



29 July 2016

12h30-13h30

GRADE 12

AP MATHEMATICS - CHOICE SECTION

Time: 1 hour

100 marks

Prelim Number : \_\_\_\_\_

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**INSTRUCTIONS TO CANDIDATES:**

1. This question paper consists of 7 questions on 8 pages and a loose information sheet.
2. Please ensure that your question paper is complete.
3. Answer all questions on folio paper. Attach question paper to the front of answers.
4. Answer each new question on a new page.
5. If you use a calculator, round off to 1 decimal place, unless told otherwise.
6. Approved non-programmable and non-graphical calculators may be used, unless otherwise stated.
7. Ensure that your calculator is in DEGREE mode or RADIAN mode when necessary.
8. It is in your own interest to write legibly and to present your work neatly.

Question	1	2	3	4	5	6	7	total
Possible	10	20	29	9	14	10	8	100
Actual								

Examiner : Mrs Raeburn

Moderator : Mr Dannatt

### Question 1

Part of a spreadsheet used to calculate terms in a second order difference equation is shown below.

Term number	
2	997.5
3	3337.769
4	11847.51
5	41846.36

The formula for calculating successive terms is given as  $T_n = aT_{n-1} + bT_{n-2}$

- 1.1 Determine the values of a and b correct to 3 decimal places. (7)
- 1.2 Hence determine the value of the first term. (3)

### Question 2

- 2.1 Shaheena's friends and family gave her cash for her eighteenth birthday present. She plans to invest this amount, which comes to R5 600, at an annual interest rate of 6,84%, compounded quarterly. Calculate the interest this once-off investment will earn over five years. (4)
- 2.2 Kiernyn deposits money at the end of each quarter in a savings account that also earns an annual interest rate of 6,84%, compounded quarterly. Calculate the value of her equal quarterly deposits if this account accrues to R10 033,38 over a five-year period. (6)
- 2.3 Chiara deposits R420 at the end of every quarter in a savings account that also earns an annual interest rate of 6,84%. However, with the bank she has chosen, interest is compounded monthly. Calculate the value to which her investments will accrue over a five-year period. (10)

### Question 3

Yael will matriculate in 2016 and wants to study a BEng for four years. The fees are as follows:

- The cost of the first year of a BEng in 2017, including books, is R63 000. This is payable at the beginning of every year.
- The fees for each of the successive three years will increase by 9% p.a.

Yael will need to get a student loan to pay for her studies.

A student loan from a bank involves 2 parties:

- The person signing on your behalf stands as surety and is expected to repay the interest while you are studying.
- The student repays the loan (without interest) as soon as she starts to work.

Repayment periods are equal to 1,5 years for every year's assistance granted.

Assume a fixed interest rate of 10,5% p.a. compounded monthly.

3.1 What is the monthly interest paid for the

- first year's loan
- second year's loan
- third year's loan
- fourth year's loan

Hence calculate the total interest on the loan at the end of the four years of study that the person standing as surety will have to pay. (14)

3.2 Yael's mom stands as surety. If her first payment occurs at the end of January 2017, and her last payment at the end of December 2020, calculate her monthly payment to the bank for each of the four years. (5)

3.3 Yael starts working in January 2021. Calculate her monthly payment to the bank if her first payment is at the end of January 2021. (6)

3.4 How much did Yael and her mom end up paying for her degree? (4)

#### Question 4

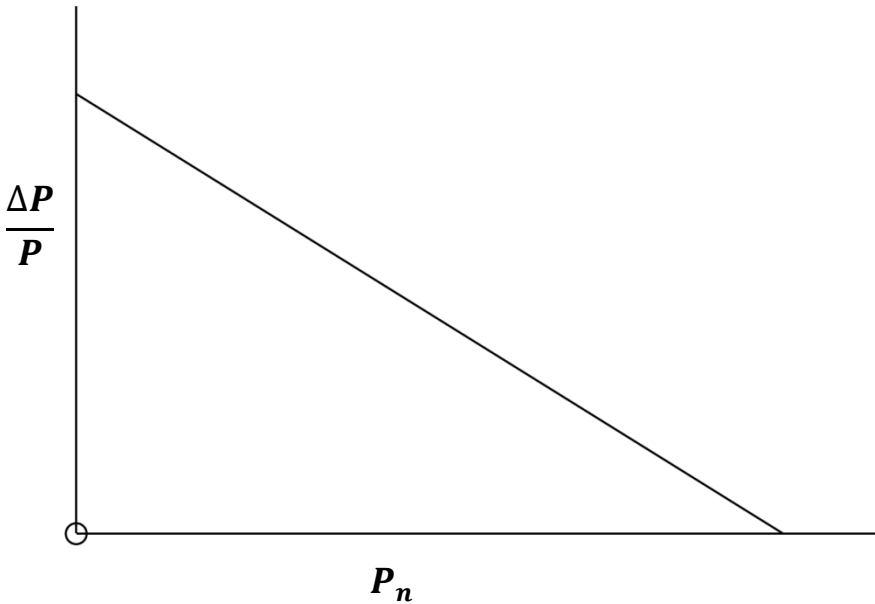
The following facts are known about servals in a game reserve:

- They have 2 litters per year.
- The average litter size is 3 kittens.
- The survival rate of serval kittens is 70%.
- 55 % of the serval population is female.
- The life expectancy of a serval is 7 years.



- 4.1 Calculate the annual growth rate of the serval population correct to 4 decimal digits. (5)
- 4.2 Express the growth rate of the serval population as a recursive formula, using an annual growth rate of serval per annum of 2,17. (2)
- 4.3 Calculate, to the nearest integer, the serval population in 7 years' time if there are currently 15 serval living in the reserve. (2)

### Question 5



In a logistic model of population growth, a graph of the growth rate of a population  $\left(\frac{\Delta P}{P}\right)$  is plotted against population ( $P_n$ ).

This graph is illustrated above.

It is not drawn to scale.

The equation of the straight line above is  $y = -0,0002x + 0,0213$

5.1 Determine:

- (a) The intrinsic growth rate of the population. (1)
- (b) The carrying capacity. (2)
- (c) The growth rate of the population when the population is 32. (2)
- (d)  $P_8$  given  $P_0 = 21$  (4)

- 5.2 Draw a sketch for the above population of population against time.  
Clearly label any significant features of this graph. (5)

### Question 6

Refer to the equations on the formula sheet representing the Predator-Prey model.

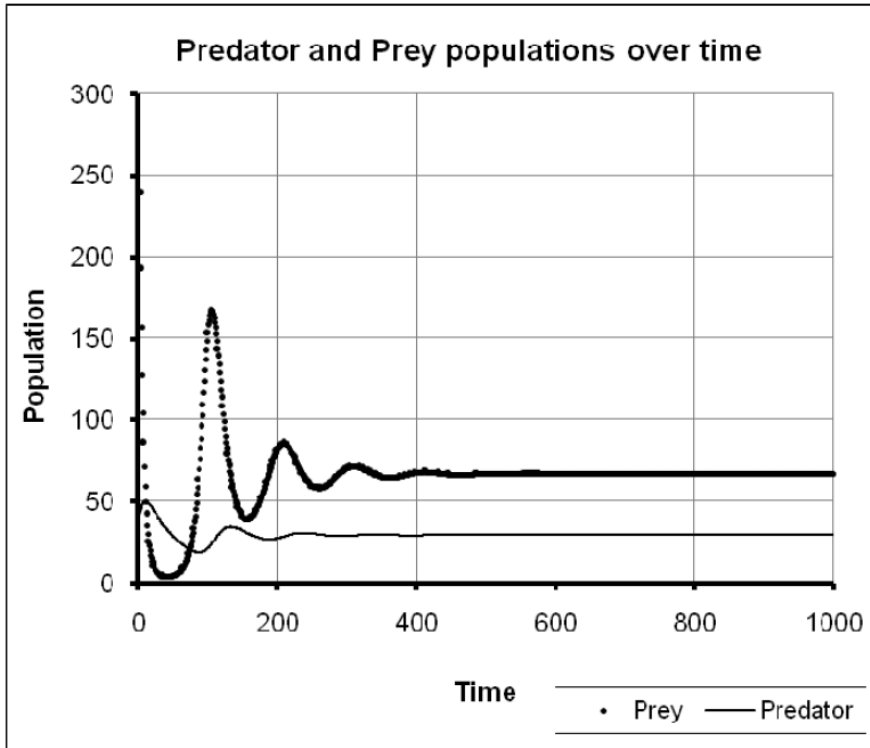
- 6.1 Prove that, after a sufficiently long time, the number of “prey” tends to the value  $\frac{c}{f \times b}$ . (6)

- 6.2 Further prove that the number of “predators” tends to the value

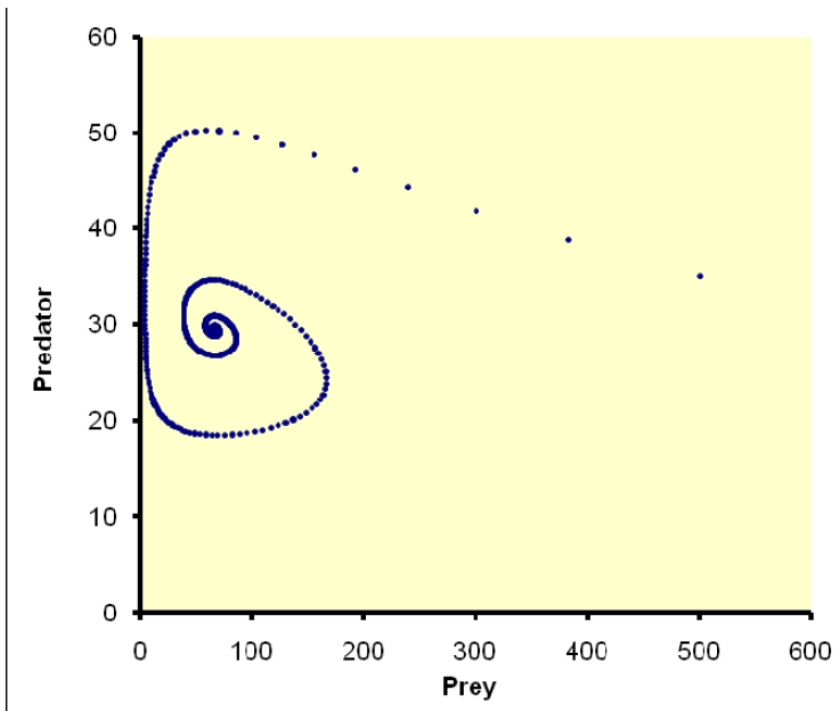
$$\frac{a}{b} \left( 1 - \frac{c}{K \times f \times b} \right) \quad (4)$$

### Question 7

Refer to the graphs that follow:



Phase Plot



Use the graphs of the Predator and Prey populations over time and the phase plot for a single Predator-prey interaction of 1000 months to answer the following:

- 7.1 Estimate the equilibrium values of the stable point. (2)
- 7.2 Give the maximum and minimum populations of
- a. the prey
  - b. the predators (4)
- 7.3 What might cause the dramatic increase in the prey population during the first 100 months? (2)