

# INSTITUTE OF ACTUARIES OF AUSTRALIA

## LIFE INSURANCE PAPER TWO

2004 EXAMINATIONS

### MARKING GUIDE

#### Level of Difficulty

#### PAPER TWO

Question	Syllabus Aims	Units	Knowledge & Understanding	Straight-forward Judgement	Complex Judgement	Total Marks
1a	21, 22	9	2	2		4
1b	21, 22	9		5		5
1c	21, 22	9		3		3
2a	20	9	2			2
2b	20, 23	9, 10	4			4
2c	23	10			2	2
2d	24	10		12		12
3a	17	7	2			2
3b	16, 17	7		3		3
3c	16, 17	7			3	3
3d	16, 17	7		3	2	5
3e	5, 16, 17	2, 7		3		3
4a	23	10	1			1
4b	15,18,24	6, 7,10		3	8	11
4c	24	10		3	10	13
5a	3,15	1,6	5.5	3.5		9
5b	19	8	1	2	13	16
5c	19	8			2	2
<b>TOTAL</b>			<b>17.5</b>	<b>42.5</b>	<b>40</b>	<b>100</b>

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### QUESTION 1

(12 Marks)

#### Analysis

Component	Aim	KU	SJ	CJ	Total
Part a	21, 22	2	2		4
Part b	21, 22		5		5
Part c	21, 22		3		3
Total		2	10		12

#### Question

You are a consulting actuary. Your client is the newly appointed Finance Director of an established life reinsurance company. He has asked for your assistance in a review of their financial reporting area and the various reports produced by this team. The financial reporting area is only one week away from completing the year end valuation and financial statements.

The Finance Director (from a banking background) is specifically concerned with the divergence of the financial reports he is receiving from his staff. For example, monthly management reports immediately prior to year end were indicating a 20% increase in profits for the full year 2004 over the previous full year (the budget was for a 5% increase). However, the profit calculated (using the draft Margin on Service (MoS) policy liability) for the full year 2004 shows a reduction of 10% from last year. The draft MoS policy liability has been calculated using a projection methodology.

The Finance Director has also received from his staff a final draft of the 31 December 2004 embedded value results, showing a significant drop from the previous year.

The Finance Director has also provided you with copies of:

- drafts of the financial statements, incorporating PR35 returns / AASB1038 Accounts (with Notes);
- the budget for the full year 2004; and
- actual monthly management reports produced throughout 2004.

He is hoping you can explain the divergence between the various reports before the valuation results and financial statements are finalised the following week.

- (a) From the documents provided to you, what sections would you review and what would you be looking for in those sections to explain the wide divergence in profit between the monthly management reports and the financial statements. (4 marks)
- (b) What other information would you request and why? (5 marks)
- (c) Discuss what steps could be taken to minimise the divergence in profit between the monthly management reports and the financial statements in the future. (3 marks)

QUESTION 1 SOLUTION

(12 Marks)

(a)

Sections to be reviewed include:

- From the financial statements, the P & L of the company and in particular the note on Segment Balance reporting showing the P & L and balance sheet by statutory fund to identify whether efforts should be concentrated on a particular statutory fund.
- From the financial statements, Note 2 (the descriptive note of actuarial methodology and assumptions) to see what specific assumptions were disclosed.
- From the financial statements, the note on analysis of profit to identify the value of the profit margins and the experience profits to see if the loss is due to poor experience and to compare the experience to that of the previous year.
- From the financial statements, the losses capitalised as these flow directly through to profit.
- From the management reports and budget, the definition of profit being calculated, i.e. do the management reports actually report MoS profit or another internal definition of profit?
- A comparison of the budget versus the actual MoS results to identify where any unusual results have occurred.

½ mark for each valid item, max 2 marks.

½ mark for describing how each item could be used, max 2 marks.

(b)

Other Information requested

- FCR should be available in a draft format and that may give some indications to the experience for the past year and valuation assumptions being used. The financial statements don't reveal detailed actuarial information because the assumptions are usually high level.
- Any changes to the IBNR assumptions/methodology and the disabled life reserve assumptions as these could cause wide fluctuations in profit.
- The embedded value report including the basis, in particular the discount rate for the current year and prior year. If the discount rate has increased then this would account for part of the decline in the embedded value.
- The valuation basis and in particular the profit margin from the previous year to indicate the expected profit for the following year. Also to identify any changes in the assumptions, particularly the maintenance expenses which may have resulted in the capitalisation of any losses.
- New business profit margins to identify whether the new business is the cause of the loss.
- Reserving basis used for the management report to identify whether it is consistent with the MoS approach.
- APRA returns for business volumes and mix of products.

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½ mark for each valid item, max 2.5 marks.

½ mark for describing how each item could be used, max 2.5 marks.

(c)

The following steps could be taken to minimise the divergence:

- Ensure that the methodology used to calculate the profit for management reporting is consistent with the profit determined in the financial statements, particularly for the movement in policy liability. Also, management reports are often produced in a very short period of time that is significantly shorter than the amount of time taken to finalise the financial statements. Consider whether any short cuts used in management reporting need to be reviewed.
- Consider whether losses were capitalised at the end of the year, which were not expected during the year. A hard close valuation (i.e. an interim earlier period valuation) would highlight this earlier.
- Consider accruals and timing differences – were there any that caused profit to shift from one year to another (being a reinsurance company the data supplied can be inconsistent).
- Consider data problems, which can be overcome by doing reconciliations between the data used to produce the financial statements and the monthly management reports.
- Consider whether assumptions used to produce the monthly management reports were up to date, which can be overcome by updating assumptions more frequently.

1 mark for each valid point and appropriate discussion, max 3 marks.

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### QUESTION 2

(20 Marks)

#### Analysis

Component	Aim	KU	SJ	CJ	Total
Part a	20	2			2
Part b	20, 23	4			4
Part c	23			2	2
Part d	24		12		12
Total		6	12	2	20

#### Question

You are an actuarial student studying the life insurance course of the Institute of Actuaries of Australia.

You have a friend who works for a life insurance company in Asia. This company only sells participating whole of life insurance with reversionary bonuses. The company sets the bonus rates and guarantees that policyholders will receive all investment returns (net of taxes and investment expenses) over the life of the entire product portfolio.

She would like you to explain the Margin on Services (MoS) profit reporting methodology to her and how the financial reporting results would change if her company were to use MoS.

Currently, her company uses statutory profits and the increase in embedded value for financial reporting.

She provides you with the following information.

#### Financial reporting measures:

<b>Statutory profits:</b>	<b>Premiums received + Investment Income – Expenses – Claims paid – Tax – increase in Statutory Reserve</b>
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Investment Income assumes assets are held at market value and includes unrealised capital gains. Expenses include commission payments.

#### Statutory Reserving Basis:

<b>Calculation method:</b>	<b>Gross premium valuation.</b>
<b>Mortality assumption:</b>	<b>Set by the regulator and is about 50% higher than the company's best estimate assumption.</b>
<b>Expense assumption:</b>	<b>Set by the regulator and is about 20% higher than the company's recent experience.</b>
<b>Interest Rate assumption:</b>	<b>Set by the regulator at 4% but the regulator does</b>

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	review the assumptions every few years. The current government bond yield is 8%.
Future bonus rate assumption:	The statutory liability includes future bonuses, assuming bonus continues at the current bonus rate.

Embedded Value:	
Net Worth:	Market Value of Assets – Capital Requirement
Value of In force:	The present value of future statutory profits assuming best estimate experience and a risk discount rate of 15%.

The Capital Requirement represents the minimum amount of assets required to be held and is equal to 125% of the Statutory Reserve.

Prepare an answer for your friend covering:

- (a) A brief description of the similarities and differences between the statutory profit in the Asian country and MoS profit. (2 marks)
- (b) A brief description of the similarities and differences between the change in embedded value and MoS profit as measures of profitability. (4 marks)
- (c) The flaw that you have identified with the Embedded Value methodology as documented by your friend in Asia, and whether this would result in the embedded value being understated or overstated? (2 marks)
- (d) Assume your friend decides to perform a statutory valuation, embedded value calculation and MoS valuation at the end of the current financial reporting year (i.e. at the valuation date). Provide a brief description of how the following items:
  - the statutory profit in both the current year and future years;
  - the embedded value at the valuation date; and
  - the MoS profit in both the current year and future years

would be impacted, if

- (i) over the 12 months preceding the valuation date, sales were higher. (3 marks)
- (ii) at the valuation date, there was a one off increase in the bonus rate declared. (3 marks)
- (iii) the best estimate expense assumption at the valuation date was higher. (3 marks)

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- (iv) the local regulator reduces the official mortality rates by 10% at the valuation date. (3 marks)

(In preparing your answer for part (d) you should:

- assume the financial reporting is at the end of the year;
- ignore the impact of capitalised losses on the MoS profit;
- consider each item in isolation; and
- assume your friend is only interested in the main issues and not the “finer points” of each method.)

### QUESTION 2 SOLUTION

(20 Marks)

(a)

Similarities

- Both methods give the same accumulated profit over the life of the policy.

Differences

- Stat basis has a new business strain followed by higher profits (representing new business strain and the release of capital). Hence it is a conservative method. MoS, however, is a realistic method, which recognises the profit over the life of the policy in line with services offered and the risk borne.
- MoS does not include the increase or decrease in capital as a profit or loss.
- MoS profits are split between shareholders and policyholders.

½ mark for each valid point, max 2 marks.

(b)

Similarities

- Both use best estimate assumptions.
- Neither treat increase in capital as an expense.
- Both are realistic measures.
- Impact of losses recognised when they occur.

Differences

- EV allows for capital requirement while MoS doesn't.
- EV allows for risk through the risk discount rate while MoS doesn't.
- EV recognises new business value while MoS spreads it out over time.
- EV immediately recognises impact of changes in assumptions while MoS spreads it out over time.

½ mark per valid point, max 4 marks.

(c)

There is an inconsistency with the reserve being used to calculate the net worth and the value of the in force. The net worth is calculated using the Capital Requirement, which is 125% of the statutory reserve. The value of the in force is based on the present value of the statutory profits, which uses the statutory reserve. This will result in the EV being understated, as the capital margin in the net worth is not being released in the calculation of the in force. To overcome this problem, the calculation of the in force should use a modified present value of statutory profits, where the capital requirement is used to calculate the profit instead of the statutory reserve.

Value in force does not include release of capital in statutory reserve. (1 mark)

Value of in force is understated. (1 mark)

(d)

Marking Note: Comments in brackets are not required to get the marks.

(i) Increase in sales

- Stat basis profits will decrease because the conservatism / implicit capital / new business strain is treated as a loss. However, future year profits will be higher as this conservatism is released.
- EV will increase by value of new business, provided it is positive.
- MoS will have minimal impact as around half the first year's profit margin is released. (**Not** OK to say no impact). Future profits will be increased from the release of the margin in future years.

1 mark for each point, max 3 marks. Note students are required to comment on current and future profit impacts – only ½ mark if they omit one.

(ii) One off increase in bonus rates

- Stat basis profits will decrease by full impact of cost of additional bonus. No future impact.
- EV will decrease slightly due to increase in the statutory reserve.
- There will be no change in the MoS profit for the current period as the increase in policy liability is offset by a decrease in the unvested policyholder liabilities. Very small (second order) impact on future profits (probably ok to say no impact on future profits).

1 mark for each point, max 3 marks. Note students are required to comment on current and future profit impacts – only ½ mark if they omit one.

(iii) Increase in best estimate expense assumptions

- No impact on Stat basis profits this year but would expect future profits to be lower.
- EV will decrease by present value (at risk discount rate) of the change in (net of tax) expense assumptions.



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- Current year MoS profit will not change for in force business. Small decrease in the MoS profit for new business. Future years MoS profits will be lower.

1 mark for each point, max 3 marks. Note students are required to comment on current and future profit impacts – only ½ mark if they omit one.

(iv) Decrease in official mortality rates

- Stat basis profits will have an increase this year, no impact on future profits.
- EV will increase as capital is released.
- MoS profit will not change since it is only the statutory reserving basis affected by the official mortality rates.

1 mark for each point, max 3 marks. Note students are required to comment on current and future profit impacts – only ½ mark if they omit one.

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### QUESTION 3

(16 Marks)

#### Analysis

Component	Aim	KU	SJ	CJ	Total
Part a	17	2			2
Part b	16, 17		3		3
Part c	16, 17			3	3
Part d	16, 17		3	2	5
Part e	5, 16, 17		3		3
Total		2	9	5	16

#### Question

You are the Appointed Actuary for APEX Life, a small Australian life insurance company. APEX has only one statutory fund, which contains single premium investment-linked products. The charging structure for these products consists of an entry fee and ongoing management fee. These products have been quite profitable for APEX, however they have received only negligible new business volumes for a number of years prior to the 2004 year.

Exceptional investment returns for the first half of 2004, combined with a reduction in the ongoing management fee, have led to a dramatic increase in new business volumes and resulted in substantial unrealised capital gains at the end of the financial year 30 September 2004. Total investment-linked account balances have almost doubled from \$715m at 30 September 2003 to \$1,360m at 30 September 2004. APEX expects sales volumes to continue at the current levels for a number of years.

You are about to calculate the Solvency, Capital Adequacy and Management Capital Requirements as at 30 September 2004. APEX currently has a policy of not applying any statutory capital offsets in the calculation of its Solvency and Capital Adequacy Requirements.

- (a) What is the purpose of the Solvency Standard (“AS2.03”) and the Capital Adequacy Standard (“AS3.03”)? (2 marks)
- (b) Describe the aspects of the Solvency and Capital Adequacy Requirement calculation process that will require greater attention compared to previous years. (3 marks)
- (c) Explain why you expect the Solvency Requirement to be greater than the Capital Adequacy Requirement (prior to applying the minimum value of the Solvency Requirement) at 30 September 2004. (3 marks)
- (d) The CEO has requested that you investigate how APEX may be able to reduce its Solvency and Capital Adequacy Requirements. Explain how Offset Statutory Capital can be utilised to reduce the Solvency and/or Capital Adequacy Requirements and discuss the impact on APEX’s capital requirements overall from utilising such a strategy. (5 marks)

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- (e) **APEX currently has a policy of holding cash assets to back all of the tax liabilities of its statutory fund. Discuss why this approach may lead to a mismatch between the assets and the liabilities. Suggest an alternative asset mix that may result in a better match.** (3 marks)

### QUESTION 3 SOLUTION

(16 Marks)

(a)

The purpose of the Solvency Standard is to prescribe the minimum capital requirement of a statutory fund to ensure that under a **range of adverse circumstances** the company would be expected to be in a position to **meet (guaranteed) obligations to policyowners and other creditors.** (1 mark)

The purpose of the Capital Adequacy Standard is to prescribe the capital requirement of a statutory fund to ensure that the **obligations and reasonable expectations of, policy owners and creditors** can be met under a **range of adverse circumstances, in the context of a viable ongoing operation.** (1 mark)

(b)

The Expense Reserve is likely to be far more important for the solvency requirement. Since these products have been effectively closed to new business the expense reserve has probably been small or zero. However we would expect a relatively large expense reserve as at 30 September 2004 due to the substantial amount of new business. (1 mark)

Similarly we would expect the new business reserve to require additional work this year. As significant new business volumes are expected it will be necessary to calculate the amount of capital required to allow solvency to be met over the next three years. The new business reserve may also be able to be reduced by profits from in force business (the questions states that it has been quite profitable). (1 mark)

Another area requiring special attention (that affects both Solvency and Capital Adequacy) is the need to check the solvency and capital adequacy liability against respective termination values following a change in product conditions and dramatic changes in business volumes.

(1 mark in total or ½ mark each for mentioning it both for Solvency and Cap Ad)

- (c) The reasons I suspect the Solvency Requirement will be greater than the Cap Ad requirement this year are as follows:

- There will be a significant Expense Reserve in the Solvency Requirement due to the increase in acquisition expenses associated with the new business growth; (1 mark)
- The investment-linked margin is applied to both the solvency liability and the minimum termination value when calculating the Solvency Requirement.

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However the equivalent margin for the capital adequacy requirement is applied to the capital adequacy liability only and this often does not affect the final CAR. (1 mark)

- While we would expect the new business reserve to increase the CAR compared to the SR, investment-linked business has relatively small capital requirements and there is likely to be a release from the in force business which will reduce the quantum of the new business reserve. (1 mark)

Thus I expect the SR to be greater than the CAR.

- (d) Offset Statutory Capital can be utilised in the calculation of the Expense Reserve when calculating the Solvency Requirement. It can serve to reduce the amount of the Expense Reserve, subject to a maximum amount of available Offset Statutory Capital. (1 mark)

Similarly Offset Statutory Capital can be used to reduce the New Business Reserve when calculating the Capital Adequacy Requirement. However the OSC is only “used” after allowance has been made for any profits emerging from in force business (and any new business capital that may arise.) (1 mark)

The total OSC used in the calculation of both the SR and CAR needs to be monitored as the total amount may not exceed the total amount of statutory capital available (\$5m). (1 mark)

Using OSC can reduce the SR and/or the CAR, however it results in a corresponding increase in the management capital requirement. Hence the capital requirements for APEX as a whole would not be impacted from using OSC, although it would move the location of the required capital from the statutory fund to the shareholders’ fund. (2 marks)

- (e) APEX’s tax liabilities consist of two components, the current tax liability and the deferred tax liability. APEX is using cash to back both components of the total tax liability.

It is probably appropriate to use cash to back the current tax liability, as it is payable in the short term and the amount is unlikely to change. (1 mark)

The deferred tax liability is likely to be significant for APEX due to the large amount of unrealised gains during the year. The deferred tax liability is not required to be paid in the short term (greater than one year) and the amount of the liability will vary as capital market movements, hence this creates a mismatch risk in respect of the deferred tax liabilities. (1 mark)

A more suitable asset mix for the deferred tax liabilities would be to adopt a similar asset mix to that backing the account balances. (1 mark)

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### QUESTION 4

(25 Marks)

#### Analysis

Component	Aim	KU	SJ	CJ	Total
Part a	23	1			1
Part b	15,18,24		3	8	11
Part c	24		3	10	13
Total		1	6	18	25

#### Question

You are the Appointed Actuary for an Australian life insurance company, INSHORE, that has two products only: immediate lifetime annuities and yearly renewable term. Both products have positive MoS profit margins, but for annuities they are very small. Only the term insurance product is open to new business.

You have just finished your 30 June 2004 year end activities, which included the calculation and documentation of net policy liabilities and the calculation of the embedded value. The embedded value, which includes the value of imputation credits at 70% of the value of future tax payable, has been calculated using the best estimate assumptions at the valuation date and a risk discount rate of 10%.

- (a) State the components of an embedded value. (1 mark)
- (b) The newly appointed Chief Financial Officer has just finished reading your draft embedded value and policy liabilities reports and she has a few questions for you.

Draft your response to your Chief Financial Officer, explaining your answers to her following queries.

- (i) Why does the analysis of change in embedded value show a positive value of business written in the period, whereas new business profits do not seem to have been included in the analysis of MoS profits? (3 marks)
- (ii) Why does the immediate annuity business have a large positive value of in force business in the embedded value, while the product has only small profit margins for policy liability purposes? Does this mean we should reopen this product to new business? (4 marks)
- (iii) The federal government changed the tax consolidation legislation during the year, resulting in a lowering of tax reserves and thus a lowering of tax expense. The analysis of MoS profit after tax includes a significant positive experience profit from this tax change. The analysis of change in embedded value shows a much smaller (positive) impact of the same tax changes. Why is the impact smaller for the change in embedded value than for the MoS profit? (4 marks)

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- (c) While reading your draft year end reports the CFO has noticed that you have incorrectly assumed total budgeted expenses for the year ending 30 June 2005 of \$15.7m when calculating your unit cost assumptions. The final budgeted expenses for this period totalled \$16.9m.

You have been informed that the additional expenses of \$1.2m are all ongoing maintenance expenses and are split equally between the annuity and the term products. The following table has been extracted from the 30 June 2004 results.

Product:	Term	Annuity	Total
Basis 2 Best Estimate Liability	-30.3	678.4	648.1
Basis 2 Present Value of Future Profit Margins	25.1	4.2	29.3
Policy Liability	-5.2	682.6	677.4
Basis 2 Modelled Maintenance Expenses (for the year ending 30 June 2005)	5.9	4.3	10.2
PV Maintenance Expenses @ Net Earned Rate	48.00	26.56	74.56
PV Maintenance Expenses @ 10%	39.70	21.97	61.67

Note: Basis 2 uses the best estimate assumptions at the current reporting date.

- (i) Estimate the impact on your draft 30 June 2004 best estimate liabilities, present value of future profit margins and policy liabilities from incorporating the additional budgeted expenses. (5 marks)
- (ii) Estimate the impact on your draft 30 June 2004 MoS profit from incorporating the additional budgeted expenses. (1 mark)
- (iii) Estimate the impact on your draft 30 June 2004 embedded value from incorporating the additional budgeted expenses. (4 marks)
- (iv) After further investigation you find out that the additional expenses of \$1.2m were budgeted policy issue acquisition expenses for the term insurance product. What would be the impacts on your draft 30 June 2004 policy liabilities, MoS profit and embedded value from incorporating the additional budgeted expenses? (3 marks)

## QUESTION 4 SOLUTION

(25 Marks)

(a)

The components of an embedded value are the adjusted net worth and the value of in force business. (1 mark)

(b)

The question has asked the student to draft a response to the CFO. Usually 1 mark is awarded for appropriate format and language. For this question deduct 1 mark if the answer has not been presented appropriately.

Dear CFO

I am writing to you in response to your queries regarding the policy liability and embedded value results as at our last year end.

(i) Impact of new business on MoS profits and change in the embedded value

New business has only a small impact on MoS profits in the period, provided the new business is profitable. Instead MoS profits emerge over the life of the policy as the services are performed.

The embedded value at any date includes the present value of all expected future profits from the business in force at that date. Hence the increase in embedded value during the year will include the present value of all future profits expected on new business written during the period.

(3 Marks – 1.5 marks for each point)

(ii) Value of immediate annuity business

The immediate annuity business has only small profit margins for policy liability purposes. This means that the product is not expected to generate significant future MoS profits. Hence the main component of the positive value of the immediate annuity in force business in the embedded value is the release of the capital margin (the excess of the capital adequacy requirement over the policy and other liabilities) held on this business.

Thus the positive embedded value does not mean we should re open this product to new business as the release of capital does not represent value creation for the shareholders. It would be worth reopening the product if the value of the new business (after allowing for financing the capital strain associated with this product) was positive, as this would represent value creation for the shareholders. However, it is likely this value would be relatively small and quite possibly negative (which is in line with the small MoS profit margins).

(4 Marks – 2 marks per point)

(iii) Impact of Tax Consolidation Legislation Changes

The analysis of MoS profits has been completed after allowing for tax. As the tax legislation changes have reduced our tax expense we observed a significant experience profit during the year. Whilst this increase in profit will continue in

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future years, it will not emerge as experience profit, as the profit margin will be increased for future years.

Imputation credits are generated from a number of sources including tax paid by the life insurance company. The embedded value calculation includes the value of imputation credits. Hence the change in tax legislation has increased operating profits but has reduced the value of imputation credits resulting in a smaller net increase in the embedded value than the increase in operating profits. (4 Marks – 2 marks per point)

Please call me if you wish to discuss any of the above further.

Regards

(c)

(i) Policy Liability Impact

Additional maintenance expenses are \$0.6m per product group.

Calculate the implied expense capitalisation factors:

	Term	Annuity
Calculated Policy Liability Expense Capitalisation Factors	= 48/5.9 = 8.136	= 26.56/4.3 = 6.177

	Term	Annuity	Total
PV Gross Additional Expenses (before tax)	= 8.136*0.6 = 4.88	= 6.177*0.6 = 3.71	8.59
Estimated Increase in BEL (after tax)	= 0.7* 4.88 = 3.42	= 0.7* 3.71 = 2.59	6.01
Impact on Future Profit Margins (after tax)	-3.42	-2.59	-6.01
<b>Policy Liability Impact</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>

2½ marks each (1½ for best estimate liability impact, ½ for present value of future profit margin impact and ½ for total policy liability impact) for calculating the impacts on the term and annuity policy liability calculations.

(ii) Impact on MoS Profit After Tax

The change is in respect of budgeted 2005 maintenance expenses so there is no change in 2004 cash flows. As shown in the Table above, there is also no impact on the policy liability. Hence, there is no impact on 2004 MoS profit after tax.

(1 mark)



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### (iii) Impact on the Embedded Value

	Term	Annuity
Calculated Embedded Value Expense Capitalisation Factors	= 39.7/5.9 = 6.729	= 21.97/4.3 = 5.109

	Term	Annuity	Total
PV Gross Additional Expenses (before tax)	= 6.729*0.6 = 4.04	= 5.109*0.6 = 3.07	7.11
PV Additional Tax	= -0.3*4.04 = -1.21	= -0.3*3.07 = -0.92	-2.13
Value of Profit Impacts	-2.83	-2.15	-4.98
Value Franking Credit Impact	= 0.7*-1.21 = -0.85	= 0.7*-0.92 = -0.64	-1.49
<b>Embedded Value Impact</b>	<b>-3.68</b>	<b>-2.79</b>	<b>-6.47</b>

2 marks for calculating the value of profit impact and 2 marks for calculating the franking credit impact.

- (iv) If the change is in budgeted 2005 acquisition expenses then there will be no impact on 2004 Policy Liabilities or Operating Profit. This is because it is the actual 2004 acquisition expenses that are used in the PL calculation. (2 marks)

Similarly there will be little or no impact on EV as acquisition costs will not affect either the net worth or value of in force business. (1 mark)

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### QUESTION 5

(27 Marks)

#### Analysis

Component	Aim	KU	SJ	CJ	Total
Part a	3,15	5.5	3.5		9
Part b	19	1	2	13	16
Part c	19			2	2
Total		6.5	5.5	15	27

#### Question

You are a consulting actuary who has been hired to help XYZ Life complete its 30 June 2004 year end calculations for its YRT product. You have been provided with the following information regarding the YRT product:

- Policy Liability as at 30 June 2003 = -\$24,189,000.
- The final net of tax profit margin at 30 June 2003 was 1.46%. The profit carrier used was claims.

YRT Projection Model Output as at 30 June 2004 (\$000)			
Model Run Description	Gross Earning Rate	Gross Best Estimate Liability <sup>1</sup>	Present Value of Profit Carrier (Claims)
Residual In force Business <sup>2</sup> on Basis 0 Assumptions (i.e. using June 2003 Basis 2 assumptions)	5.0%	-23,769	42,192
Residual In force Business <sup>2</sup> on Basis 1 Assumptions	6.5%	-21,367	37,781
Residual In force Business <sup>2</sup> on Basis 2 Assumptions	6.5%	-20,117	36,282
2004 New Business At Inception <sup>3</sup> on Basis 2 Assumptions	6.5%	140	4,445
2004 New Business From Year End <sup>4</sup> on Basis 2 Assumptions	6.5%	-2,607	4,447

YRT Product - Cash Flows for Year Ending 30 June 2004 (\$000)	Actual Cash Flows
Premium Income	9,862
Investment Earnings <sup>5</sup>	-1,293
Claim Payments	4,909
Acquisition Expenses & Commission	3,004
Maintenance Expenses & Commission	2,449

#### Notes:

1. The gross best estimate liability excludes tax. i.e. no tax is included in the cash flows used for discounting and a gross earned rate is used as the discount rate.
2. Residual In Force Business refers to those policies that were in force at 30 June 2003 and remain in force at 30 June 2004.
3. 2004 New Business At Inception refers to a projection from policy issue date of new policies issued since 30 June 2003.

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4. 2004 New Business From Year End refers to a projection of new policies issued since 30 June 2003 using 30 June 2004 as the projection date.
  5. Investment Earnings does not include earnings on capital in excess of policy liabilities.
- (a) Calculate the policy liability and the MoS profit/loss after tax as at 30 June 2004 for the YRT product. (9 marks)
- (Hint: Calculate the 30 June 2004 policy liability gross of tax and then allow for the impact of tax.)
- (b) You have also been provided with the following information, in addition to the information provided above:

YRT Actual and Expected Items For Year Ending 30 June 2004			
	30/6/03 Basis 2 Assumptions	Actual Experience	30/6/04 Basis 2 Assumptions
Policies In Force 30 June 2003	9,602	9,602	9,602
Annual Premium In Force 30 June 2003 (\$000)	9,655	9,655	9,655
Gross earning rate in period	5.0%	5.5%	6.5%
Inflation	3.0%	3.0%	3.0%
Maintenance Expenses <sup>6</sup>			
- % premiums	5.0%	5.3%	5.2%
- \$ per policy pa	100	105	105
Policy Lapse Rate (year ending 30 June 2004)	15.0%	16.0%	15.5%
Claims Cost (as % of premium income)	51.5%	51.2%	51.5%
Residual Policies In Force 30 June 2004 <sup>7</sup>	8,162	8,066	8,066
Residual Annual Premium In Force 30 June 2004 <sup>7</sup> (\$000)	9,191	9,083	9,083
Expected claims cost (year ending 30/6/04) (\$000)	4,815		

### Notes:

6. Maintenance expenses exclude maintenance commission of 10% of premium income.
7. Residual policies and premium in force statistics ignore new business written during the 12 months to 30 June 2004

Assuming that there are no experience profits or losses in respect of new business issued during the year, calculate the following for the year ending 30 June 2004:

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- (ii) The planned profits, total experience profits and any other components of MoS profit after tax. (2 marks)
  - (iii) The experience profit/loss due to maintenance expenses. (3 marks)
  - (iv) The experience profit/loss due to lapse experience. (4 marks)
  - (v) The experience profit/loss due to claims experience. (2 marks)
  - (vi) The experience profit/loss due to investment/economic conditions. (4 marks)
  - (vii) Summarise the analysis of experience variations and determine the residual untraced amount. (1 mark)
- (c) Briefly describe how you could use XYZ's projection models to improve the accuracy of your analysis (i.e. reduce your untraced amount). (2 marks)

### QUESTION 5: SOLUTION

(27 Marks)

(a)

#### POLICY LIABILITY CALCULATION

Note all calculations are undertaken gross of tax for simplicity

PM Carried Forward (Net of Tax)	1.46%	
PM Carried Forward (Gross of Tax)	2.09%	(½ mark)

#### Basis 1 – Residual IF

BEL (Gross of Tax) = -21,367

PVPC = 37,781

PL =  $(-21,367 + 37,781 * 2.09\%) = -20,577$  (1 mark)

#### Basis 2 – Residual IF

BEL (Gross of Tax) = -20,117

PVPC = 36,282

Basis 2 PV Profits =  $(-20,577 - -20,117)$

= -460 (i.e. loss so take PVFP's to zero)

PL = -20,117 (1½ marks)

#### New Business Since 30 June 2003

BEL at Inception = 140

PVPC at Inception = 4,445

NB PM = 0% (as product is in loss) (1 mark)

BEL EOY = -2,607

NB PL = -2,607 (½ mark)

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$$\text{Total PL} = (-2,607 + -20,117) = -22,724 \quad (1 \text{ mark})$$

$$\text{Total Cumulative Losses} = +460 + 140 = 600 \quad (1 \text{ mark})$$

### CALCULATE TAXABLE PROFIT & OPAT

$$\text{Tax reserve (t)} = \text{Policy liability (t)} - \text{Cumulative losses (t)}$$

$$\text{Tax reserve BOY} = -24,189 - 0 = -24,189$$

$$\text{Tax reserve EOY} = -22,724 - 600 = -23,324 \quad (1 \text{ mark})$$

$$\text{Taxable Profit} = -24,189 - -23,324 + 9,862 + -1,293 - 4,909 - 3,004 - 2,449 = -2,658 \quad (1/2 \text{ mark})$$

$$\text{Tax} = 30\% * -2,658 = -797. \quad (1/2 \text{ mark})$$

$$\text{Profit after tax} = -24,189 - -22,724 + 9,862 + -1,293 - 4,909 - 3,004 - 2,449 - -797 = -2,461 \quad (1/2 \text{ mark})$$

(b)

### (i) BASIC ALLOCATION OF PROFIT (2 marks)

$$\text{Total profit after tax} = -2,461$$

$$\text{Planned net profit after tax} = 1.46\% * 4,815 = 70 \quad (1 \text{ mark})$$

$$\text{Change in Capitalised Losses} = -600 \quad (1/2 \text{ mark})$$

$$\text{Other (Experience Variations)} = -1,931 \quad (1/2 \text{ mark})$$

### (ii) ANALYSIS OF EXPERIENCE PROFITS

$$\text{Average Premium In force (\$000)} = \{(9,655 + 9,191) * 0.5\} = 9,423$$

$$\text{Average Policies In Force} = \{(9,602 + 8,162) * 0.5\} = 8,882$$

$$\text{Actual average policies in force} = 0.5 * (9,602 + 8,066) = 8,834$$

$$\text{Actual average premium in force} = 0.5 * (9,655 + 9,083) = 9,369$$

The above calculations are required for parts ii) to v).

### Maintenance Expense Experience Profit

$$\text{Estimate Amount} = (1 - \text{tax rate}) * (\text{Expected expenses} - \text{Actual maintenance expenses}) * (1 + I_e)^{0.5}$$

$I_e$  = expected earnings rate

$$\begin{aligned} \text{Expected expenses} &= 8,882 / 1000 * 100 * 1.03^{0.5} + 9,423 * (5.0\% + 10\%) = \\ &2,315 \quad \text{Actual expenses} = 8,882 / 1000 * 105 * 1.03^{0.5} + 9,423 * (5.3\% + 10\%) = \\ &2,388 \end{aligned}$$

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$$\text{EXPENSE EXPERIENCE PROFIT} = (2,315 - 2,388) * (1 - 30\%) * (1.050^{0.5}) \\ = -52$$

(3 marks, suggested breakdown is ½ mark for the formula, 1 mark for expected expenses, 1 mark for actual expenses, ½ mark for expense profit)

### (iii) Lapse Experience Profit

There is no surrender value for this product, so the impact of lapse experience variance is the impact on lapses on cash flows and end of year liability.

However a simpler approach is to apply the difference between actual and expected lapse rates to the surrender value (=0) minus BOY policy liability i.e.  
Lapse profit = 15% - 16% \* (0 - -24,189) \* (1 - 30%) = -169

Alternatively a similar answer could be derived long hand as follows:

$$\text{Impact on cash flows} = \text{Actual cash flows} - \text{expected cash flows} \\ = [(9,369 - 9,423) * (1 - 5.3\% - 10\% - 51.5\%) - (8,834 - 8,882) / 1000 * 105 * \\ 1.03^{0.5}] * (1 - 30\%) * 1.050^{0.5} \\ = -9$$

$$\text{Impact on end of year PL} = \text{Expected PL} - \text{Actual PL}$$

$$\text{Basis 0 PL EOY (uses actual 2004 lapse rates)} = -23,769 + 42,192 * 2.09\% = -22,887$$

$$\text{Approx B0 PL assuming expected lapse rates} = -22,887 / (1 - 16\%) * (1 - 15\%) \\ = -23,159$$

$$\text{Impact on year end PL} = (1 - 30\%) * (-23,159 - -22,887) = -190$$

$$\text{LAPSE EXPERIENCE PROFIT} = -199$$

(4 marks, suggested breakdown is 1 mark for impact on cash flows, 2 marks for impact on policy liability, 1 mark for lapse profit)

### (iv) Claims Experience Profit

We are only given claims loss ratios so calculation is relatively easy as we can't estimate impact on end of year PL. Hence experience profit equals expected less actual cash flows (net of tax plus investment earnings)

$$\text{CLAIMS EXPERIENCE PROFIT} = 9,369 * (51.5\% - 51.2\%) * (1 - 30\%) * \\ 1.050^{0.5} = 20 \quad (2 \text{ marks})$$

### (v)

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### Investment Experience Profit

Actual earning rate in period = 5.5%

Expected earning rate in period = 5.0%

Actual discount rate end of period = 6.5%

Expected discount rate end of period = 5.0%

Impact of earning rate variation on actual cash flows

$$\begin{aligned} &= (1 - 30\%) * (5.5\% - 5.0\%) * [-24,189 + 9,369 * (1 - 5.3\% - 10.0\% - 51.2\%) / 2 \\ &\quad - 105 * 8,834 / 1000 * (1.03^{0.5}) / 2] \\ &= -81 \end{aligned}$$

Impact of change in discount rate

Basis 0 PL EOY (uses old earning rate) =  $-23,769 + 42,192 * 2.09\% = -22,887$

Basis 1 PL EOY (uses new earning rate) =  $-21,367 + 37,781 * 2.09\% = -20,577$

Approx impact of change in discount rate =  $(1 - 30\%) * (-22,887 - -20,577)$   
= -1,617

TOTAL INVESTMENT EXPERIENCE PROFIT = -1,698

(4 marks, suggested breakdown is 2 marks for impact on cashflows and 2 marks for impact of change in discount rate.)

### (vi) SUMMARY OF EXPERIENCE PROFITS

Expense Experience Profit	= -52
Lapse Experience Profit	= -199
Claims Experience Profit	= +20
Investment Experience Profit	= -1,698
Untraced	= -2
Total Experience Profit	= -1,931

(1 mark to set out final analysis & residual untraced)

(c) A more accurate experience analysis could be undertaken using the valuation models as follows:

- Start with final basis 2 projections from June 2003.
- Rerun this projection using actual maintenance expense assumptions for 2004, but no change to any other assumptions (including maintenance expenses for 2005+).
- Repeat step 2 (3 more times) but progressively changing 2004 claims, lapses and investment earnings assumption to match actual experience.
- Finally change the model discount rate to the 30 June 2004 actual rate.

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The difference in the projected MoS profit for the year to 2004 can be taken from the progressive runs to give a more accurate analysis of experience profits. (2 marks)

**END OF PAPER TWO SOLUTIONS**