

INSTITUTE AND FACULTY OF ACTUARIES

EXAMINATION

13 April 2021 (am)

Subject CM1B - Actuarial Mathematics Core Principles

Time allowed: One hour and forty-five minutes

<p>In addition to this paper you should have available the 2002 edition of the Formulae and Tables and your own electronic calculator.</p>
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If you encounter any issues during the examination please contact the Assessment Team on
T. 0044 (0) 1865 268 873.

1 Mortality tables for males and females are given in the Q1 Base worksheet.

Calculate the probability for a male life aged 25 exact and a female life aged 27 exact that:

- (a) both lives are still alive on the date of the female's 60th birthday.
- (b) both lives have died before the date of the female's 60th birthday.
- (c) the female has died before age 60 exact and the male life is still alive at the end of the year of the female's death.

[14]

2 The Q2 Base worksheet contains data from 20 different banks, labelled A to T. For each bank, you are given the effective annual yield available on non-income bearing investments of different terms ranging from 1 to 10 years.

- (i) Calculate the 10-year par yield offered by each bank. [7]
- (ii)
 - (a) Determine which bank offers the highest 1-year forward rate at time 3 years.
 - (b) Determine which bank offers the highest rate of interest on a 2-year forward investment starting at time 6 years.

[8]

An investor would like to purchase a 10-year increasing annuity certain, payable annually in arrears, from one of the banks. The first annuity payment, made at the end of the first year, will be \$1,000. Subsequent payments will increase by a fixed amount of \$500 each year.

- (iii) Determine which bank would provide the annuity at the lowest cost. [8]
- (iv) Calculate the effective annual rate of return achieved by the investor on purchasing the annuity from the bank as determined in part (iii). [5]
- (v) Calculate the duration of the annuity determined in part (iii). [5]

[Total 33]

- 3** A life insurance company issues a new 20-year without-profit endowment assurance to lives aged 40 exact. The sum assured of £100,000 will be paid if the policyholder dies during the term of the policy or on survival to the end of the policy term. The death benefit is payable at the end of the policy year of death.

Surrender of the policy is permitted at any time during the policy year. The surrender value is equal to the net premium reserve held at the beginning of the policy year of surrender and is payable immediately on surrender.

Premiums of £4,000 are payable annually in advance throughout the term of the policy or until earlier death.

The company will hold net premium reserves for this policy. The valuation basis is given in the Q3 Valuation Basis worksheet.

- (i) Determine the net premium reserves for each policy year. [10]

All the assumptions used to perform the profit test of the policy are contained in the Q3 Profit Test Basis worksheet.

- (ii) Determine the profit test dependent rates of mortality and surrender for each policy year. [10]

- (iii) Determine the profit margin for the policy. [33]

[Total 53]

END OF PAPER