

CHUKA



UNIVERSITY

UNIVERSITY EXAMINATIONS

**EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE IN
ACTUARIAL SCIENCE**

ACMT 401: LIFE CONTINGENCIES II**STREAMS:****TIME: 2 HOURS****DAY/DATE: WEDNESDAY 18/12/2024****8.30 A.M – 10.30 A.M****INSTRUCTIONS:****Question One**

- a) Explain the meaning of the symbol $\ddot{a}_{xy:n|}$ (2 marks)
- b) Write down the actuarial notation for the EPVs of the below benefits. Assume that at time 0 the lives (x) and (y) are alive.
- i. An insurance of 1 payable on the death of (y), conditional on (x) dying first. (2 marks)
 - ii. A last survivor annuity of 1 per year, payable continuously, deferred for n years. (2 marks)
- c) Briefly discuss any two reserving methods used in insurance. (4 marks)
- d) An actuarial student wishes to calculate $\ddot{a}_{68|60}^{..12}$ on the following basis:
- Mortality: First life: PMA92C20
Second life PFA92C20
Interest: 4% pa .
- Calculate the value of this annuity. (4 marks)
- e) Prove that $\bar{A}_x = \bar{A}_{xy}^1 + \bar{A}_{xy}^2$ (5 marks)
- f) Joseph and Mary, both aged exactly 55, take out a policy that provides a lump sum of Kshs.50,000 payable immediately on the second death. Premiums are payable annually in

advance while at least one of Joseph and Mary is alive. Calculate the annual premium for the policy assuming PA92C20 mortality, 4% pa interest, and no expenses.(5 marks)

- g) A whole life policy has expected future benefit payments of Kshs.100,000 payable at the end of 30 years. Annual premiums of Kshs.2,000 are paid at the beginning of each year for the 30 years. Given an interest rate of 5% per annum, Calculate the prospective reserve for this policy. (6 marks)

Question Two

- a) Define what is claims reserve. (2 marks)
- b) What do you understand by the symbol p_x^w . (2 marks)
- c) Give the formulae for and hence calculate $a_{60|55}^{mf}$. (4 marks)
- d) Evaluate $A_{60:60}$ assuming both lives follow PMA92C20 and $i=4\%$ pa. (3 marks)
- e) Discuss three risk treatment options available to a pension scheme, and how each can be used to manage different scenarios? (9 marks)

Question Three

- a) The table below shows extracts from two life tables appropriate for a husband and wife, who are assumed independent with respect to mortality.

| Husband | | wife | |
|---------|--------|------|--------|
| x | l_x | y | l_y |
| 65 | 43,302 | 60 | 47,260 |
| 66 | 42,854 | 61 | 47,040 |
| 67 | 42,081 | 62 | 46,755 |
| 68 | 41,351 | 63 | 46,500 |
| 69 | 40,050 | 64 | 46,227 |

- i. Calculate ${}_3p_{xy}$ for a husband aged $x = 66$ and a wife aged $y = 60$. (3 marks)
- ii. Calculate ${}_2p_{xy}$ for a husband aged $x = 65$ and a wife aged $y = 62$. (3 marks)
- iii. Calculate the probability that a husband, currently aged 65, dies within two years and that his wife, currently aged 61, survives at least two years. (3 marks)

b) Peter and Jane, both aged 60, buy an annuity payable monthly in advance for at most 20 years, which is payable whilst at least one of them is alive. Calculate the expected present value of the annuity assuming 4% pa interest and PA92C20 mortality. (11 marks)

Question Four

a) Assume the following scenario:

- Initially, $\mu_{60}^{(1)} = 0.02$ and $\mu_{60}^{(2)} = 0.03$
- Due to a new health intervention, $\mu_{60}^{(1)}$ is reduced to 0.01 while $\mu_{60}^{(2)}$ remains the same.

For age 60:

- Calculate the initial total force of mortality μ_{60} . (2 marks)
- Determine the initial survival probability p_{60} . (2 marks)
- Compute the initial decrement probabilities $q_{60}^{(1)}$ and $q_{60}^{(2)}$. (6 marks)
- Recalculate the total force of mortality μ_{60} , survival probability p_{60} and decrement probabilities $q_{60}^{(1)}$ and $q_{60}^{(2)}$ after the health intervention. (8 marks)
- Discuss the impact of the health intervention on the survival and decrement probabilities. (2 marks)

Question Five

a) Explain the meaning of the symbol $\ddot{a}_{xy:n|}$. (2 marks)

b) State three transitions that, in real life, might affect the expected present value of the sickness benefits for a new policyholder who is currently healthy. Assume that the policyholder is to pay regular premiums. (3 Marks)

c) Define the following terms.

i) Contingent assurances (2 marks)

ii) Reversionary annuities (2 marks)

d) Assume AM92 Ultimate mortality, calculate ${}_3q_{50:50}^2$ (3 marks)

e) A 65-year old male and a 62-year old female take out a joint whole life policy with sum insured £10,000 and premium payment term of 5 years. The death benefit is payable immediately on the first death. Premiums are payable monthly in advance. Show that the net monthly premium is £100. Basis: PA92C20 mortality, 4% pa interest. (8 marks)

