

WRITTEN EXAMINATION

4 MAY 2023 (am)

Subject A213 — Contingencies Intermediate Technical

Time allowed: Two hours and fifteen minutes (which includes 15 minutes of reading time)

Scan and upload time: Twenty minutes (at the end of the examination)

Total marks: 100

INSTRUCTIONS TO THE CANDIDATE

1. Once you have entered the ASSA Exam Platform, ensure that you have accessed the **Video Room Invigilation** link with both your camera and microphone switched on **before you attempt the examination**.
2. Your computer must be placed, and camera angled, so that your head and shoulders as well as your writing area on your desk are visible to the invigilator. Readjust your camera if you bump or move your computer by accident.
3. Ensure that you have your exam permit handy. It reflects your candidate number to input as **part of the two hours 15 minutes examination and not before the start of the examination**. Write your candidate number at the top of each page during the examination time only. Do not use your name or member number anywhere on your answer script.
4. The cell phone to be used to scan your final answer script must be switched **OFF** during the two hours and 15 minutes examination time. Place the cell phone at the top of your examination pad / writing pages in view of the invigilator.
5. You are strongly encouraged to use the first 15 minutes as reading time only, however, you may start answering the paper whenever you are ready.
6. The question paper is only available on the ASSA Exam Platform as a PDF download and may not be printed.
7. You are required to write your answers on a clean A4 examination pad. Write only on one side of the paper and number your pages.
8. Attempt all questions, beginning your answer to each question on a new page.
9. Write in black or dark blue pen.
10. Show calculations where appropriate. You may use blank paper to make notes. This paper must not be scanned as part of your answer script.
11. You may not access any file from your computer, use any other computer program (e.g., Email, MS Word or Excel), or open any other browser during the examination.
12. You may not use any other material (e.g., a Formulae and Tables book) during the examination. Any such information that may be required will be provided to you in the examination.
13. Mark allocations are shown in brackets.
14. Assume that months are all equal length, unless otherwise stated.

15. *At the end of the two hours and 15 minutes examination time, you must stop writing and start scanning and uploading your script. **You may NOT continue to write or review your script during this time.***
16. *Scan ALL your answer pages to PDF so that your candidate number is clear at the top of each page.*
17. *Save your PDF scanned file using your candidate number as file name. Do not use your name or member number anywhere in your answer script nor as file name.*
18. *Transfer your scanned script file to your computer and upload it to the ASSA Exam Platform.*
19. *Click on the **Upload Answers** link below the examination paper link. Ensure you click on **Finish** below the upload box and again on **Finish All and Submit**, before the 20-minute upload time is up. (After submission, the number of files successfully submitted will be reflected.)*

Note: The Actuarial Society of South Africa will not be held responsible for any late submissions or loss of data where candidates have not followed instructions as set out above.

END OF INSTRUCTIONS

QUESTION 1

A life insurance company has issued a 25-year term endowment assurance policy for two individuals, referred to as x and y . Upon the occurrence of the second death within the policy term, a death benefit of R500 000 will be paid immediately. At maturity each surviving individual will receive a benefit of R200 000. An annual premium is paid continuously throughout the policy term or until the second death if it happens earlier.

- i. Calculate the expected net present value of the death benefits, only. [6]
- ii. Calculate the expected net present value of the survival benefits, only. [4]
- iii. Calculate the annual premium payable under the policy. [5]

Basis:

Force of interest	5% per annum
Expenses	None
Mortality	$\mu_x = 0.02 \forall x$ and $\mu_y = 0.03 \forall y$
Profit loading	R25 000

[Total 15]

QUESTION 2

A population is subject to two modes of decrement, α and β .

In the single decrement table, we have:

$${}_tP_{30}^{\alpha} = \frac{1}{30}(30-t) \text{ for } 0 \leq t \leq 30$$

and

$${}_tP_{30}^{\beta} = \frac{1}{900}(30-t)^2 \text{ for } 0 \leq t \leq 30$$

Calculate the value of $(aq)_{30}^{\alpha}$, from first principles.

[Total 7]

QUESTION 3

A South African life insurance company has sold the following assurance policy: a 15-year term assurance policy with a sum assured amount of R500 000, with the death benefit payable at the end of the year of death.

On 1 January 2021, the company sold 9 000 term assurance policies to male individuals aged 50. The premiums for these policies are payable annually in advance. Over the course of the first two years, 24 deaths were recorded. Recent estimates show that the number of deaths during 2023 is expected to be similar to what was observed annually over the past two years.

- i. Calculate the aggregate death strain at risk for all the term assurance policies during the year 2023. [7]

PLEASE TURN OVER

- ii. Explain whether you would expect a mortality profit or loss. Do not calculate a mortality profit or loss.

[3]

Basis:

Rate of interest 4%
Mortality AM92 Ultimate

[Total 10]

QUESTION 4

A life insurance company has issued a 35-year without-profit endowment assurance policy to a 30-year-old policyholder. The policy requires level premiums of R2 000 paid monthly in advance, while the policyholder is alive. The sum assured of R 1 000 000 will be payable at maturity or at the end of the year of death, whichever occurs first.

The insurance company is considering adding a “paid-up” option to the policy. The “paid-up” value of the policy is defined as the adjusted sum assured that the insurance company can offer over the remaining policy term, if the policyholder stops making further premium payments.

The policyholder decides to exercise this option at the start of the 21st policy year immediately before the premium then due.

- i. Calculate the gross premium retrospective reserve that the insurance company would have held immediately before this option is exercised.

[10]

- ii. Calculate the paid-up sum assured value.

[8]

- iii. Comment on the reasonability of your calculated paid-up value.

[2]

Basis:

Mortality: AM92 Ultimate
Interest: 6% per annum
Renewal expenses: R480 per annum payable at the start of the second and subsequent policy years inflating at 1.92308% per annum, and 2.5% of the second and subsequent monthly premiums.
Claims expense: R2 000 incurred at the end of year of death and inflating at 1.92308% per annum from inception.
Paid-up conversion expense: R2 500 once-off at the date of selecting the paid-up option.
Inflation: All expense amounts are quoted as at the start of the policy.

[Total 20]

QUESTION 5

- i. Define the concept: “profit vector”.

[2]

- ii. Define the concept: “profit signature”.

[2]

- iii. Describe the concept: “non-unitised accumulating with-profits contract”.

[6]

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- iv. Describe the concept of a “terminal bonus” and the benefits, to both a client and the insurance company, of a terminal bonus.

[4]

[Total 14]

QUESTION 6

An insurer offers a reversionary annuity of R400 000 per annum that is payable continuously in respect of a male and female life, respectively aged 50 and 55 exactly. Payments commence on the first death and continue for three years after the second death.

Calculate the expected present value of this reversionary annuity.

Basis:

Mortality	PMA92C20 for the male life PFA92C20 for the female life
Interest Rate	4% per annum effective

[Total 9]

QUESTION 7

A life insurer offers a 40-year-old client a deferred annuity contract. A premium of R18 000 must be paid annually in advance for 25 years or until the policyholder's death.

If the policyholder lives to 65, he receives an annuity payable continuously at a rate of R60 000 per annum, for the rest of his life. If he dies during the initial deferment period, his beneficiaries receive a lump sum equal to all premiums paid up to that point, without interest, at the end of that year.

Calculate the current expected value of benefits from the policy.

Basis:

Mortality	AM92 Select before 65 and PMA92C20 after 65
Interest rate	4% pa effective

[Total 6]

QUESTION 8

A life insurance company is considering offering a policyholder a benefit of R100 000 on survival after a period of exactly two years, from the date of the sale of the policy.

Calculate the expected present value of the policy sold to a male aged 63.25 exactly under the following assumptions:

PLEASE TURN OVER

- i. Uniform distribution of deaths between integer ages [4]
- ii. Constant force of mortality between integer ages [4]

Basis:

Mortality English Life Table 15
Rate of interest: 4% per annum effective

[Total 8]

QUESTION 9

An insurer is selling a deferred with-profits annuity policy to a 50-year-old. Fifteen years from now, the annuity payments will begin if he is still alive. The initial payment rate will be R240 000 per year paid continuously, with a 2% annual compound increase rate.

Calculate the expected present value of this benefit.

Basis:

Mortality: PMA92C20 before 65 years old
Constant force of 0.0502438 per year after 65 years of age
Interest: 3% per annum effective

[Total 7]

QUESTION 10

Explain the principle that an insurance policy must be “self-funding” and the impact that this would generally have on the profitability of an insurance policy, all else being equal.

[Total 4]

[GRAND TOTAL 100]

END OF EXAMINATION