Module 1 · Investment decisions P14 · 1.1–1.5

SM pp. 6–59 (exercise 60–68). **9 marks in every paper since Jun'24** (expected 9.0): **Q2(a) an NPV sum in all 6 papers — every December a machine replacement** (D23, D24, D25 with a subsidy) — plus **MCQ (i)** on MNPV / MIRR (three times), PI or APV. Capital rationing (1.4) and social cost-benefit (1.5): never asked.

Paper	Q2(a)	MCQ (i)
Jun'23	overhaul v replace parts (costs rising 5%); case Q8: EAC, real v nominal	base-case NPV of a perpetuity
Dec'23	**replacement**: annual savings, PV, viability	APV with a perpetual debt tax shield
Jun'24	new AI system: savings, deferred payment, advance maintenance	–
Dec'24	**replace a manual machine**: cash savings, NPV	reinvestment rate from MNPV
Jun'25	replacement with trade-in, WDV, staged working capital	MNPV at 12% reinvestment
Dec'25	**replacement with a 15% subsidy: NPV and PI**	initial outlay from PI
Jun'26	new project: capacity build-up, WDV, extra working capital	initial investment from MNPV

HOW IT IS ASKED

- **December Q2(a)**: old machine (book value, sale value, remaining life) v new machine (price + installation, salvage, subsidy) → incremental savings → incremental depreciation → tax → CFAT → NPV and PI at the given factors.
- **Twists**: subsidy received at the end of year 1; trade-in price; WDV depreciation; working capital staged and released at the end; "ignore tax on the loss on the old machine".
- **MCQ (i)**: MNPV / MIRR either way; outlay from PI; APV.

A Formula sheet — when to use

Formula	When to use · notes	SM
CFAT = EBIT (1 − t) + depreciation	Interest is excluded (financing decision); depreciation added back.	[SM 7–8]
Initial outflow = cost + installation + working capital − salvage of old asset (± tax)	Replacement: sale value of the old machine is an inflow at t_0; sunk cost ignored.	[SM 6–7]
Terminal inflow = salvage ± tax on loss / gain on sale + release of working capital	Last year of the project.	[SM 9]
PI = PV of inflows ÷ PV of outflows (or ÷ initial outlay)	Accept if > 1; rank by PI when outlays differ; MCQ: outlay = PV of inflows ÷ PI.	[SM 18–19]
APV = base-case NPV + PV of tax shield on debt − issue costs	Adjusted NPV (MCQ D23, MQP).	[SM 20–21]
IRR = lower rate + (higher − lower) ÷ (NPV_L − NPV_H) × NPV_L	Interpolation between two trial rates; at IRR, PI = 1.	[SM 22–23]
MIRR = (FV of inflows at the cost of capital ÷ PV of outflows)$^{1/n}$ − 1	One IRR even for non-conventional flows.	[SM 25]
MNPV = terminal value (inflows compounded at the reinvestment rate) × PVIF − outlay	Terminal-value method; MCQ asks it backwards (rate or outlay).	[SM 26–27]
EAC / EAB = NPV ÷ PVIFA (× capital recovery factor)	Unequal lives: compare the annual equivalent.	[SM 30]
Payback reciprocal = CFAT p.a. ÷ initial investment	Rough IRR proxy (MCQ).	[SM 14]

Real cash flow = nominal ÷ (1 + inflation)^t; (1 + nominal rate) = (1 + real)(1 + inflation)	Discount real with real, nominal with nominal.	[SM 35]

B The replacement NPV · Q2(a) 1.1

1 · Net outlay at t_0
new cost + installation + testing − sale of old (± tax on loss / gain) + working capital

↓

2 · Incremental savings
savings − extra costs (salaries, maintenance)

↓

3 · Incremental depreciation
new − old (SLM or WDV as told)

↓

4 · CFAT
(savings − depreciation) × (1 − t) + depreciation

↓

5 · Discount
CFAT × factors + subsidy / salvage / working capital at their years → NPV, PI → advise

- Initial cash flow includes cost, installation, transport and incidental costs; **sunk cost is ignored**. [SM 6]
- Replacement: the old item's salvage value is an inflow subtracted from the outlay; extra working capital is an outflow. [SM 7]
- **Interest exclusion principle**: interest is a financing charge, not deducted when estimating cash inflows. [SM 7]
- Relevant costs = future costs that differ between alternatives; SM Illus. 2: book value of the old machine is sunk (not relevant); its current salvage and the new machine's cost and operating costs are relevant. [SM 9–10]
- NPV **advantages**: time value, all cash flows, adds to shareholders' wealth; **limits**: ignores size of outlay and different lives — hence PI and EAC. [SM 18]
- Capital rationing: **divisible** projects ranked by PI; **indivisible** — accept whole or reject (combinations). [SM 38]

PROBLEMS BOX · REPLACEMENT NPV (Q2(a) — RECOMPUTED BY SCRIPT m01_patterns.py)

WORKED PATTERN · ICMAI WORKBOOK CH1 ILLUS. 9 (NEW INDIA LTD)

Cost of the new machine	2,20,000
Less: sale value of the old machine	(50,000)
Less: tax saving on loss [(1,50,000 − 10,000 × 5) − 50,000] × 35%	(17,500)
Add: additional working capital	30,000
Net cash outflow	**1,82,500**
Sales + 60,000 − costs 20,000 − extra depreciation (22,000 − 10,000) 12,000 = PBT	28,000
PAT (35% tax) + depreciation 12,000 = CFAT, years 1 to 10	30,200
30,200 × 6.145 + working capital 30,000 × 0.386	1,85,579 + 11,580
NPV = 1,97,159 − 1,82,500 → replace	**14,659**

DEC'25 Q2(a) PEGUS — THE DECEMBER TEMPLATE (OUR WORKING)

- Cost of Y = 24,00,000 + 1,40,000 + 60,000 = 26,00,000 − sale of X 1,80,000 = **₹24,20,000** net outlay (tax on the loss ignored, as told).
- Savings 3 × 1,68,000 + 4,80,000 + 3,50,000 − 3,90,000 − 1,54,000 = **₹7,90,000**.
- Depreciation Y (26,00,000 − 3,20,000) ÷ 6 = 3,80,000 − X 4,80,000 ÷ 6 = 80,000 → incremental 3,00,000.
- CFAT = (7,90,000 − 3,00,000) × 0.70 + 3,00,000 = **₹6,43,000** × 3.888 = 24,99,984.
- + subsidy 15% × 24,00,000 at year 1: 3,15,720 + salvage 3,20,000 × 0.456 = 1,45,920 → PV inflows **₹29,61,624**.
- **NPV ₹5,41,624; PI 1.2238** → replace. ⚠ Assumption stated: depreciation on full cost, subsidy a separate inflow (if the subsidy reduces the cost, recompute depreciation).

PRACTISE THESE (MOST LIKELY FIRST)

D25, D24, D23 Q2(a) (December replacement) · J25 Q2(a) (trade-in, WDV) · J26, J24 Q2(a) (new project) · MQP Q2(a) (choose CD or EF) · J23 Q2(a) · SM Illus. 2–16 · SM exercise sums 1–2 (SM 63) · **ICMAI Practice Workbook Ch1 illus. 1, 9, 11, 14** · MCQ bank Q1, Q2, Q4–Q6, Q8–Q10, Q173, Q180, Q181.

C PI, APV, IRR, MIRR, MNPV, EAC · MCQ (i) 1.1 · 1.2 · 1.3

WORKED PATTERNS · SM ILLUSTRATIONS (RECOMPUTED)

- **PI** (Illus. 10): PV of CFAT 71,951 ÷ 70000 = **1.028** → accept. Illus. 11: PI 1.25 v 1.17 although NPV 15,000 v 20,000 → choose Project 1. [SM 18–19]
- **APV** (Illus. 12): base-case NPV (−) ₹5,12,700 + PV of tax shield 4,03,270 − issue cost 1,37,000 = **(−) ₹2,46,430** → reject. [SM 21]
- **MIRR** (Illus. 15): FV at 12% = 2,09,793; $(2.09793)^{1/5}$ − 1 = **15.97%**. [SM 26]
- **MNPV** (Illus. 16): terminal value 1,54,324 × 0.683 = 1,05,403 − 1,20,000 = **₹ −14,597** → reject. [SM 27]
- **IRR** (Illus. 13): NPV 2,720 at 10%, (1,560) at 12% → IRR = 10% + 2% × 2720 ÷ [2720 − (−1560)]. [SM 23–24] = 11.27% (⚠ the SM prints 1.28% → 11.28%; 2 × 2,720 ÷ 4,280 = 1.27.)

PRACTISE

MCQs D23, D24, J25, D25, J26 Q1(i), MQP / PTP Q1(i), postal Q1(vi) · J23 Q8 (EAC, real v nominal) · SM Illus. 15–21, 22 (capital rationing) · **WB Ch1 illus. 2, 4, 5, 6, 7, 10** · PTP Q2(a) (capital rationing) · MCQ bank Q7, Q11–Q15, Q174, Q176, Q177, Q201.

- **NPV v IRR**: NPV assumes reinvestment at the cost of capital, IRR at the IRR itself; MIRR removes the multiple-IRR and reinvestment problems. [SM 22, SM 25]
- **MNPV / terminal value**: compound each inflow at the reinvestment rate to the end, discount the total at the cost of capital, deduct the outlay. [SM 26–27]
- **Unequal lives**: equivalent annual benefit / cost resolves the conflict. [SM 30]
- **Abandonment value**: abandon when the abandonment value exceeds the PV of the remaining cash flows. [SM 32]
- **Inflation**: nominal cash flows ÷ inflation → real cash flows, discounted at the real rate; or nominal at the nominal rate — same answer. [SM 35]

Item	Rule	SM
CFAT	EBIT (1 − t) + depreciation	[SM 8]
PI	PV inflows ÷ outlay	[SM 18]
MIRR	$(FV \div PV)^{1/n} - 1$	[SM 25]
EAC	NPV ÷ PVIFA	[SM 30]

TRAPS

- Do not deduct interest from cash flows; do not count sunk costs (book value of the old machine).
- Depreciation shield is on the **incremental** depreciation (new − old).
- Working capital: outflow at the start (or when it is needed), inflow at the end.
- Subsidy at the end of year 1 → discount with the year-1 factor; state how it affects depreciation.
- Salvage at book value → no tax; above / below book value → tax on the gain / saving on the loss.