

# **INSTITUTE OF ACTUARIES OF INDIA**

## **Subject SP1 - Health and Care**

### **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)

| S. No. | Risk                               | Type                         | Scenario Justification                                                                                                                         |
|--------|------------------------------------|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.     | Morbidity / claims deterioration   | Insurance risk               | Loss ratio has risen from 94% to 118%; cancer and cardiac claims among ages 45-60 are materially worsening experience.                         |
| 2.     | Adverse selection / anti-selection | Insurance risk               | Volume-incentivised telesales agents are likely selling to impaired lives without adequate health declaration scrutiny.                        |
| 3.     | Moral hazard                       | Operational / Insurance risk | Suspected fraudulent short-duration claims from a cluster of network hospitals in one state indicate a potential organised provider collusion. |
| 4.     | Operational / distribution risk    | Operational risk             | Over-reliance on volume-incentivised telesales without robust controls creates systematic process failures in underwriting at point of sale.   |
| 5.     | Increased non-renewal or lapse     | Persistency/insurance risk   | the fraud cluster and declining service standards may damage insurer's brand, increasing lapse and non-renewal rates.                          |

Other risks:

- Regulatory / compliance risk: Regulator may review product pricing or levy corrective action if loss ratios persist across the portfolio.

**[5]**

ii)

a)

- Volume-based commission gives agents no financial incentive to conduct thorough health declarations.
- Probing for medical history slows the sale, creating a direct opportunity cost against commission targets.
- This misalignment produces a systematic bias toward accepting incomplete applications, allowing impaired lives into the pool at standard rates.
- Adverse selection is self-reinforcing: worsening claims drive up premiums, causing healthy lives to lapse and concentrating impaired lives further.
- As impaired lives accumulate, claims costs rise disproportionately, accelerating healthy life lapse in a classic death spiral.
- The cancer and cardiac claims spike in the 45–60 band is consistent with adverse selection, as this cohort is more likely to carry undisclosed pre-existing conditions.

**[3]**

b)

**Recommendation 1 — Balanced incentive structures for agents**

- Replace volume-only commission with a balanced structure incorporating claims loss ratio for each agent's book.
- Agents whose sold portfolio exceeds a trigger loss ratio (e.g., 90% in year 1) may be (dis)-incentivised accordingly e.g. through reduced renewal commission.

**Recommendation 2 — Mandatory tele-medical or video medical declaration**

- For sum insured above Rs. 10 lakh or applicants aged 45 and above, require a structured tele-medical interview conducted by a trained medical underwriter, independent of the selling agent.
- Responses to be recorded and retained for 60 months in view of the moratorium period under regulatory provision.

### **Recommendation 3 — Pre-issuance data analytics screening**

- Integrate with third-party medical claims databases to flag applicants with recent hospitalisation history before policy issuance.
- Deploy predictive risk-scoring models to identify high-risk application profiles for enhanced underwriting review prior to issuance.

### **Recommendation 4 — Enhanced scrutiny of early claims**

- Mandate full medical underwriting review of all claims arising within 12 months of policy issuance for telesales-originated policies.
- Any claim within 90 days of issuance to trigger investigation for non-disclosure, with avoidance proceedings where warranted. [4]

iii)

### **Indicators of Provider Fraud in the Scenario**

- A geographic cluster of suspect hospitals in one state may be an indicator of organised provider collusion, typically involving a hospital owner, TPA or intermediary network.
- Short-duration admissions generating high-value claims suggest billing for procedures not performed, inflated length-of-stay coding, or fictitious admissions.
- Short-duration claims inconsistent with the clinical care pathway for the diagnosed condition are a strong fraud signal.
- The cluster having been identified through internal analytics suggests a systemic pattern, not isolated fraud.

### **Fraud Detection Methods**

- Quantitative analysis: compare claims frequency per policy, average claim size and length of stay for the suspect cluster against network-wide benchmarks.
- Diagnosis-procedure anomaly detection: flag inconsistent ICD diagnosis and procedure code combinations across claims from the cluster.
- Short-stay monitoring: automatically flag all admissions under 48 hours where the claim value exceeds a threshold (e.g., Rs. 50,000) for manual review.
- Repeat claimant analysis: identify policyholders making multiple claims at the same hospital within a 12-month window.
- Commission an independent field investigation of the highest-value claims from cluster hospitals, verifying discharge summaries, treatment records and patient presence.
- Audit TPA cashless approval decisions for the cluster to identify whether the same authoriser processed a disproportionate share of approvals, indicating potential internal collusion.

### **Governance and Escalation**

- Escalate findings to the Fraud Monitoring Committee to apprise and for necessary actions.
- Suspend the cashless facility at the suspect hospitals pending investigation;
- Flag the same as per regulatory requirement/provisions if organised fraud is substantiated.
- Engage legal counsel to assess recovery proceedings and preserve evidence for potential proceedings under applicable Indian statutes.
- Strengthen TPA empanelment agreements to include explicit fraud audit rights.

**Solution 2:****i)**

- Insurable risk and risk transfer: Product must cover genuine insurable risks with clear risk transfer; no purely financial or speculative covers.
- Simplicity and transparency: Wordings, cover, exclusions and conditions to be simple, clear and not unduly complex.
- Policyholder interest: Design and pricing must explicitly protect policyholder interests, reflecting good governance and market conduct expectations.
- Fair, adequate, non-discriminatory premiums: Premiums must be fair, not excessive or inadequate or unfairly discriminatory, and provide value for money while ensuring viability and self-sustainability.

**Health-specific and policyholder-protection provisions**

- Health product classification: Health products to be appropriately classified, for example as indemnity or benefit, individual/family/group, etc.; this product is indemnity retail.
- PED and specific waiting periods: Pre-existing disease waiting period capped at a maximum of certain months (e.g. 36 months) of continuous coverage, with encouragement to use shorter waits.
- Moratorium: After certain months (e.g. 60 months) of continuous coverage (including migration/portability), policy/claims cannot be contested for non-disclosure/misrepresentation except fraud, increasing long-term protection.
- Renewability and portfolio-level loadings: Health policies must be renewable except in limited circumstances; no individual claim-based loadings, only portfolio-level changes, protecting claimants from targeted repricing.
- Inclusive coverage: Board-approved underwriting policy should support coverage across various parameters e.g. ages, medical conditions, AYUSH, and multiple treatment settings (IPD, day-care, home-care, OPD where applicable).
- Customer Information Sheet and disclosures: Mandatory CIS with key features, limits, waiting periods, free-look, renewal, migration/portability and moratorium to support informed decisions.

**Governance – PMC and policyholder-centric operations**

- Product Management Committee (PMC): Board-constituted PMC must approve product, ensure compliance with design/pricing principles, perform due diligence on capital, profitability and reinsurance risks, and sign-off before launch.
- Annual AA review: Appointed Actuary (AA) must review all products at least annually for financial viability and emerging risks, and report with recommendations to PMC.
- Protection of Policyholders Regulations: Insurer must have a Board-approved policy for protection of policyholder interests, covering sales practices, suitability, claim handling, and grievance redressal.
- Free-look and servicing standards: Individual health policies must offer free-look (e.g. 30 days), clear servicing turn-around times (TATs) and robust grievance mechanisms, explicitly supporting fair treatment.

**Reinsurance regulations – programme and CBRs**

- Objectives and retention: Reinsurance programme must maximize retention within India, ensure adequate diversification and protection at reasonable cost, and avoid fronting.
- Board-approved retention and filings: Insurer must have Board-approved, segment-wise retention policy (including the “Health” segment), and file proposed and final annual reinsurance programmes with the Regulator.
- Catastrophe protection: Programme must explicitly address catastrophe accumulations (e.g. pandemics) with Board-approved catastrophe modelling basis.
- Reinsurance placement to be made as per regulatory provisions and Board approved reinsurance policy and only with reinsurers meeting eligibility criteria, credit rating and limits.

## ii)

## A. Data and exposure analysis

1. Experience data: Use internal health portfolio data (frequency, severity, lapse, NCB take-up) by age, geography, sum insured, family size, channel, and benefit options, adjusted for proposed richer benefits (no room caps, home-care, AYUSH).
2. External benchmarks: Supplement with market or reinsurer data where internal history is insufficient (e.g. for new benefits or higher sums insured), with appropriate credibility weighting.

## B. Claims and morbidity assumptions

1. Base morbidity: Derive incidence and severity by relevant risk cells, explicitly allowing for higher utilization from broader coverage and cashless features.
2. PED / waiting-period effects: Model worsening of morbidity after expiry of PED/specific waiting periods (up to 36 months), particularly for chronic conditions.
3. Trend and inflation: Allow for medical cost inflation and secular trend in utilization, with scenario and sensitivity testing.
4. Impact of moratorium: Recognise that after 60 months, contestability is restricted; allow for increased anti-selection and reduced ability to decline claims in long-tenure cohorts.

## C. Expenses, lapses and other assumptions

1. Expense structure: Set acquisition, admin and claims expenses consistent with actual cost structure and regulatory EOM constraints; include TPA fees structured independently of ICR (per Master Circular).
2. Lapses and persistency: Model lapses by age, duration and channel; reflect effect of richer benefits and NCB in improving persistency for some cohorts.

## D. Reinsurance within pricing

1. Net risk cost: Incorporate quota-share and excess-of-loss structures when determining net premium – ceded premium, commissions, reinstatement premiums and expected recoveries – ensuring net rate remains adequate and consistent with domestic retention objectives.
2. Volatility and capital relief: Use stochastic/scenario analysis to show how reinsurance reduces claim volatility and required capital at tail percentiles, and test robustness to reinsurer terms changes.

## E. Reserving (technical provisions)

1. Premium and unexpired risk reserves: Set UPR and assess need for unexpired risk/premium deficiency reserve where expected future claims + expenses (net of reinsurance) exceed unearned premium, reflecting product richness and guarantees.
2. Claims reserves: Establish case reserves and IBNR/IBNER using appropriate triangles, with allowance for fast cashless settlement, but also disputes or delayed documentation; model reinsurance recoverables consistently.

## F. Margins and solvency/capital interaction

1. Prudence and margins: Add explicit margins over best estimates for key risks (morbidity, inflation, lapse, reinsurance recovery) consistent with professional standards and insurer risk appetite.
2. Solvency impact: Demonstrate to Board/PMC that product plus reinsurance are compatible with maintaining required solvency margin; use capital model to verify impact of growth and adverse scenarios.

## G. Monitoring and management actions

1. Ongoing monitoring: Set up regular management information loss ratios, claim severity, NCB cost, reinsurance utilisation, and segments showing adverse trends; feed into at least annual AA review required by Products Regulations.

2. Corrective actions: Define triggers for portfolio-level premium or benefit changes, underwriting tightening or reinsurance adjustments, ensuring changes follow regulatory process (PMC approval, filings etc.).

[8]

[15 Marks]

### Solution 3:

i)

#### Option 1: Accept renewal at flat or minimal rate increase (below 15%)

- Financial: the scheme is at >140% loss ratio. A flat renewal perpetuates an annual underwriting loss cross-subsidised by the rest of the portfolio.
- Even a 15% increase is likely to leave the scheme loss-making if the claims trend continues.
- Regulatory norms would require health insurance premium rates to be actuarially justified. Renewing below the actuarially required rate creates pricing governance and regulatory risk.
- Strategic: retaining 80,000 lives provides scale and diversification, but only if the financial terms are not permanently loss making.

#### Option 2: Non-renewal

- Financial: eliminating the scheme would produce an immediate improvement in the portfolio loss ratio.
- Reputational: non-renewal of a large employer scheme may attract adverse media attention and weaken insurer's position in the corporate health segment.

#### Option 3: Structured multi-year deal with rate correction and benefit redesign

- Propose a two-to-three year rate corridor with a Year 1 increase of 20–25% (actuarially supported), with agreed trigger-based reviews in subsequent years and transparent experience data sharing.
- Introduce sub-limits for high-cost treatments (cardiac, oncology), co-payment provisions for specified conditions, or a deductible layer to reduce insurer exposure without increasing the headline premium by required amount.
- A structured deal with transparent data-sharing demonstrates long-term partnership.
- A supplementary wellness and disease management initiatives may help reduce the underlying claims trend.

#### Recommendation

- Accepting a flat rate perpetuates ongoing losses. If the client declines any increase beyond 15%, insurer should proceed to non-renewal with appropriate notice, accepting the short-term reputational impact.
- A transparent, actuarially supported rate correction with benefit redesign is the most financially viable and sustainable outcome. Therefore, Option 3 is the preferred course.

[8]

ii)

#### Metric 1 — Loss Ratio

- Definition: total incurred claims (paid plus IBNR) divided by net earned premium, measured quarterly.
- Rationale: primary measure of underwriting profitability; the portfolio is at significantly above a sustainable level for a health insurer.
- Trigger: management action if the loss ratio exceeds 95% for two consecutive quarters; Board or Risk Management Committee escalation if it exceeds 105%.

#### Metric 2 — Solvency Coverage Ratio

- Definition: available solvency margin (ASM) divided by required solvency margin (RSM) as prescribed under regulatory norms.
- Rationale: maintaining the minimum control level solvency ratio of 150% of RSM and higher for healthy and adequate solvency levels; deteriorating claims make active capital monitoring essential.
- Trigger: management alert if the ratio falls below 170%; immediate Board action and regulatory reporting if it approaches 150%.

#### Metric 3 — Claims Fraud Indicator Rate

- Definition: number of claims flagged as suspected fraud as a percentage of total claims volume, monitored monthly.
- Rationale: the identified hospital fraud cluster requires a quantitative leading indicator to support early detection and TPA governance.
- Trigger: management review if the suspected fraud rate exceeds 1.5% of claims volume; suspension of cashless facility at specific empanelled providers if the cluster-level rate exceeds 5%.

#### Metric 4 — Group Scheme Concentration Ratio

- Definition: premium income from the top five group schemes as a percentage of total health premium income.
- Rationale: the 80,000-life textile scheme represents a material concentration; excessive reliance on a single large group creates earnings volatility and pricing leverage for the client.
- Trigger: Board review if any single scheme exceeds 15% of total health premium; portfolio target of no more than 30% from the top five schemes combined.

#### Metric 5 — Early Claims Rate

- Definition: proportion of claims arising within 12 months of policy issuance as a percentage of total claims count.
- Rationale: a rising early claims rate is a leading indicator of adverse selection and non-disclosure at point of sale, identifying underwriting breakdown before it fully flows through to the overall loss ratio.
- Trigger: underwriting audit triggered if the early claims rate exceeds 20% in any quarter; agent-level analysis initiated if an individual agent's portfolio early claims rate exceeds 30%.

[10]

iii)

#### Volatility vs Expected Loss

- Proportional reinsurance (quota share or surplus) transfers both premium and claims in a fixed proportion.
- It reduces earnings volatility but also cedes a share of expected profit.
- Given the 118% loss ratio, insurer must assess whether reinsurers will accept the portfolio on commercial terms or price the cession to reflect the adverse experience.

#### Cession Terms and Pricing

- Reinsurers may require detailed claims data by cause, age band and duration.
- Given the group scheme losses, they may impose exclusions for specific providers or large group schemes, or apply event limits.
- The ceding commission must exceed the insurer's expenses for the cession to generate a net financial benefit.

#### Recommendation

- Aggregate stop-loss reinsurance, covering total claims above a fixed percentage of net earned premium, may be more appropriate than proportional reinsurance for managing the group scheme volatility specifically, as it preserves expected profit while providing protection against adverse aggregate experience.

[5]

[23 Marks]

**Solution 4:**

i)

**States**

- Healthy — no claim made; premiums in payment.
- Early-stage CI claimed — early-stage diagnosis confirmed; 25% benefit paid; policy still in force.
- Dead — all cashflows cease.
- Lapsed — policy surrendered or lapsed before any claim.
- Note: there is no persistent advanced-stage in-force state — once the remaining 75% is paid, the policy terminates.

**Transitions**

- Healthy → Early-stage CI: early-stage morbidity inception (inception rate).
- Early-stage CI → Advanced-stage payment and policy termination: disease progression rate from early to advanced stage.
- Healthy → Dead: mortality of a healthy life.
- Early-stage CI → Dead: mortality of an early-stage CI life — this will be higher than healthy-life mortality and must be modelled separately.
- Healthy → Lapsed: lapse or surrender while being healthy.
- Healthy → Advanced-stage direct: where a policyholder is first diagnosed at an advanced stage without a prior early-stage diagnosis.

[4]

ii)

**Deterministic Approach**

- Uses a single fixed set of assumptions and produces a single projected outcome.
- Uncertainty can only be explored by running additional scenarios or sensitivity tests — each run still uses fixed inputs.
- Simpler, faster and easier to build, run and communicate to management.

**Stochastic Approach**

- Assumptions are modelled as probability distributions; the model is run many times (e.g. via Monte Carlo simulation), producing a distribution of outcomes.
- Enables explicit quantification of the probability of adverse outcomes and captures correlations between risk factors — for example, morbidity inception and progression rates deteriorating simultaneously.
- Far more data-intensive, complex and computationally demanding to build and validate.

**Recommendation**

- A deterministic approach is more appropriate for the Company at this stage.
- Company has no credible internal data on early-stage inception rates or disease progression rates — insufficient to fit reliable probability distributions for a stochastic model.
- The added complexity is not justified until a credible volume of experience has accumulated;
- Sensitivity testing on the deterministic model provides an adequate measure of uncertainty in the near term.

[4]

iii)

- Sensitivity analysis involves varying one or more key assumptions away from the best-estimate value, re-running the model, and observing the impact on the output — typically the break-even premium, reserve or expected profit.
- The actuarial team should identify the most critical assumptions for this product — such as the early-stage CI inception rate, the disease progression rate, lapses, expenses and investment return, and tests a plausible range above and below the base (e.g. inception rate  $\pm 10\%$  and  $\pm 20\%$ ).
- The output of each sensitivity run is compared to the base case to determine which assumptions the model is most sensitive to.
- Sensitivity analysis helps the actuary set an appropriate margin for adverse deviation in the premium, rather than relying solely on uncertain central estimates.
- Company has no prior internal experience of tiered CI products — it holds no data on early-stage inception rates or disease progression rates, so best-estimate assumptions carry significant uncertainty.
- The disease progression rate is a parameter unique to tiered CI with no established industry benchmark, yet it directly drives the larger 75% benefit payment — even a modest upward deviation could materially increase total claims cost.

[4]

## iv)

## a)

- An analysis of surplus reconciles the actual surplus (profit) that emerged during a period with the surplus that would have been expected based on the pricing or reserving assumptions.
- It disaggregates the total difference into components attributable to each individual assumption — for example, the contribution from morbidity inception experience, from the progression rate, from lapses, from investment returns and from expenses.
- The sum of all components, together with the expected surplus, should equal the actual surplus for the period — providing a complete and auditable reconciliation.

[2]

## b)

Early-stage CI Inception Rate (Expected: 8.0; Actual: 11.5 per 1,000) — Adverse

- Actual inception is materially higher than expected, meaning more early-stage claims are being paid than priced for, directly increasing outgo and reducing surplus.
- The higher inception rate also enlarges the pool of lives who have claimed at early stage and are now exposed to a subsequent progression claim, amplifying the longer-term claims risk even if the progression rate itself appears favourable.

Progression Rate: Early to Advanced (Expected: 20%; Actual: 14%) — Favourable

- Fewer lives are progressing to the advanced stage and triggering the larger 75% benefit payment than assumed, reducing total claims outgo relative to expectation.
- However, because the inception rate is materially higher than expected, the favourable progression rate only partially offsets the adverse inception experience — the net pipeline of lives at risk of an advanced-stage claim remains larger than priced.

Annual Lapse Rate (Expected: 8%; Actual: 13%) — Adverse

- Higher lapses mean fewer policyholders remain in force to pay future premiums, reducing future premium income.
- This is particularly adverse if healthier lives are disproportionately lapsing, worsening the average morbidity of the remaining in-force portfolio — an anti-selection risk that increases future expected claims per policy.

## Investment Return (Expected: 6%; Actual: 7%) — Favourable

- Higher investment income on the reserves and premium float increases surplus, partially offsetting adverse experience on inception and expenses.
- However, investment return is generally the least controllable of the assumptions and should not be relied upon to offset structural underwriting losses.

## Expense per Policy (Expected: ₹1,200; Actual: ₹1,470) — Adverse

- Actual expenses exceed the priced assumption by approximately 22.5%, directly eroding the surplus per policy.
- The overrun may partly reflect one-off setup and systems costs for administering a new tiered CI product, but if recurring it represents a structural pricing deficiency that must be addressed in future rate filings.

[5]

c)

## Pricing and Reserving

- Investigate whether the 44% inception overrun reflects genuine adverse morbidity, anti-selection or a first-year statistical effect before revising assumptions.
- If the adverse experience persists, strengthen the pricing basis for new business and initiate a premium review where premiums are reviewable.

## Lapse Management

- Investigate the profile of lapsing policyholders to assess whether healthier lives are disproportionately lapsing and worsening the in-force risk pool.
- Improve retention through policyholder communications and greater premium payment flexibility.

## Expenses

- Determine whether the expense overrun is a one-off setup cost or recurring; if recurring, revise the pricing expense assumption for future new business.

## Overall Assessment

- One year of data is insufficient to draw firm conclusions on a new product — repeat the analysis as experience accumulates before making major pricing or product changes.

[3]

[22 Marks]

**Solution 5:**

i)

- A top-up health insurance policy pays claims only above a specified threshold — the deductible — which represents the amount the policyholder must bear before the top-up benefit is triggered.
- The deductible is typically set at the sum insured level of the policyholder's existing base health insurance policy, so that the top-up activates once the base policy is exhausted.
- On a super top-up basis, the deductible applies in aggregate across all claims in the policy year, not per individual claim — protecting against multiple smaller claims that collectively exceed the threshold.
- Benefits are paid on an indemnity basis for eligible medical costs (hospitalisation, surgery, ICU, specialist consultations) incurred above the deductible.
- Premiums are expected to be materially lower than a standalone comprehensive health policy of the same sum insured, since the insurer only pays the excess above the deductible.
- The product is typically offered as an individual or family floater arrangement, with a policy-year sum insured that resets annually.

[3]

ii)

**Deductible Structure**

- The insurer must decide whether to offer a per-claim deductible (top-up) or an aggregate annual deductible (super top-up), or both as variants — the aggregate structure is more customer-friendly but exposes the insurer to a wider range of hospitalisation events.
- The deductible options offered should align with the sum insured levels of base health policies commonly sold in the market, so policyholders can dovetail the top-up coverage seamlessly.
- A range of deductible levels should be offered (e.g. ₹3 lakh, ₹5 lakh, ₹10 lakh) to serve policyholders with different base policy sizes and risk appetites.

**Sum Insured**

- The maximum sum insured must be set at a level that covers catastrophic or high-cost hospitalisation events which are the primary use case for top-up products.
- Family floater options — where the sum insured is shared across all insured family members — reduce premium cost but increase the insurer's aggregate claims exposure if multiple members are hospitalised in the same year.

**Benefit Scope and Exclusions**

- The policy must clearly define which costs are covered above the deductible — the benefit scope should be consistent with the base health policy to avoid coverage gaps or ambiguity at the point of claim.
- Pre-existing disease waiting periods must be specified;
- the insurer should consider whether to credit waiting periods already served under the policyholder's base policy to avoid penalising customers for switching or adding cover.

**Premium Rating Factors**

- Premium rates must be differentiated by deductible level, sum insured, age, and family floater versus individual basis;
- the insurer must model the excess loss distribution above each deductible level carefully, as small errors in the tail distribution have a disproportionate impact on claims cost.

**Claims Process**

- The claims process must be designed to handle coordination between the base policy and the top-up — the insurer needs to verify what has already been settled by the base insurer before paying the excess, which requires clear documentation requirements and potentially a cashless network arrangement.

[5]

iii)

**Top-Up**

- Lower premium for a high sum insured — the customer retains the deductible risk but gains catastrophic cover at an affordable cost, which is the primary appeal of the product.
- The customer must self-fund or use an existing base policy for costs up to the deductible; there is no cover if the base policy is not in place or is insufficient, creating a potential coverage gap for modest claims.
- A super top-up provides broader protection by aggregating the deductible across the year, but requires the customer to track cumulative claims carefully to know when the top-up activates.

**Comprehensive Indemnity**

- Provides seamless, first-rupee cover (or from a small co-payment) for all eligible hospitalisation costs without the customer needing to manage a deductible threshold or coordinate with multiple insurers.

- Higher premium for the same sum insured compared to a top-up, which may make it unaffordable at higher sum insured levels.

### Assessment

- A top-up product is most suitable for customers who already hold a base health policy and wish to extend their coverage limit cost-effectively for catastrophic events; a comprehensive product is more suitable for customers who want complete, integrated cover without the operational complexity of layered policies.

[2]

[10 Marks]

## Solution 6

i)

### Equation of Value

- The equation of value sets the expected present value (EPV) of premium income equal to the expected present value of claims outgo plus expenses.
- For a one-year renewable PMI product:  $EPV(\text{premiums}) = EPV(\text{claims}) + EPV(\text{expenses})$ , where claims and expenses are typically assumed to occur at mid-year and are discounted back to the start of the policy year at the assumed investment return.
- Expected claims are derived as the product of expected claim frequency and expected average claim amount, summed across all benefit categories covered by the policy
- The break-even premium  $P$  is solved algebraically:  $P = (\text{Expected claims} + \text{Expenses}) \div (1 + i)^{0.5}$ , where  $i$  is the assumed investment return.

### Limitation for PMI

- PMI covers a wide and heterogeneous range of treatments with highly variable claim frequencies, average costs and timings;
- A single formula cannot capture changes in treatment mix, medical cost inflation or shifting claims patterns across the policy year — a detailed cashflow model stratified by treatment type is more appropriate.

[3]

ii)

### Advantages

- Rewards claims-free policyholders with a lower renewal premium, improving retention of lower-risk lives and reducing adverse selection at renewal.
- Creates a financial incentive for policyholders to self-fund minor claims rather than claiming on the policy, reducing moral hazard and low-value claim frequency.
- May improve the overall loss ratio if a material proportion of policyholders avoid small claims in order to protect their accumulated discount.
- Positive marketing proposition — differentiates the product and may attract health-awareness, lower-risk customers who expect to remain claim-free.
- Better-risk policyholders who have built up a discount are less likely to lapse, improving persistency in the lower-risk segment of the portfolio.

### Disadvantages

- Operationally complex to administer — the insurer must track each policyholder's claims history across renewal years and apply the correct NCD tier at each renewal, increasing IT and administrative costs.
- Under portability rules in many markets, the insurer may be required to transfer the NCD benefits when a policyholder switches insurer, which significantly reduces the retention benefit of the feature.
- If the NCD discount is set too generously, the premium reduction at higher NCD tiers may not be offset by lower claims from those policyholders, creating an underpricing risk in the discounted tiers.

- Policyholders may time non-urgent treatments to fall in a policy year where they have already claimed (i.e. the discount is already lost), increasing claims clustering and distorting claims timing patterns.
- Difficult to price accurately at outset without claims frequency distribution data stratified by NCD level — the insurer lacks this data when launching a new NCD scheme.

[5]

iii)

### Impact on Premium Rating

- The NCD creates distinct risk sub-groups within the portfolio — policyholders at different discount levels are not homogeneous;
- Premium rates must be differentiated by NCD tier rather than set on a single pooled basis.
- Insurer must model the expected claim frequency distribution at each NCD level and project how the portfolio will migrate across tiers over time as the scheme matures, since the proportion of policyholders in each tier will shift year on year.
- The base premium (before NCD) must remain adequate even after the maximum discount is applied — the insurer cannot assume that maximum-NCD policyholders are profitable without verifying that their claims experience justifies the discounted rate.

### Risks from Inadequate Adjustment

- Anti-selection: high-NCD policyholders may not be genuinely lower risk — they may simply be deferring non-urgent treatment to protect their discount, causing systematic underpricing that only becomes visible as the scheme matures.
- Structural **loss**: if rates are not adjusted as experience emerges, the maximum-NCD tier could become structurally loss-making; correcting this requires a significant premium increase, increasing lapse risk among the better-risk lives the scheme was designed to retain.

[3]

[11 Marks]

\*\*\*\*\*