EXAMINATION

5 October 2009 (am)

Subject CT5 — Contingencies
Core Technical

Time allowed: Three hours

INSTRUCTIONS TO THE CANDIDATE

1. *Enter all the candidate and examination details as requested on the front of your answer booklet.*

2. *You must not start writing your answers in the booklet until instructed to do so by the supervisor.*

3. *Mark allocations are shown in brackets.*

4. *Attempt all 14 questions, beginning your answer to each question on a separate sheet.*

5. *Candidates should show calculations where this is appropriate.*

Graph paper is not required for this paper.

AT THE END OF THE EXAMINATION

Hand in BOTH your answer booklet, with any additional sheets firmly attached, and this question paper.

In addition to this paper you should have available the 2002 edition of the Formulae and Tables and your own electronic calculator from the approved list.

1 Evaluate ${}_{20}q^{2}_{[45]:[45]}$

Basis: AM92 Select for both lives. [3]

2 Give an expression for the expected present value of a benefit of 1 under a critical illness assurance contract for a healthy life aged x for term of n years. [3]

3 Calculate ${}_{0.5}q_{72.25}$ using the assumption of a constant force of mortality.

Basis: PMA92Base [3]

4 Using the following data:

Age	*Population*	*Number of deaths*
40	121,376	104
41	134,292	127
42	133,277	132

(i) Calculate the crude mortality rate for the total population. [1]

(ii) Calculate the standardised mortality ratio for this population using AM92 Ultimate. [3]

[Total 4]

5 Derive an expression for the variance of the present value of a temporary annuity-due in terms of assurance functions for a life aged x with a term of n years. [4]

6 A life insurance company sells annual premium whole life assurance policies with benefits payable at the end of the year of death. Renewal expenses are incurred at the start of each year, and claim expenses are nil.

(a) Write down a recursive relationship between the gross premium reserves at successive durations, calculated on the premium basis. Define all symbols used.

(b) Explain the meaning of this formula in words.

[4]

7 (a) State what is meant by direct expenses incurred by a life insurance company in respect of a life insurance contract.

(b) Describe three different categories of direct expenses and give an example of each.

[5]

8 (i) Identify three classes of pensioner in receipt of a benefit from a pension fund. [3]

(ii) Give two examples of selection that might be exhibited by these pensioners.[2]

[Total 5]

9 (i) Describe how insurance companies use responses to questions from prospective policyholders to ensure the probability of a profit is set at an acceptable level. [5]

(ii) Explain why an insurance company might not use questions requesting genetic information from prospective policyholders? [3]

[Total 8]

10 A pension fund provides a pension from normal retirement age of £1,000 per annum for each complete year of service. The pension is payable monthly in advance for 5 years certain and for the whole of life thereafter and is only paid if the life remains in service to normal retirement age of 65.

Calculate the expected present value of the pension for a new entrant aged 62 exact.

Basis: Interest: 4% per annum
Mortality after retirement: PMA92C20
Independent decrement rates before retirement

Age x	q_x^d	q_x^w
62	0.005650	0.015672
63	0.006352	0.078441
64	0.007140	0.055654

[8]

11 A life insurance company offers special endowment contracts that mature at age 65. Premiums are payable annually in advance on 1 January each year. The sum assured payable at the end of year of death during the term is one half of the sum assured that will be paid if the policyholder survives until maturity.

Details of these contracts in force on 31 December 2007 are:

Exact age	*Total sums assured payable on maturity (£)*	*Total annual premiums (£)*
60	12,250,000	440,000

The claims in 2008 were on policies with the following total sums assured and annual premiums:

Total sums assured payable on maturity (£)	*Total annual premiums (£)*
200,000	7,000

Calculate the mortality profit or loss in 2008 given that the company calculates reserves for these contracts using the gross prospective method.

Basis: Mortality: AM92 Ultimate
Interest: 4% per annum
Expenses: Nil

[9]

12 (i) Define in words $1000\bar{A}^{2}_{x:y}$. [3]

(ii) Calculate:

(a) $1000\bar{A}^{2}_{30:40}$

(b) The annual premium payable continuously until the 2nd death for the above assurance in (a) with a sum assured of £1,000.

Basis: μ = .02 for a life aged 30 exact at entry level throughout their life
μ = .03 for a life aged 40 exact at entry level throughout their life
δ = .05 throughout
Expenses: Nil

[7]

(iii) Outline the main deficiency of the above premium paying scheme and suggest an alternative. [3]

[Total 13]

13 A life insurance company issues a 35-year non profit endowment assurance policy to a life aged 30 exact. Level premiums are payable monthly in advance throughout the term of the policy. The sum assured of £75,000 is payable at maturity or at the end of year of death of the life insured, if earlier.

(i) Show that the monthly premium is approximately £74.

Basis:	Mortality:	AM92 Select
	Interest:	6% per annum
	Initial expenses:	£250 plus 50% of the gross annual premium
	Renewal expenses:	£75 per annum, inflating at 1.92308% per annum, at the start of the second and subsequent policy years and 2.5% of the second and subsequent monthly premiums
	Claims expense:	£300 inflating at 1.92308% per annum
	Inflation:	For renewal and claim expenses, the amounts quoted are at outset, and the increases due to inflation start immediately.

[7]

(ii) The insurance company calculates a surrender values equal to the gross retrospective policy value, assuming the same basis as in (i) above.

Calculate the surrender value at the end of the 30^{th} policy year immediately before the premium then due. [7]

[Total 14]

14 A life insurance company issues a special term assurance policy for a 3-year term. Under the policy, a sum assured of £10,000 is paid at the end of the year of death. In addition on survival to the end of the term 50% of total premiums paid are returned.

Basis:		
	Initial expenses:	20% of the first year's premium
	Renewal expenses:	5% of 2nd and 3rd years' premiums
	Reserves:	Net Premium using AM92 Ultimate at 4% interest (allowing for return of 50% of net premiums paid on survival)
	Mortality experience:	80% AM92 Select
	Withdrawals:	20% in year 1, 10% in year 2 (with all withdrawals assumed to occur at end of year)
	Surrender Value:	Nil
	Interest earned:	6% per annum
	Risk discount rate:	10% per annum

(i) On the basis of the above information, calculate the level annual premium payable in advance for a life aged 57 exact to achieve the required rate of return. [12]

(ii) Discuss the effect of increased withdrawal rates on the rate of return to the company from this policy. [2]

Following comments from the marketing department, it has been decided to allow a surrender value at the end of years 1 and 2 equal to 25% of total premiums paid.

(iii) Calculate the revised annual premium using the basis above. [3]

[Total 17]

END OF PAPER