INSTITUTE OF ACTUARIES OF AUSTRALIA

COURSE 2B LIFE INSURANCE MAY 2007 EXAMINATIONS

MARKING GUIDE

Level of Difficulty

Question	Syllabus Aims	Units	Knowledge & Understanding	Straight-forward Judgement	Complex Judgement	Total Marks
1 (a)	1, 2	1	3	3		6
1 (b)	1, 2	1	3			3
1 (c)	1, 2	1		2		2
1 (d)	1, 9	1, 5		2	2	4
2 (a)	3	2		3		3
2 (b)	3, 1, 2	2, 1		5		5
2 (c)	3	2			3	3
2 (d)	3, 6	2, 3			5	5
3 (a)	4	2	3			3
3 (b)	4, 10	2, 5	3	4	1	8
3 (c)	4, 10	2, 5		4		4
3 (d)	4, 6, 10	2, 3, 5			4	4
4 (a)	5	3		6		6
4 (b)	1, 2	1			6	6
4 (c)	7	4			2	2
4 (d)	2	1			6	6
5 (a)	1, 5	1, 3	4			4
5 (b)	5, 12	3, 5, 6		6		6
5 (c)	5, 12	3, 6			5	5
6 (a)	8	4	5			5
6 (b)	7	4		3		3
6 (c)	8, 6	4, 3			7	7
TOTAL			**21**	**38**	**41**	**100**

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INSTITUTE OF ACTUARIES OF AUSTRALIA

COURSE 2B LIFE INSURANCE **MAY 2007 EXAMINATIONS**

QUESTION 1 **(15 Marks)**

Analysis

Component	Aim	KU	SJ	CJ	Total
Part (a)	1, 2	3	3		6
Part (b)	1, 2	3			3
Part (c)	1, 2		2		2
Part (d)	1, 9		2	2	4
Total		6	7	2	15

Question

You are the valuation actuary of Super Life (SL), which has a leading position in the Australian superannuation market. SL is about to launch a new product providing a complete package of superannuation services to corporate clients with at least 100 employees. The new product will provide trustee, administration, investment, group risk insurance (death, TPD, and salary continuance cover) and professional services (accounting, actuarial, audit, legal etc).

Charges are negotiated with each client being based on numbers of members (administration), funds under management (investment and trustee services), a component of the premium rates (group risk insurance), and activity-based charges (professional services). There are no upfront charges for any client.

The product development actuary has told you that on best estimate assumptions:

- **initial sales, set-up, and other acquisition costs for a new client are expected to be about 25% of the first year charges for the client, and**
- **excluding the initial sales and set-up costs, the expected profit to SL is about 15% of the total charges each year.**

You are now asked to consider the method of setting the policy liabilities and recognising profits for the group risk insurance component of this product (you are not required to consider the other components of the product).

a) Firstly, consider a projection method for calculating the margin on services policy liabilities. Outline your approach to the liability calculation for the initial valuation of the group risk insurance component of this business, including identifying any special assumptions you might need for this component, and your choice of profit carrier, with reasons. (6 marks)

b) Secondly, consider an accumulation method. Outline your approach to the liability calculation for the initial valuation of the group risk insurance component of this business. (3 marks)

c) What are the relative advantages and disadvantages of the projection and accumulation methods for the group risk insurance component of this business ? What is your preferred method, with reasons ? (2 marks)

d) SL also calculates its profit every year based on the increase in the embedded value of the company from the start of the year to the end of the year. What are the main differences in profit recognition between the margin on services method and the embedded value method for the group risk insurance component of the product ? What are the implications of these differences for this component of the product ? (4 marks)

QUESTION 1: SOLUTION (15 marks)

(a) I would approach the projection method as follows:

- Start with the in-force business at the valuation date.
- Build the projection model
- Project forward the cash flows for the in-force business using best estimate assumptions for revenue, expenses, tax, etc.
- Discount the cash flows to the valuation date using the risk-free rate.
- Calculate BEL as the PV of future claims and expenses less the PV of future premiums.
- Calculate Profit Margin (PM) as minus BEL divided by PV of profit carrier.
- Calculate MoSL as the sum of BEL plus PM multiplied by PV of profit carrier.
- Add the liabilities for unexpired risk, reported and unreported claims and claims in payment.

Marking guide:
– 0.5 marks for in-force business at the valuation date;
– 0.5 marks for projection model;
– 0.5 marks for projection using best estimate assumptions;
– 0.5 marks for discounting at the risk-free rate;
– 0.5 marks for calculation of BEL;
– 0.5 marks for calculation of PM;
– 0.5 marks for calculation of MoSL;
– 0.5 mark for IBNR, RBU and CICP;
to a maximum of 3 marks (KU).

Special assumptions required for this product are:

- Assumed salary increases and membership growth of the in-force business.
- Claims cost may be expressed as a percentage of premiums because competition is likely to force down premiums if the profit margins become too high.
- Possibly an allowance for loss of business as a result of re-tenders at intervals of say 3 years. The re-tenders are more likely to apply to the super package not just the group risk.
- Any Group Risk non-standard mortality assumptions and rating factors (eg occupation class).
- Reinsurance method and terms.

Marking guide:
– 0.5 marks for growth assumptions;

– 0.5 marks for claims cost as % of premiums;
– 0.5 marks for business re-tenders;
– 0.5 marks for non-standard group assumptions;
– 0.5 marks for reinsurance terms;
to a maximum of 2 marks (SJ).

Profit carrier.

The major service is the payment of claims and this is also the biggest risk to the company. So the profit carrier should be "expected claims". Note for salary continuance this can result in a slow rate of profit recognition as claims can continue for many years.

Marking guide:
– 0.5 marks for identifying expected claims as the profit carrier;
– 0.5 marks for reason;
– 0.5 marks for noting the long duration of GSC claims;
to a maximum of 1 mark (SJ).

(b) I would approach the accumulation method as follows:

- Make sure all revenue items (including premiums, claims and expenses) are accrued to the valuation date in the accounts.
- Also check that tax & other liabilities are correctly accrued to the valuation date in the accounts
- Initially calculate MoS policy liability as the sum of the liabilities for unexpired risk, reported and unreported claims and claims in payment.
- Then decide whether or not to hold a deferred acquisition cost (DAC) as a negative liability for the initial sales and set-up costs. The acquisition costs can reasonably be amortised on a basis consistent with revenue recognition. If acquisition costs are not considered material then it may be decided not to hold a DAC for reasons of practicality.
- The actuary must be satisfied that the accumulation method produces materially similar results to a projection method.

Marking guide:
– 0.5 marks for accrual of accounting items;
– 0.5 marks for correct accrual of tax and other liabilities;
– 0.5 marks for unexpired risk;
– 0.5 marks for IBNR, RBU and CICP;
– 0.5 marks for DAC materiality;
– 0.5 marks for method of amortising DAC if material;
– 0.5 marks for confirming suitability of method;
to a maximum of 3 marks (KU).

(c) The relative advantages and disadvantages are as follows:

- The accumulation method is simpler as it does not require financial projections and all the assumptions needed for those calculations.

- The projection method automatically satisfies the valuation standard ie no need to check that the method is suitable.
- The premiums for this business are likely to be reviewed at intervals over time having regard to the claims experience. This is different from the defined premiums / charges that usually apply to retail products. So the projection method may represent unwarranted precision and on balance it is likely the accumulation method would be preferred.

Marking guide:
– 0.5 marks for simplicity of accumulation method;
– 0.5 marks for projection method meets valuation standard automatically;
– 1 mark for sensible choice of preferred method with reason.
to a maximum of 2 marks (SJ).

(d) Differences in profit recognition will arise from:

- The embedded value method uses a risk discount rate (RDR) rather than the risk free rate used to discount the MoS liabilities.
- The embedded value method recognises profit / loss at inception to the extent that the product IRR is higher / lower than the RDR.
- The embedded value method capitalises any assumption changes, whereas profits are re-spread under MoS.
- The embedded value method recognises releases of capital which are not recognised under MoS.

Marking guide:
– 0.5 marks for RDR vs risk free rate;
– 0.5 marks for profit recognition at inception;
– 0.5 marks for capitalising assumption changes;
– 0.5 marks for recognising release of capital;
to a maximum of 2 marks (SJ).

The effect on profit recognition for this product:

- Considering the initial investment and returns given in the question, it is likely that the packaged product has a product IRR well above the RDR.
- Assuming this is true also of the group risk component, then the EV method is likely to recognise significant profit at inception.
- This will be offset by the use of a higher discount rate for EV.
- The capital requirements / release for this product should be modest.
- Therefore the recognition of profit at inception should mean the EV profit recognition will be faster than the MoS profit recognition.

Marking guide:
– 0.5 marks for high product IRR for product as a whole;
– 0.5 marks for EV method recognising profit at inception for group risk;
– 0.5 marks for offset of high RDR;
– 0.5 marks for modest capital requirement / release;

– 0.5 marks for faster profit recognition under EV;
to a maximum of 2 marks (CJ).

QUESTION 2 **(16 Marks)**

Analysis

Component	Aim	KU	SJ	CJ	Total
Part a)	3		3		3
Part b)	3, 1, 2		5		5
Part c)	3			3	3
Part d)	3, 6			5	5
Total			8	8	16

Question

You are the appointed actuary for ALC, an Australian life insurance company. Your company launched a new product in 2001 which has proven to be very successful.

The product is a unit-linked, single premium, ordinary investment fund that allows investors access to a balanced portfolio. The product provides a minimum benefit payment under the contract of the initial amount paid into the fund less the initial and ongoing fees payable. This guarantee applies after the fifth policy anniversary. The ongoing fee is 2.5% p.a. of the account balance, which includes a fee of 1% p.a. of the account balance to cover the cost of the guarantee ("option fees").

"Account balance" for a policy means the current value of units held after deduction of fees payable.

The fund has an investment mandate as follows:

Asset type	Benchmark	Minimum	Maximum
Australian equities	65%	50%	75%
Australian fixed interest	35%	25%	50%

Assume that investment returns were not exceptional between 2001 and 2005, but investment returns from the equity market in 2006 were negative. (This is an assumption for this question only.)

Some of the policies issued in 2001 were surrendered in 2006 for an amount higher than the account balance.

The results to date of the business have been as follows:

	Business written in 2001 ($'000)	Subsequent business ($'000)
Option fees received	**5,298**	**12,430**
Surrender payments paid in excess of account balances	**1,066**	**0**
Account balances at 31 December 2006 for remaining in-force policies	**83,658**	**219,094**
Surrender values at 31 December 2006 for remaining in-force policies	**92,441**	**219,094**

a) Estimate the accumulated loss to ALC of offering this option as at 31 December 2006 for the 2001 business, and for the subsequent business.
(3 Marks)

b) What principles would you apply in valuing this option in accordance with the standard on Valuation of Policy Liabilities (AS 1.04) for the 2001 business, and for the subsequent business ? **(5 Marks)**

c) Given this experience, how would you investigate whether the assumptions used in determining the option fee are still appropriate ? **(3 Marks)**

d) Market sentiment is gloomy at the end of 2006 and you are concerned about the impact of a further fall in share prices during 2007. What actions would you suggest in the short term to protect the company against further option losses ?
(5 Marks)

QUESTION 2: SOLUTION **(16 marks)**

(a) Estimate the cost of the option

- For the 2001 business the profit from the option is option premium received less option benefits paid less option value at 31 December 2006
  = 5,298 – 1,066 + 83,658 – 92,441
  = -4,551
  That is a loss of $4,551,000.
- The subsequent business has had less time to accumulate interest and dividends so the surrender value deficit at 31 December must be at least as high as a percentage of account values as the 2001 business so the estimated loss is:
  = 219,094 * (92,441 / 83,658 - 1) – 12,430
  = 10,572
  This loss is not yet vested as the policies have not yet been in-force for five years.

Marking guide:
- 1 mark for cost of 4,551 for 2001 business;
- 1 mark for estimate for later business;

– 1 mark for sound reasoning;
to a maximum of 3 marks (SJ).

(b) I would value the option as follows:

- AS 1.04 requires policy options to be included in the value of the policy liabilities on an appropriate basis.
- For the 2001 business the value of the option depends on future investment returns and the surrender rate in the period until the account balances catch up to the guaranteed surrender value. The key assumption is the rate of surrenders since the investment return will eventually cover the deficit. Given the size of the difference at 31 December 2006 the best estimate surrender assumption could be quite high, perhaps 50% pa.
- Thereafter the option still has a value reducing over time as the investment value progressively outpaces the guarantee, and this is best estimated by the use of stochastic methods.
- For the subsequent business stochastic modelling may also be used because the results depend on future investment earnings results and the outcomes are not symmetric.
- The option costs (and option fees) are included in the BEL and if the present value of future profits is negative the product will move into loss recognition and the PV of the losses would be recognised in 2006.

Marking guide:
– 1 mark for including cost of option in PL;
– 1 mark for key assumptions, investment returns and possible high surrenders, for the 2001 business;
– 1 mark for the option value when the option is "out of the money";
– 1 mark for use of stochastic methods for the subsequent business because results are not symmetric;
– 1 mark for potential loss recognition;
to a maximum of 5 marks (SJ).

(c) Review of the option fee

- Review the key assumptions such as returns, volatilities, correlations, and compare these with the assumptions used in the original pricing.
- Develop appropriate method / models and compare these with the method / models used in the original pricing.
- Ensure the method / models and assumptions chosen are consistent with the policy terms and the investment mandate.
- Carry out stochastic modelling using the chosen method / models and up-to-date assumptions to compare the expected cost of the guarantee with the current option fee.

Marking guide:
– 1 mark for reviewing assumptions;
– 1 mark for choosing appropriate method / models;
– 1 mark for consistency with policy terms and investment mandate;

– 1 mark for stochastic modelling of expected option cost vs current option fee;
to a maximum of 3 marks (CJ).

(d) Short term actions:

- Within the investment mandate increase the proportion of fixed interest investments to the maximum level permissible. This may reduce long term investment expectations but should reduce the cost of the guarantee in the short term.
- It may be worth buying derivatives (eg put options) to protect the fund against large falls in security values in the short term. The derivatives are likely to be expensive in the circumstances outlined in the question.
- Within the asset classes it should be possible to switch to less volatile investments than the current portfolio (eg shorter duration of fixed interest investments).
- Consider reinsuring part of this portfolio or otherwise share the risks with a third party.
- If the option has been under-priced for any reason, then re-price or discontinue the product.

Marking guide:
– 1 mark for use of mandate limits;
– 1 mark for using derivatives (expensive);
– 1 mark for switching to less risky investments within asset classes;
– 1 mark for reinsurance or risk sharing;
– 1 mark for re-pricing product if required;
to a maximum of 5 marks (CJ).

QUESTION 3 **(19 Marks)**

Analysis

Component	Aim	KU	SJ	CJ	Total
Part (a)	4	3			3
Part (b)	4, 10	3	4	1	8
Part (c)	4,10		4		4
Part (d)	4, 6, 10			4	4
Total		6	8	5	19

Question

You are an actuary working at a large Australian life insurance company. The company specialises in retail lump sum risk insurance products such as term life, total and permanent disablement, and trauma insurances. These products are sold through financial planners who are paid first year commissions of 100% of premiums and renewal commissions of 10% of premiums.

You have been asked to calculate the Solvency Requirement for this business which is treated as a single Related Product Group and written in a separate Statutory Fund. You have been provided with the following information:

Item	($'000)
Margin on Services Policy Liability	-23,440
Solvency Liability	-23,440
Minimum Termination Value	18,148
Expense Reserve	5,506
Current Termination Value	18,148
Other Liabilities	4,119
Inadmissible Assets Reserve	2,628
Resilience Reserve	2,684
Transitional adjustment	0

a) Calculate the Solvency Requirement from this information showing clearly the steps required as set out in the Solvency Standard (AS2.04).

(3 Marks)

b) The newly appointed Chief Financial Officer (CFO) reviews your calculations and is puzzled by some of the results. He asks you to explain :

(i) Why the Policy Liabilities for these products are negative.

(ii) Why the Solvency Liability is the same as the Policy Liability even though the assumptions used to calculate the Solvency Liability are more conservative than those used to calculate the Policy Liability.

(iii) Why there is a Resilience Reserve requirement even though the assets of this Statutory Fund are entirely invested in cash.

(iv) Why there is an Inadmissible Assets Reserve even though there are no significant counterparty risks and no investments in related companies in this Statutory Fund.

Draft a memo to the CFO giving your answers to each of these questions. (8 Marks)

c) The CFO has reviewed your calculation of the Capital Adequacy Requirement for this Fund and has sent you an email expressing surprise that the Capital Adequacy Requirement is the same as the Solvency Requirement. Draft a reply email to the CFO explaining how this might have occurred. (4 Marks)

d) The CFO has also reviewed your analysis of the claims experience of this business and observed that on your best estimate assumptions the actual / expected claims ratio for the business reinsured is lower than the ratio for the business retained. The CFO suggests that the surplus reinsurance program may not be effective and that the company's retention level should be increased for this business. Outline the main points you would make to the CFO on this suggestion. (4 Marks)

QUESTION 3: SOLUTION (19 Marks)

a) Calculate the Solvency Requirement

Start with Solvency Liability
Solvency Liability = -23,440

Greater of Solvency Liability and Minimum Termination Value
= Greater of -23,440 and 18,148
= 18,148

Add Expense Reserve
= 18,148 + 5,506
= 23,654

Greater of previous total and Current Termination Value
= Greater of 23,654 and 18,148
= 23,654

Add Other Liabilities
= 23,654 + 4,119
= 27,773

Add Inadmissible Assets Reserve
= 27,773 + 2,628
= 30,401

Add Resilience Reserve

= 30,401 + 2,684
= 33,085

There is no Transitional Adjustment

So total Solvency Requirement is 33,085 which is a significant margin above the Policy Liability of -23,440.

Marking guide:
- 1 mark for following all the steps in the right order;
- 1 mark for clearly showing the required steps;
- 1 mark for the correct final answer;

to a maximum of 3 marks (KU).

b) Memo to CFO

Memo to CFO
From Actuary
Dated:

The answers to your questions are as follows.

i) The negative policy liability represents largely the deferred acquisition costs related to the high first year commissions on this business and other acquisition costs. For Life Insurance companies this deferred acquisition cost is included in the policy liabilities (as a negative liability) rather than as an asset on the balance sheet. This enables the acquisition costs to be amortised in a way that planned profits are recognised over the lives of these policies in proportion to the profit carrier chosen.

OR

This could also be explained in terms of the projection method such that the present value of future claims, expenses and profit margins is less than the present value of future premiums given future premiums include an allowance to recoup acquisition costs which have already been experienced.

Marking guide:
- 0.5 marks for linking high initial commission to PL;
- 1 mark for DAC as a negative PL and the reason;

to a total of 1.5 marks (KU).

ii) The Solvency assumptions are more conservative than the Best Estimate MoS assumptions. However additional reserves are only required if the planned profit margins are insufficient to cover the more conservative scenario. Also the premium rates on these products could be increased, with due notice to customers and distributors to offset the more conservative experience and this can be allowed for in the Solvency Liability.

Marking guide:
- 1 mark for PL includes future profit margins as a buffer but SL does not;
- 1 mark for allowance for future premium rate changes;

to a total of 2 marks (SJ).

iii) The Solvency liabilities for the Resilience test are reserves for unexpired risk, unreported claims and unpaid claims. These claims will not be paid immediately and so their value is affected by changes in economic assumptions. The value of the cash is not affected by changes in economic conditions and so the assets are not exactly matched by duration to the liabilities. The mismatch gives rise to the modest Resilience Reserve.

Marking guide:
- 1 mark for duration of the SL;
- 1 mark for mismatch with cash assets;

to a total of 2 marks (SJ).

iv) Apart from asset concentration risks and investments in subsidiaries the Inadmissible Assets Reserve also covers business assets held within the statutory fund that could not be realised for the value at which they are held in the accounts. This item covers items such as computer software and future income tax benefits.

Marking guide:
- 0.5 marks for components of the Inadmissible Assets Reserve;
- 1 mark for business assets;

to a total of 1.5 marks (KU).

Marking guide:
- 1 mark for memo format and clarity of expression for Part b) of this question;

to a total of 1 mark (CJ).

c) Capital Adequacy equals Solvency

Email to CFO
From Actuary
Dated:

For this business the Minimum and Current Termination Benefits are considerably higher than the Solvency Liabilities and it is likely they are also higher than the Capital Adequacy Liabilities. So the starting point for both calculations is the Termination Benefits.

The Solvency Requirement includes an Expense Reserve. Solvency Reserves are intended to ensure that a company can close to new business and still meet its policy and other liabilities. The Expense Reserve is to meet redundancy and other acquisition costs which do not cease immediately when the new business ceases. There is no Expense Reserve for the Capital Adequacy Requirement, so on this account alone the Solvency Requirement is higher than the Capital Adequacy Requirement.

This is to offset to some degree by a higher Resilience Reserve and/or Inadmissible Assets Reserve under the Capital Adequacy calculation, but the Solvency Requirement may still be higher than the Capital Adequacy Requirement. The Actuarial Standard prescribes that in this situation the Capital Adequacy Requirement is set equal to the Solvency Requirement.

In addition, a New Business Reserve is then added to the Capital Adequacy Requirement, however given this is a large Life Office it is likely that the profits from the in-force business are sufficient to fund the New Business and therefore no New Business Reserve is likely to be required.

Marking guide:
- 1 mark for similar MTV;
- 1 mark for expense reserve;
- 1 mark for resilience reserve and inadmissible assets reserve;
- 1 mark for new business reserve unlikely to be required;

to a total of 4 marks (SJ)

d) Reinsurance coverage

For this business the company retains the risk on each policy up to the retention level and the reinsurer has the risk above that level. This means that the reinsurer has a bigger exposure to the larger cases which are more tightly underwritten than the smaller cases. So it is normal that the actual / expected ratio for the reinsured business is lower than the ratio for the retained business and this is allowed for in the reinsurance terms.

This business is capital intensive because of the high first year costs and one of the advantages of the reinsurance program is that it reduces the capital needs for a given volume of business. Another advantage is that the claims experience is smoothed from year to year which reduces the volatility of published profits.

The disadvantage of the reinsurance program is the profit and expense margins of the reinsurer.

So the choice of a retention level is a balance between the advantages and disadvantages listed above. The statistical distribution of total claims can be modelled to help set an optimal level of reinsurance.

Reinsurance terms are set by commercial negotiation and the reinsurance market is competitive so it is worthwhile tendering reinsurance contracts at regular intervals.

Marking guide:
- 1 mark for explanation of the difference in the claims ratios between the direct insurer and reinsurer:
- 1 mark for noting this may be allowed for in the reinsurance terms;
- 1 mark for the assistance with capital requirements;
- 1 mark for the costs of reinsurance;
- 1 mark for overall clarity and expression in drafting the memo;
- 1 mark for reviewing competitive reinsurance terms;

to a maximum of 4 marks (CJ).

QUESTION 4 **(20 Marks)**

Analysis

Component	Aim	KU	SJ	CJ	Total
Part a)	5		6		6
Part b)	1, 2			6	6
Part c)	7			2	2
Part d)	2			6	6
Total			6	14	20

Question

You are an actuary working in the valuation department of Australian Life Company ("ALC") which is a subsidiary of Australian Bank Company ("ABC"). ALC has a portfolio of lifetime annuities. About half of the annuities provide payments which are increased annually in line with inflation.

The profitability of this business has been unsatisfactory. Three years ago as a result of poor investment, expense and mortality experience, the product was reviewed and the following actions taken:

- **the product was closed to new business**
- **the investments supporting the liabilities were changed to long duration fixed interest securities issued by government enterprises, including inflation-linked bonds, which overall provide a reasonable match to the duration of the annuity liabilities**
- **the best estimate assumptions for the portfolio were revised, the product moved into loss recognition and a significant loss was recognised that year.**

You have been asked to make a preliminary review of the experience of the portfolio for the current year starting with an analysis of experience for this year. You are provided with the following information:

	Expected Results ($'000)	Actual Results ($'000)
Total assets boy	**608,131**	**608,131**
Policy liabilities boy	**539,885**	**539,885**
Annuity payments	**47,355**	**47,272**
Management expenses	**3,137**	**2,748**
Investment income on total assets	**34,995**	**35,593**
Total assets eoy	**592,634**	**593,704**
Policy liabilities eoy	**520,293**	**519,844**
Profit	**4,095**	**5,614**

Where "boy" is beginning of the year and "eoy" is end of the year.

The policy liabilities at the end of the year are calculated using the same assumptions used for the policy liabilities at the beginning of the year.

(a) Analyse the profit between investment income on the excess assets, the planned profit, and the experience profit and further analyse the experience profit between investment earnings, management expenses and mortality. For this purpose assume annuity payments and management expenses were paid mid-way through the year and that inflation adjustments to annuity payments were exactly as expected.
(6 marks)

(b) These results are forwarded to the company's chief accountant (CA). The CA asks you whether the best estimate assumptions can now be improved and some of the past loss recognition reversed in the current year. Comment on the likely causes of this year's experience and the considerations involved in changing the best estimate of each assumption.
(6 marks)

(c) You conclude that it is not appropriate to change the best estimate assumptions this year. The CA is not convinced and points to a table in last year's embedded value report which attributes substantial value of in-force business to the annuity portfolio. Briefly explain to the CA the reasons for this. **(2 marks)**

(d) The CA considers this for some time and then asks you whether the best estimate assumptions might be changed in the following circumstances:
(i) the annuity payment process is outsourced to a department of ABC which specialises in regular transfers of funds, with the prospect of substantial expense savings
(ii) the investments are changed to good quality corporate bonds with higher credit risk margins than the current investments
Comment on whether each of these suggestions would be effective in reversing the loss recognition, and what general considerations would apply in each case. **(6 marks)**

QUESTION 4: SOLUTION **(20 marks)**

(a) Analysis of profit

Expected Inv Earnings = 2*I / (A+B-I)
= 2 * 34,995 / (608,131 + 592,634 – 34,995)
= 6%
Actual Investment Earnings = 2 * 35,593 / (608,131 + 593,704 – 35,593)
= 6.1%
Expected earnings on excess assets = 6% * (608,131 – 539,885)
= 4,095
So planned profit is nil as expected for loss recognition.

Actual earnings on excess assets = 6.1% * (608,131 – 539,885)

= 4,163
Planned profit = 0
Therefore experience profit = 5,614 – 4,163
= 1,451

Investment earnings profit = 35,593 – 4,163 –
6% * 539,885 + (1.06^.5 – 1) * (47,272 + 2,748)
= 516

Expense profit = (3,137 – 2,748) * (1.06^.5)
= 401

Mortality profit = (47,355 – 47,272) * (1.06^.5) +520,293 – 519,844
= 534

Check 516 + 401 + 534 = 1,451

Marking guide:
- 1 mark for earnings rates;
- 1 mark for nil planned profit;
- 1 mark for earnings on excess assets
- 1 mark each for interest expense and mortality profits;

to a total of 6 marks (SJ).

(b) Interpretation of results

Investment earnings

Likely causes
- Profit may result from changes in market conditions, eg reduced interest rates resulting in unrealised gains on the fixed interest securities and index-linked securities
- Credit risk margins could be higher than assumed

Changes to best estimate assumption
- Investment profits from changes in the market level of risk-free interest rates will not lead to loss reversal because they will be offset against asset gains / losses each year. This is not true to the extent of mismatched assets and liabilities but the question states there is reasonable matching
- If the credit risk margins are higher than expected and this is sustainable, this should be reflected in the investment earnings assumption (with no change to risk discount rates) and would lead to loss reversal.

Marking guide:
- 0.5 mark for change in economic conditions;
- 0.5 mark for change in credit risk margins;
- 0.5 marks for market changes not affecting loss reversal;
- 0.5 marks for credit risk margins;

to a total of 2 marks (CJ).

Expenses

Likely cause
- Possibly the expense allowances were set at a time when there was a lot of work relating to the review
- Reduced expenses may reflect the closure to new business
- Check expense allocation to see if all direct and overheads expenses relating to this portfolio have been properly allocated.

Considerations
- Best estimate assumptions must reflect the expected level in the year following the valuation date, therefore need to review the management budget for expenses
- Also check the expense allocation for this year and the experience of recent past years for consistency
- If the reductions in expense levels are considered sustainable then a change would lead to loss reversal

Marking guide:
– 0.5 mark for reduction in costs since business review;
– 0.5 mark for reduced costs following business closure;
– 0.5 mark for checking expense allocation for completeness and consistency;
– 0.5 mark for reviewing budget for next year;
– 0.5 mark for loss reversal if sustainable;
to a total of 2 marks (CJ).

Mortality

Likely cause
- More deaths than expected leading to reduced payments and claims liabilities
- Possibly assumed level of mortality improvement has proved too strong
- Possibly catch-up of deaths not picked up in previous years

Considerations
- How credible is the experience? Check statistical significance and check for consistency with the results in recent years.
- Also review industry experience analysis and trends for consistency.
- If claims experience is credible and sustainable (and not caused by admin errors) then a change would lead to loss reversal.

Marking guide:
– 0.5 mark for lower mortality improvement;
– 0.5 mark for timing of claims / administration delays;
– 0.5 mark for credibility of experience;
– 0.5 mark for reviewing industry experience and trends;
– 0.5 mark for loss reversal if credible and sustainable;
to a total of 2 marks (CJ).

(c) Consistency with EV

Main points are:
- Value of in-force reflects a combination of future losses and release of the capital supporting the business.
- The capital support for annuity products is high because of the long term mortality and investment risks. This is exacerbated if there are no future profit margins to act as a buffer against adverse experience.
- The positive value of the in-force reflects the release of these capital margins.

Marking guide:
– 1 mark for high capital support for annuities;
– 1 mark for VIF includes the release of this capital;
to a total of 2 marks (CJ).

(d) Suggestions for change

Outsourcing

- If expenses can be reduced sustainably by outsourcing or any other method this can lead to loss reversal.
- The servicing expenses will reflect the costs of confirmations that annuitants are still alive and inflation adjustments which are probably not part of the bank's transfer payments systems. Must check that the proposed system has all the required functionality
- The payments system must link into the general ledger system of ALC. There may be some costs in achieving this.
- For any outsourcing agreement a written service agreement will be required and some monitoring of service standards. The costs of these items will need to be allowed for.

Marking guide:
– 1 mark for system capability (inflation and status checks);
– 1 mark for linking to ALC accounting system;
– 1 mark for cost of outsourcing;
– 1 mark for loss reversal if change is sustainable;
to a total of 3 marks (CJ).

Corporate bonds

- The additional credit risk margins should be allowed for in the best estimate assumptions and can lead to loss reversal
- Note that it is often difficult to obtain corporate bonds of long duration and with inflation linking. If the level of matching in the portfolio is reduced then this potentially increases risk for ALC and also capital requirements
- If the level of credit risk becomes significant it may be appropriate for the actuary to allow for this in the capital requirements also.
- Inadmissible asset requirements are tighter for corporate bonds than for government bonds so the investment portfolio may need to be more diverse if invested in corporate bonds. This applies also to any exposure to ABC.

Marking guide:
– 1 mark for suitability of corporate bonds (duration, index linking);

– 1 mark for affect on capital requirements;
– 1 mark for loss reversal from increased credit risk margins;
to a total of 3 marks (CJ).

QUESTION 5 **(15 Marks)**

Analysis

Component	Aim	KU	SJ	CJ	Total
Part (a)	1, 5	4			4
Part (b)	5, 12		6		6
Part (c)	5, 12			5	5
Total		4	6	5	15

Question

You are the valuation actuary for Nice Tidy Finance (NTF), a life insurance company based in an Asian country selling traditional business. NTF has been in operation for many years and has been successful in attracting new business in a highly competitive market.

NTF has declared a reversionary bonus rate of 4% annually on its whole of life product. Currently there is no terminal bonus paid on this product. Shareholders receive a profit payment of 25% of the declared bonus. The valuation has recently been completed and the bonus rate to be declared for the current year is being discussed.

Information extracted from the most recent valuation is as follows:

	($'000)
Value of supporting assets (VSA)	**128,463**
Present value of sum insured and previously declared bonus (PVB)	**80,932**
Present value of expenses (PVE)	**16,111**
Present value of premiums (PVP)	**100,000**

Bonus rate declared	Present value current year bonus ($'000)	Present value future years bonuses ($'000)
4%	**2,790**	**61,720**
6.5%	**4,571**	**100,565**
9%	**6,430**	**124,990**

An analysis of the sources of profit and retained earnings has revealed that the profit has arisen from the following sources:

Source	Percentage share (%)
Mortality	**68**
Investment market movements	**23**
Expenses	**-12**
Surrenders	**21**
Total	**100**

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a) Determine the supportable bonus rate for this product. (4 marks)

b) Identify the issues you would consider when setting the current year's bonus rate for this product. (6 marks)

c) NTF has just announced it is having discussions with a larger competitor which wishes to purchase the business of NTF. The Board of Directors of NTF are concerned to protect the entitlements of the NTF participating policyholders and have informally raised this issue with you. Outline three ways in which the interests of the participating policyholders could be compromised after the proposed purchase and suggest two alternative methods of providing protection for these policyholders in the purchase agreement. (5 marks)

QUESTION 5: SOLUTION (15 Marks)

(a) Supportable bonus rate

VSA = PVB + PVE – PVP + CYSB + CYSM + FYSB + FYSM

Where CYSB is current year supportable bonus, CYSM is current year shareholder margin and the other terms are identified similarly.

Therefore:

CYSB + CYSM + FYSB + FYSM = VSA - PVB - PVE + PVP
= 131,420

CYSM = .25 x CYSB and FYSM = .25 x FYSB

So:

{CYSB + FYSB} x 1.25 = 131,420

CYSB + FYSB = 105,136

From the table, with a bonus rate of 6.5% this gives 4,571 + 100,565 = 105,136.

The supportable bonus rate is 6.5%.

Marking guide:

- 1 mark for correct formula;
- 1 mark for PV bonus + PV shareholder margin;
- 1 mark for adjusting 25%;
- 1 mark for identifying correct supportable bonus rate;

to a total of 4 marks (KU).

(b) Issues when setting the bonus rate:

- Investment market/economic outlook – the PVs are assumed calculated on best estimate assumptions but how variable are future returns ? If there is a significant proportion of growth assets in the fund the bonus philosophy may need to be more flexible and include some terminal bonus component. If not the results argue for an increase in the reversionary bonus rate.

- Bonus policy and PRE – Bonus policy should be in line with PRE and the previous policy of NTF. This will influence the variability of bonus declarations and the form of bonus declarations. Unless the VSA increased significantly last year, the issue of increasing bonuses must have been considered in previous years and some precedents established.

- Shareholders will prefer an increase in bonuses so that their proportionate share of the profits from the par fund vest earlier.

- Capital adequacy – check whether the proposed bonuses create any additional capital adequacy requirements for NTF.

- Competition - NTF has been competing successfully in a competitive market with a bonus rate of 4%. Given NTF's favourable position now, how has this been achieved and what actions are competitors expected to take to be competitive with NTF ?

- Sources of profit - Substantial profits have arisen from mortality and surrenders which may suggest that death benefits in particular are set too low. Again this may suggest a move towards a terminal bonus system with the terminal bonuses being paid on death claims as well as long-term surrenders.

- New business. The supportability of current bonuses for new business needs to be considered. Should the benefits of the current build-up in the VSA be shared with new policyholders who have not contributed to the build-up ?

Marking guide:
- 1 mark for economic outlook;
- 1 mark for bonus policy and PRE;
- 1 mark for shareholder considerations;
- 1 mark for check on capital adequacy issues;
- 1 mark for competition issues;
- 1 mark for source of profits;
- 1 mark for bonus supportability for new business;

to a maximum of 6 marks (SJ).

(c) The par products of NTF may be closed to new business after the purchase and there would then be no need for the new shareholders to maintain competitive bonus rates. The risk is that the new shareholders may attempt to transfer value from the closed portfolio of NTF par policies to themselves by:

- Increasing the expense allocation to this portfolio (of which 80% would be borne by the par policyholders through reduced bonuses over time) and reducing the expense allocation to the non-par business to the benefit of the new shareholders.

- Merging the par business of NTF with the par business of the purchaser and using the VSA of the NTF portfolio to subsidise new business for the purchaser.

- Underpaying bonuses to the NTF par policyholders in the hope that the residual VSA when the policies are finally paid out will revert to the shareholders of the purchaser.

Two methods to protect the entitlements of these policyholders would be:

- Link the bonus rates for the NTF policies to the bonus rates declared over time on a comparable product of the purchaser which remains open to new business.

- Ring-fence the VSA for the existing NTF policyholders with some independent professional oversight to ensure fair treatment.

Marking guide:
- 1 mark for expense allocation;
- 1 mark for subsidising new business;
- 1 mark for underpaying bonuses;
- 1 mark for bonus-linking;
- 1 mark for ring-fencing the NTL par fund;

to a maximum of 5 marks (CJ).

QUESTION 6 **(15 Marks)**

Analysis

Component	Aim	KU	SJ	CJ	Total
Part a)	8	5			5
Part b)	7		3		3
Part c)	8, 6			7	7
Total		5	3	7	15

Question

You have recently been engaged as a consulting actuary to Sleepy Life Limited ("SLL"). The owners of SLL have decided in principle to sell the company because they have not been able to achieve satisfactory returns from their investment.

SLL sells a range of non-participating products through its single statutory fund. The appointed actuary of SLL calculated the MoS profits for the year ending 31 December 2006 and your first assignment was to calculate an appraisal value of SLL at that date.

You adopted a risk discount rate (net of tax) of 12% p.a. and otherwise used the MoS best estimate assumptions which included a net investment earnings rate of 5% p.a. To value the new business you calculated the PV at 31 December 2006 of projected earnings from SLL's budgeted new business (volume and product mix) for the 2007 calendar year. This resulted in a value of one year's new business of -$8 million. After some thought you decided to value the future new business by multiplying the value of one year's new business by a multiplier of 2. The results are shown in the following table:

	31 December 2006 ($ millions)
MoS Liabilities	362
Other Liabilities	0
Shareholder Capital and Retained Profit	85
Total Liabilities and Equity	447
Assets (100% cash)	447
Total Capital Adequacy Requirement	432
Value of Net Worth	15
Value of In-force	189
Value of New Business	-16
Total Appraisal Value	188

In this question you can assume that all cash flows are at year-end.

a) The owners realise that it will be some time before the sale will take place and ask you to make an estimate of the embedded value of the company at 31 December 2007 using only the above information. Show your calculation explaining each step and stating clearly the assumptions you have made.
(5 marks)

(b) The owners are concerned about the negative value of future new business. Explain how the negative value arises and its implications for a prospective buyer of SLL. (3 marks)

(c) The owners ask for your advice as to how to fix the negative value of new business in the short term. Set out the steps you would take to assist the owners in addressing this issue. (7 marks)

QUESTION 6: SOLUTION (15 marks)

a) Roll forward of EV

The assumptions are:

- The experience in 2007 is exactly in line with the MoS assumptions
- The MoS assumptions are unchanged at 31 December 2007
- No dividend is paid in 2007
- The new business written in 2007 is the same by volume and product mix as the VNB assumptions.

Marking guide:
- 0.5 marks for experience in line with MoS assumptions;
- 0.5 marks for no change in MoS assumptions;
- 0.5 marks for no dividend;
- 0.5 marks for new business as expected;

to a maximum of 2 marks (KU).

Value of Net Worth increases with net fund earnings rate ie

Value of Net Worth = 15 * 1.05
= 15.75

Value of In-force increases with net risk discount rate ie

Value of In-force = 189 * 1.12
= 211.68

Add value of new business written in 2007 to the in-force at the end of 2007:

Value of In-force = 211.68 – 8.00 * 1.12
= 202.72

Embedded Value = Value of Net Worth + Value of In-Force
= 15.75 + 202.72
= 218.47

Marking guide:
- 1 mark for Value of Net Worth;
- 1 mark for Projected value of In-force;
- 1 mark for deduction for new business;

to a maximum of 3 marks (KU).

b) Negative value of new business

The negative value of new business arises because the internal rate of return on the capital invested to support the assumed volumes and mix of new business is lower than the risk discount rate used to calculate the PV.

This means the new business acquisition activities of SLL are not meeting shareholder objectives in terms of the RDR required on their capital.

Ceasing new business would increase the appraisal value, but this can not be achieved overnight hence the low multiplier of 2 in the calculation of the AV.

Implications for the buyer are that there is currently no "goodwill" value of the business of SLL. At worst the buyer can close down the new business operations but on the upside there may be the opportunity to add value by introducing new products to SLL distribution or by selectively selling the products which do have a positive VNB.

A common reason for negative VNB is insufficient volume to cover the overhead acquisition costs. A buyer may be able to increase volumes through adding distribution.

Marking guide:
- 1 mark for explaining negative value of NB;
- 0.5 marks for explaining low multiplier;
- 0.5 mark for closing down new business;
- 1 mark for selectively maintaining good business;
- 1 mark for addressing lack of NB volumes;

to a maximum of 3 marks (SJ).

c) Address the issue

Step 1:
Analyse the VNB by product and distribution channel to identify which business produces positive VNB and which produces negative VNB.

Step 2:
Look at relevant value added by policyholder sub-segments (eg split by sum insured band, aged band, investment size) to determine if any policy features should change, eg introduce minimum premiums, investment sizes, raise premiums for certain age bands, etc

Step 3:
Review the analysis of profit by product and/or by distribution for the last several years to identify the cause of the unsatisfactory results. This could point to problem areas such as underwriting or claims management standards.

Step 4:
Compare the products and distribution costs of SLL with the products and distribution costs of its competitors to look for opportunities for re-pricing. Also consider whether SLL has an appropriate product range for its distribution.

Step 5:
Check that the best estimate assumptions used in the MoS and AV calculations are consistent with those used in the product pricing. There may be a need to re-price.

Step 6:
Review the expense analysis to determine whether there are opportunities for reducing expenses particularly in the acquisition costs.

Step 7:
Understand sensitivity to new business volumes. Investigate if the issue is related to economies of scale / low sales volumes such that overhead costs cannot be covered. In this case, ways to increase sales volumes could also be explored.

Step 8:
Investigate if the problem is due to high lapses, especially at early durations, and if so, whether this relates to particular parts of the distribution network.

Step 9:
Draw conclusions from the above analysis and report these clearly to the owners.

Marking guide:
- 1 mark for analysis by product and distribution channel;
- 1 mark for analysis by PH sub-segment;
- 1 mark for review of past analysis of profits;
- 1 mark for competitor analysis;
- 1 mark for checking pricing assumptions and possible re-pricing;
- 1 mark for review of expense analysis for expense savings;
- 1 mark for lapses at early durations;
- 1 mark for understand sensitivity to new business volumes;
- 1 mark for clear report to the owners;

to a maximum of 7 marks (CJ).

END OF PAPER