Actuarial Society of South Africa

WRITTEN EXAMINATION

22 MAY 2020

Subject A213 — Contingencies

Time allowed:
Two hours and fifteen minutes – exam time
20 minutes (at the end of the exam) – scan and upload time

INSTRUCTIONS TO THE CANDIDATE

1. *Ensure that you have logged into your ProctorU account before you attempt the exam. Your PC must be placed so that your writing area is visible to proctor.*

2. *Ensure that you have your candidate number handy to input as part of the exam. Write your candidate number at the top of each page. (DO NOT WRITE YOUR NAME.)*

3. *Your cell phone that will be used to scan your final answer script must be switched **OFF** during the 2 hours and 15 minutes exam time. Place your cell phone at the top of your exam pad / writing pages in view of the proctor.*

4. *Questions are only available in this Moodle learning platform and may not be printed.*

5. *You are required to write your answers on a clean A4 exam pad. Write only on 1 side of the paper.*

6. *Attempt all questions, beginning your answer to each question on a new page and numbering your answers clearly.*

7. *Write in black or dark blue pen.*

8. *You should show calculations where this is appropriate.*

9. *You MAY NOT use any computer program (e.g. email, MS Word or Excel), files or open any other browsers during the examination time.*

10. *Pages from the Actuarial Tables and Formulae book will be made available within the learning platform.*

11. *You have 15 minutes at the start of the exam to read the questions. You are strongly encouraged to use this time for reading only, but notes may be made. You then have two hours to complete the paper.*

12. *Mark allocations are shown in brackets.*

13. *You may use additional scrap paper to make notes where this is appropriate. This paper MUST NOT BE SCANNED as part of your answer script.*

14. *At the end of the 2 hours and 15 minutes exam time, the exam part will close, and you will have **20 minutes to scan and upload your answer script** into the Moodle learning platform.*

15. *Access to your PC will be opened-up after the exam time so you can access your scanned file. You may now also switch on your cell phone to scan.*

16. *Scan ALL your answer pages to .pdf so that your candidate number at the top of the page is clear.*

17. *Save your .pdf scanned file using your candidate number as file name. (DO NOT USE YOUR NAME AS FILE NAME)*

18. *Transfer your .pdf script to your PC and click on the UPLOAD ANSWERS link below the exam paper link.*

19. *Upload your answer file into the Moodle Learning Platform and ensure you click on FINISH below the upload box and again on FINISH all and SUBMIT, **before** the 20 minute upload time is up. (If the status on the summary page indicates "Answer saved" your file was uploaded. You can click on Review attempt to see the file you've uploaded.)*

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

END OF INSTRUCTIONS

QUESTION 1

Outline the main features of a non-unitised accumulating with-profits contract.

[Total 6]

QUESTION 2

The two parents of a dependent child have decided to take out a life assurance policy that provides a lump sum payment of R500 000 immediately on the death of the second parent only. Level annual premiums are payable in advance whilst the policy is in force. Both parents, one male and one female, are 50 years old exactly.

i. Calculate the annual gross premium. [3]

ii. Calculate the gross premium prospective reserve just before the 11th premium is due, assuming that both lives are still alive at that time. [3]

Basis:

Mortality: PMA92C20 and PFA92C20 respectively
Interest: 4% pa effective
Expenses: Initial: R500
               Renewal: 5% of each premium, excluding the first

[Total 6]

QUESTION 3

i. State the conditions necessary for a gross premium prospective reserve and a gross premium retrospective reserve to be equal.

[2]

ii. Consider a whole life assurance contract that has:
  - a sum assured of S payable at the end of the year of death;
  - annual gross premiums of G payable for the duration of the contract;
  - initial expense of I incurred at the start of the contract;
  - regular expenses of e $p.a.$ incurred at the start of each year while the policy is in force;
  - claim expenses of f incurred with the payment of the sum assured; and
  - age at entry equal to x.

  Demonstrate algebraically that the gross premium retrospective reserve is equal to the gross premium prospective reserve for this policy under the conditions outlined in (i) above, after exactly t years ($t = 1,2,\cdots$).

[7]

[Total 9]

PLEASE TURN OVER

QUESTION 4

Flexnit, an online streaming service, is offering a promotion whereby subscription fees are fixed at R100 per month for a three-year period. Subscription fees are payable monthly in advance. A contract is automatically renewed, at the end of the year, unless the subscriber requests a cancellation at that time. Contracts can only be cancelled at the end of the year. Subscriptions cease immediately on the death of a subscriber.

Calculate the expected present value of the contracts to Flexnit, over only the first three-year period, if 150 people subscribe to this offering.

Basis:

Interest:	7.5% p.a. effective
Mortality rate:	0.5% p.a. throughout
Probability of renewal:	95% on first anniversary and 90% thereafter.
Expenses:	Initial expenses of R15 per member payable at outset and renewal expenses at R5 of each subscription fee including the first payment.

[Total 10]

QUESTION 5

i.   Define in words the term *expected death strain*.

[2]

An insurer only sells 15-year annual premium endowment assurance policies with a sum assured of R500 000 to male lives aged 45 exactly. 100 of these policies were sold. Premiums are payable in advance and death benefits are paid at the end of year of death.

Initially, the company did not perform any medical underwriting. All policies are priced assuming AM92 Ultimate mortality and an effective rate of interest of 6% per annum. You must ignore expenses.

ii.   Calculate the expected death strain in the first year, for a group of 100 of these policies, using the above pricing basis.

[4]

The company has decided to introduce medical underwriting and as a result changes its pricing basis. For "healthy" lives the company assumes AM92 Select mortality. For "unhealthy" lives the AM92 Select mortality is used but lives are assumed to be five years older than their actual age. The interest rate and expense assumptions remain the same.

iii.   Calculate the expected death strain in the first year for a group of 100 policyholders, 95 of whom were classified as "healthy" and 5 were classified as "unhealthy" using the new pricing basis.

[10]

iv.   Comment on the difference in your answers in ii) and iii) above.

[2]

[Total 18]
PLEASE TURN OVER

QUESTION 6

An elderly couple has recently purchased a joint life annuity from an insurer. The husband is aged 65 exactly and the wife is aged 60 exactly. The annuity policy provides the following benefits:

- Guaranteed payments of R50 000 per month, payable monthly in arrears for the first 5 years (irrespective of the survival status of the two lives);

- If both lives are alive after the initial 5-year period, the benefit increases to R60 000 per month payable monthly in arrears until the death of the first life, after which payments will continue at R50 000 per month payable monthly in arrears until the death of the remaining life;

- If at the end of the 5-year guarantee period:
  - the husband is alive, but the wife is dead, a lump sum of R2 500 000 will be paid to the husband and no further payments will be made.
  - the wife is still alive but the husband is dead, she will continue to receive payments of R50 000 per month payable monthly in arrears until she dies.

Calculate the single premium that should be paid by the couple for this policy. You must ignore all expenses.

Basis:

Mortality: PMA92C20 for the husband; and
                  PFA92C20 for the wife.
Rate of interest: 4% per annum, effective.

[Total 15]

QUESTION 7

ARK Life, a new insurer has decided to launch a new product to disrupt the insurance market. The aim of ARK life is to provide potential policyholders with the flexibility to choose the level of the initial premium and the subsequent premium payment pattern. The level of the sum assured will then vary depending on these two choices.

A prospective policyholder, a 45-year-old female, wants to purchase a with-profits endowment policy. Death benefits are paid at the end of the year of death. The initial sum assured will increase with simple reversionary bonuses at a rate of 4% per annum and will vest at the end of the year (*i.e.* the death benefit payable does not include the bonus declared in the year of death).

The policyholder is considering the following premium payment patterns and wants to know the initial level of sum assured that will be offered:

i.   Level annual premiums of R12 000 payable in advance which increase every year by R500 from the start of the second policy year onwards; or

ii.   Level annual premiums of R18 000 payable in advance for the first 15 years and then reducing to R7 000 from the start of the 16th policy year onwards.

Calculate the initial sum assured payable under the two premium payment patterns above, using the following basis:

Policy term: 20 years.
Mortality: AM92 Select.
Rate of interest: 4% *p.a.* effective.
Initial expenses: R250 plus half of the first annual premium.
Death Claim expenses: R300 on death, payable at the end of year of death.
Maturity Claim expenses: R150 on maturity.

[Total 21]

PLEASE TURN OVER

QUESTION 8

A new insurer in the market, Solvency Co sells a term assurance and critical illness policy with a 20-year term to a life aged 45 exactly. The policy provides a sum assured of R1 000 000 payable immediately on death or the earlier diagnosis of a critical illness. The policy terminates on payment of a claim.

i.   Draw a diagram of the multiple state model for this policy with clear labels.

[2]

ii.   Calculate the total expected present value of the benefits under this policy.

Basis:

Force of mortality from the healthy state:	0.03
Force of mortality from the critical illness state:	0.06
Force of getting a critical illness:	0.01
Annual effective rate of interest:	5.5%

[7]

Solvency Co has introduced a no claim bonus to differentiate their product from competitors. The no claim bonus is an amount of R15 000 which is paid if the insured life does not claim for the duration of the contract.

iii. Calculate the expected present value of this bonus using the same basis as above.

[6]

[Total: 15]

[GRAND TOTAL 100]

END OF EXAMINATION