

INSTITUTE AND FACULTY OF ACTUARIES

EXAMINATION

10 April 2019 (am)

Subject CM1B – Actuarial Mathematics Core Principles

Time allowed: One hour and forty-five minutes

INSTRUCTIONS TO THE CANDIDATE

1. *You are given this question paper and three Excel files.*
2. *Mark allocations are shown in brackets.*
3. *Attempt all questions. Each question is to be answered in a separate document.*

If you encounter any issues during the examination, please contact the Examination Team at
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- 1** A loan of £250,000 is taken out at an effective rate of interest of 3.5% per annum for the first three years and an effective rate of interest of 7.5% per annum thereafter.

For the first 18 months, no loan repayments are made. After this time, level loan repayments are made monthly in arrears such that the loan will be fully repaid 25 years after it is taken out. If repayments are insufficient to cover the interest due then the loan will be increased to cover the shortfall.

Construct the loan schedule. [14]

- 2** A coffee company is opening a new store in a large town. The company purchased the premises for £500,000 on 1 January 2019. The total cost of refurbishing the premises will be £1,500,000 which will be incurred in six equal instalments payable monthly in advance with the first payment made on 1 October 2019.

The store is expected to open on 1 May 2020 and is expected to sell cups of coffee each month as shown in the base sheet of the CM1 Q2 workbook, with each cup of coffee assumed to sell for £3. All income from coffee sales can be assumed to be received continuously during the month.

The costs of staffing and maintaining the new store will be £10,000 per month payable continuously from 1 May 2020 and it is assumed that these will increase on each 1 September by 2% per annum effective. It is also assumed that all costs and income will cease at the end of 2030.

The risk discount rate is 12% per annum effective.

- (i) (a) Calculate the net present value of the proposed store and determine whether the store is profitable. [16]
- (b) Calculate the discounted payback period to the nearest month. [4]
- (c) Calculate the internal rate of return. [4]

The company now assumes that the price of cups of coffee increases by 5% at the start of each calendar year, with the first increase on 1 January 2023.

- (ii) Calculate the revised net present value. [6]
- (iii) Comment on your answers to part (i)(a) and part (ii) and the suitability of the underlying assumptions made. [8]

[Total 38]

- 3 A life insurance company issues a 25-year variable premium unit-linked endowment assurance to a life aged 45 exact. Under this policy, the premiums increase by fixed monetary amounts for the first five years of the policy and then remain constant thereafter. The premiums, which are payable annually in advance throughout the term of the policy or until earlier death, and the allocation rates are as follows:

<i>Policy year</i>	<i>Premium payable</i> £	<i>Allocation rate</i> %
1	1,500	45
2	1,500	45
3	1,850	100
4	2,000	100
5	2,250	100
6–25 inclusive	3,000	105

If the policyholder dies during the term of the policy, the death benefit is £100,000 or the bid value of units, whichever is higher, and is payable at the end of the policy year of death. The policyholder may surrender only at the end of each policy year. On survival to the end of the policy term, or on surrender, the bid value of units is payable.

The units are subject to a bid-offer spread of 6% and an annual management charge of 1% of the bid value of units is deducted at the end of each policy year. Management charges are deducted from the unit fund before death, surrender and maturity benefits are paid.

The assumptions used to profit test this policy are given on the “Profit Test Assumptions” sheet of the CM1 Q3 workbook.

- (i) Determine, for each policy, the dependent rates of mortality and surrender for ages 45 to 70 inclusive. [5]

The unit fund cashflow for this policy is given in tab ii of the of the CM1 Q3 workbook.

- (ii) Calculate the profit margin for the policy. [20]

The company is considering making an Accumulating With Profit (AWP) version available as an investment option for new policyholders. Under the AWP version, all premiums are paid into an account rather than being allocated to units. The account grows at a bonus interest rate declared annually by the company. A terminal bonus is added to the account to give the total benefit payable on maturity or on earlier death. The benefit on surrender is the value of the AWP account. No terminal bonus is added on surrender.

The company expects to pay an annual bonus of 2% per annum. All other profit testing assumptions and policy conditions remain unchanged and you may ignore reserves.

- (iii) Calculate the percentage terminal bonus the company should expect to declare for the AWP option in order to give the same profit margin as the unit-linked option in part (ii).

[23]

[Total 48]

END OF PAPER