

INSTITUTE OF ACTUARIES OF INDIA

Subject SP5 - Investment and Finance

May 2026 Examination

INDICATIVE SOLUTION

Introduction:

The indicative solution has been written by the Examiners with the aim of helping candidates. The solutions given are only indicative. It is realized that there could be other points as valid answers and examiners have given credit for any alternative approach or interpretation which they consider to be reasonable.

Solution 1:**i)**

A market-capitalisation weighted equity index gives each stock a weight in proportion to its market value.

Since this is an institutional benchmark, the relevant market value should be based on free-float market capitalisation, because only the freely tradable shares are realistically available to investors.

Free-float market capitalisation = Price × Number of shares × Free-float factor

Amounts are in ₹ million, since shares are given in millions.

Stock	Price ₹	Shares million	Free-float factor	Free-float market cap
A	50	100	0.80	$50 \times 100 \times 0.80 = 4,000$
B	80	50	0.60	$80 \times 50 \times 0.60 = 2,400$
C	40	150	0.90	$40 \times 150 \times 0.90 = 5,400$
Total				11,800

The initial benchmark weights are therefore:

Stock	Free-float market cap	Weight
A	4,000	$4,000/11,800 = 33.90\%$
B	2,400	$2,400/11,800 = 20.34\%$
C	5,400	$5,400/11,800 = 45.76\%$
Total	11,800	100.00%

Assuming the benchmark index is set at 100 initially:

$$\text{Initial divisor} = \frac{11,800}{100} = 118$$

Ignoring corporate-action adjustments for the moment, the closing free-float market capitalisation is:

Stock	Closing price ₹	Shares million	Free-float factor	Closing free-float market cap
A	55	100	0.80	$55 \times 100 \times 0.80 = 4,400$
B	72	50	0.60	$72 \times 50 \times 0.60 = 2,160$
C	44	150	0.90	$44 \times 150 \times 0.90 = 5,940$
Total				12,500

This gives,

$$\begin{aligned} \text{Closing index level} &= \frac{12,500}{118} = 105.93 \\ \text{Benchmark return} &= \frac{12,500 - 11,800}{11,800} = 5.93\% \end{aligned}$$

So, before making corporate-action adjustments, the market-capitalisation weighted benchmark return is 5.93%.

[3]

ii)

The corporate actions need to be treated carefully because they can otherwise create artificial gains or losses in the benchmark.

Where a change in market capitalisation arises from a corporate action rather than from investment performance, the index base or divisor should be adjusted to maintain continuity.

Rights issues and other capital changes require such adjustment because they alter the number of shares and introduce new capital into the company.

Dividends are treated differently depending on whether the benchmark is a price index or a total return index.

In a price index, dividends are not added back, whereas in a total return index, dividends should be included or assumed to be reinvested.

Stock A: 1-for-5 rights issue at ₹40

A 1-for-5 rights issue means that for every 5 existing shares, 1 new share is issued.

$$\text{New shares issued} = \frac{100}{5} = 20 \text{ million shares}$$

New total shares:

$$100 + 20 = 120 \text{ million shares}$$

The free-float value of the cash raised is:

$$20 \times 40 \times 0.80 = 640$$

This ₹640 million is new capital introduced into the company. It should not be treated as investment return. So the benchmark divisor or base market capitalisation should be adjusted.

Adjusted market capitalisation base:

$$11,800 + 640 = 12,440$$

The theoretical ex-rights price for Stock A, immediately after the rights issue, would be:

$$\frac{(5 \times 50) + 40}{6} = \frac{290}{6} = ₹48.33$$

This shows that the rights issue mechanically changes the share price and number of shares, but it does not by itself create investment performance.

The closing free-float market capitalisation after allowing for the new shares is:

Stock	Closing calculation	Closing free-float market cap
A	$55 \times 120 \times 0.80$	5,280
B	$72 \times 50 \times 0.60$	2,160
C	$44 \times 150 \times 0.90$	5,940

Stock	Closing calculation	Closing free-float market cap
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Total		13,380
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The price-only return after adjusting for the rights issue is:

$$\frac{13,380 - 12,440}{12,440} = 7.56\%$$

Without the rights issue adjustment, the return would have been:

$$\frac{13,380 - 11,800}{11,800} = 13.39\%$$

This could overstate the true investment return because it would incorrectly treat the cash raised from the rights issue as performance.

Stock B: cash dividend of ₹4 per share

A cash dividend reduces the share price when the stock goes ex-dividend. In a price index, the dividend is not added back, so the index return reflects only the price movement.

For a total return index, the dividend should be added back or assumed to be reinvested.

Free-float dividend amount:

$$4 \times 50 \times 0.60 = 120$$

The total return after allowing for the rights issue and dividend is:

$$\frac{13,380 + 120 - 12,440}{12,440} = \frac{1,060}{12,440} = 8.52\%$$

As a result,

Price return, ignoring corporate actions in the simple calculation	5.93%
Price return after adjusting for Stock A rights issue	7.56%
Total return after adjusting for rights issue and adding Stock B dividend	8.52%

Stock C has no corporate action, so its impact arises only from its price movement.

[4]

iii)

- Free-float adjustment is needed because an institutional investor can normally invest only in the shares available for public trading. Shares held by promoters, governments, strategic investors or group companies may not be available to the market. A free-float adjusted index therefore gives a more realistic investable benchmark.
- It also prevents companies with large locked-in shareholdings from receiving excessive benchmark weights. Without this adjustment, a company could appear very large by total market capitalisation even though only a small proportion of its shares can actually be bought or sold by investors.
- Corporate-action adjustments are needed to maintain index continuity. Events such as rights issues, share buybacks, mergers, new issues and changes in constituents can change market capitalisation without representing investment performance. Adjusting the divisor or chain-linking the index avoids artificial jumps or falls.

- For performance measurement, these adjustments are essential because the benchmark should measure market performance, not mechanical changes caused by capital restructuring or dividend payments. This makes comparisons between the active portfolio and the benchmark more meaningful.

[3]

iv)

- A market-capitalisation weighted benchmark can become concentrated in the largest companies or sectors. This may not reflect the active manager's actual opportunity set, style or mandate, particularly if the manager invests across market caps, sectors or valuation styles.
- It may also overweight shares whose prices have already risen sharply and may be overvalued, while underweighting potentially attractive smaller or undervalued companies. This can make the benchmark pro-cyclical and may not be an ideal measure of the manager's skill.
- Other limitations include limited allowance for liquidity constraints, ESG or mandate restrictions, tax considerations, transaction costs, and the fact that the benchmark reflects market consensus weights rather than the active manager's best investment views.

[2]

[12 Marks]

Solution 2

i)

Given:

- EPS = ₹25
- Dividend payout ratio = 40%
- Expected growth for first 3 years = 8% per annum
- Long-term growth thereafter = 4% per annum
- Required return = 11%

The current dividend per share is:

$$D_0 = EPS \times \text{payout ratio}$$

$$D_0 = 25 \times 40\% = ₹10$$

Assume dividends are paid annually in arrears and dividends grow in line with earnings.

Step 1: Project dividends for the first three years

$$D_t = D_0(1 + g)^t$$

Year	Formula	Dividend ₹
1	10×1.08	10.800
2	10×1.08^2	11.664
3	10×1.08^3	12.597

Step 2: Calculate dividend in Year 4

After Year 3, dividends are assumed to grow at the long-term growth rate of 4%.

$$D_4 = D_3(1 + g_\infty)$$

$$D_4 = 12.597 \times 1.04 = ₹13.101$$

Step 3: Calculate terminal value at the end of Year 3

Using the Gordon growth model:

$$TV_3 = \frac{D_4}{k - g_\infty}$$

$$TV_3 = \frac{13.101}{0.11 - 0.04}$$

$$TV_3 = \frac{13.101}{0.07} = ₹187.157$$

Step 4: Discount dividends and terminal value to present value

$$V_0 = \frac{D_1}{(1+k)} + \frac{D_2}{(1+k)^2} + \frac{D_3}{(1+k)^3} + \frac{TV_3}{(1+k)^3}$$

Cash flow	Amount ₹	Discount factor at 11%	Present value ₹
Dividend Year 1	10.800	$1/1.11 = 0.9009$	9.73
Dividend Year 2	11.664	$1/1.11^2 = 0.8116$	9.47
Dividend Year 3	12.597	$1/1.11^3 = 0.7312$	9.21
Terminal value at Year 3	187.157	$1/1.11^3 = 0.7312$	136.85
Total value			165.26

$$V_0 = 9.73 + 9.47 + 9.21 + 136.85 = ₹165.26$$

Hence, the estimated intrinsic value of the share is approximately:

₹165.3 per share

Assumptions made

The valuation assumes that:

- the current EPS of ₹25 is a sustainable starting point;
- the dividend payout ratio remains constant at 40%;
- dividends grow at 8% per annum for the first three years;
- growth falls to a stable long-term rate of 4% from Year 4 onwards;
- the required return remains constant at 11%;
- dividends are paid annually at the end of each year;
- there are no major changes in capital structure, tax, regulation, business model or competitive position;
- the long-term growth rate is less than the required return, so the terminal value formula is valid.

[7]

ii)

- The valuation depends heavily on the quality of the dividend and growth assumptions. This is especially important because the company operates in a cyclical sector and has recently reported strong earnings growth.

- The starting EPS of ₹25 may not represent normalised earnings. In a cyclical industry, recent strong performance may reflect favourable economic conditions, high demand, strong pricing power or unusually low input costs. If the company is near the top of the cycle, using current EPS as the base may overstate sustainable dividends and hence overvalue the share.
- The assumption of 8% growth for the next three years may also be optimistic. Cyclical companies often experience volatile earnings rather than smooth year-on-year growth. A downturn in the economic cycle could reduce sales volumes, margins and dividend capacity. A more prudent valuation might use normalised earnings across a full business cycle or scenario-weighted growth assumptions.
- The constant payout ratio of 40% may not hold in practice. Management may reduce dividends during downturns to preserve cash, maintain liquidity, meet debt obligations or fund investment. Alternatively, the company may maintain dividends temporarily despite falling earnings, which would weaken dividend cover.
- The long-term growth assumption of 4% is important because most of the valuation comes from the terminal value. While 4% may appear moderate, it must be assessed against long-term industry growth, inflation, competition and the maturity of the sector. For a cyclical business, assuming stable perpetual growth is a simplification.
- The required return of 11% may be too low if the company has high operating leverage, financial leverage, commodity price exposure or high sensitivity to economic conditions. A cyclical company usually requires a higher risk premium than a defensive company, so the discount rate should reflect business and market risk.
- On balance, the valuation gives a useful starting estimate, but it should be treated with caution. For investment decision-making, it should be compared with market price, peer valuation multiples, normalised earnings analysis, free cash flow valuation and downside scenarios.

[4]

iii)

The valuation is highly sensitive to the assumed growth rates, especially the long-term growth rate, because the terminal value forms most of the total value.

In the base case:

PV of terminal value = ₹136.85

Total value = ₹165.26

So the terminal value represents approximately:

$$\frac{136.85}{165.26} = 82.8\%$$

In other words, that a large part of the valuation depends on the assumed long-term growth rate.

Illustrative sensitivity:

Assumption changed	Estimated value ₹
Long-term growth = 3% instead of 4%	147.0
Base case long-term growth = 4%	165.3
Long-term growth = 5% instead of 4%	189.6

This shows that a 1% change in the long-term growth assumption materially changes the valuation.

The valuation is also sensitive to the short-term growth rate, because it affects the first three dividends and the base from which terminal value is calculated:

Short-term growth assumption	Estimated value ₹
6% for first 3 years	156.8
Base case: 8% for first 3 years	165.3
10% for first 3 years	174.1

For a cyclical company, sensitivity analysis is essential. A single-point estimate of ₹165.3 should not be treated as precise; it should be interpreted as one outcome under a specific set of growth and discount-rate assumptions.

[2]

[13 Marks]

Solution 3

i)

1. Debt-to-equity ratio

$$\begin{aligned}\text{Debt-to-equity ratio} &= \frac{\text{Debt}}{\text{Equity}} \\ &= \frac{150}{250} = 0.60\end{aligned}$$

So, DJT Ltd has ₹0.60 of debt for every ₹1 of equity.

2. Debt-to-assets ratio

$$\begin{aligned}\text{Debt-to-assets ratio} &= \frac{\text{Debt}}{\text{Total assets}} \\ &= \frac{150}{400} = 0.375 = 37.5\%\end{aligned}$$

So that 37.5% of the company's assets are financed by debt.

3. Interest coverage ratio

$$\begin{aligned}\text{Interest coverage ratio} &= \frac{\text{EBIT}}{\text{Interest expense}} \\ &= \frac{60}{10} = 6.0 \text{ times}\end{aligned}$$

The company currently earns EBIT equal to 6 times its interest cost.

4. Return on equity

$$\begin{aligned}\text{ROE} &= \frac{\text{Net profit}}{\text{Equity}} \\ &= \frac{35}{250} = 14.0\%\end{aligned}$$

Comment on current financial position

DJT Ltd currently appears to have a reasonably stable financial position. The debt-to-equity ratio of 0.60 times is well below the credit-rating warning level of 1.0 times, and interest coverage of 6.0 times is comfortably above the negative outlook trigger of 3.5 times.

The ROE of 14.0% indicates reasonable profitability for shareholders. That said, the company's debt is predominantly floating-rate, so the existing interest cost is exposed to rising market interest rates. This is important because the company is an insurer, so weakening profitability or capital buffers could also create solvency and credit-rating concerns.

[5]

ii)

Assumptions

The following assumptions are made:

- the full ₹100 crore equity issue increases equity from ₹250 crore to ₹350 crore;
- the funds raised are invested in the expansion, so total assets increase from ₹400 crore to ₹500 crore;
- no new debt is raised;
- existing floating-rate debt reprices upward by 2 percentage points;
- tax is charged at 30%;
- revenue is not separately projected because only the EBIT impact is provided.

First, the revised EBIT:

$$\text{Revised EBIT} = 60 \times 1.15 = 69$$

So revised EBIT is:

$$\boxed{\text{₹69 crore}}$$

Next, the revised interest expense:

Current implied interest rate on existing debt:

$$\frac{10}{150} = 6.67\%$$

After a 2 percentage point increase in interest rates:

$$6.67\% + 2.00\% = 8.67\%$$

Revised interest expense on existing floating-rate debt:

$$150 \times 8.67\% = 13.0$$

So revised interest expense is approximately:

$$\boxed{\text{₹13.0 crore}}$$

This gives the revised profit before tax and net profit:

$$\text{Profit before tax} = 69 - 13.0 = 56.0$$

$$\text{Tax} = 56.0 \times 30\% = 16.8$$

$$\text{Net profit} = 56.0 - 16.8 = 39.2$$

Revised income statement under equity financing

Item	Current ₹ crore	Revised ₹ crore
EBIT	60.0	69.0
Interest expense	10.0	13.0
Profit before tax	50.0	56.0
Tax expense	15.0	16.8
Net profit	35.0	39.2

Net profit increases from ₹35 crore to ₹39.2 crore, mainly because the expansion increases EBIT. Still, the increase in interest rates partly offsets this benefit.

Finally, the revised ratios:

Revised balance sheet figures:

Item	Current ₹ crore	Revised ₹ crore
Total assets	400	500
Debt	150	150
Equity	250	350

Debt-to-equity ratio

$$\frac{150}{350} = 0.429$$

0.43 times

Debt-to-assets ratio

$$\frac{150}{500} = 30.0\%$$

30.0%

Interest coverage ratio

$$\frac{69}{13.0} = 5.31$$

5.31 times

Return on equity

$$\frac{39.2}{350} = 11.2\%$$

11.2%

Comparison of current and revised ratios

Ratio	Current	After equity financing	Comment
Debt-to-equity ratio	0.60x	0.43x	Improves, as equity increases and debt is unchanged
Debt-to-assets ratio	37.5%	30.0%	Improves, as the asset base is funded by new equity
Interest coverage ratio	6.00x	5.31x	Falls slightly due to higher interest rates, but remains above 3.5x
ROE	14.0%	11.2%	Falls due to equity dilution

Overall assessment of equity financing

Equity financing strengthens DJT Ltd's balance sheet and reduces leverage. It also avoids adding new fixed interest obligations, which is beneficial in a rising interest rate environment.

The main disadvantage is shareholder dilution. Although net profit rises from ₹35 crore to ₹39.2 crore, equity increases from ₹250 crore to ₹350 crore, so ROE falls from 14.0% to 11.2%.

From a solvency and credit-rating perspective, equity financing appears prudent. The debt-to-equity ratio remains well below 1.0 times, and interest coverage remains comfortably above the 3.5 times warning threshold.

iii)

Higher leverage improves shareholder returns only if the expansion's return exceeds the cost of debt and the company maintains adequate solvency, liquidity and credit quality. Key risks:

Interest rate risk: DJT Ltd's debt is predominantly floating-rate, so rising rates directly increase interest costs, reducing profit, retained earnings and capital generation capacity for an insurer.

Interest coverage and credit-rating risk: at the negative-outlook trigger of 3.5x, a stress test under debt financing gives coverage of only $72/24.0=3.0x$ (EBIT $60 \times 1.20=72$; existing debt interest $150 \times 8.67\%=13.0$; new debt interest $100 \times 11\%=11.0$), below the threshold, a downgrade would raise future borrowing costs and could affect market and policyholder confidence.

Debt-to-equity and refinancing risk: under debt financing, debt-to-equity reaches $250/250=1.0$, exactly the rating agency's concern threshold; any further borrowing or profit weakness would push it higher, and refinancing could become harder or costlier.

Solvency and regulatory capital risk: as an insurer, DJT Ltd must maintain capital to support its insurance liabilities; higher leverage and interest costs weaken the capital base and retained-earnings generation, especially if the expansion underperforms.

Liquidity risk: interest payments are a fixed cash outflow that would compete with claims, surrenders and integration costs in a stress scenario, potentially forcing asset sales at unfavourable prices.

Overall, increasing leverage now would be risky. The interest coverage stress test alone shows the negative-outlook trigger could be breached. Equity financing is the more conservative option, protecting solvency at the cost of some ROE dilution. [4]

iv)

Yes. If DJT Ltd uses debt financing and has floating-rate debt, it could enter into a pay-fixed, receive-floating interest rate swap.

The floating receipts under the swap would offset the floating interest payments on the debt. It would effectively convert floating-rate borrowing into fixed-rate borrowing, giving greater certainty over future interest payments. The swap would not remove all risks. DJT Ltd would still face counterparty risk, basis risk, collateral or liquidity requirements, and the possibility that it pays more than necessary if interest rates fall.

[1]

[14 Marks]

Solution 4:

i)

Securitisation converts a pool of illiquid assets (₹500 crore of residential mortgages) into tradable securities repaid from the pool's cashflows.

The bank pools the mortgages and transfers them to a Special Purpose Vehicle (SPV) via a true sale, legally separating the assets from the bank. The SPV funds this purchase by issuing tranching securities to investors: Senior Notes (₹350cr, 7%), Mezzanine Notes (₹100cr, 10%), and an Equity Tranche (₹50cr, residual cashflows) and distributes collected cashflows through the payment waterfall, with losses absorbed sequentially: equity first, then mezzanine, then senior.

Role of the SPV: as a separate legal entity, it means investors are exposed to the mortgage pool's performance rather than the bank's general credit risk. Investors bear the pool's credit, prepayment and liquidity risk directly, while senior notes benefit from subordination by the junior tranches. The bank obtains funding upfront and can reduce balance-sheet exposure.

The bank retains the equity tranche, so it keeps the first-loss risk, this also gives investors comfort ("skin in the game") but means risk transfer is incomplete.

[3]

ii)

Assume the default rate is applied to the initial mortgage pool and ignore timing differences during the year.

Mortgage pool = ₹500 crore

Expected annual default rate = 3%

Expected defaulted amount = $500 \times 3\% = ₹15$ crore

The recovery rate is 60%, so the loss-given-default is:

$$1 - 60\% = 40\%$$

$$\text{Expected loss} = 15 \times 40\% = ₹6 \text{ crore}$$

So:

Expected loss over the next year = ₹6 crore

This loss would be absorbed first by the equity tranche.

Item	Amount ₹ crore
Mortgage pool	500
Expected defaults at 3%	15
Expected recoveries at 60%	9
Expected loss	6

The equity tranche is ₹50 crore, so an expected loss of ₹6 crore would be fully absorbed by the equity tranche.

$$\frac{6}{50} = 12\%$$

So the expected loss represents 12% of the equity tranche, but it does not reach the mezzanine or senior tranches under this expected scenario.

As an additional reasonableness check, the mortgage pool produces annual interest of:

$$500 \times 9\% = ₹45 \text{ crore}$$

The promised annual coupons on the rated tranches are:

$$(350 \times 7\%) + (100 \times 10\%) = 24.5 + 10 = ₹34.5 \text{ crore}$$

So there is an initial excess spread of approximately:

$$45 - 34.5 = ₹10.5 \text{ crore}$$

This excess spread provides some protection before allowing for expenses, servicing costs, timing of defaults, prepayments and other structural features.

[2]

iii)

Prepayment risk is the risk that borrowers repay their mortgages earlier than expected. At the stated 5% annual rate, expected prepayments are $500 \times 5\% = ₹25$ crore; actual prepayments may differ.

If prepayments are higher than expected (typically when rates fall), investors get principal back early, lose future interest income, must reinvest at lower yields, and see the security's effective maturity shorten (a form of negative convexity).

If prepayments are lower than expected (relevant here, since rates are expected to rise), the opposite occurs: cashflows arrive later, duration extends, investors stay locked into older coupons while market yields have risen, and fixed-rate tranche values may fall.

The impact varies by tranche: senior investors are affected mainly through principal timing, while the equity tranche is affected through residual cashflows and excess spread. Overall, prepayment risk makes investor cashflows less predictable, raising valuation difficulty and the yield investors will demand. [3]

iv)

Suitability depends on the investor's objectives, risk appetite, liquidity needs and mandate.

Senior Notes suit conservative institutions (insurers, pension funds) i.e. the lowest coupon (7%) but with 30% subordination (₹150cr of mezzanine and equity below it), so losses would need to exceed ₹150cr before principal is affected. They still carry prepayment, extension, liquidity and model risk.

Mezzanine Notes (10% coupon) suit investors with a higher risk appetite and capacity for structured credit risk, provided the extra yield compensates for default and complexity risk.

The Equity Tranche carries the highest risk and return, absorbing losses first. The bank's decision to retain it aligns its incentives with the pool's performance, but means risk transfer is incomplete; it is suitable mainly for the originator or specialist investors.

Relative to government bonds, these securities offer higher expected return at the cost of credit, liquidity, prepayment and model risk; relative to corporate bonds, they diversify exposure across a mortgage pool but depend heavily on structuring and underwriting quality.

Institutional use is also constrained by regulation and mandate such as minimum credit ratings, concentration limits, capital charges and Statement of Investment Principles restrictions all apply, so uptake is likely to be selective rather than broad-based.

[4]

[12 Marks]

Solution 5

i)

Attribution analysis breaks down the portfolio's active return into the sources from which the outperformance or underperformance has arisen. Active return is the return earned relative to the benchmark.

$$\text{Active return} = \text{Portfolio return} - \text{Benchmark return}$$

This is useful because the committee does not only want to know whether the manager outperformed. It wants to understand why the manager outperformed and whether the outperformance is likely to be genuine, repeatable and consistent with the mandate.

Attribution analysis is preferred because it separates performance into components such as:

Component	Meaning
Allocation effect	Value added or lost by being overweight or underweight in sectors relative to the benchmark
Selection effect	Value added or lost by choosing securities within each sector that outperform or underperform the sector benchmark

Component	Meaning
Interaction effect	Combined effect where the manager is both actively weighted in a sector and has different stock-selection performance in that sector

This helps distinguish between top-down sector positioning and bottom-up stock selection. For instance, an active equity manager may outperform because they were overweight a strong sector, or because they selected better stocks within sectors, or both.

Attribution analysis also supports governance and accountability. It helps the investment committee assess whether the manager's decisions were consistent with the agreed investment process, risk budget and benchmark-relative mandate.

It is also useful for comparing the manager's performance against expectations. Performance attribution compares the actual fund with notional funds, so that outperformance can be split between stock selection and sector selection effects.

Still, attribution analysis should be interpreted with risk measures such as tracking error and information ratio, because outperformance alone does not prove good risk-adjusted performance. Active return is uncertain, active risk is often measured through tracking error, and the information ratio relates relative return to tracking error.

[4]

ii)

Portfolio and benchmark returns:

$$R_P = (0.35 \times 14) + (0.20 \times 9) + (0.15 \times 6) + (0.10 \times 5) + (0.20 \times 11)$$

$$R_P = 4.90 + 1.80 + 0.90 + 0.50 + 2.20 = 10.30\%$$

$$R_B = (0.30 \times 11) + (0.20 \times 10) + (0.25 \times 8) + (0.10 \times 4) + (0.15 \times 9)$$

$$R_B = 3.30 + 2.00 + 2.00 + 0.40 + 1.35 = 9.05\%$$

$$\text{Active return} = 10.30\% - 9.05\% = 1.25\%$$

So, the portfolio outperformed the benchmark by 1.25%

The attribution formulas used are:

$$\text{Allocation effect}_i = (w_{P,i} - w_{B,i}) \times (R_{B,i} - R_B)$$

$$\text{Selection effect}_i = w_{B,i} \times (R_{P,i} - R_{B,i})$$

$$\text{Interaction effect}_i = (w_{P,i} - w_{B,i}) \times (R_{P,i} - R_{B,i})$$

All figures below are in percentage points of return.

Sector	Allocation effect	Selection effect	Interaction effect	Total contribution
Technology	$5\% \times (11\% - 9.05\%)$ $= 0.0975\%$	$30\% \times (14\% - 11\%)$ $= 0.90\%$	$5\% \times 3\% = 0.15\%$	1.1475%
Healthcare	$0\% \times (10\% - 9.05\%)$ $= 0.0000\%$	$20\% \times (9\% - 10\%)$ $= -0.20\%$	$0\% \times -1\% = 0.00\%$	-0.2000%
Financials	$-10\% \times (8\% - 9.05\%)$ $= 0.1050\%$	$25\% \times (6\% - 8\%)$ $= -0.50\%$	$-10\% \times -2\%$ $= 0.20\%$	-0.1950%
Energy	$0\% \times (4\% - 9.05\%)$ $= 0.0000\%$	$10\% \times (5\% - 4\%)$ $= 0.10\%$	$0\% \times 1\% = 0.00\%$	0.1000%
Consumer	$5\% \times (9\% - 9.05\%)$ $= -0.0025\%$	$15\% \times (11\% - 9\%)$ $= 0.30\%$	$5\% \times 2\% = 0.10\%$	0.3975%

Sector	Allocation effect	Selection effect	Interaction effect	Total contribution
Total	0.2000%	0.6000%	0.4500%	1.2500%

The attribution reconciles exactly to the active return:

$$0.20\% + 0.60\% + 0.45\% = 1.25\%$$

Comment on interaction effects

The interaction effect is +0.45%, which is material relative to the total active return of +1.25%.

$$\frac{0.45}{1.25} = 36\%$$

So interaction accounts for approximately 36% of the total active return.

The interaction effect is significant because the manager has active weights in sectors where the portfolio-sector return differs from the benchmark-sector return. In particular:

- Technology has a positive interaction effect because the manager was overweight Technology and selected stocks that outperformed the Technology benchmark.
- Consumer also has a positive interaction effect because the manager was overweight Consumer and achieved positive stock selection.
- Financials has a positive interaction effect because the manager was underweight Financials and the stocks held within Financials underperformed the sector benchmark.

[5]

iii)

Attribution analysis is useful, but it has several limitations.

First, it is backward-looking. It explains what happened over the past year, but it does not prove that the manager can repeat the performance in future periods.

Second, the results depend heavily on the benchmark selected. If the broad market index is not a fair representation of the manager's investable universe, style, sector limits or risk profile, the attribution results may be misleading.

Third, attribution analysis focuses mainly on return decomposition and may not fully capture the risk taken to generate the return. A manager may outperform by taking excessive tracking error, sector concentration, factor exposure, liquidity risk or downside risk.

Other limitations include:

- sensitivity to the attribution model used;
- possible difficulty in interpreting interaction effects;
- failure to fully capture transaction costs, tax, fees and implementation shortfall;
- distortion from cashflows and timing effects;
- possible masking of style or factor exposures;
- limited evidence from one period of performance.

So, attribution analysis should be used as one input into manager assessment, not as the sole basis for judging skill.

[3]

iv)

The portfolio outperformed the benchmark by 1.25%.

$$R_P = 10.30\%, R_B = 9.05\%, \text{Active return} = 1.25\%$$

The largest positive contributor was Technology, with a total contribution of approximately +1.15%. This came from:

- positive allocation effect of +0.10%;
- strong pure selection effect of +0.90%;
- positive interaction effect of +0.15%.

This indicates that the manager benefited from both being overweight Technology and selecting Technology stocks that outperformed the sector benchmark.

The next largest positive contributor was Consumer, with a total contribution of approximately +0.40%. This was mainly due to stock selection and positive interaction. The allocation effect was almost zero.

Energy added a modest +0.10%, entirely due to stock selection, as the portfolio and benchmark weights were the same.

These positive effects were partly offset by:

- Healthcare, which detracted -0.20%, due to weak stock selection;
- Financials, which detracted approximately -0.20%, despite a positive allocation effect, because stock selection within Financials was poor.

Driver	Contribution
Allocation effect	+0.20%
Pure selection effect	+0.60%
Interaction effect	+0.45%
Total active return	+1.25%

The manager's outperformance was therefore driven mainly by stock selection and interaction effects, especially in Technology and Consumer. The allocation effect was positive but relatively small.

In terms of consistency with the manager's stated strategy, the answer depends on the mandate. If the manager is expected to take active sector positions and select stocks within sectors, the results appear broadly consistent with an active equity strategy.

The outperformance is concentrated in a small number of sectors, especially Technology. This raises questions about diversification, sector concentration and whether performance depends heavily on a specific market environment.

For the broader portfolio objectives, the committee should assess whether the active risk taken was consistent with the fund's risk budget, total portfolio diversification, liability profile, liquidity needs and governance framework. Good one-year performance is encouraging, but it is not sufficient on its own.

[4]

v)

Technology overweight

Technology had a benchmark return of 11%, which was higher than the overall benchmark return of 9.05%. The manager was overweight Technology by 5 percentage points.

$$35\% - 30\% = 5\%$$

The allocation effect was:

$$5\% \times (11\% - 9.05\%) = 0.0975\% \approx 0.10\%$$

So the Technology overweight added value on an allocation basis.

In addition, stock selection in Technology was strong:

$$30\% \times (14\% - 11\%) = 0.90\%$$

The interaction effect was also positive:

$$5\% \times (14\% - 11\%) = 0.15\%$$

So, Technology contributed approximately:

$$0.10\% + 0.90\% + 0.15\% = 1.15\%$$

The Technology overweight appears to have added significant value.

Financials underweight

Financials had a benchmark return of 8%, which was lower than the overall benchmark return of 9.05%. The manager was underweight Financials by 10 percentage points.

$$15\% - 25\% = -10\%$$

The allocation effect was:

$$-10\% \times (8\% - 9.05\%) = 0.105\% \approx 0.11\%$$

So the decision to underweight Financials added value on an allocation basis.

Even so, stock selection within Financials was poor:

$$25\% \times (6\% - 8\%) = -0.50\%$$

The interaction effect was positive:

$$-10\% \times (6\% - 8\%) = 0.20\%$$

Total Financials contribution was therefore:

$$0.11\% - 0.50\% + 0.20\% = -0.19\%$$

So the Financials underweight decision itself was correct, but the manager's stock selection within Financials detracted from performance.

Governance and regulatory assessment

These decisions are acceptable only if they are consistent with the investment mandate, risk limits and governance framework.

The committee should check:

- maximum permitted sector overweight and underweight limits;
- tracking error and active risk limits;
- concentration limits;
- whether the Technology overweight creates excessive growth or momentum exposure;
- whether the Financials underweight creates unintended style or macroeconomic exposure;
- whether the manager documented the rationale for these positions;
- whether there has been any breach of mandate, internal policy or regulatory requirements.

Investment agreements and regulation may impose restrictions such as limits on sectors or assets, counterparty limits, ethical restrictions and other admissibility or governance requirements.

[3]

vi)

Attribution analysis is helpful, but it is not sufficient on its own to decide whether to retain the manager.

1. Risk taken

The manager has generated a positive active return, but the committee must assess the risk taken to achieve it. This includes:

- tracking error;
- sector concentration;
- active money positions;
- beta exposure;
- downside risk;
- Value at Risk;
- factor exposures;
- liquidity risk;
- drawdown risk.

Tracking error is a key measure of active risk relative to a benchmark. Active money alone does not fully capture risk because different stocks can have different sensitivity to market movements.

A manager who outperforms by taking excessive risk may not be suitable, even if the one-year return is strong.

2. Consistency and repeatability

One year of outperformance does not prove skill. The committee should review:

- performance over multiple periods;
- results across different market environments;
- whether the same investment process explains returns over time;
- whether outperformance is persistent or concentrated in one favourable period;
- performance during market stress.

A good past record does not guarantee future outperformance, particularly as market conditions change. Successful active management requires superior data, analysis or execution, and a previously successful approach may not work in a different future period.

3. Suitability of the benchmark

Attribution results are meaningful only if the benchmark is appropriate.

The committee should check whether the broad market index reflects:

- the manager's investable universe;
- the fund's risk tolerance;
- sector and market-cap exposure;
- any style bias;
- liquidity constraints;
- ESG or ethical exclusions;
- regulatory constraints;
- the manager's agreed mandate.

If the benchmark is unsuitable, the apparent allocation and selection effects may be misleading.

4. Implementation, costs and fees

Attribution often focuses on gross returns. The committee should also consider:

- investment management fees;
- transaction costs;
- turnover;
- taxes;
- market impact;
- liquidity costs;
- operational errors;
- implementation shortfall.

A manager may show attractive gross attribution but produce weaker net value added after costs.

5. Governance, process and reporting

The committee should evaluate qualitative factors such as:

- strength of investment research;
- clarity of decision-making;
- stability of the investment team;
- risk management process;
- compliance with mandate restrictions;
- transparency of reporting;
- responsiveness to committee challenge;
- conflicts of interest;
- stewardship and voting practices.

A manager who outperforms but breaches risk limits, lacks transparency or fails to follow the agreed process may still be unsuitable.

Attribution analysis provides important evidence, but it is only one part of the manager review. The committee should combine attribution with risk-adjusted performance, tracking error, information ratio, factor analysis, qualitative due diligence, governance review and compliance checks before deciding whether to retain the manager.

[5]

vii)

Yes. The observed outperformance could reflect exposure to rewarded systematic risk factors rather than genuine stock-picking skill.

For e.g., the manager was overweight Technology, and Technology often has exposure to growth, momentum and sometimes quality factors. If these factors performed strongly during the year, the Technology contribution may reflect a favourable factor environment rather than pure manager skill.

Similarly, the Consumer exposure may have benefited from quality, defensive growth or momentum characteristics, depending on the specific stocks held. The underweight in Financials may also reflect a style or macroeconomic position, because Financials can be sensitive to interest rates, credit conditions and cyclical factors.

This matters because a manager may appear to have generated alpha when, in fact, the portfolio was exposed to systematic factors that happened to be rewarded during the period.

The committee should therefore use a multifactor model or holdings-based factor analysis to decompose active return into:

- market beta;
- sector exposure;
- growth;
- value;

- momentum;
- quality;
- size;
- volatility;
- residual stock-specific alpha.

Multifactor models can explain security returns using a set of risk factors and can be used in active management and risk control.

If the manager's outperformance disappears after controlling for factor exposures, there is weaker evidence of genuine skill. If positive alpha remains after allowing for these exposures, this provides stronger evidence of manager skill.

In practice, consistently identifying and implementing rewarded factor exposures may itself be valuable if it is part of the manager's stated process and is delivered within the agreed risk budget and governance framework.

[3]

[27 Marks]

Solution 6

i)

The portfolio value is: ₹200 crore

The expected transition cost includes:

1. explicit transaction costs;
2. market impact costs;
3. opportunity cost from temporary cash holding.

1. Explicit transaction costs Explicit transaction cost = $200 \times 1.5\% = ₹3.00$ crore These include brokerage, exchange fees, taxes, custody costs and other directly observable dealing costs.

2. Market impact costs Market impact cost = $200 \times 2.0\% = ₹4.00$ crore Market impact is the adverse price movement caused by executing large buy or sell orders. This is especially relevant because the current portfolio differs materially from the benchmark and significant rebalancing trades are required.

3. Opportunity cost from temporary cash holding

The expected temporary cash holding is 10% of the portfolio:

$$200 \times 10\% = ₹20 \text{ crore}$$

Assume 250 trading days in a year. Expected foregone return = $20 \times 12\% \times \frac{20}{250} = ₹0.192$ crore

This represents the expected return lost by holding cash rather than equities during the 20 trading-day transition period.

4. Total expected transition cost

Cost component	Calculation	Amount ₹ crore
Explicit transaction costs	$200 \times 1.5\%$	3.000
Market impact costs	$200 \times 2.0\%$	4.000
Opportunity cost of cash holding	$20 \times 12\% \times 20/250$	0.192

Cost component	Calculation	Amount ₹ crore
Total expected transition cost		7.192

Total expected cost = ₹7.192 crore

As a percentage of the portfolio:

$$\frac{7.192}{200} \times 100 = 3.596\%$$

The total expected transition cost is approximately:

₹7.19 crore, or 3.60% of the portfolio

[4]

ii)

The main risks arise because the insurer is making a large, one-off portfolio restructuring during a volatile period, exposing it to price-movement, timing, dealing-cost and tax risk. Derivatives can help mitigate some of these.

1. Implementation shortfall risk

Implementation shortfall is the gap between the portfolio's theoretical value if the transition were executed instantly and the value achieved after costs and delays. The expected cost here is already material at ₹7.19 crore (3.60% of the portfolio), and could rise further if markets turn more volatile, liquidity deteriorates or trades are delayed.

2. Market impact and liquidity risk

Because the portfolio differs materially from the benchmark, large trades are needed and can move prices adversely, especially if the active portfolio holds mid/small-cap or less liquid stocks while the benchmark concentrates in large-cap names. Poor liquidity forces a choice between worse prices or a longer transition, both raising costs.

3. Timing and market movement risk

Over the 20-day transition, the portfolio tracks neither the old strategy nor the new benchmark: holding cash means missing out if markets rise, while a market fall still leaves the eventual passive portfolio exposed. Given 20% annualised volatility, this timing risk is material, and the actual outcome could differ significantly from the expected cost estimate.

4. Tracking error and relative performance risk

Tracking error will arise here from holding cash, incomplete rebalancing and mismatches between actual holdings and index weights. Since the end goal is a passive, index-replicating strategy, minimising this short-term tracking error matters.

5. Solvency capital risk

As an insurer, solvency capital is sensitive to equity markets and a fall during the transition would weaken both asset values and the solvency position. This could also affect regulatory capital requirements if temporary derivative or cash exposures are treated differently from physical equities.

6. Operational and execution risk

A transition involves many operational steps such as trade-list preparation, execution, settlement, reconciliation and reporting. Each could possibly be a source of error (e.g. incorrect benchmark weights, failed settlements, miscommunication between teams). This risk is higher without specialist expertise.

[6]

iii)

Derivatives can act as a temporary overlay, altering portfolio characteristics without disturbing the underlying assets during the transition.

Use of equity index futures: Buying index futures on the target benchmark (e.g. ₹20 crore notional against the expected cash holding) maintains equity exposure and avoids missing out if markets rise and can be unwound gradually as physical securities are bought.

Use of equity swaps: An equity total return swap on the benchmark index gives synthetic exposure without physical trading, though it introduces counterparty credit risk and is less marketable than exchange-traded futures.

Use of options: Index put options or a collar would protect against a sharp market fall, at the cost of the option premium and some upside.

Regulatory constraints: Derivative use is subject to insurance regulations, the investment mandate, counterparty limits and solvency capital rules.

The insurer should ensure derivatives are used for hedging or efficient portfolio management, not speculation. Derivative exposures should be marked to market, reported clearly, and included in risk and solvency monitoring. Derivative reporting should include individual derivative positions, market values and explanations needed to understand the fund's exposure.

Behavioural factors: Behavioural biases may reduce effectiveness. Management may delay the transition because of loss aversion or regret aversion if markets are volatile. They may anchor on the previous active portfolio and be reluctant to sell familiar holdings. They may also be overconfident in their ability to time the market, instead of following a disciplined transition plan.

There may also be excessive fear of derivatives because they are perceived as complex or risky. Conversely, overconfidence in derivatives could lead to too much reliance on futures or swaps without fully allowing for basis risk, counterparty risk and liquidity requirements.

Derivatives can be very useful for reducing tracking error and market exposure gaps during the transition. But they should be used within a clear transition plan, with defined hedge ratios, counterparty limits, collateral management, governance oversight and post-transition reporting.

[2]

[12 Marks]

Solution 7

i)

Duration measures the sensitivity of the market value of an asset or liability to changes in interest rates. A higher duration means greater sensitivity to interest rate movements.

Initial surplus:

$$\begin{aligned}\text{Surplus} &= A - L \\ &= 1,200 - 1,050 = ₹150 \text{ crore}\end{aligned}$$

Initial solvency ratio:

$$\frac{A}{L} = \frac{1,200}{1,050} = 114.3\%$$

A common asset-liability duration gap measure is:

$$\text{Duration gap} = D_A - \left(\frac{L}{A}\right) D_L$$

Where:

$$D_A = 7, D_L = 10, A = 1,200, L = 1,050$$

$$\frac{L}{A} = \frac{1,050}{1,200} = 0.875$$

$$\text{Adjusted liability duration} = 0.875 \times 10 = 8.75$$

$$\text{Duration gap} = 7 - 8.75 = -1.75 \text{ years}$$

Which gives:

Duration gap = -1.75 years

Interpretation

The duration gap is negative, meaning that the insurer's liability duration, after allowing for the asset-liability size relationship, is greater than the asset duration.

In other words, the liabilities are more sensitive to interest rate changes than the assets.

If interest rates fall:

- the value of assets will increase;
- the value of liabilities will also increase;
- but liabilities will increase by more than assets;
- the insurer's surplus and solvency position will deteriorate.

If interest rates rise:

- the value of assets will fall;
- the value of liabilities will also fall;
- but liabilities will fall by more than assets;
- the surplus may improve, based on a first-order duration approximation.

Since interest rates are expected to decline over the next 12 months, the current duration mismatch is a concern. The insurer is exposed to an adverse fall in solvency if rates decline.

To approximately immunise the surplus against small parallel shifts in interest rates, the insurer would need:

$$D_A = \left(\frac{L}{A}\right) D_L = 8.75 \text{ years}$$

So the asset duration would need to increase from 7 years to about 8.75 years.

Implications for the proposed asset allocation changes

Increasing the allocation to long-duration bonds would increase asset duration and reduce the negative duration gap. It would improve the interest-rate hedge against falling rates, although it may increase exposure to rising rates and may reduce portfolio yield or liquidity.

Using long-dated receive-fixed, pay-floating interest rate swaps could also increase the effective duration of the asset portfolio without physically buying long bonds. Swaps can be used to change the nature and duration of a fixed-interest portfolio, and long-duration interest rate swaps are often used as part of a liability-driven investment approach.

Increasing exposure to equities would not directly hedge the interest-rate sensitivity of the liabilities. It may increase expected return, but it would also increase market risk and could increase regulatory solvency capital requirements.

ii)

Using the duration approximation:

$$\frac{\Delta V}{V} \approx -D \times \Delta y$$

Here:

$$\Delta y = -1\% = -0.01$$

Change in asset value

$$\frac{\Delta A}{A} \approx -7 \times (-1\%) = +7\%$$

$$\Delta A = 7\% \times 1,200 = ₹84 \text{ crore}$$

$$\text{New asset value} = 1,200 + 84 = ₹1,284 \text{ crore}$$

Change in liability value

$$\frac{\Delta L}{L} \approx -10 \times (-1\%) = +10\%$$

$$\Delta L = 10\% \times 1,050 = ₹105 \text{ crore}$$

$$\text{New liability value} = 1,050 + 105 = ₹1,155 \text{ crore}$$

Change in surplus

Item	Before rate fall	After 1% rate fall
Assets	₹1,200 crore	₹1,284 crore
Liabilities	₹1,050 crore	₹1,155 crore
Surplus	₹150 crore	₹129 crore

$$\text{New surplus} = 1,284 - 1,155 = ₹129 \text{ crore}$$

$$\text{Reduction in surplus} = 150 - 129 = ₹21 \text{ crore}$$

Relative change in surplus:

$$\frac{-21}{150} = -14.0\%$$

This gives:

The solvency ratio also falls:

$$\text{Initial solvency ratio} = \frac{1,200}{1,050} = 114.3\%$$

$$\text{New solvency ratio} = \frac{1,284}{1,155} = 111.2\%$$

So the solvency ratio falls by approximately:

$$114.3\% - 111.2\% = 3.1\%$$

The fall in rates increases both assets and liabilities, but the liabilities rise more because they have a longer duration. This reduces the insurer's surplus and weakens its solvency position.

This is important because the insurer is subject to regulatory solvency capital requirements based partly on interest rate stresses. The company should therefore assess the impact under regulatory stress scenarios, not only under the expected fall in rates.

The calculation is only an approximation. It assumes a small parallel shift in the yield curve and ignores convexity, non-parallel yield curve movements, credit spread movements, liquidity effects, policyholder behaviour, guarantees, tax, transaction costs and any differences between economic and regulatory valuation bases.

[3]

iii)

Behavioural biases can lead management to make decisions misaligned with the insurer's liability profile and solvency risk.

Recency bias and availability bias: The team may over-weight the recent rate trend and increase long-duration bond exposure mainly to chase capital gains rather than for asset-liability matching, risking excessive duration if the forecast proves wrong.

Overconfidence: The team may back its own rate forecasts too heavily, using swaps to take a view rather than to close the duration gap, or adding equities for return even though these do not hedge long-duration liabilities and add solvency strain.

Loss aversion: Management may avoid a necessary hedge that shows a mark-to-market loss, or delay corrective action hoping the solvency position recovers on its own, even where this raises long-term risk.

The insurer should not make asset allocation changes purely because rates are expected to fall. The primary objective should be to manage solvency risk and reduce the asset-liability mismatch. Increasing long-duration bonds or using receive-fixed swaps may be appropriate if they reduce the negative duration gap, but increasing equities should be assessed carefully because it does not directly hedge the interest-rate sensitivity of liabilities and may increase solvency risk.

[3]

[10 Marks]
