INSTITUTE AND FACULTY OF ACTUARIES

EXAMINATION

12 April 2022 (am)

Subject CM1 - Actuarial Mathematics
Core Principles

Paper B

Time allowed: One hour and fifty minutes

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

If you encounter any issues during the examination please contact the Assessment Team on T. 0044 (0) 1865 268 873.

1 A life insurance company issues a 25-year unit-linked policy to a life aged x exact. The profit vector of the policy and the relevant assumptions used to perform the profit test on this policy are given on the Q1 Base worksheet.

(i) Determine the reserves required at the end of each year to zeroise future negative expected cashflows for this policy. [6]

(ii) Calculate the present value of profits both before and after allowing for the reserves calculated in part (i). [10]

(iii) Discuss the impact on the profits for this policy of setting up these reserves. [5]

[Total 21]

2 The Q2 Base worksheet contains mortality data and other assumptions used by a life insurance company for pricing assurances and annuities.

(i) Calculate the expected present value of a reversionary annuity of £10,000 p.a. payable annually in advance, starting immediately on the death of a female currently aged 62 exact, to a male currently aged 63 exact. [15]

(ii) Calculate the probability that a male annuity holder currently aged 56 exact dies after a female annuity holder currently aged 61 exact. [6]

(iii) Calculate the expected present value of a 30-year last survivor term assurance of £100,000 payable immediately on death, for a male currently aged 27 exact and a female currently aged 25 exact. [16]

[Total 37]

3 A piece of land is available for sale for £10,000. Green Energy Ltd believes that it can install electricity-producing solar panels on the land.

The total cost of development will be £85,000. This cost will be paid monthly in advance in six equal instalments. The first payment will be made at the same time that the land is purchased. Electricity production will start 6 months after the land is purchased.

It is estimated that the development will produce 80,000 units of electricity per year, with production assumed to be uniform across each year. Green Energy Ltd will sell the produced electricity to the national power supplier at a rate of £0.12 per unit. Payments for electricity produced will be received quarterly in arrears.

The level of electricity production will fall as the solar panels start to degrade. It is estimated that the level of electricity produced will fall by 0.5% p.a. Electricity production is assumed to fall annually, with the first decrease of 0.5% occurring 6 months after production begins.

Green Energy Ltd will start monthly maintenance work after 6 months of electricity production. The maintenance costs are expected to be £1,000 p.a. incurred monthly in arrears. Annual maintenance costs will increase by 3% p.a. with the first increase taking place 1 year after the maintenance work starts.

The risk discount rate is 6.5% p.a. effective.

(i) Construct an **annual** cashflow schedule including all income and outgo payments for Green Energy Ltd for the first 30 years of the project. [23]

(ii) Determine, using the schedule produced in part (i):

(a) the accumulated profit after 30 years.

(b) the project year in which the accumulated profit first becomes positive. [5]

The local government has decided to offer an incentive to new generators of renewable electricity. This incentive will be paid at a rate of £0.10 per unit of electricity produced in the first 5 years of electricity production and will be payable at the end of every 6-month period.

(iii) Determine, using a revised **annual** cashflow schedule, how your answer to part (ii)(b) will change once these incentive payments are taken into account. [7]

(iv) Comment on the suitability of the model and the assumptions used by Green Energy Ltd. [7]

[Total 42]

END OF PAPER