JUN'25 Q3(b), SAME NUMBERS)

- Each ₹10 cut doubles demand: 100 → 20,000; 90 → 40,000; **80 → 80,000 (full capacity)**. Target cost = 80 − 25% = **₹60**. [SM 188–189]
- Variable cost = 40% of today's cost (100 − 25 = 75) = **₹30**; cost at full capacity 24 + 36 = ₹60 lakh v target ₹48 lakh → **reduce ₹12 lakh**; profit 64 − 48 = 16 lakh ÷ 16% = **₹100 lakh** maximum investment. [SM 189]

MCQ (xv) · SM ILLUSTRATION 36 (TARGET COST WITH AN ROI)

40,000 mixers × ₹6,000 = ₹24,00,00,000; profit 15% of ₹40,00,00,000 = ₹6,00,00,000 → ₹18,00,00,000 ÷ 40,000 = **₹4,500** a mixer. [SM 186] Same template: D23 Q1(v), D25 Q1(xv), J26 Q1(xv).

PRACTISE THESE

SM Illus. 45, 41, 36, then 35, 37–40, 42–44, 46 (SM 185–197) · J26, J25, D23 Q3(b) · MCQs J23 Q1(iii), D23 Q1(v), J24 Q1(vi), D25 Q1(xv), J26 Q1(xv), MQP / PTP Q1(xv), postal Q1(vii) · essays 11, 12 (SM 248) · **ICMAI Practice Workbook Ch1 illus. 8–10** · MCQ bank Q18, Q35–Q38, Q188, Q198, Q200, Q203, Q241, Q244, Q258, Q260, Q265.

D Life-cycle costing · Q3(b) 3.6, 3.7

PROBLEMS BOX · PRODUCT AND ASSET LIFE-CYCLE COST (RECOMPUTED BY SCRIPT)

WORKED PATTERN · SM ILLUSTRATION 49 (= DEC'25 Q3(b) TYPE)

Kent (₹)	80,000 at 300	1,00,000 at 255
Dies and tools (once)	10,25,000	10,25,000
Manufacturing 125 a unit	1,00,00,000	1,25,00,000
Selling 100 a unit + 12,500 × 4 years	80,50,000	1,00,50,000
Administration 50,000 × 4 · warranty parts + visits	2,00,000 + 1,60,000 + 80,000	2,00,000 + 2,00,000 + 1,00,000
Life-cycle cost · profit	**1,95,15,000 · 44,85,000**	**2,40,75,000 · 14,25,000**

Price cut lowers profit → do not cut. [SM 205–206]

DEC'25 Q3(b) MEU (OUR WORKING)

R&D 32,50,000 + manufacturing 175 × 1,25,000 + fixed 12,75,000 × 3 + marketing 90 × 1,25,000 + fixed 6,72,000 × 3 + admin 6,60,000 × 3 + warranty 1,25,000 ÷ 50 × 4 × 30 = **₹4,44,96,000** (₹355.97 a unit) → profit **₹55,04,000**. Revised: 1,40,000 at ₹380, marketing 89.20 (commission 4% of 380), fixed manufacturing 13,95,000 a year, warranty 3,36,000 → **₹4,87,55,000**, profit **₹44,45,000 → do not cut the price**.

ASSET LIFE-CYCLE · SM ILLUSTRATION 50 (= JUN'24 Q3(b) ÷ 200)

- Exe (12 years): 19,000 − 957 scrap + 13,624 repairs + 1,864 overhaul = PV 33,531 → EAC **4,922.35**. [SM 215]
- Wye (6 years): 13,000 − 1,692 + 11,320 + 1,366 = PV 23,994 → EAC **5,511.42** → buy Exe. [SM 215]

> **⚠ SM SLIP · ILLUSTRATION 50**
> Working note 2 calls 4.354 the 8-year annuity factor; it is the 6-year one (Wye's life), which the table uses. The EAC uses rounded factors (23,994 × 0.2297); exact division gives 5,510.89 — same decision.

JUN'24 Q3(b) POSIN (OUR WORKING, THE QUESTION'S FACTORS)

BX: 38,00,000 − 6,00,000 × 0.32 + 4,00,000 × 6.81 + 8,00,000 × 0.47 = 67,08,000 → EAC **₹9,85,022**. SW: 26,00,000 − 6,00,000 × 0.56 + 5,20,000 × 4.36 + 4,00,000 × 0.68 = 48,03,200 → EAC **₹11,01,651 → buy BX**.

PRACTISE THESE

SM Illus. 49, 50, 47, 48, 51–53 (SM 201–218) · D25, J24 Q3(b) · essays 13, 14 (SM 248) · **ICMAI Practice Workbook Ch1 illus. 13** · MCQ bank Q225, Q230, Q231, Q255.

E Probability in decisions · Q3(b), MCQ (i) 3.8, 3.2

WORKED PATTERN · SM ILLUSTRATION 56 (= DEC'24 Q3(b) TYPE)

- Contribution 6 − 3.50 = 2.50; BEP = 34,000 ÷ 2.50 = **13,600** → P(sales ≥ 13,600) = 0.25 + 0.30 + 0.20 = **0.75**. [SM 232]
- Profit ≥ 10,000: 44,000 ÷ 2.50 = 17,600 units → P = **0.20**. [SM 232]

DEC'24 Q3(b) SOVAN (OUR WORKING)

Contribution 200 − 120 = 80. BEP 20,00,000 ÷ 80 = **25,000**; profit ₹6 lakh → **32,500**; loss ₹5 lakh → **18,750**. P(break-even) = **0.80**; P(≥ 32,500) = **0.50**; P(≥ 18,750) = **0.90**.

EXPECTED VALUE · SM ILLUSTRATION 54 (= MCQ (i) TYPE)

Expected profit (₹'000): A 254, **B 280**, C 276 → choose B. [SM 230]

MCQ (i) (D25, J26): expected profit × probability of success (commercial × technical), or the chance of at least a given profit from a demand table. **Practise**: D25 Q1(i), J26 Q1(i), MQP Q1(i), PTP Q1(i), MQP Q3(b), postal Q5(b), J23 Q5(b) · SM Illus. 54–58 (SM 230–236), essay 15 (SM 248) · **WB Ch1 illus. 14**.

3.2 Pricing — MCQs only (J23 Q1(vi) margin with a mark-up and a mark-down; D24 Q1(vi) monopoly price): read SM 117–137 once (pricing strategies, yield management); practise MQP Q1(xi), MCQ bank Q32, Q33, Q39, Q195, Q196, Q209, Q236, Q243, Q266, Q270.

TRAPS

- Probability of "at least X units": add the probabilities of every level ≥ X — not just the next one.
- Life-cycle cost: R&D once, fixed costs × years, warranty per batch of units; re-price any cost tied to sales (commission) when the price changes.
- Target costing: price first, then profit, then cost — never cost + margin.

Module 5 · Variance analysis P16 · 5.1, 5.2

SM pp. 331–410 (exercise 411–416). **Q5 = one 14-mark variance question in every paper**, plus MCQ (v) (a back-solve) and a theory MCQ. Module 5 per paper: **J26-20 · D25-18 · J25-16 · D24-16 · J24-16 · D23-16** (J23-14, old layout); Dec'26 expected ≈ 18.

Paper	Q5 (14)	MCQs
Dec'23	material, labour, VOH, FOH variances + **reconcile actual with standard profit**	FOH volume, two products
Jun'24	(a) two worker grades, breaks, idle time; (b) **overheads from a flexible budget**	actual price from the price variance
Dec'24	full set incl. power-failure idle time + sales; **reconcile**	standard material cost
Jun'25	standard cost of output, all cost variances, **reconcile standard and actual cost**	standard material cost (= D24 word for word)
Dec'25	(a) **missing material variances with a mix variance**; (b) **back-solve overhead variances**	FOH volume · standard v budget (theory)
Jun'26	(a) **two grades with process loss: price, usage, mix, yield**; (b) **budget v actual profit: cost, sales price, sales volume**	actual hours from efficiency · capacity usage ratio

HOW IT IS ASKED · DEC'26

- **Two kinds of Q5**: one 14-mark "full set + reconciliation" (D23, D24, J25) or two 7-mark halves (J24, D25, J26). The last two papers were halves: mix / yield and missing figures (a), overheads or sales (b).
- Most likely Dec'26: **mix and yield** (D25, J26), **overheads with capacity / efficiency (and calendar)** (MQP, PTP), a **labour gang** (MQP), or the full set + reconciliation.
- Every answer = the four-column table (standard, revised standard, actual at standard, actual) + each variance with F / A + a check line.

A Formula sheet — when to use

Formula (F if positive)	Notes	SM
Material cost = SQ × SP − AQ × AP = usage + price	SQ = standard quantity for the ACTUAL output.	[SM 334]
Usage = SP (SQ − AQ) = **mix** SP (RSQ − AQ) + **yield** SP (SQ − RSQ)	RSQ = actual total input in the standard proportions. Yield also = standard cost per unit of output × (actual − standard output).	[SM 334]
Price = AQ (SP − AP)	On purchases if "extracted at receipt" (Illus. 21), else on usage.	[SM 335]
Labour cost = ST × SR − AT × AR = rate + efficiency (+ idle)	Rate on hours PAID; efficiency on hours WORKED.	[SM 335]
Rate = AT (SR − AR); **efficiency** = SR (ST − AT) = mix + yield	Gang mix: SR (revised standard hours − actual hours).	[SM 335–336]
Idle time = idle hours × SR (always A)	Power failure, waiting for material — abnormal idle only.	[SM 337]
VOH: expenditure = SR × AH − actual; efficiency = SR (SH − AH)	Rate per hour = VOH per unit ÷ hours per unit.	[SM 355–356]
FOH: expenditure = budget − actual; volume = SR (SH − BH) = efficiency SR (SH − AH) + capacity SR (AH − BH) (+ calendar)	SR = budgeted FOH ÷ budgeted hours. Calendar = SR × (revised budget hours − budget hours) for extra / fewer days.	[SM 356–357]
Sales price = AQ (AP − SP); **sales volume** = (AQ − BQ) × standard profit (or price)	Profit basis for a profit reconciliation; price basis for a sales-value variance.	[SM 332, 339]
Ratios: efficiency = SH ÷ AH; activity = SH ÷ BH; capacity = AH ÷ BH (× 100)	Activity = efficiency × capacity (MCQ (xi)).	[SM 358–359]

B Material: mix, yield, missing figures · Q5(a) 5.1

1 · Standard for the actual output
scale the standard batch (allow the normal loss: input = output ÷ yield %)

↓

2 · Four columns per input
SQ×SP · RSQ×SP · AQ×SP · AQ×AP

↓

3 · Differences
yield = 1 − 2 · mix = 2 − 3 · usage = 1 − 3 · price = 3 − 4 · cost = 1 − 4

↓

4 · Check
mix + yield = usage; usage + price = cost

Missing-figure questions: write the unknowns as a, b in the same four columns and use the given variances as equations (SM Illus. 8, 14).

WORKED PATTERN · SM ILLUSTRATION 8 (MISSING FIGURES)

- A and B 50 : 50 at ₹12 and ₹15; normal loss 10%; B used 70 kg; A bought at ₹15; cost variance 650 (A); yield 135 (A). [SM 378]
- Yield: 1,350 − (945 + 13.5a) = −135 → **a = 40 kg**; cost: 15a + 70b = 2,000 → **b = ₹20**. [SM 379]
- RSQSP 1,485 · AQSP 1,530 · AQAP 2,000 → mix **45 (A)**, usage **180 (A)**, price **470 (A)**. [SM 379]

OUR WORKINGS · JUN'26 Q5(a) AND DEC'25 Q5(a) (RECOMPUTED BY SCRIPT m05_patterns.py)

JUN'26 Q5(a) ZENITH: A 60 KG AT ₹150, B 40 KG AT ₹100, LOSS 5%

₹	SQ×SP	RSQ×SP	AQ×SP	AQ×AP
A	6,000 × 150	6,420 × 150	6,200 × 150	6,200 × 160
B	4,000 × 100	4,280 × 100	4,500 × 100	4,500 × 90
Total	13,00,000	13,91,000	13,80,000	13,97,000

Output 9,500 kg needs 10,000 kg input. Yield **91,000 (A)** · mix **11,000 (F)** · usage **80,000 (A)** · price **17,000 (A)** (A 62,000 A, B 45,000 F) · cost **97,000 (A)**.

DEC'25 Q5(a) DOXIN: FIND THE MISSING VARIANCES

- R usage 600 (A) = 30 (SQ − 70) → **standard input of R = 50 kg**; total standard 100, actual 110 → RSQ 55 each.
- Mix: P 24 (55 − 40) = 360 F; R 30 (55 − 70) = 450 A → **90 (A)** ✓ (given).
- Usage P = 24 (50 − 40) = **240 (F)**; price P = 40 (24 − 30) = **240 (A)**, R = 70 (30 − 40) = **700 (A)**.
- Cost P = 1,200 − 1,200 = **nil**; R = 1,500 − 2,800 = **1,300 (A)**.

PRACTISE THESE (MIX / YIELD FIRST)

J26, D25 Q5(a) · MQP Q5(a), PTP Q5(a) · SM Illus. 5–8, 11 (SM 373–383), 14 (sales, SM 385–387) · **ICMAI Practice Workbook Ch3 illus. 1–10** · MCQ bank Q16, Q55–Q59, Q65–Q67, Q187, Q189, Q192, Q208, Q235, Q250.

C Labour: gang mix, idle time · Q5 5.1

WORKED PATTERN · SM ILLUSTRATIONS 9 AND 10

- Illus. 9 gang (skilled 32 / semi 12 / unskilled 6 in the standard gang; 40-hour week; 1,800 standard hours produced): SRSH 4,536 · SRRSH 5,040 · SRAH 4,960 · ARAH 6,960 → mix **80 (F)**, efficiency **424 (A)**, rate **2,000 (A)**. [SM 380–381]
- Illus. 10: 800 idle hours × ₹100 = **₹80,000 (A)**; efficiency on hours worked: (6,000 − 5,700) × 100 = **₹30,000 (F)**. [SM 381]

Jun'24 Q5(a) Ront (our working): standard hours = units ÷ daily standard × 8-hour day (breaks are inside the standard): Type I 2,000 ÷ 8 × 8 = 2,000 h, Type II 1,200 ÷ 10 × 8 = 960 h → **standard cost ₹2,46,400**; paid 2,400 h × 90 + 1,200 h × 100 = 3,36,000 → **cost variance ₹89,600 (A)**.

⚠ JUN'24 Q5(a) IDLE TIME
"16 hours lost … as per expectation" while normal waiting is already inside the standard: state your reading (expected idle = no idle variance, or 16 h per worker × SR as idle) and split efficiency on the hours actually worked. No ICMAI answer in our files.

Practise: J24 Q5(a), D24 Q5 (power failure 4,000 h), MQP Q5 (gang) · SM Illus. 9, 10, 11 (labour part), 17 (SM 380–392) · MCQs J23 Q1(viii), J26 Q1(v) (actual hours from the rate / efficiency variance).

D Overheads: flexible budget, capacity, calendar, back-solving · Q5(b) 5.1

WORKED PATTERN · SM ILLUSTRATIONS 19 AND 12

- Illus. 19: 2 hours a unit, FOH ₹1 and VOH ₹0.20 an hour; 10,400 units → SH 5,200; AH 4,800. FOH cost **100 (F)** = volume 200 (F) + expenditure 100 (A); VOH cost **140 (F)** = 80 (F) on hours + expenditure 60 (F). [SM 393–394]
- Illus. 12 (calendar): 22 days v 20 → efficiency **18,480 (A)**, capacity **8,800 (F)**, calendar **16,000 (F)**, expenditure 8,000 (A). [SM 384–385]

⚠ SM WORDING

Illus. 19 calls the VOH hours variance a "volume" variance — it is the efficiency variance. SM 357 writes the FOH capacity variance per unit as SR × (budgeted − actual); work in hours: capacity = SR (AH − BH), efficiency = SR (SH − AH), F if positive.

Jun'24 Q5(b) Zosin (our working): flexible budget: variable 30,000 ÷ 2,000 = ₹15 a unit, fixed ₹60,000; 5 h a unit → VOH ₹3, FOH ₹1 an hour; SH 77,800, AH 74,000, BH 60,000. VOH efficiency **11,400 (F)**, expenditure 2,22,000 − 2,32,500 = **10,500 (A)**; FOH efficiency **3,800 (F)**, capacity **14,000 (F)**.

Dec'25 Q5(b) (our working, back-solve): expenditure = cost 2,800 A − volume 2,000 A = **800 (A)** → actual OH **12,800** → AH = 12,800 ÷ 8 = **1,600**; SR = 12,000 ÷ 2,400 = **₹5**; volume −2,000 = 5 (SH − 2,400) → **SH 2,000**; capacity 5 (1,600 − 2,400) = **4,000 (A)**; efficiency 5 (2,000 − 1,600) = **2,000 (F)**.

Practise: J24, D25 Q5(b), MQP / PTP Q5(b) · SM Illus. 12, 13, 19 (SM 384–394) · MCQs D23 Q1(x), D25 Q1(v) (FOH volume).

E The full set + reconciliation · 14-mark Q5 5.1

WORKED PATTERN · SM ILLUSTRATION 21 (OPERATING STATEMENT) · OUR D23, D24, J25 (RECOMPUTED BY SCRIPT)

Illus. 21 (2,000 units, standard profit ₹70,000): material price 1,550 A (on purchases), mix 866.67 A, yield 1,866.67 F; labour rate 2,100 F, efficiency 1,500 A, idle 1,000 A; VOH expenditure 8,600 F, efficiency 3,600 A; FOH expenditure 4,100 A, volume 2,500 A → **actual profit ₹67,450**; the ₹50 gap to the books = price variance on receipt (1,550) v on use (1,500). [SM 397–400]

DEC'23 Q5 DOTSON (OUR WORKING), ₹

Budgeted profit 2,000 × 40 · sales volume (1,800 − 2,000) × 40	80,000 · 8,000 A
Sales price 9,50,000 − 1,800 × 550	40,000 A
Material price 2,000 A · usage 10,000 F	8,000 F
Labour rate 20,000 A · efficiency 32,000 F	12,000 F
VOH expenditure 20,000 A · efficiency 16,000 F	4,000 A
FOH expenditure 2,000 F · volume 10,000 A	8,000 A
Actual profit (as given)	**40,000**

DEC'24 Q5 GINTECH (OUR WORKING), ₹

- Material price 66,000 A, usage 10,000 A; labour rate 6,800 A, **idle 4,000 h × 2 = 8,000 A**, efficiency (1,60,000 − 1,66,000) × 2 = 12,000 A.
- VOH (₹0.40 an hour) expenditure 6,400 F, efficiency 2,400 A; FOH expenditure 16,000 F, efficiency 6,000 A, capacity 34,000 A.
- Budget 3,20,000 − sales volume 64,000 A − cost variances 1,22,800 A = **1,33,200** ✓ (price variance nil: ₹140 both).

JUN'25 Q5 ZINTECH (OUR WORKING), ₹

Standard cost of 18,000 units **25,74,000**. Material price 76,000 F, usage 48,000 A; labour rate 16,800 A, efficiency 42,000 F; VOH expenditure 4,000 A, efficiency 12,000 F; FOH expenditure 30,000 A, volume 1,00,000 A → total **68,800 A** → actual **26,42,800** ✓.

PRACTISE

D23, D24, J25 Q5 in full · SM Illus. 20 (reverse: actuals from variances), 21, 17 (SM 389–400) · SM exercise (SM 411–416).

F Sales and profit variances · Q5(b), MCQs 5.1, 5.2

Jun'26 Q5(b) PIL (our working): budgeted profit X 25,000 × 12 + Y 20,000 × 12 + Z 15,000 × 16 = **₹7,80,000**; actual 20,000 × 12 + 22,000 × 6 + 16,000 × 18 = **₹6,60,000**. Cost variance (std − actual cost) × actual units = **68,000 A**; sales price = **32,000 A**; sales volume (actual − budget units) × standard profit = **20,000 A** → total 1,20,000 A ✓.

- **Planning v operating**: planning = original standard v revised standard (outside causes); operating = revised standard v actual. [SM 346–347]
- Ratios: efficiency, activity, calendar, capacity usage, capacity utilisation, idle time. [SM 358]

MCQ facts asked: standard cost and budgeted cost are interrelated, not interdependent (D25 xiii); more actual hours → higher capacity usage ratio (J26 xi); uniform costing cannot work where processes are unique (J26 xiii, 5.2 — SM 404–410, MCQ bank Q68, Q233).

SM ILLUSTRATIONS 14 AND 16

- Illus. 14 (sales missing figures): R standard 400 units, S actual 800 units; price variances R 1,500 F, S 4,000 F; S volume 6,000 F. [SM 385–387]
- Illus. 16 (profit variance statement with price indices): sales price 21.60 F, sales volume 12 A … from a profit of 5 to a loss of 4 (₹ lakh). [SM 388–389]

TRAPS

- Standard quantity / hours are for the **actual output**, never the budget.
- Labour rate on hours paid, efficiency on hours worked; idle is always adverse.
- Write F / A on every line and add a check line — half marks sit in the signs.
- Reconcile from **budgeted** profit (with the sales volume variance) or from standard profit on actual sales — say which.

⚠ SM SLIPS

Illus. 11: revised standard cost written 27,322 and 27,325; labour check adds "357 + 634" (643). Illus. 21: yield 1,866.67 printed as 1,866.40 in one column.

Module 4 · ABC, JIT, throughput P16 · 4.1–4.5

SM pp. 253–320 (exercise 321–326). **Q4(a) = a 7-mark ABC or throughput sum in every paper** + MCQ (iv) (ABC) and (xii) (Kanban). Q4(b) is the 7-mark theory half — see Module 1 (value analysis, BPR) and Module 2 (cost of quality, lean accounting). Module 4 per paper: **J26-11 · D25-11 · J25-11 · D24-11 · J24-9 · D23-9** (J23-9).

Paper	Q4(a)	MCQs
Dec'23	bank: activity rates, cost of three products	throughput gain at the bottleneck
Jun'24	**throughput ranking + optimal mix; effect of a court-ordered supply** (= SM Illus. 13 + a twist)	ABC cost per unit
Dec'24	batch: prime-cost absorption v ABC (= SM Illus. 4 layout)	ABC (= J23 template) · return per bottleneck hour
Jun'25	**four products, runs of 24, machine cost spread 4 : 3 : 2**	backflush · throughput price
Dec'25	**TFC, cost per hour, return per bottleneck hour, TA ratios, throughput cost, efficiency** (= SM Illus. 15's six asks)	ABC handling · Kanban
Jun'26	**= Jun'25 Q4(a) word for word**	ABC over-recovery · Kanban

HOW IT IS ASKED · DEC'26

- ABC (4 papers) and throughput (2 papers) alternate; Decembers had the bank (D23), the batch (D24) and the six throughput asks (D25).
- Likely: an ABC rate sum (pools → drivers → cost per unit) or the throughput six asks; JIT financial impact (MQP Q4(a), SM Illus. 10) is due — no long JIT question since Jun'23.

TRAPS

- ABC: build the pools first (shared cost in the given ratio), then rates; runs = units ÷ run size, orders = units ÷ batch size.
- Throughput ranks by return per **bottleneck** hour; a TA ratio below 1 does not mean drop the product if a fixed order (court, contract) forces it.
- JIT: never count depreciation and the interest on the same capital.

A Formula sheet — when to use

Formula	When to use · notes	SM
Cost driver rate = activity cost ÷ driver volume; product cost = Σ rate × its driver use	Pools first (spread shared costs in the given ratio), then rates, then cost per unit.	[SM 266–269]
Throughput = sales − direct material	Everything else is factory cost (fixed in the short run).	[SM 292]
Return per factory hour = throughput per unit ÷ bottleneck time	Rank by this; fill demand in rank order.	[SM 292]
Cost per factory hour = TFC ÷ bottleneck time available	TFC = all costs except material.	[SM 292]
TA ratio = return per hour ÷ cost per hour	Above 1: the product covers the factory cost; below 1: cut it.	[SM 292]
Throughput cost = standard bottleneck time of output × cost per unit of time; efficiency = throughput cost ÷ actual TFC	Asks (v)–(vi) of the six.	[SM 297, 300]

JIT impact = interest on stock released + savings − (interest on new capital + new running cost + stock-out cost)	Depreciation is ignored (it is the capital cost again).	[SM 287]

B Activity based costing · Q4(a), MCQ (iv) 4.1

PROBLEMS BOX · ABC (RECOMPUTED BY SCRIPT m04_patterns.py)

WORKED PATTERN · SM ILLUSTRATION 3 (RATES)

Machine hours 96,230 → ₹1.724 an hour; orders 8,760 ÷ 30 = ₹292; set-ups 21,400 ÷ 50 = ₹428; spare parts 44,690 ÷ 36 = ₹1,241.39; handling 25,545 ÷ 81 = ₹315.37 → factory cost P 25.14, Q 28.17, R 60.40, S 55.08. [SM 266–268]

SM ILLUSTRATION 4 (BATCH = DEC'24 LAYOUT)

Rates 527.27 · 367.65 · 798.07 · 115.48 · 195.56 · 30 → batch overheads ₹1,79,436 + prime cost ₹3,75,000 = **₹5,54,436**. [SM 268–270]

JUN'26 = JUN'25 Q4(a) PASN (OUR WORKING) — LEARN THIS ONE

Pool (machine 63,000 → 4 : 3 : 2)	₹	Driver	Rate
Set-up 20,000 + 28,000	48,000	96 runs (units ÷ 24)	500
Store 15,000 + 21,000	36,000	200 requisitions	180
Inspection 10,000 + 14,000	24,000	96 runs	250
Handling	2,592	192 orders (units ÷ 12)	13.50

Per unit: A 32,310 ÷ 720 = **44.875** · B 28,425 ÷ 600 = **47.375** · C 24,540 ÷ 480 = **51.125** · D 25,317 ÷ 504 = **50.232**; total 1,10,592 = all overheads ✓.

DEC'24 Q4(a) ANTOX (OUR WORKING)

- Overheads 51,79,300 ÷ prime cost 3,01,39,000 → on the batch's prime cost 30,13,900: cost **₹235.46** a unit.
- Rates: ₹1,500 an order · ₹190.53 a maintenance hour · ₹304.22 a set-up · ₹189.96 an inspection → batch overheads 2,43,246 → **₹217.14** a unit under ABC.

DEC'23 Q4(a) ADF BANK (OUR WORKING)

Rates: ATM ₹0.50 · computer ₹0.40 · statement ₹1.60 · enquiry ₹0.60 a minute → checking accounts 15,80,000 ÷ 30,000 = **52.67**; personal loans 2,14,000 ÷ 5,000 = **42.80**; Gold Visa 4,66,000 ÷ 10,000 = **46.60**.

PRACTISE THESE (MOST LIKELY FIRST)

J26 = J25, D24, D23 Q4(a) · PTP Q4(a) · SM Illus. 1–8, solved cases 1–3 (SM 263–281), Illus. 9 (when ABC fits) · MCQs J23 Q1(vii), J24 Q1(viii), D24 Q1(viii), D25 Q1(iv), J26 Q1(iv), MQP / PTP Q1(iv) · **ICMAI Practice Workbook Ch2 illus. 1, 2, 5–7** · MCQ bank Q40–Q44, Q190, Q193, Q202, Q215, Q238.

C Throughput accounting · Q4(a), MCQs 4.3

PROBLEMS BOX · THROUGHPUT (RECOMPUTED BY SCRIPT)

WORKED PATTERN · SM ILLUSTRATION 15 (THE SIX ASKS = DEC'25)

- (i) TFC = all costs except material = **₹78,250**; (ii) ÷ 31,300 minutes = **₹2.50** a minute. [SM 299]
- (iii) Return a minute X (35 − 20) ÷ 5 = ₹3; Y (35 − 17.5) ÷ 10 = ₹1.75; (iv) TA X **1.20**, Y **0.70**. [SM 300]
- (v) Standard minutes 30,250 × 2.50 = **₹75,625**; (vi) efficiency 75,625 ÷ 78,250 = **96.6%**. [SM 300]

Dec'25 Q4(a) MOBN (our working): TFC = labour 5,40,000 + variable OH 8,50,000 + fixed 4,50,000 = **₹18,40,000**; ÷ 2,30,000 h = **₹8**; return S ₹12, T ₹11; TA S **1.5**, T **1.375**; throughput cost 2,20,000 h × 8 = **₹17,60,000**; efficiency **95.65%**.

⚠ SM SLIP · ILLUSTRATION 15

The comment calls Y's TA ratio 0.75; the working gives 0.70. Illustrative 12 writes "5 hours" for 5 minutes.

SM ILLUSTRATION 13 (RANK AND MIX = JUN'24 TYPE)

Return an hour A 12, B 10, C 15 → C 40,000 (1,20,000 h), A 30,000 (1,50,000 h), B 12,500 with the last 50,000 h. [SM 297–298]

Jun'24 Q4(a) BIVON (our working): per machine hour VN 500, XN 375, DN 250 → VN 3,000, XN 2,000, DN 2,000 → profit **₹30,00,000**. Court order DN 2,500 first: VN 3,000, XN 1,250 → **₹26,25,000** → the order costs **₹3,75,000**.

SM ILLUSTRATION 18 (TA RATIO MCQ)

Cost ₹2.95 a minute; per minute X 2.8, Y 3, Z 2.5 → TA **0.95, 1.02, 0.85** → push Y. [SM 305–306]

Theory of constraints: identify → exploit → subordinate → elevate → repeat. More output from a non-bottleneck only builds stock (J23 MCQ).

Practise: D25, J24 Q4(a) · postal Q6 · SM Illus. 12–18 (SM 296–306) · MCQs J23 Q1(iv), D23 Q1(vii), D24 Q1(iv), J25 Q1(vi), postal Q1(viii) · **WB Ch2 illus. 8–10** · MCQ bank Q47–Q50, Q184, Q221, Q277.

D JIT, Kanban, backflush · MCQ (xii), Q4 4.2, 4.4, 4.5

WORKED PATTERN · SM ILLUSTRATION 10 (JIT FINANCIAL IMPACT = MQP Q4(a))

Costs: interest 15% on ₹10,00,000 + running 1,08,000 + stock-outs 77,000 = **₹3,35,000**; benefits: 15% on stock released (₹40,00,000 − ₹10,00,000) + two salaries 1,20,000 + rent 33,000 + taxes 22,000 = **₹6,25,000** → net **₹2,90,000** → adopt JIT. [SM 287]

- **JIT**: goods received only as needed — a **demand-pull** system; aims: less inventory, faster turnover. [SM 283]
- **Kanban**: a visual signal to replenish stock — ensures continuous supply (D25, J26 MCQ (xii)). [SM 283]
- **Backflush costing**: costs are recorded after production ends — one entry from the bill of materials; suits JIT, little or steady WIP, fast lead times (J25 MCQ). [SM 307]

Practise: MQP Q4(a), J23 Q4(b) (JIT purchasing) · SM Illus. 10, 11 (SM 286–289), 19, 20 (backflush, SM 310–313) · MCQs D25, J26 Q1(xii), J25 Q1(iii) · **WB Ch2 illus. 3, 4, 11** · MCQ bank Q45, Q46, Q51–Q54, Q199, Q206, Q220.

Module 11 · PERT, CPM, crashing P16 · 11.0

SM pp. 600–625 (exercise 626–635). The most frequent Q6–Q7 sum: **a whole 14-mark Q7 in J24, D24, J25**, a 7-mark half in D23 and J26, none in D25; MCQs on floats, variance, crash days. Module 11 per paper: **J26-7 · D25-0 · J25-16 · D24-18 · J24-16 · D23-9** (J23-10). PERT has come in every June.

Paper	Network question	MCQ
Dec'23	Q7(a): a fire after day 15 — new duration, critical path, probability	independent float
Jun'24	Q7 (14): a / m / b network, paths, SD, P(3 weeks early / late), P(miss 18 weeks)	activity variance
Dec'24	Q7 (14): **crashing** — critical path, % cost increase for 21 days	variance · crash days
Jun'25	Q7 (14): predecessors table, P(54 days), revised extreme estimates	SD of the critical path
Jun'26	Q7(b): EST / LST, critical path, P(38 weeks), 95% duration (MQP Q7(b) times)	–

HOW IT IS ASKED · DEC'26

- One of the four Q6–Q7 halves; Decembers had the fire (D23) and crashing (D24) — **crashing or a PERT probability** is the likely form.
- Every PERT answer: te and variance table → network → all paths → critical path → σ → Z → probability (use only the Z values printed with the question).

A Formula sheet — when to use

Formula	When to use · notes	SM
t_e = (a + 4m + b) ÷ 6; SD = (b − a) ÷ 6; variance = SD^2	Activity times follow a beta distribution; the project time is taken as normal.	[SM 612]
Project σ = √ Σ variances on the critical path	Two critical paths: take the larger variance.	[SM 613]
Z = (scheduled time − T_E) ÷ σ; duration for p% = $T_E + Z_p \times \sigma$	95%: Z = 1.645 (the question may print 1.65).	[SM 613]
Slack = L − E of an event; **total float** = $L_j - E_i - t$	Zero float = critical activity.	[SM 606]
Free float = total float − head slack; **independent float = free float − tail slack**	Independent ≤ free ≤ total (D23 MCQ).	[SM 607]
Cost slope = (crash cost − normal cost) ÷ (normal − crash time)	Crash the cheapest critical activity first; crash parallel paths together.	[SM 616–618]

B PERT probability · Q7 11.0

PROBLEMS BOX · PERT (RECOMPUTED BY SCRIPT m11_patterns.py)

WORKED PATTERN · SM ILLUSTRATION 4 (95% DURATION → BID)

Critical path 1-2-3-5-7-9 = **77.49 days**; variance 3.36 + 1.36 + 4 + 0 + 17.36 = 26.08 → σ = **5.11**; (t_s − 77.49) ÷ 5.11 = 1.645 → **86 days**; bid = 8 lakh + 86 × 9,000 = **₹15,74,000**. [SM 614–615]

JUN'26 Q7(b) (OUR WORKING)

Path	Weeks
1-2-6-7 (7 + 11 + 18) **critical**	**36**
1-3-6-7 (6 + 7 + 18) · 1-4-7 (14 + 11) · 1-2-5-7 (7 + 5 + 4)	31 · 25 · 16

JUN'24 Q7 JOBSON (OUR WORKING)

Paths 1-3-5-6 = 4 + 6 + 7 = **17** (critical), 1-2-5-6 = 10, 1-4-6 = 8; σ = √(1 + 4 + 4) = **3**. P(≤ 14) = 0.5 − 0.3413 = **15.87%**; P(≤ 20) = **84.13%**; P(miss 18) = 0.5 − 0.1293 = **37.07%**.

DEC'23 Q7(a) FIRE AFTER DAY 15 (OUR WORKING)

Original critical 1-2-5-6 = **37 days**. Restart 2-4, 2-5, 3-6 at day 15; 5-6 now 20: 2-5-6 ends 15 + 13 + 20 = **48** (critical), 2-4-6 36, 3-6 32. σ = √($1.33^2 + 0.47^2$) = 1.41 → Z(46) = −1.42 → **7.78%**.

MCQ ONE-LINERS

- Variance from a and b: $((b - a) \div 6)^2$ (D24); from t_e, m, b: first find a = $6t_e - 4m - b$ (J24).

Variance 4 + 4 + 16 = 24 → σ 4.899. P(38): Z = 0.41 → 0.5 + 0.1591 = **65.91%**. 95%: 36 + 1.65 × 4.899 = **44.08 weeks**. Event times E / L: 1 0/0 · 2 7/7 · 3 6/11 · 4 14/25 · 5 12/32 · 6 18/18 · 7 36/36.

JUN'25 Q7 SIMCON (OUR WORKING)

t_e: A 5, B 12, C 6, D 3, E 2, F 5, G 14, H 22. Paths ADH 30, BDH 37, BEH 36, **BGH 48**, CGH 42, CF 11. σ^2 = 1.778 + 1.778 + 7.111 = 10.667 → Z(54) = 1.84 → **96.67%**. Wider estimates (B, G, H): σ^2 17.889 → Z 1.42 → **92.22%** (t_e unchanged).

- SD of a path: √ of the sum of variances, never the sum of SDs (J25).
- Independent float = free float − tail slack (D23).

PRACTISE THESE

J26, J25, J24 Q7, D23 Q7(a) · **MQP Q7(b) (= J26's times)**, PTP Q7(b), postal Q10(b) · SM Illus. 1–4 (SM 608–615), exercise sums 1–5 (SM 633–635) · MCQ bank Q125–Q147, Q207, Q211, Q222, Q224, Q226, Q228, Q261, Q272, Q273, Q282.

C Crashing · Q7 (D24) 11.0

WORKED PATTERN · SM ILLUSTRATION 5

- Normal 22 days, critical 1-2-4-6-7; direct ₹4,700 + indirect 22 × 100 = **₹6,900**. [SM 618–619]
- Stage 1: crash 1-2 (slope ₹200) by 1 → 21 days, **₹7,000**; 1-3-4-6-7 also critical. [SM 619]
- Then 6-7 (350), 4-6 (550 × 4) → 16 days **₹9,050**; 1-2 + 3-4 together (750) → 15 days **₹9,700**. [SM 620–621]

Every slope here exceeds the ₹100 a day of indirect cost, so total cost rises with each crash: the cheapest total is the normal 22 days.

Dec'24 Q7 Rontech (our working): paths A-B-E-G 24, **A-C-E-G 25**, A-C-F-G 23, A-D-F-G 24; normal cost ₹4,500. Slopes A 200, D 100, E 100, F 200, G 400 (B's crash time exceeds its normal time and C has none — say so). To 21 days: E by 1 (100) → two paths at 24; then A by 2 (200 a day) and E + D by 1 (200) → **extra ₹700** → ₹5,200 = **+15.56%**.

TRAPS

- List **every** path with its length — the marks for "indicate all paths" are separate.
- Crash only critical activities; when two paths are critical, cut both (a common activity or one on each).
- Never crash an activity below its crash time or beyond what keeps the path critical.
- A dummy carries zero time and zero variance but counts in the path.

Module 14 · Forecasting P16 · 14.0

SM pp. 682–710 (exercise 711–716). **Q8(b) = a 7-mark forecasting sum in every paper since Dec'23** + a theory MCQ. Module 14 per paper: **J26-7 · D25-7 · J25-7 · D24-9 · J24-7 · D23-9**. Decembers: seasonal indices (D24, D25); Junes: exponential smoothing (J25, J26) — the trend line came in D23 and J24.

Paper	Q8(b)
Dec'23	least-squares trend, years 2 apart; forecast 2019 and 2025
Jun'24	least-squares trend, 7 years; forecast 2025
Dec'24	trend equation × seasonal index, four quarters (= SM Illus. 9, base year moved, indices III / IV swapped)
Jun'25	exponential smoothing 0.1, quarterly
Dec'25	**monthly seasonal indices by the trend ratio method**
Jun'26	exponential smoothing 0.1, monthly (= SM Illus. 10 template)

DEC'26

- Both recent Decembers had **seasonal indices** — expect trend × index, the trend ratio method, or a moving-average index.
- MCQs: exponential smoothing is not qualitative (D23); α near 1 weights recent demand (D24).

Formula	Notes	SM
y = a + bx; a = Σy ÷ n, b = Σxy ÷ Σx^2 with x centred (Σx = 0)	Even number of years: origin between the middle two, x unit = half a year (… −3, −1, 1, 3 …).	[SM 701]
Forecast = trend × seasonal index ÷ 100 (multiplicative)	Additive: trend + seasonal variation.	[SM 707]
Trend ratio: data ÷ trend × 100 → average per month / quarter → adjust to 1,200 / 400	Multiplicative data only.	[SM 702]
$\mathbf{u_t = u_{t-1} + \alpha (y_t - u_{t-1})}$	Error → α × error → add to the old forecast. Higher α discounts old data sooner.	[SM 707–708]

PROBLEMS BOX · Q8(b) (RECOMPUTED BY SCRIPT m14_patterns.py)

WORKED PATTERNS · SM ILLUSTRATIONS 6, 9, 10

- Illus. 6 (2014–2023): Σy 192, Σxy 177, Σx^2 330 → **y = 19.2 + 0.536x** (x unit 6 months); 2029 (x = 21) = **30.456**. [SM 701]
- Illus. 9: y = 25 + 0.6t; 2028 quarters t = 36–39 → trend 46.6, 47.2, 47.8, 48.4 × indices → **41.94, 44.84, 52.58, 50.82**. [SM 706–707]
- Illus. 10 (α 0.1): forecast 1,000, actual 900 → 990, then 992, 996, 994, 988, 990, **993**. [SM 708]

DEC'25 Q8(b) TREND RATIO (OUR WORKING)

Monthly averages 24.5, 29.667, 35.833 → trend a = 30 (mid-2023), b = 5.667 a year = 0.472 a month; trend for each month; actual ÷ trend × 100; average the three years; adjust to 1,200:

Jan 76.9	Feb 75.8	Mar 94.5	Apr 92.8	May 103.0	Jun 92.2
Jul 79.9	Aug 99.7	Sep 107.4	Oct 124.4	Nov 114.0	Dec 139.4

⚠ The SM explains the trend ratio method (SM 702) but has no worked example; ICMAI may fit the trend to all 36 months — state your method.

OUR WORKINGS · THE OTHER Q8(b)s

- **J26 My Fashion** (α 0.1, April forecast 200, actual 210): May **201**, June 202.3, July 203.77, Aug 206.19, Sept 209.07, Oct **210.67** (Nov 211.70), in '000.
- **J25 ship unloading** (forecast 195 for Q1 2023): … Q1 2025 = **198.60** tons.
- **D24 cumin**: t = 16–19 → trend 34.6, 35.2, 35.8, 36.4 × 0.90, 0.95, 1.05, 1.10 = **31.14, 33.44, 37.59, 40.04**.
- **J24 exports**: a 26, b = 53 ÷ 28 = 1.8929 → 2025 (x = 7) = **39.25**.
- **D23 zinc** (years 2 apart, x = −2…2): y = 42 + 0.4x → 2019 = **42.2**, 2025 = **43.4**.

PRACTISE THESE

D25, D24 Q8(b), J26, J25, J24, D23 Q8(b) · MQP / PTP Q8(b), postal Q10(a) · SM Illus. 4–10 (SM 697–708), Illus. 1–3 regression (SM 688–696) · MCQs D23 Q1(xv), D24 Q1(xiv) · **ICMAI Practice Workbook Ch9 illus. 1–10** · MCQ bank Q164–Q173, Q204, Q218.

Traps: centre x and state the origin and the unit; even years use half-year units; smoothing starts from the GIVEN first forecast; seasonal indices must total 1,200 (monthly) or 400 (quarterly).

Module 10 · Simulation P16 · 10.0

SM pp. 576–588 (exercise 589–596). **A 7-mark simulation half in 5 of 6 papers** (not in Jun'26 — due back) + MCQs. Module 10 per paper: **J26-2 · D25-7 · J25-7 · D24-9 · J24-9 · D23-9**.

Paper	Simulation half
Dec'23	travel agency: 10 clients, waiting, P(officer idle)
Jun'24	same distributions, 12 clients, vouchers for waits over 10 minutes
Dec'24	bakery: 10 days' profit with penalties for unsold / unmet
Jun'25	average profit from price, variable cost, volume (5 trials)
Dec'25	laptop service centre: 7 days, laptops held over

1 · Probability → cumulative → ranges
start at 00: 0.20 → 00–19, next 0.40 → 20–59 …

↓

2 · Read each random number
into its range → the value

↓

3 · Simulation table
queue: arrival, start, end, wait, idle; stock: demand, sold, unsold, penalty

↓

4 · Answer the ask
average, count, probability = idle ÷ total time

PROBLEMS BOX · SIMULATION (RECOMPUTED BY SCRIPT m10_patterns.py)

WORKED PATTERNS · SM ILLUSTRATIONS 2 AND 5

- Illus. 2: ranges 00-03, 04-25, 26-41, 42-83, 84-93, 94-99; ten weeks' demand total 120 → average **12** ('00 kg). [SM 581]
- Illus. 5 (queue, opens 8.00): first patient enters at 8.07 (doctor idle 7); total waiting **129** minutes, average 12.9; doctor idle **115** of 366 minutes = **0.314**. [SM 586]

DEC'23 Q6(b) TRAVEL AGENCY (OUR WORKING)

Intervals 1, 8, 8, 15, 15, 8, 25, 8, 8, 15 (arrivals at 1, 9, 17, 32 … 111 minutes after 10.00); service 14, 14, 14, 10, 6, 6, 14, 10, 14, 4. Clients 2–6 and 8–10 wait (6, 12, 11, 6, 4, 6, 8, 7 = **60 minutes**); officer idle 1 + 15 = **16** of 122 minutes → **P(idle) = 0.131**.

Jun'24 Q6(b) (12 clients, line 1 / line 2): waits over 10 minutes — clients 3 (12) and 4 (11) → **2 vouchers = ₹30**. Part (i) "how you would simulate" = step 1–3 above in words.

OUR WORKINGS · STOCK AND PROFIT TYPES

- **D24 bakery** (ranges 00-09 → 97, 10-24 → 98, 25-44 → 99, 45-79 → 100, 80-94 → 102, 95-99 → 103): demand 97, 103, 100, 103, 102, 97, 100, 98, 98, 98; profit a day = 18 × sold − 1,400 − 3 × unsold − 1 × unmet (97 → 337) → **₹3,740** for 10 days.
- **J25 Pikon**: trials (price, VC, units): (5, 2, 5,000) +11,000 · (3, 2, 3,000) −1,000 · (4, 1, 2,000) +2,000 · (3, 2, 2,000) −2,000 · (4, 2, 2,000) 0 → **average ₹2,000**.
- **D25 laptops** (one held at the start): arrivals 11, 10, 10, 9, 12, 9, 10; capacity 10, 10, 11, 10, 11, 12, 10 → held 2, 2, 1, 0, 1, 0, 0 → **6 ÷ 7 = 0.857 a day**.

PRACTISE THESE

D25 Q7(a), D24, J25, J24, D23 Q6(b) · MQP Q7(a), postal Q9(a) · SM Illus. 1–6 (SM 580–588), exercise MCQs (SM 590–592) · MCQs D23 Q1(ix), J24 Q1(xiv) (steps), D24 Q1(xv) (analogue simulation), J26 Q1(vii) · **ICMAI Practice Workbook Ch7 illus. 1–10** · MCQ bank Q116–Q124, Q205, Q249, Q281.

Traps: write the range table first (it carries marks); keep the 00-start convention all through; use the random numbers in the given order and line; state when the clock starts.

Module 13 · Maxima and minima P16 · 13.0

SM pp. 662–675 (exercise 676–680). **Q8(a) = a 7-mark profit-maximising sum in 5 of 6 papers** (D24 had a game instead) + MCQs on MR / MC / average cost. Module 13 per paper: **J26-7 · D25-7 · J25-9 · D24-2 · J24-9 · D23-7** (J23-6).

Paper	Q8(a)
Dec'23	dolls: demand x = 1500 − 75p, cost 4x + 1400 → quantity, price, profit
Jun'24	monopolist: cost x^2 + 78x + 300, demand x = (600 − P) ÷ 8
Jun'25	**price discrimination** in two sub-markets (= SM Illus. 7 type)
Dec'25	price and cost as cubic functions of X: maximum-profit X and profit
Jun'26	**maximum profit v maximum revenue** — do they coincide?

1 · Price from the demand function
p in terms of x

↓

2 · Profit π = TR − TC
TR = p × x

↓

3 · dπ/dx = 0 (or MR = MC)
critical values

↓

4 · $d^2\pi/dx^2 < 0$
maximum → price, profit

Rule	Notes	SM
Necessary: dy/dx = 0; sufficient: $d^2y/dx^2 < 0$ maximum, > 0 minimum	Second derivative = 0: point of inflexion.	[SM 663]
Profit maximum where MR = MC and the slope of MR < slope of MC	Same answer as dπ/dx = 0.	[SM 669]
Price discrimination: MC = MR_1 = MR_2; multi-plant: MR = MC_1 = MC_2	Each market priced from its own demand function.	[SM 669]
Minimum average cost: d(C ÷ x)/dx = 0	MCQ (J25); MC from AC: TC = AC × x, then differentiate (D24).	[SM 664]

PROBLEMS BOX · Q8(a) (RECOMPUTED BY SCRIPT m13_patterns.py)

WORKED PATTERNS · SM ILLUSTRATIONS 5 AND 7

- Illus. 5: C = $x^3/3 - 7x^2 + 111x + 50$, x = 100 − p → (x − 1)(x − 11) = 0; maximum at **x = 11**, price **₹89**, profit **₹111.33**. [SM 669–670]
- Illus. 7 (= J25 type): $MR_1 = 80 - 10x_1$, $MR_2 = 180 - 40x_2$, MC = 20 → $x_1 = 6$, $x_2 = 4$; prices **₹50 and ₹100**; profit **₹480**. [SM 671–672]
- Illus. 1: revenue maximum at p = **₹46.11**; Illus. 2: average cost minimum at **x = 1,200**. [SM 664]

OUR WORKINGS

- **J26 Ajooba**: p = 900 − 3q. Revenue maximum q = 150 (₹67,500); profit maximum: 576 − 6q = 0 → **q = 96, p = ₹612, profit ₹26,648** (at q = 150 profit is only ₹17,900) → **they do not coincide**.
- **D25 Suton**: π = $2X^3 - 63X^2 + 648X$ → X = 9 or 12; second derivative −18 at 9 → **sell 9, profit ₹2,187**.
- **J25 Rolex**: 400 − $4Q_1$ = 300 − $4Q_2$ = 60 → Q_1 85 (₹230), Q_2 60 (₹180); profit **₹18,650**.
- **J24 Zuzoo**: π = $522x - 9x^2 - 300$ → **29 sets**, price **₹368**, total cost ₹3,403, profit **₹7,269**.
- **D23 Zoxin**: π = $16x - x^2/75 - 1{,}400$ → **600 dolls**, price **₹12**, profit **₹3,400**.

PRACTISE THESE

J26, D25, J25, J24, D23 Q8(a) · MQP / PTP Q8(a) · SM Illus. 1–8 (SM 663–675), exercise sums 1–5 (SM 680) · MCQs J24 Q1(xii), D24 Q1(vii), J25 Q1(viii) · **ICMAI Practice Workbook Ch8 illus. 1–7** · MCQ bank Q156–Q163, Q252.

Traps: write p from the demand function before TR; check the second derivative (a cubic has a minimum too); profit at the optimum uses the full cost incl. fixed cost.

Module 1 · SCM, value chain, value analysis, BPR P16 · 1.1–1.4

SM pp. 5–36 (exercise 37–42). Theory only: a **7-mark Q4(b) list** (value-analysis phases D23 = D24 word for word; BPR J23) and **MCQ (x) / (xiv)** facts. Module 1 per paper: **J26-4 · D25-4 · J25-2 · D24-9 · J24-2 · D23-9** (J23-10). Value-analysis phases are the analysis's top pick for Dec'26 Q4(b) (also in the MQP and the PTP).

Asked	Answer
D23 Q4(b) = D24 Q4(b) (7)	phases of value analysis (any five)
J23 Q2(a) (6)	characteristics and principles of BPR
D23 = D24 MCQ	strategic positioning analysis = the company's comparative position
J24 = J26 MCQ	blue ocean: make the competition irrelevant
J23 MCQ	service is not a support activity; red ocean does not break the value-cost trade-off
J25 MCQ	outbound logistics delivers to the customer
D25 / J26 MCQs	"what else will do the job" = value engineering; "rely on hierarchy" is not a BPR principle; BPR's major risk = employee resistance

MODEL ANSWER · PHASES OF VALUE ANALYSIS (SEVEN)

- **Origination** — pick the project, form a team of experts.
- **Information** — collect specifications, drawings, methods, materials and costs.
- **Functional analysis** — functions of the product and its parts, cost and importance of each, a value index.
- **Innovation** — creative generation of alternatives.
- **Evaluation** — test alternatives for economic and technical feasibility.
- **Choice** — choose the best, draw up action plans.
- **Implementation** — put it to use, monitor and follow up. [SM 24]

MODEL ANSWER · BUSINESS PROCESS REENGINEERING

Concept (Hammer and Champy): the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in cost, quality, service and speed. [SM 27]

Characteristics: several jobs combined into one · workers make decisions · steps in a logical order · work done where it makes most sense · quality built in · manager a single point of contact · centralised and decentralised operations combined. [SM 27]

Seven principles: design processes for outcomes, not tasks · users of the output perform the process · information processing inside the work that produces it · treat dispersed resources as centralised · link parallel activities instead of integrating them · doers self-managing · capture information once at source. [SM 27]

VA v VE: value analysis works on an **existing** product (remedial); value engineering applies the same techniques at the **design** stage of a new product (preventive).

Porter's value chain	SM
Primary: inbound logistics · operations · outbound logistics · marketing and sales · service	[SM 7]
Support: procurement · human resource management · technological development · infrastructure	[SM 7–8]
SCM pillars: strategic positioning (comparative position), cost driver analysis (structural, executional), value chain analysis	[SM 6]

Red ocean	Blue ocean
compete in existing market space	create uncontested market space
beat the competition	make the competition irrelevant
exploit existing demand	create and capture new demand
make the value-cost trade-off	break the value-cost trade-off

Source: SM 13. Cost control v cost reduction (SM 21): preventive v corrective; past standards v present and future; assumes standards v assumes hidden savings in them (postal paper).

Practise: D23, D24 Q4(b), J23 Q2(a) · MQP / PTP Q4(b) (value analysis), MCQs above · SM exercise (SM 37–42) · MCQ bank (Module 1 range).

Module 12 · Learning curve P16 · 12.0

SM pp. 638–652 (exercise 653–656). **MCQ (viii) in every paper**; a **7-mark pricing half in both Decembers that had one (D23, D25)** — due again. Module 12 per paper: **J26-2 · D25-9 · J25-2 · D24-2 · J24-2 · D23-9** (J23-8).

Paper	Asked
Dec'23	Q7(b) boats, 90%, price = VC + 20%: average for 4 and 8, 3rd and 4th boat · MCQ second set-up time (incremental model)
Jun'24	MCQ: time of the 200th unit, 85%
Dec'24	MCQ: learning rate from the first unit and 16-unit total
Jun'25	MCQ: time of the 16th unit, 85%
Dec'25	Q7(b) fire alarms, 80% table, 25% mark-up, two orders · MCQ cost of the 2nd unit, 90%
Jun'26	MCQ: learning rate from the first unit and 4-unit total

Rule	SM
Cumulative average time falls to r every time output doubles; ratio = average of 2n ÷ average of n	[SM 639]
$Y = aX^b$, b = log r ÷ log 2 (Y = cumulative average)	[SM 640]
Total for X units = X × aX^b; time of the Xth unit = total(X) − total(X − 1)	–

PROBLEMS BOX · LEARNING CURVE (RECOMPUTED BY SCRIPT m12_patterns.py)

WORKED PATTERNS · SM ILLUSTRATIONS 4 AND 5

- Illus. 4 (80%, first unit 10 h, ₹12 an hour): 8 units 5.12 × 8 = **40.96 h** = ₹491.52; 32 units 104.86 h → repeat order of 24 = **63.90 h = ₹766.80**. [SM 648]
- Illus. 5: rate ≈ 85%; b = log 0.85 ÷ log 2 = **−0.2344**; average of 30 = 46 × $30^{-0.2344}$ = **20.73** min; below 15 min after 119.179 → **120 units**. [SM 649]

> ⚠ **TWO MODELS**
> The SM defines the curve on the **cumulative average** (Wright), but its Example 1 (80%, 20 → 16 → 12.8 → 10.24 h) applies r to **each unit's own time** (incremental-unit model) — so did D23 MCQ (viii), which named that model. "Average" / "total" in the question → cumulative average; "time of the 2nd set-up" under the "incremental unit-time model" → unit × r.

MCQ TEMPLATES (OUR WORKING)

- Rate from the 1st unit and the 4-unit total: r = √(total ÷ 4 ÷ first) — e.g. 324 h ÷ 4 ÷ 100 → **90%** (J26, D24 with 16 units: 4th root).
- Cost of the 2nd unit, 90% average model: 2 × 0.9 × first − first = **0.8 × first** (D25).
- Time of the 16th unit (85%, first 100 h): 16 × 100 × 0.85^4 − 15 × 100 × $15^{-0.2345}$ ≈ **40.26 h** (J25, J24 type).

DEC'23 Q7(b) BOATS (OUR WORKING)

First boat: materials 8,000 (no learning) + labour 1,000 h × ₹4 + variable OH 200% of labour. Average hours 1,000 → 900 → 810 → 729. **4 boats**: 8,000 + 810 × 12 = 17,720 → **₹21,264** a boat; **8 boats**: 8,000 + 729 × 12 = 16,748 → **₹20,097.60**; 3rd and 4th: (3,240 − 1,800) ÷ 2 = 720 h → 16,640 → **₹19,968** each.

DEC'25 Q7(b) FIRE ALARMS (OUR WORKING)

Learning on Dept B (skilled) only — Dept A is highly automatic (state it). B: first 100 = 4,000 h; cumulative 160 at 86.1% = 5,510.4 h → order 1: 1,510.4 ÷ 60 = 25.17 h a unit; cumulative 200 at 80% = 6,400 h → order 2: 889.6 ÷ 40 = 22.24 h. Cost a unit = 500 + 200 + B labour × 15 + 20% VOH + A FOH 160 + B FOH × 5 → × 1.25: **order 1 ₹1,848.73**, **order 2 ₹1,764.40**.

PRACTISE THESE

D25, D23 Q7(b), J23 Q10(a) · MCQs every paper Q1(viii) + MQP / PTP Q1(viii) · SM Illus. 1–7 (SM 645–652), exercise MCQs (SM 653–654) · MCQ bank Q148–Q155, Q197, Q212, Q213, Q227, Q240, Q253, Q262, Q264, Q275, Q278.

Traps: materials do not learn; overheads charged on labour hours do; price on the order's own hours (total − earlier total), not the cumulative average.

Module 8 · Assignment P16 · 8.0

SM pp. 514–536 (exercise 537–544). **A 7-mark assignment half in every December** (D23 jobs, D24 travelling salesman, D25 unbalanced road repairs) + an MCQ in June papers. Module 8 per paper: **J26-2 · D25-7 · J25-2 · D24-7 · J24-2 · D23-7** (J23-10). **Due in Dec'26.**

0 · Balance and convert
unequal → dummy row / column of zeros; maximise → subtract every cell from the largest; barred cell → a very large cost

↓

1 · Row, then column reduction
subtract each row's minimum, then each column's

↓

2 · Cover all zeros with the fewest lines
lines = order → optimal; else take the smallest uncovered number off the uncovered cells, add it at the crossings

↓

3 · Assign
a row or column with a single zero first; cross out the rest of its row and column

Paper	Asked
Dec'23	5 jobs to 5 mechanists, least cost (= SM Illus. 2 type)
Dec'24	travelling salesman, 5 cities, start and end at A (= Illus. 7 type; J23 Q8(b) matrix)
Dec'25	**= SM Illus. 4 with every bid doubled** (two R4 bids swapped): unbalanced, grant, discount for the eliminated contractor
MCQs	special case of transportation (J23) · maximisation → regret matrix (J24) · single-zero marking (J25) · 3 items × 3 vendors (J26)

PROBLEMS BOX · ASSIGNMENT (CHECKED OVER EVERY POSSIBLE ASSIGNMENT BY SCRIPT m08_patterns.py)

WORKED PATTERN · SM ILLUSTRATION 4 (= DEC'25 TEMPLATE), ₹ LAKH

- 5 contractors, 4 roads → a dummy road of zeros; two improvement rounds → optimal. [SM 523–524]
- Road 1 B 7 · Road 2 D 12 · Road 3 A 19 · Road 4 E 16 = **₹54 lakh**; grant ₹50 lakh → supplementary **₹4 lakh**; C gets the dummy → unsuccessful. [SM 525]

DEC'25 Q6(b) (OUR WORKING), ₹ LAKH

With C1 on R1 (18) and C5 on R2 (30) as the question states: R3 to C4 (36), R4 to C3 (38) → **₹122 lakh** (₹8 lakh over the ₹114 grant); **C2 is eliminated**. Cheapest way in for C2: R4 (39 v C3 38, with C4 still on R3) costs ₹1 lakh more → C2 must cut its bid by **more than ₹1 lakh**. ⚠ Without that condition the optimum is ₹108 lakh (C2 R1, C4 R2, C1 R3, C5 R4) and C3 is out — state the reading.

DEC'23 Q6(a) FIVE JOBS (OUR WORKING)

Job 1 → D (3), Job 2 → A (3), Job 3 → E (9), Job 4 → B (2), Job 5 → C (4) = **₹21** (the only optimum).

DEC'24 Q6(a) TRAVELLING SALESMAN (OUR WORKING)

Assignment first (no city to itself: put a large number on the diagonal); if the answer splits into sub-tours, try the next-best zero. Shortest round trip **74 km**, two routes: **A-B-C-D-E-A** (12 + 16 + 18 + 16 + 12) and **A-B-E-C-D-A** (12 + 7 + 23 + 18 + 14).

PRACTISE THESE

D25 Q6(b), D24 Q6(a), D23 Q6(a), J23 Q8(b) · MQP Q6(b), PTP Q6(b), postal Q8(a) · SM Illus. 1–8 (SM 515–536) · MCQs J23 Q7(i), J24 Q1(xiii), J25 Q1(vii), J26 Q1(vi), PTP Q1(vi) · **ICMAI Practice Workbook Ch6 illus. 1–12** · MCQ bank Q82, Q85–Q107, Q201.

Traps: balance first; for maximisation convert before reducing; check for alternative optima (SM Illus. 5) and sub-tours in the salesman problem; write the final table with each cost and the total.

Module 2 · Quality cost management P16 · 2.1–2.5

SM pp. 43–69 (exercise 70–75). **Q4(b) 7-mark theory**: cost of quality (J25, J26), lean accounting (J24 = D25 word for word), TQM steps (J23); an MCQ on quality-cost categories most papers. Module 2 per paper: **J26-7 · D25-7 · J25-9 · D24-2 · J24-9 · D23-2** (J23-20).

MODEL ANSWER · COST OF QUALITY (J25, J26 CLASSIFY)

Category	Examples
Prevention — stop failures happening	quality training, quality circles, statistical process control, quality improvement
Appraisal — check for failures	testing and inspecting materials, WIP and final product, package inspection, depreciation of test equipment
Internal failure — defects found before the customer	scrap, spoilage, rework, downtime due to defects, retesting
External failure — defects found by the customer	field servicing, complaints, warranty repairs and replacements, lost sales

[SM 48–49]

MCQs asked: warranty returns, inferior products delivered → external (J23, D24); downtime due to defects → internal (D23); uncovering defects → appraisal (J24); courtesy is a service, not a manufacturing, quality dimension (J25).

Manufacturing quality	Service quality
conformance · performance · reliability · features · durability · serviceability	tangible factors · consistency · responsiveness · courtesy · timeliness · atmosphere

Source: SM 45.

MODEL ANSWER · LEAN ACCOUNTING (J24 = D25)

- Costs by **value stream**, not department; all value-stream costs direct; costs outside it are "business sustaining". [SM 60]
- Three guiding principles: **customer value · continuous improvement · respect for people**. [SM 60]
- Principles → practices: lean and simple business accounting (eliminate waste; value stream mapping, kaizen, PDCA) · accounting that supports lean (performance measurement linkage chart, value stream costing and income statements, target costing) · clear and timely communication ("plain English" statements, visual boards, box scores) · planning from a lean perspective (hoshin, sales-operations planning, capital planning, invest in people) · strengthen internal control (transaction elimination matrix). [SM 61–62]

MODEL ANSWER · STEPS IN TQM (J23)

- Identify customer groups · their expectations · their decision-making requirements and product utilities · perceived problems · compare with other firms (benchmarking) · customer feedback · identify improvement opportunities and implement the improvement process (PRAISE). [SM 51–52]

PRAISE: problem identification · ranking · analysis · innovation · solution · evaluation. [SM 54]

6 C's: commitment · culture · continuous improvement · co-operation · customer focus · control; **4 P's**: people · process · problem · preparation. [SM 52]

Six Sigma DMAIC: define · measure · analyse · improve · control; **DMADV** (new design): define · measure · analyse · design · verify (SM prints "DMIADV"). [SM 65]

Practise: J26, J25, D25, J24 Q4(b), J23 Q2(b), Q3 · MQP / PTP Q4(b) · SM exercise (SM 70–75).

Module 6 · Linear programming P16 · 6.0

SM pp. 422–455 (exercise 456–466). The exam asks LP as a **formulation** (+ the dual): J24 = J26 Q6(a) word for word, D25 Q6(a) with the dual; MCQs: corner-point Z, shadow price. Module 6 per paper: **J26-7 · D25-11 · J25-0 · D24-0 · J24-7 · D23-0** (J23-6).

1 · Decision variables
"Let x_1, x_2 … = units of …"

↓

2 · Objective
max contribution (price − variable costs; fixed costs out) or min cost

↓

3 · Constraints
one per resource; demand minimums (≥); ratios as equations; x ≥ 0

↓

4 · Dual (if asked)
max ↔ min; constraint limits become the objective; transpose the coefficients; ≤ ↔ ≥

WORKED PATTERN · SM ILLUSTRATION 6 (= D25 TYPE)

- Max Z = $6x_1 + 4x_2$; machining $x_1 + 2x_2 \le 720$, labour $2x_1 + x_2 \le 780$, Alpha $x_1 \le 320$. [SM 437–438]
- Simplex optimum: **280 Alpha, 220 Beta, Z = ₹2,560**; shadow prices ₹2/3 a machine hour, ₹8/3 a labour hour, 0 for Alpha's sales limit. [SM 440–441]

OUR WORKINGS (RECOMPUTED BY SCRIPT m06m07m09_patterns.py)

JUN'26 Q6(a) = JUN'24 Q6(a) (LEARN IT)

Max Z = 50A + 50B + 80C
Material I: 3A + 4B + 5C ≤ 5,000 · Material II: 5A + 3B + 5C ≤ 7,500
Labour (A = 2 × B = 3 × C in time; 3,000 A-units): A + B/2 + C/3 ≤ 3,000, i.e. **6A + 3B + 2C ≤ 18,000**
Minimum demand: A ≥ 600, B ≥ 650, C ≥ 500
Ratio 2 : 3 : 4: **3A = 2B** and **4B = 3C** (so C = 2A); A, B, C ≥ 0.

DEC'25 Q6(a) LM (FORMULATION + DUAL)

Contribution: Alfa 1,000 − 200 − 160 − 60 − 380 = **200**; Beta 900 − 200 − 80 − 120 − 350 = **150** (fixed ₹35 / hour left out).
Max Z = 200x + 150y; material 4x + 4y ≤ 960; labour 4x + 2y ≤ 800; painting x + 2y ≤ 400; x, y ≥ 0.
Dual: Min W = $960u_1 + 800u_2 + 400u_3$; $4u_1 + 4u_2 + u_3 \ge 200$; $4u_1 + 2u_2 + 2u_3 \ge 150$; u ≥ 0.
(Not asked: best corner (160, 80) → Z = ₹44,000.)

MCQs: Z at each corner, take the best (D25); a shadow price of ₹10 a labour hour = one more hour adds ₹10 to Z (D25).
Practise: J26, D25, J24 Q6(a), J23 Q8(a) · MQP / PTP Q6(a), postal Q7(i), Q11 · SM Illus. 1–12 (SM 427–455) · **ICMAI Practice Workbook Ch4 illus. 1–10** · MCQ bank Q69–Q76, Q254.

Module 9 · Game theory P16 · 9.0

SM pp. 550–563 (exercise 564–570). **MCQ (vii) "value of the game" in most papers**; a 7-mark dominance game in D24 and J26. Module 9 per paper: **J26-7 · D25-2 · J25-2 · D24-7 · J24-2 · D23-2** (J23-8).

1 · Saddle point?
max of row minimums = min of column maximums → pure strategies, value

↓

2 · Dominance
drop a row ≤ another row (maximiser); drop a column ≥ another column (minimiser); averages of two may dominate

↓

3 · 2 × 2 by odds
$P(A_1) = |b_1 - b_2| \div (|b_1 - b_2| + |a_1 - a_2|)$; value = $(a_{11}a_{22} - a_{12}a_{21}) \div (a_{11} + a_{22} - a_{12} - a_{21})$

WORKED PATTERNS · SM ILLUSTRATIONS 1 AND 4

- Illus. 1 [1 5; 4 2]: no saddle (maximin 2, minimax 4); A plays 1/3, 2/3; B 1/2, 1/2; **value 3**. [SM 555–556]
- Illus. 4 (two toy makers, = J26 type): M_4 dominated by M_1, J_1 by J_3, M_1 by the average of M_2 and M_3 → saddle at J_3M_2, **value 12**. [SM 560–561]

OUR WORKINGS (RECOMPUTED BY SCRIPT m06m07m09_patterns.py)

JUN'26 Q7(a) MARKET SHARE, 4 × 4

A2 ≤ A1 → drop A2; for B, B1 and B2 ≥ B3 → drop both; then A3 ≤ A4 → drop A3. Left [A1: 25, 5; A4: 10, 15] — no saddle (10 v 15). A plays **A1 20%, A4 80%**; B plays **B3 40%, B4 60%**; **value 13** (A gains 13% share).

DEC'24 Q8(a) ADVERTISING, 3 × 3

No saddle (maximin 12, minimax 14). "No advertising" row ≤ "Medium" → drop; Q's "No advertising" column ≥ "Medium" → drop. Left [Medium: 12, 15; Heavy: 14, 10]: P plays Medium 4/7, Heavy 3/7; Q plays Medium 5/7, Heavy 2/7; **value 90/7 = 12.86**.

MCQs: 2 × 2 value (D23); saddle-point value of a 3 × 3 / 3 × 4 (J24, J25, D25 — check the saddle first). **Practise**: J26 Q7(a), D24 Q8(a), J23 Q9(a) · PTP Q7(a), postal Q8(b), MQP / PTP Q1(vii) · SM Illus. 1–5 (SM 555–563) · MCQ bank Q108–Q115, Q242, Q251.

Module 15 · Tools for data analytics P16 · 15.0

SM pp. 722–746. **MCQ (ix) in every paper since Dec'25's fixed order**, 1–2 MCQs a paper; no long question since Jun'23. Module 15 per paper: **J26-2 · D25-2 · J25-4 · D24-4 · J24-4 · D23-4** (J23-6). Learn as facts.

Asked	Answer
D23 (xiii)	not BI: AWS Glue (an ETL tool)
D23 (xiv)	financial analytics tools: Hyperion, Jedox, NetSuite
J24 (ix) · D25 (ix)	features of Jedox · of Zoho Analytics
J24 (x)	"why did profit fall" = diagnostic analytics
D24 (xi)	not a spreadsheet: EViews
D24 (xii)	"# Script Ends" = a comment in the SM's Python example
J25 (iv)	financial data analytics: value driver, ratio, predictive sales
J25 (v)	runs on many systems = platform independent (Python)
J26 (ix)	QuickBooks = accounting and financial management

- **Four types**: descriptive — what happened · diagnostic — why · predictive — what is likely to happen · prescriptive — what action to take. [SM 723–724]
- **ETL (data transformation)**: Xplenty, Stitch, Glue (the SM prints "ABS Glue"), Skyvia. [SM 725]
- **Spreadsheets**: MS-Excel (pivot tables, scenario manager), Google Sheets, Quip. [SM 725–726]
- **BI tools** retrieve, analyse and turn data into visual insights: data mining, predictive analytics, NLP, OLAP, visualisation, dashboards, alerts, embedded analytics. [SM 727–731]
- **Financial analytics** types incl. value driver analytics and ratio analysis; tools **Jedox, Zoho Analytics, QuickBooks**; others Hyper Anna, NetSuite, FICO. [SM 733–735]
- **R**: open source, statistical, command line, platform independent, integrates with C / C++. [SM 736–737]
- **Python**: interpreters (IDLE on Windows; preinstalled on Ubuntu, Fedora); uses in security, Raspberry Pi, games, AI, NLP. [SM 742]

Practise: the eleven MCQs above · SM exercise MCQs (end of the module) · MCQ bank (Module 15 range).

Module 7 · Transportation P16 · 7.0

SM pp. 470–499 (exercise 500–508). **A 7-mark VAM half in J25 and J26** (both June); D23 MCQ. Module 7 per paper: **J26-7 · D25-0 · J25-7 · D24-0 · J24-0 · D23-2**. Lower chance in December.

0 · Balance
supply ≠ demand → dummy row / column with zero cost

↓

1 · Penalties
each row and column: second-lowest − lowest cost

↓

2 · Allocate
highest penalty → its cheapest cell → as much as possible; tie: least cost, then larger allocation

↓

3 · Repeat, then cost
m + n − 1 cells; total = Σ cost × units; optimum test by MODI if asked

WORKED PATTERN · SM ILLUSTRATION 3 (VAM)

3 plants, 4 shops: P1R1 20, P1R3 30, P2R2 20, P2R4 35, P2R3 20, P3R4 25 → **₹650 thousand**, ₹20 thousand better than NWCM and ₹5 thousand better than LCM. [SM 482]

MODI: $u_i + v_j$ = cost for allocated cells; for empty cells cost − (u + v) < 0 → improve. Most negative cell enters (D23 MCQ: it lowers cost fastest). [SM 482]

OUR WORKINGS (VAM RECOMPUTED BY SCRIPT m06m07m09_patterns.py; OPTIMUM CHECKED BY LP)

JUN'25 Q6(a) CNG, ₹ '000

VAM: X→B 450, X→D 250, Y→C 350, Y→D 50, Z→A 400, Z→D 200 (6 cells) → **₹7,350 thousand** — this is also the optimum (an LP check finds no cheaper plan).

JUN'26 Q6(b) TRUCKS (UNBALANCED)

Supply 25 v demand 23 → dummy customer of 2 (cost 0). VAM: A→X 5, B→W 5, B→X 3, B→Y 2, C→Y 5, C→dummy 2, D→Y 3 (7 cells) → **₹98** (the first-step tie between B and C gives the same total). Not asked: MODI reaches ₹90 (B→dummy 2, C→Y 7).

Practise: J26 Q6(b), J25 Q6(a), MQP Q1(vi), postal Q7(ii) · SM Illus. 1–8 (SM 473–499) · **ICMAI Practice Workbook Ch5 illus. 1–10** · MCQ bank Q77–Q81, Q83, Q84, Q232.