# Subject SP2 April 2022 – Questions

**1** A life insurance company sells a without-profits level term assurance product and is performing control checks around its year-end results.

The following table shows figures used in the sum assured data checks for 31 December 2020 and 31 December 2021.

| | **31/12/2020 ($*m*)** | **31/12/2021 ($*m*)** |
|---|---|---|
| Sum assured in-force at start of year | 5,400 | 5,295 |
| Sum assured lapsed | 195 | 210 |
| Sum assured paid out | 220 | 122 |
| Sum assured from new policies | 256 | 432 |

(i) Describe the data checks that could be performed with this information. [3]

(ii) Perform the data checks that are possible using the figures in the table above. [3]

(iii) Suggest possible reasons for any discrepancies identified by the data checks conducted in part (ii). [3]

[Total 9]

**2** (i) Describe the considerations that influence a company's investment strategy. [4]

Two life insurance companies sell similar unit-linked individual pensions and without-profits immediate annuities. Company A is a large company with significant free surplus and Company B is a small company with limited free assets.

(ii) Compare the likely investment strategy of the two companies. [6]

[Total 10]

**3** A life insurance company sells a conventional with-profits endowment assurance product. The asset shares at the end of the year for this business have been calculated and they are lower than the equivalent figures at the previous year end.

(i) Suggest possible reasons why the asset shares for this business have reduced. [5]

The company uses the additions to benefits method to distribute the bonuses for its with-profits business.

(ii) Suggest possible actions the company may take following the reduction in asset shares since the last year end. [5]

[Total 10]

**4** A life insurance company sells without-profits endowment assurance policies.

The company calculates a 'net of profit premium' using best estimate assumptions and then increases this 'net of profit premium' by a fixed percentage (the profit margin) to allow for its profit criteria. This uplifted value then forms the premium charged to the policyholder.

The surrender values are set using best estimate assumptions on a prospective method. The company also monitors the 'Profit Adjusted Earned Asset Share' (PA EAS). The PA EAS is the same as the 'Earned Asset Share' (EAS), except that the premium used in the calculation of the PA EAS is the 'net of profit premium' that excludes the profit margin.

(i) Explain why the company monitors the contract using the PA EAS as opposed to the EAS. [2]

At 31 December 2021, for a given cohort of policies, the policy data is as follows:

| Item | Amount |
|---|---|
| Sum assured on death and maturity | 100,000 |
| Annual premium | 6,292 |

The prospective surrender value is set using the following information:

- Expected expenses (e) of 100, assumed to be payable at the beginning of the year. These annual per policy expenses include variable and overhead costs as well as all claim costs and are the same as those assumed the previous year.
- Assurance factor (Abar) = 0.839868.
- Annuity factor (adue) = 8.166749.

(ii) Calculate, showing all workings, the surrender value at 31 December 2021. [2]

The PA EAS at 31 December 2021 was calculated as 36,127.

The company has since reviewed the expense analysis, and the actual expenses over 2021 were 30% higher than expected and are expected to remain at this level. Over 2021, the interest rate earned was 2%.

(iii) Calculate, showing all workings, the surrender value and the PA EAS at 31 December 2021, allowing for the increase in expenses in both calculations. [2]

(iv) Contrast the change in the surrender value and the PA EAS due to the change in expenses. [1]

(v) Discuss why the current approach to setting the surrender value may be unsuitable. [8]

[Total 15]

**5** A life insurance company uses a deterministic model to price its without-profits immediate annuity products. The pricing model uses model points, based on the key risk factors, to represent expected new business.

(i) List possible risk factors that the company may use when setting the model points. [3]

The company conducts a full sensitivity analysis.

(ii) Discuss possible sensitivities that are likely to show a reduction in expected profit for the annuity business. [9]

(iii) Discuss how the company may use the results of the sensitivity analysis to help determine the pricing and design of the annuities. [6]

[Total 18]

**6** A large life insurance company has a portfolio of without-profits term assurance policies.

The results of the most recent experience investigations for these policies have been summarised in the table below. The results compare the actual experience across the whole portfolio over the last year and over the last five years, with the equivalent assumptions used in the supervisory valuation.

| | **Over 1 year (%)** | **Over 5 years (%)** |
|---|---|---|
| Mortality | 120 | 95 |
| Surrenders | 120 | 105 |
| Expenses | 100 | 110 |
| Investment return | 75 | 85 |

The supervisory valuation assumptions have not been changed for this product for the past five years. The company is now considering whether to review the supervisory valuation assumptions, based on the information in the table above.

(i) Discuss whether the company should consider changing any supervisory valuation assumptions, based on the information in the table. [12]

The company's Board has reviewed the experience investigation results in the summary table above and is considering a proposal that the assumptions should not be changed for this supervisory valuation.

However, the Board is concerned that if the assumptions are not changed it may imply that appropriate management systems and controls are not in place.

(ii) Comment on whether the concerns expressed by the Board are justified. [6]

[Total 18]

**7** A life insurance company sells unit-linked endowment assurance policies. The maturity value is the value of the units at the maturity date.

On death before maturity a lump sum is paid to the dependants, with the death benefit equal to the higher of the value of the units held at the time of death, or the sum of the premiums paid by the policyholder up to the date of death.

A policy can be surrendered at any time prior to maturity. The surrender value is equal to the value of units held at the date of surrender, and a surrender penalty is applied if the surrender is made in the first five years of the policy.

A policy charge equal to a percentage of the fund is deducted from the policy value each month.

(i) Describe the main risks the insurance company is exposed to under this product. [6]

(ii) Describe the main risks the policyholder is exposed to under this product. [4]

New business sales have been falling over recent years and the company is considering adding a guarantee to the surrender value for new business. This guarantee would ensure that payment on surrender within the first five years would be at least equal to the sum of the premiums paid by the policyholder up to the date of surrender.

(iii) Comment on how the addition of the guarantee to the surrender value changes the risk profile of the contract for the insurance company, and separately the policyholder. [3]

(iv) Discuss the implications for persistency of the addition of the guaranteed surrender value. [3]

(v) Discuss the implications for the pricing terms of adding the guaranteed surrender value. [4]

[Total 20]

**END OF PAPER**

# Subject SP2 April 2022 – Solutions

## Overview of the paper

*The questions in this exam cover a variety of topics:*

- *data checks (Question 1)*
- *investment strategy (Question 2)*
- *reasons for asset shares to reduce and actions to take in response (Question 3)*
- *surrender values and asset shares (Question 4)*
- *using model points and sensitivity analysis for pricing (Question 5)*
- *deciding whether to update the valuation basis following an experience investigation (Question 6)*
- *risks for insurer and policyholders and consequences of adding a surrender guarantee (Question 7).*

*A range of products is covered – there are at least two questions on each of term assurances, endowment assurances and annuities, but there is no question on whole life assurances. The products are either unit-linked or without-profits, with the exception of Question 3 that looks at a with-profits product.*

*There are two numerical calculation questions on this paper (Question 1 and Question 4). Although the calculation parts themselves are not worth many marks, the numerical answers are needed to generate ideas in the following parts. Question 6 also has a numerical element in that a table of data is provided that needs to be interpreted.*

***Examiners' Report***

***The examiners commented that stronger candidates were able to generate a good range of points in places where the question required a broad response (eg Question 6(i) and Question 7(i)) and were able to demonstrate a greater depth of understanding of the subject area (eg Question 3(ii), Question 4(v) and Question 6(ii)).***

## Solution 1

***Overview***

*This is a relatively straightforward question to start with on data checks. These are described in Chapter 27.*

(i) ***Data checks description***

*This part asks for a description of the data checks that can be performed with the table of data provided in the question. This is partly bookwork as the data checks are described in Chapter 27. But we need to be selective and only choose the checks that would use the data in the table.*

*The data provided is ideal to perform a data reconciliation check. But this on its own will not be enough for three marks. So we can also think of what other data sources might be available to double check the figures provided in the table.*

Check that:

sum assured at start year – sum assured left in the year + sum assured written in the year

= sum assured at end of year [1]

It would be expected that the sum assured at the end of the year (calculated above) would be equal to the sum assured at start of the following year (given in the table). [½]

The sum assured lapsed could be checked against the persistency assumptions. [½]

The sum assured paid out could be checked against the mortality assumptions. [½]

The sum assured written could be checked against the previous year's new business. [½]

***Additional points***

The sum assured lapsed could be checked against recent lapse experience investigations … [½]

… *eg* by taking the expected withdrawal rate and multiplying by the start of year sum assured. [½]

The sum assured paid out could be checked against recent mortality experience investigations … [½]

… *eg* by taking the expected mortality rate and multiplying by the start of year sum assured. [½]

The sum assureds for both paid out and lapsed could also be compared year to year for consistency. [½]

[Maximum 3]

(ii) ***Data checks calculation***

*In this part we are asked to use the data for the previous year (2020) and the current year (2021) to perform some data checks. The natural place to start is with the data reconciliation check described in part (i). But we can also compare each row in the table for changes year on year – taking these figures as a ratio of the business in force might help to remove distortions caused by an expanding or contracting book of business. Finally, remember to comment on whether your calculations indicate a potential problem with the data.*

Given the data for the prior year, the expected sum assured in-force at the start of the current year is 5,400 – 195 – 220 + 256 = 5,241. [½]

This compares to 5,295 in the table, which is 54 higher. [½]

Sum assured lapsed was 195/5,400 = 3.6% for prior year and 210/5,295 = 4.0% in current year. [½]

This looks fairly consistent year on year. [½]

Sum assured paid out was 220/5,400 = 4.1% for prior year and 122/5,295 = 2.3% in current year. [½]

This seems like a significant movement year on year. [½]

***Additional points***

Sum assured from new policies was 256/5400 = 4.7% for prior year and 432/5295 = 8.2% in current year. [½]

But taking a percentage of the start of year in-force for new business is potentially not as relevant. [½]

*If there are more policies in-force at the start of the year, then it makes sense that there will be more lapses and more payouts. However, the link between policies in-force and the number of sales is much weaker, eg the company might be growing rapidly due to greater spending on advertising.*

So instead, we can calculate the increase year on year of 432/256 – 1 = 69%. [½]

[Maximum 3]

(iii) ***Reasons for discrepancies***

*We now need to suggest reasons for any discrepancies indicated by our data checks in part (ii). The sum assured lapsed looked fairly consistent from year to year, so there is no need to comment on that further.*

*Our first thought might be that the numbers provided in the table are wrong, and we should certainly mention that. But the problem might be more subtle – we are told about changes to the sum assured due to lapses, payouts and new business, but there may be other reasons for the sum assured to change. Finally, some of the changes in the numbers may be explained by the experience of the company over the year. Having come up with these broad reasons for the discrepancies we need to generate a number of examples to explain each discrepancy identified in part (ii).*

*If your figures in part (ii) were incorrect, you could still get credit in this part for making reasonable comments based on those figures.*

The sum-assured in-force discrepancy could be due to a data correction discovered in the current year … [½]

… or the difference could be due to adjustments to sums assured from any options. [½]

The reduction in sum assured paid out may be because the current year was a light year for mortality, or the previous year was heavier. [½]

The increase in new business sum assured seems a high increase and could be due to targeting a new segment of the market … [½]

… or using a new distribution channel to access a wider market. [½]

There could be errors in the data. [½]

***Additional points***

The sum-assured in-force discrepancy could also be due to additional claims paid out in the current year but that were incurred in the prior year and not allowed for in the prior year movements. [½]

Possible reasons for the mortality experience include:

- the current year may have had a milder winter or medical improvements [½]
- the previous year may have had an epidemic. [½]

Alternatively claims underwriting may have become stricter in the last year reducing the claims paid out. [½]

The increase in new business sum assured could be due to a different mix of business, *eg* higher average sum assured per policy. [½]

An example of a possible data error is that the sum assured recorded for new policies in 2020 is too low (or the payouts are too high). [½]

[Maximum 3]

***Examiners' Report***

***The examiners said that this question was well answered. In part (iii), stronger candidates linked data checks back to the underlying assumptions made.***

## Solution 2

***Overview***

*This question is about investment strategy, as covered in Chapter 28. Part (i) looks at the considerations affecting investment strategy in general. Part (ii) then applies these ideas to two different companies.*

(i) ***Considerations influencing investment strategy***

*The ideas needed to answer this part come from the investment principles covered in Section 2 of Chapter 28. However, we need to do more than simply state these principles to satisfy the command verb 'describe' and gain the four marks on offer. So we should look to explain why these principles are important.*

The liabilities the company has would influence the investment strategy … [½]

… in order to match their nature, *eg* guaranteed, discretionary or investment-linked … [½]

… and to match the term of the liabilities. [½]

The company's investment strategy will also be influenced by the level of free assets it has … [½]

… as high free assets allow greater investment freedom as the free assets can absorb losses if required. [½]

The investments should be selected to maximise the overall return on the assets … [½]

… taking account of the company's appetite for risk … [½]

… *eg* whether it would seek to mismatch investments to pursue a higher return. [½]

***Additional points***

The company's appetite for risk will influence the extent to which it wants to invest in assets with poor credit rating. [½]

The currency of the liabilities would also influence the investment choice. [½]

The company may consider reputational issues … [½]

… *eg* investing in ethical investments. [½]

Regulations will need to be considered, which may restrict certain assets. [½]

Liquidity requirements may also influence the assets chosen. [½]

Practical constraints may influence the investment strategy, *eg* the availability of assets. [½]

[Maximum 4]

(ii) ***Investment strategy for the two companies***

*In this part we need to apply the investment principles from part (i) to the two different companies.*

*A good place to start in many investment questions is to consider how assets could be chosen to match the liabilities, and this approach would certainly work well with this question. The question tells us that both companies sell unit-linked policies and annuities, so we should make specific suggestions for assets that would match these liabilities.*

*The question also tells us that Company A has much larger free assets than Company B. This information will be useful when we consider the potential to mismatch in search of higher expected returns.*

*We are also told that Company A is larger than Company B, and this may have an impact on the suitability of property investment for example.*

*As the command verb is 'compare', a good structure for our answer would be to have separate headings for the similarities and the differences.*

*Similarities*

Both companies are likely to invest in long-term fixed-interest bonds to match the annuities … [½]

… or index-linked bonds for annuities with an inflation-linked benefit … [½]

… with term matching the term of the annuities where possible. [½]

Both are likely to match the unit-linked liabilities with the underlying investments in the relevant funds. [½]

The associated non-unit liabilities are likely to be invested in cash and bonds. [½]

Both are also likely to invest in index-linked bonds to match the expenses. [½]

*Differences*

As Company A has higher free surplus, it could afford to mismatch … [½]

… which could be done by investing more heavily in corporate bonds to back the annuities, instead of government bonds … [½]

… to target a higher expected return but with higher risk. [½]

Company's A's larger size and so larger liabilities and investment potential may open up property as an investment option subject to illiquidity risk … [½]

… as Company A has significant free assets and is less likely to be constrained from a cashflow and liquidity point of view. [½]

In contrast, Company B will have limited freedom to take more investment risk due to its limited free assets. [½]

***Additional points***

*Similarities*

Both companies would have to consider cashflow and liquidity constraints … [½]

… *eg* sufficient assets would need to be held in liquid assets to meet short-term liabilities. [½]

*Differences*

Company A may decide to mismatch the unit-linked liabilities to seek a higher return … [½]

… depending on regulation allowing this. [½]

As Company A is larger it may also be able to offer a wider range of unit-linked funds. [½]

Company A could also look to invest in equities to match the expense liabilities … [½]

… increasing risk but increasing potential return. [½]

Company B will match assets more closely to liabilities … [½]

… and would be expected to invest mostly in government bonds to back the annuity book … [½]

… and to have limited or no direct investment in equity or property outside of the assets matching unit-linked liabilities. [½]

[Maximum 6]

***Examiners' Report***

***The examiners commented that both parts of this question were generally well answered.***

## Solution 3

***Overview***

*This question is about conventional with-profits business. It starts by looking at reasons why the asset share has fallen and then looks at actions that could be taken in response to this.*

(i) ***Reasons for asset shares to reduce***

*This part looks at the reasons why the asset share has reduced compared to last year. A natural structure for the solution would be to work through each component of the asset share systematically and give examples of why the additions to asset share could be small and the deductions from the asset share could be large.*

*It is not clear from the question whether individual asset shares have reduced, or whether the total (aggregate) asset share for the business has reduced. So extra marks can be gained by considering both possibilities.*

*Asset shares are covered in Chapter 5.*

A reduction in the asset share indicates that the total deductions have been greater than the premium income … [½]

… and/or investment returns have been negative. [½]

Premiums could have reduced due to policies being made paid up. [½]

Expenses could have been high … [½]

… *eg* due to improvements required to systems. [½]

Mortality could have been high … [½]

… particularly for policies at early durations where the excess of benefit over asset share is larger. [½]

If payment on surrender is higher than asset share, then there could have been a high number of surrenders. [½]

If there is without-profits business in the same fund, then there may have been losses on this business. [½]

If aggregate asset shares have reduced (rather than individual asset shares), then the number of policies may have reduced due to the business being in run-off. [½]

***Additional points***

Asset share is the accumulation of premiums less the deductions associated with the contract … [½]

… accumulated at the actual rate of return earned on investments. [½]

Negative investment returns may be caused by equity and/or property values falling, or interest rates rising so that bond prices reduce. [½]

Tax could have been high … [½]

… *eg* forced sales of assets leading to a realised capital gain. [½]

There may have been a mistake in the calculations. [½]

The company may have changed the calculation of asset shares … [½]

… *eg* it may have used actual instead of smoothed investment returns, or changed the cost of capital charge. [½]

Aggregate asset shares may also have reduced due to a high number of maturities, surrenders and deaths … [½]

… or a reduction in new business. [½]

[Maximum 5]

(ii) ***Actions to take following asset share reduction***

*This part asks us to suggest possible actions that the company could take in response to the fall in asset shares.*

*The first thing the company would want to do is check that the figures are correct and that the asset share really has reduced.*

*After that, it would want to take actions that would increase the asset share in the future. So we can take each reason for the asset share to fall from part (i) and suggest how to reverse this in the future.*

*Finally, the question tells us that the company uses the additions to benefits method for conventional with-profits (as described in Chapter 6). So we can suggest actions relating to the bonus strategy. In particular, we can consider reversionary bonuses, terminal bonuses and smoothing.*

The company should check the calculation for errors. [½]

If expenses have been high, then ways to reduce these should be investigated … [½]

… *eg* outsourcing if high per policy expenses are being driven by a reducing number of policies. [½]

If the surrender payout is higher than asset share, then the company could investigate whether there is the ability to change this or charge for it. [½]

If investment return has not been positive, then this should be considered against the overall market. [½]

If investment return is out of line with the market, then consider changing the underlying investment approach. [½]

Depending on the driver for the reduction, the company could consider reducing reversionary bonus … [½]

… or more likely terminal bonus. [½]

The company could consider whether it needs to adjust its smoothing approach. [½]

The actions the company takes will depend on policyholder expectations. [½]

***Additional points***

If individual asset shares have reduced, then action will depend on the cause of this, so the company should determine what this is. [½]

If there have been losses on without-profits business in the fund, then the cause of this should be investigated and appropriate action considered. [½]

If the investment return is in line with market movements, then the asset class allocations should be considered for reasonableness and stability against the profile of the business. [½]

May need to match guarantees more closely if asset share has fallen to a point where there is a danger that the guarantees will bite. [½]

Actions will also depend on:

- the need to ensure that all policyholders are treated fairly [½]
- the need to be in line with regulations [½]
- practice of competitors if the cause is market driven. [½]

It may be appropriate to take no action, *eg* if the reduction in asset shares is in line with expectations or is not material. [½]

[Maximum 5]

***Examiners' Report***

***The examiners commented that most candidates were able to break down the calculation of the asset share in part (i) to identify reasons why it may have reduced. Many candidates were then able to suggest possible actions the company could take in part (ii), but answers were generally more limited, with only stronger candidates scoring well.***

## Solution 4

***Overview***

*This question is about surrender values (as described in Chapter 21).*

*Surrender values can be calculated using either the retrospective method or the prospective method. In this question the surrender value is calculated prospectively, but the question also provides information about the asset share (a retrospective approach) as a means of comparison.*

*This question is split into five parts. Only the last part has more than two marks. However, it is important to spend some time on the earlier parts as these will help to generate ideas in the final part.*

(i) ***Reasons to use the profit adjusted earned asset share***

*The question introduces a new concept that it calls a Profit Adjusted Earned Asset Share (PA EAS). Don't worry if you see a new concept in the exam – you are not expected to have seen this before. But it is important to read all the information given carefully to make sure you understand how the PA EAS works.*

*The PA EAS is based on the familiar asset share found in Chapter 5. The only difference is that the PA EAS uses a different premium (the net of profit premium). So the PA EAS will be lower than the standard asset share because it accumulates the lower net of profit premium, ie it excludes the profit loadings in the premiums paid to date.*

*The question asks why the company would use the PA EAS. Asset shares can be used for setting bonuses and calculating payouts for with-profits policies, but the contract in this question is without-profits, so these ideas don't help us here. However Chapter 5 tells us that asset shares can also be useful in setting surrender values. The rest of the question looks at surrender values too, which gives us confidence that the PA EAS will help when monitoring surrender values.*

*So to answer the question we need to give reasons why the PA EAS might be more helpful when monitoring surrender values than the standard asset share. If the company paid out the standard asset share on surrender, it would make no profit, as it would have paid out all the accumulated cashflows from the policy. So the PA EAS is helpful as it gives an indication of what can be paid out, while still retaining the profit loadings from the premiums paid to date.*

The company may want to monitor the maximum that it could pay on surrender without making a loss. [½]

However, the (standard) EAS does not say anything about the profit the company would have made if the contract were not surrendered. [½]

By using the net of profit premium (which excludes the profit margin), the PA EAS represents the maximum that the company could pay while retaining the profit loadings in the premiums paid to date. [1]

***Additional points***

The PA EAS does not capture the total profits that the company could have made … [½]

… but the company may want to just measure the profits it would have made to date. [½]

[Maximum 2]

(ii) ***Initial calculation of surrender value***

*This part asks us to calculate the surrender value. We are told that the surrender value is calculated prospectively, so we should be careful not to use the retrospective approach considered in part (i). A prospective approach takes the present value of the benefits, plus expenses, less the premiums.*

*The question gives us all the information we need, so there is no need to look anything up in the Tables. Actuarial notation can be difficult to type, but the question helpfully tells us to use the notation Abar and adue.*

The surrender value (SV) is calculated as follows:

SV = sum assured * Abar + e * adue – premium * adue [½]

So, SV = 100,000 * 0.839868 + 100 * 8.166749 – 6,292 * 8.166749 [1]

= 33,418 [½]

***Additional point***

In this case, all expenses are included in e. [½]

[Maximum 2]

(iii) ***Calculations following restatement of expenses***

*We are now told that the company has reviewed its expense analysis. So the figures that we have been given in the question so far are using an out-of-date set of expenses from a previous expense analysis. We now need to restate our calculations for the updated expenses.*

*Firstly we need to update the surrender value. We already have a calculation for this in part (ii), so we just need to repeat this with the higher expenses.*

*Secondly we need to calculate the revised PA EAS. The figure we have been given includes expenses of only 100, so we need to reduce this figure to allow for the restated expenses of 130. The question tells us that all expenses are assumed to occur at the beginning of the year. So we need to accumulate these expenses with interest for a year.*

The revised SV = 100,000 * 0.839868 + 130 * 8.166749 – 6,292 * 8.166749 = 33,663 [1]

The revised PA EAS = 36,127 – 30 * 1.02 = 36,096 [1]

[Total 2]

(iv) ***Comments on changes to the calculations***

*In this part we have been asked to contrast the changes to the surrender value and PA EAS due to the restatement of the expenses. As there is only one mark available, then it is sufficient to note which one goes up and which one goes down.*

The surrender value has increased by 245. [½]

The PA EAS has decreased by 31. [½]

***Additional point***

The SV has increased whereas the PA EAS has decreased. [½]

[Maximum 1]

(v) ***Reasons why the surrender value approach may be unsuitable***

*In this part we are asked to discuss the suitability of the company's approach to calculating surrender values. Usually in a 'discuss' question we would cover both the advantages and disadvantages. However, this question asks why the 'surrender value may be unsuitable', so we only need the disadvantages here.*

*We have two sources of information that will help us to assess the suitability of the surrender value methodology. Firstly, we have the information given in the question. But we also have our conclusions from the earlier question parts, and in particular how the surrender value reacts to the restatement of the expenses compared to the PA EAS.*

*So we should assess the suitability of the surrender value calculation with reference to the following facts:*

- *the surrender value is calculated using best estimate assumptions*
- *the surrender value is calculated using the prospective method*
- *the restatement of the expenses increased the surrender value, but decreased the PA EAS*
- *the allowance for expenses includes a contribution to overheads as well as the costs directly incurred by the policy.*

As the surrender value is calculated prospectively using best estimate assumptions, then the insurer makes the full expected profit from the contract … [½]

… and this might be considered unfair for the policyholders as the insurer has not been exposed to the risk for the full term. [½]

The calculation will give a negative surrender value at early durations … [½]

… as the profit margin in the future premiums is a deduction to the prospective value. [½]

It seems inconsistent for the surrender value and the PA EAS to move in opposite directions in response to the restatement of the expenses. [½]

We can see from part (iii) that the PA EAS has reduced due to the allocation of additional overhead expenses … [½]

… but the surrender value has increased … [½]

… significantly. [½]

The increase in surrender value assumes the present value of the increase in expenses will be saved if the policy surrenders … [1]

… and so passes this on to the policyholder via the surrender value. [½]

This is not a suitable outcome … [½]

… because in reality, the overheads will not change if this policyholder surrenders as the overheads will still be incurred. [1]

It may be more suitable to only allow for variable costs to be an addition to the SV … [½]

… as these are the only future costs that are saved in the future. [½]

***Additional points***

The current approach may be considered to be not treating customers fairly. [½]

The company taking the full expected profit from the contract may appear particularly unfair for surrenders at early durations. [½]

There may be pressure from policyholders / distributors / regulators to amend the terms on surrender if they feel the terms are unfair. [½]

The current approach may be out of line with market practice … [½]

… and as a result, the surrender value may also be low compared to competitors' surrender values. [½]

Increasing the surrender value by the loading for overheads means that the company will make a loss … [½]

… as it cannot recoup the increase in surrender value from the other policies as they are without-profits. [½]

The expense loadings do not take account of the difference between expense types, such as claims, surrender and overhead expenses. [1]

Claims expenses should be a deduction from the surrender value (*ie* the cost of processing the surrender) … [½]

… as opposed to being included in the total expenses and therefore increasing the surrender value. [½]

[Maximum 8]

***Examiners' Report***

***The examiners said that many candidates found this question challenging, with a limited number of candidates able to fully articulate a reason for the company to monitor the revised asset share in part (i). The calculations in parts (ii) and (iii) were managed well by those who attempted them, and some commentary was produced in part (iv). The answers to part (v) were generally focused on exploring the approach with relation to alteration principles, rather than in relation to the movements noted in parts (ii) to (iv), though candidates could score reasonably well here using this approach, without having performed the calculations in earlier parts.***

## Solution 5

***Overview***

*This question is about the use of model points and sensitivity analysis in the pricing of annuities. Sensitivity testing is covered in Chapter 14 and the use of model points in pricing is covered in Chapter 15.*

(i) ***Risk factors***

*This part asks for the risk factors that would be used to price annuities. So we are looking for the key drivers of mortality. Each model point would then consider a particular combination of these risk factors, eg 65 year old, female, non-smoker or 70 year old, male, smoker.*

*As the command verb is 'list', there is no need to add any detail to our points.*

- age of annuitant [½]
- gender (where regulation allows) [½]
- size of premium / initial annuity [½]
- single life / joint life first death / joint life last survivor [½]
- level of indexation (*eg* level, fixed increases or price inflation) [½]
- smoker status [½]

***Additional points***

- there may be separate model points for any options … [½]
- … *eg* guaranteed period [½]
- distribution channel [½]
- region or postcode [½]
- occupation / socio-economic status [½]
- impaired life status [½]

[Maximum 3]

(ii) ***Sensitivity tests showing a reduction in profit***

*Sensitivity testing involves changing the value of the parameters in the model to observe the impact on the output. So a good structure for our answer is to consider each of the key parameters (or assumptions) in our pricing model in turn.*

*The command verb is 'discuss' so we should write about the senstivities in some detail. It won't be enough to simply say that we should senstivity test mortality. Instead, we need to explain how lower mortality (or equivalently, higher longevity) can reduce profitability.*

*Mortality* [½]

A lower mortality rate will result in policyholders being assumed to live longer … [½]

… leading to reduced profit due to more annuity payments. [½]

An increase in the rate of mortality improvement could be considered, as well as a flat change in the mortality rate. [½]

*Investment return* [½]

A reduction in the investment return will reduce expected profit. [½]

*New business volumes* [½]

The level of new business will determine the aggregate profit for the product. [½]

If assumed new business is too low, then development and initial expenses will not be recovered. [½]

*Mix of new business* [½]

The expected split of policies between risk factors will influence profit. [½]

If there are more smaller policies, then the fixed expenses may not be covered if loadings are expressed as a percentage of the premium. [½]

*Expenses* [½]

A higher level of regular administration expenses will reduce profit. [½]

*Inflation* [½]

A higher level of inflation will reduce profit … [½]

… through increased expenses … [½]

… and increasing the rate at which indexed annuities grow. [½]

***Additional points***

*Mortality*

Lower mortality will also result in more expenses (as benefits are paid for longer). [½]

If the annuity has a guaranteed period or return of premium option, then a higher mortality rate in the option period may reduce profit. [½]

*For example, the contract may provide a guarantee that if the policyholder dies within the first five years then they will receive the benefits for the full five years. As the remaining payments are paid as a lump sum, it will be more expensive to pay the benefits for someone who dies early than someone who dies at time five.*

*Investment return*

The annuity has a guaranteed benefit … [½]

… which relies on a certain level of investment return. [½]

Sensitivities may be carried out on the impact of increasing credit spreads, taking into account probability of default. [½]

*New business volumes*

If assumed new business is too low, then regular expenses may not be covered by premium loadings. [½]

*Mix of new business*

Depending on the age / gender split and the target market, more new business in certain categories may reduce profit … [½]

… *eg* older / younger policyholders, male / female. [½]

*Expenses*

An increase in initial set up expenses / development expenses will reduce profit. [½]

*Other*

An increase in distribution channel costs (*eg* higher commission) may reduce profits. [½]

Changes in tax rates or method of calculation may reduce profits. [½]

[Maximum 9]

(iii) ***Using sensitivity tests to determine the pricing and design of the annuity***

*Having looked at the sensitivity tests in part (ii), we are now asked how the company should respond. We are asked to consider the impact on both pricing and product design.*

*The company would also consider other aspects, such as investment strategy, but these are beyond the scope of the question (which only looks at pricing and design). However, thinking about other changes such as this might help to inform the pricing decision, eg the investment strategy will impact on the need for margins in the pricing.*

*A good structure for this part is to take each sensitivity test from part (ii) in turn and suggest how pricing and/or product design may be modified to reduce the risk of reduced profit.*

The analysis will help to identify the key risk factors that may require more of a margin in the assumptions. [½]

The company may decide to introduce a minimum or maximum age. [½]

The company may introduce a minimum size of initial premium … [1]

… to ensure initial expenses are covered … [½]

… and reduce sensitivity to increasing maintenance expenses. [½]

The company may remove or adjust options … [1]

… *eg* the guaranteed period. [½]

The rate of annuity indexation may be changed to a fixed rate rather than inflation linked. [½]

The investment sensitivity may help the company to decide its investment strategy and hence its investment return pricing assumption. [1]

***Additional points***

The key risk factors are likely to be mortality and investment return. [½]

Margins could be applied to different assumptions at different levels. [½]

Additional margins in the assumptions may make certain model points unattractive in the market. [½]

The company could adjust its pricing and product design to target the more profitable segments of the market. [½]

The company may decide to adjust the initial expense assumption in the pricing basis. [½]

The investment sensitivity may help the company to set any margin for default in the investment assumptions if corporate bonds are assumed to back the annuity liabilities. [½]

[Maximum 6]

***Examiners' Report***

***The examiners reported that most candidates scored very well in part (i), and many also scored well in part (ii). Part (iii) was less well answered, with many candidates not giving sufficient detail on how the company might respond to the sensitivity analysis, and often not including a sufficient breadth of points.***

## Solution 6

***Overview***

*This question looks at whether the company should update its valuation assumptions. The first part looks at specific assumptions and considers whether they should be updated in the light of the results of the experience investigations given. The second part looks at the more general question of whether it is important to update the assumptions as part of the company's management controls.*

*Setting assumptions is covered in Chapters 17 and 18.*

(i) ***Changing the valuation assumptions using the experience investigations***

*In this part we look at whether the results of the recent experience investigations should lead to a change in assumptions. If the actual experience was particularly high (low) compared to the assumption this would indicate that the company should consider increasing (decreasing) its assumption.*

*The question tells us that it is the supervisory valuation assumptions that are under consideration. The table shows the recent experience as a percentage of the current supervisory valuation assumptions. These assumptions may contain margins for prudence and, if so, we would expect the actual experience to be usually better than the assumptions.*

*At 12 marks, this is the longest individual part of any question on the paper. However, the good news is that the table of data gives us a very clear structure for answering the question. Firstly, we can break the question down under the four headings given by the assumptions in the rows of the table. Then we can subdivide this by the columns to talk about the recent experience and the long-term experience separately. We may also want to add a heading of general comments that would apply to all four assumptions, as this will avoid repetition.*

*General comments*

Supervisory valuation assumptions are long-term assumptions … [1]

… and hence need to reflect expectations of the long-term future. [½]

The assumptions may also include an element of prudence. [½]

*Mortality*

The long-term experience would appear to be in line with the assumptions. [½]

The long-term experience is slightly better than the assumption, indicating a degree of prudence … [½]

… which may indicate that there is no need to change the assumption. [½]

But there has been a one-off increase over one year … [½]

… in which case the company may not want to change anything but only monitor … [½]

… or it could be a rising trend over recent years from a low base … [½]

… in which case the company may want to consider changing the long-term assumption for future years. [½]

*Surrenders*

The long-term experience appears to be higher than the assumption. [½]

The short-term experience is significantly ahead of assumptions … [½]

… and when combined with long-term experience it would make sense to review this assumption. [½]

*Expenses*

The long-term experience is significantly above assumptions … [½]

… although the short-term experience is in line. [½]

The company may have reduced expenses over the 5-year period … [½]

… and the results are only now coming through in the short-term experience. [½]

We would expect the actual expenses to be lower than the assumptions if the basis was prudent. [½]

Given the long-term experience, the company will probably want to review these assumptions. [½]

*Investment return*

Both the short-term and long-term experience are well below the assumptions. [½]

We would expect the actual investment returns to be higher than the assumptions if the basis was prudent. [½]

So the company may want to review the assumption. [½]

But given the materiality of this assumption it will probably not be a priority to change it. [½]

***Additional points***

*General comments*

Before any changes are made to the assumptions, further information would be needed. [1]

As this is a large company there will be sufficient data on which to set assumptions … [½]

… so that it can split experience by risk factors … [½]

… *eg* term / age / gender / smoker status. [½]

*Mortality*

Mortality is a key assumption for term assurance. [½]

*Surrenders*

Surrenders are a key assumption for term assurance. [½]

A lower number of policies in force than expected may mean that overhead expenses are not covered by charges. [½]

As the long-term experience is higher than the assumption, the company may wish to review the assumptions. [½]

The experience could be due to a general economic downturn which may not be repeated in the future … [½]

… but it could indicate a long-term trend. [½]

A low lapse assumption will be more prudent if reserves are positive, as will be the case later in the term … [½]

… but a high lapse assumption could be more prudent if reserves are negative early in the term. [½]

*Expenses*

Expenses are key assumptions for term assurance. [½]

*Investment return*

Investment return is not a key assumption for term assurance … [½]

… given the level of supervisory reserves is low. [½]

[Maximum 12]

(ii) ***Concerns about the management systems and controls***

*The Board is concerned that if the assumptions are not updated then this will indicate a failure of management systems and controls. The risk of a failure of appropriate management systems and controls is covered in Chapter 11. This section of Core Reading is a good starting point for our answer, but will not be enough on its own to generate 6 marks. So we will need to use the information in the question to help to generate extra ideas.*

*Useful ideas from the question include:*

- *the company is large (and so probably has other products as well as the term assurance)*
- *the assumptions have not been changed for five years*
- *the assumptions are to be used for the supervisory valuation*
- *the Board has received the results of the experience investigations in the form of the table given in the question*
- *the results in the table are only a summary.*

The Board of Directors has a responsibility to impose proper systems of management and controls on the financial operations of the company. [1]

Any failure of controls may lead to:

- financial losses for the insurer [½]
- regulatory intervention [½]
- reputational damage. [½]

The Board has received information on the experience analysis … [½]

… but this information is in a very summarised form. [½]

This summary information indicates the possibility of assumptions needing to be changed in some situations. [½]

Assumptions have not been changed for five years … [½]

… so the Board's actions have probably increased the risk of financial losses to the company. [½]

But it could be that the term assurance portfolio is not a material portfolio … [½]

… so resources could be used elsewhere on more significant products. [½]

***Additional points***

The actuary will make recommendations as to how the company should operate so that its risk profile stays within the resources available to it. [½]

The Board will usually follow the actuary's recommendations, but it does not have to. [½]

Examples of assumptions that could be updated include expenses and possibly withdrawals. [½]

The Board may be making a decision to concentrate on more significant risks … [½]

... and to recognise that the risk associated with term assurances exists … [½]

… and will be monitored. [½]

In which case the Board is maintaining appropriate management systems and controls. [½]

If the product is significant to the company, then there could be regulatory intervention if financial losses arise … [½]

… which in turn would lead to reputational damage … [½]

… particularly if competitors are changing assumptions … [½]

… and hence the company appears out of line. [½]

The Board may have assessed that the risk for this year is not significant … [½]

… and suggest reviewing over a given time period in the future. [½]

[Maximum 6]

***Examiners' Report***

***The examiners commented that part (i) required a considerable level of detail, but that many candidates produced a limited discussion, and that generally a wider range of points was required to get close to full marks. Answers to part (ii) often swiftly concluded that this was a control breach without considering the Board's position as a stakeholder and the considerations they might make, plus the control systems already in place.***

## Solution 7

***Overview***

*This question is about a unit-linked endowment assurance. It starts by looking at the risks that the company and policyholder are exposed to. It then considers the addition of a surrender value guarantee and how this changes the risk, persistency and pricing of the product.*

*The question provides a lot of detail about the product. So before attempting to answer the question, it's a good idea to make a list of the product features. We can then refer back to this list to help us to generate ideas in each part.*

*The key features of the product prior to the introduction of the surrender guarantee are:*

- *it is unit-linked*
- *the maturity benefit is the value of the units*
- *the death benefit is the greater of the value of the units and the premiums paid to date*
- *the surrender benefit is the value of the units if surrender occurs after five years*
- *the surrender benefit is the value of the units less a surrender penalty if surrender occurs in the first five years*
- *a policy charge is deducted each month as a proportion of the unit fund.*

(i) ***Risks for the insurance company***

*This part looks at the risk of the contract from the company's point of view. These risks are covered in Chapters 10 to 12.*

*Often the best approach to answering risk questions is to take the risk factors listed in the syllabus objectives and cover each relevant risk in turn. However, we need to be careful in this question as we are only asked to describe the main risks. So we will need to be selective when choosing which risks to cover.*

*When describing the risks, it is important to link them back to the key features of the product that we listed above. This will also give us confidence that we have selected the main risks, rather than lesser more generic risks that could apply to any product.*

*Mortality risk* [½]

There is mortality risk from deaths occurring when premiums paid exceed the unit fund. [½]

So the risk is that investment returns have been lower than the policy charge. [½]

*Expense risk* [½]

Expense inflation may be higher than expected. [½]

Higher expenses will reduce the profit from the excess of charges over expenses. [½]

*Investment risk* [½]

Charges received may not cover the expenses … [½]

... as the charges are a percentage of the fund value which will vary as the unit fund varies. [½]

*Lapse risk* [½]

There may be more lapses than expected leading to a loss of future income … [½]

… and losses where expenses incurred are higher than the charges received. [½]

***Additional points***

*Mortality risk*

This risk is increased as there is no specific mortality charge related to the sum at risk. [½]

Anti-selection risk due to the death benefit … [1]

… as a policyholder in poor health is unlikely to surrender their policy if the unit value is less than the premiums paid. [½]

*Investment risk*

Poor investment returns may also lead to reputational risk … [½]

… and will increase the likelihood of the return of premium guarantee biting on death. [½]

*Other*

Business volumes may be higher or lower than expected. [½]

Premium size may be lower than expected resulting in lower policy charges. [½]

Changes in regulations or tax. [½]

Operational risks in processing the surrender value. [½]

[Maximum 6]

(ii) ***Risks for the policyholder***

*Part (ii) continues with the theme of risk, but now looks at this from the policyholder's point of view.*

*Again, we can look at the key features of the product to help to generate ideas. In particular, we should consider the policyholder's needs and ways in which the product may fail to meet them.*

There is an investment risk … [½]

… such that the value of the units held is lower than expected / required at maturity ... [1]

… which could leave the policyholder short of money for what they were originally planning to use the proceeds for. [½]

Charges may be increased in the future … [½]

… if they are variable. [½]

The policyholder may be unable to pay future premiums and so lapse the policy. [1]

***Additional points***

The value on surrender may be less than the premiums paid. [1]

They may be unable to afford the policy if they have been made redundant. [½]

There is a risk of company insolvency. [½]

[Maximum 4]

(iii) ***Changes to the risk profile due to the surrender guarantee***

*The final three parts of the question look at the impact of adding a surrender value guarantee. The guarantee only applies to surrenders within the first five years and ensures that the policyholder gets at least a return of premiums.*

*Part (iii) looks at the risk from both the company and policyholder view, so we should remember to cover both. Parts (i) and (ii) have already covered the risk of the contract without the surrender guarantee, so we just need to select the risks from those parts that have changed.*

The insurance company now has additional investment risk in the first five years … [1]

… due to the return of premium guarantee. [½]

This means the insurance company is bearing the risk that the fund value falls below the value of the premiums paid at the point of surrender. [1]

The policyholders' investment risk is reduced over the first five years. [½]

***Additional points***

Lapse risk for the insurance company may increase in the first five years as more policies may lapse … [½]

... particularly when the guarantee is substantially in the money (financial selection). [½]

[Maximum 3]

(iv) ***Impact on persistency of the surrender guarantee***

*This part looks at the impact of the surrender guarantee on persistency.*

*Adding a surrender guarantee is going to increase surrenders when the guarantee bites – in this case that appears to be when the fund value drops below the premiums paid, but only within the first five years.*

*But there is a more subtle point. If we go back to the list of product features listed in the comments at the start of the question, we see that a surrender penalty is deducted from the value of the units in the first five years. So actually the guarantee bites when the fund value less the surrender penalty drops below the premiums paid. It would be easy to miss this idea, so it's important to keep going back to our list of key ideas from the question as we work through the later parts.*

*Before thinking about what the persistency experience will be like after the introduction of the surrender guarantee, it's worth thinking about what the persistency would have been like without the guarantee. Policyholders will have been unhappy about the surrender penalty, so some policyholders might have waited until the end of the five year period before withdrawing, leading to a large spike in surrenders at time five.*

Lapses may be higher in the first five years than previously. [½]

Policyholders who previously would have waited to surrender may be more inclined to surrender now … [1]

… as the surrender value may now be higher. [½]

But there may be fewer lapses at the five-year point than previously … [½]

… as policyholders may no longer hold off surrendering until no penalty applies. [½]

***Additional points***

There is a danger of very large withdrawals at the same point in time (mass lapse risk) following a stock market crash in the first five years. [½]

[Maximum 3]

(v) ***Impact on pricing of the surrender guarantee***

*Finally the question turns to the impact on pricing of the introduction of the surrender guarantee. The modelling process followed when pricing is covered in Chapter 15.*

*Again we can generate more points by using the information given in the question, eg the product features we listed in the comments at the start of the solution. A key thing to note is that this product is unit-linked. So we will not be setting the premium here – the premium amount will be the policyholder's decision based on how much they want to save. Instead, the pricing model is used to set charges for unit-linked business.*

The company will need to consider the impact on surrender experience of the new guarantee … [½]

… and allow for a best estimate view in the pricing of the policy. [½]

The insurer will want to price the contract so that the required level of profit is still made. [1]

As the surrender penalty doesn't apply to the return of premiums then the value of the guarantee is even greater… [½]

… so other charges on the contract may have to change to pay for the guarantee … [1]

… *eg* the percentage deducted from the fund may increase for the policy charge. [½]

***Additional points***

The company could introduce or increase other charges, *eg* any initial allocation rate may be reduced. [½]

The addition of the guarantee is likely to increase reserving requirements (and hence the cost of capital in the pricing calculation). [½]

Overall, the cost to the policyholder is likely to increase due to the inclusion of the guarantee. [1]

Business volumes may change as a result. [½]

[Maximum 4]

***Examiners' Report***

***The examiners commented that the answers to the first two parts were generally good, with a sensible range of risks being identified. Parts (iii) to (v) were answered less well, with only stronger responses providing a sufficient breadth of points and a clear understanding of the implications of adding the guarantee.***

# ActEd's Hints

## Question 1

(i) Which of the data checks covered in Chapter 27 is the data provided most suitable for? Also consider which sources of data could be used to check the data provided.

(ii) Perform the data check that you identified as most suitable in part (i). Also consider how to check for consistency between the numbers for the two years.

(iii) Give examples for reasons why the figures calculated in part (ii) might look out of line. The data might be correct and so there may be very good reasons for the changes. Or there might be some data missing from the table, or the data in the table might be incorrect.

## Question 2

(i) Describe how the investment principles impact the investment strategy.

(ii) Suggest suitable assets to back the products that these companies sell. Consider how the differences in the two companies (stated in the question) might impact their investment strategy.

## Question 3

(i) Consider each component of the asset share and give examples of why they may have caused the asset share to reduce.

(ii) Consider each reason for the asset share to fall from part (i) and suggest actions that reverse this trend. Also consider how bonuses might change for the additions to benefits method for conventional with-profits.

## Question 4

(i) The PA EAS is calculated using a net of profit premium, so that it ignores the profit loading in the premium. Explain why this might be useful when monitoring surrender values.

(ii) Calculate the prospective value of the benefits, plus expenses, less premiums.

(iii) Adjust the surrender value and PA EAS to allow for the restatement of expenses (they are now 30 higher than previously calculated). Remember that the surrender value is calculated prospectively so expenses should be added, and that the PA EAS is calculated retrospectively so expenses should be subtracted.

(iv) For each of the surrender value and the PA EAS, state whether they go up or go down.

(v) Assess the suitability of the surrender value calculation using the information provided in the question, *ie* the prospective method is used with best estimate assumptions. Also consider how the surrender value was impacted by the change in the expenses. Remember that part of these expenses is a contribution to overheads.

## Question 5

(i) The risk factors are the key drivers of mortality such as age.

(ii) Consider each assumption in the pricing model and explain how adverse experience could cause a reduction in profit.

(iii) Take each sensitivity test from part (ii) in turn and suggest how pricing and product design may be modified to reduce the risk of reduced profit.

## Question 6

(i) Take each item of experience in the table in turn and consider both the long-term and more recent experience separately. If the actual experience is particularly high (low) compared to the assumption this indicates that the company should consider increasing (decreasing) its assumption. Also consider the possible need for prudence in the valuation assumptions.

(ii) Consider the consequences of a failure of appropriate management systems and controls. The company may have other lines of business, so consider the significance of the term assurance business.

## Question 7

(i) Choose the most significant of the risks listed in the syllabus objectives and describe them with reference to the features of the product given in the question.

(ii) Consider the policyholder's needs and give reasons why the product may fail to meet them.

(iii) Consider risk from both the company and policyholder points of view. Go back through the risks in parts (i) and (ii) and comment on only those that have changed (either got better or worse).

(iv) Consider both the timing and amount of the guarantee. Also consider how the existence of the surrender penalty affects this.

(v) As this contract is unit-linked, pricing involves setting charges to meet the company's objectives.