PARKLANDS COLLEGE

PRELIM EXAMINATION 2019

GRADE 12:

AP MATHEMATICS
PAPER 2

MARKS: 100

TIME: 1 hour

EXAMINER: A Rossouw **Signature: …….**

MODERATOR: S Loseby **Signature: …….**

This paper consists of 11 pages.

NAME: _____

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	TOTAL
(10)	(8)	(17)	(14)	(12)	(12)	(17)	(10)	100

INSTRUCTIONS AND INFORMATION :

1. **Write in blue or black pen only.**
2. **Correction fluid, highlighters and erasable pens may not be used.**
3. **Answer all the questions.**
4. **Leave a line open between each question.**
5. **Draw a 2 cm marking margin on the right hand side of each page.**
6. **Rule a line after each section.**
7. **This paper consists of 8 QUESTIONS and 11 PAGES, including an INFORMATION (FORMULA) SHEET.**
8. **All calculations must be shown.**
9. **Unless stated otherwise, calculators (non-programmable) may be used, in which case answers must be correctly approximated to two decimals.**
10. **Where applicable, answers must be left with positive exponents.**
11. **The diagrams are not necessarily drawn to scale, unless stated otherwise.**
12. **Number your answers correctly according to the numbering system in this paper.**

QUESTION 1

Merel deposits R500 000 into an investment account and plans to withdraw R8 000 at the end of each month, starting in one month's time. The account earns interest at a rate of 7,5% p.a., compounded monthly.

(a) Write down the recursive formula for the value of the investment fund after n months. (3)

(b) Find $T_1; T_2$ and T_3, which represent the amount of money in the account after 1,2 and 3 months respectively. (3)

(c) Determine how many months it will take for the value of the investment fund to be worth just less than half of its original value. (2)

(d) Calculate the effective annual interest rate. (2)

[10]

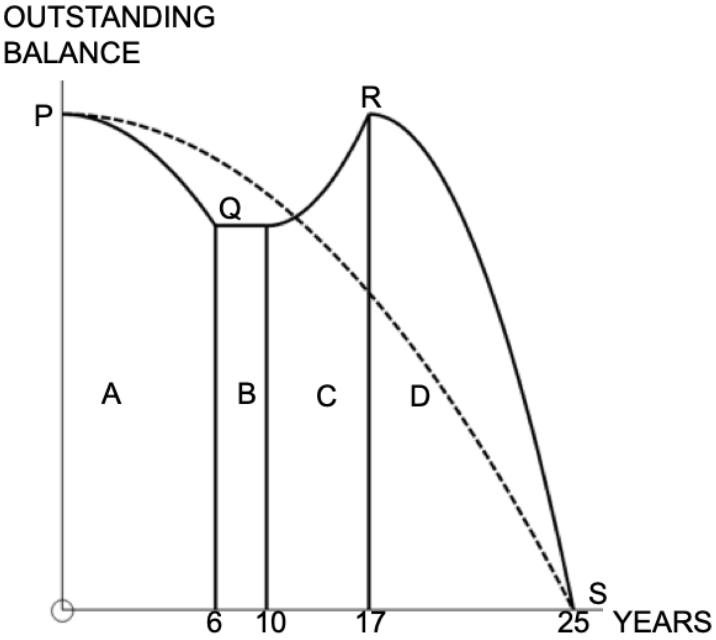
QUESTION 2

Sita took out a loan P, with the intention of paying it back with monthly instalments over a period of 25 years.

The continuous curve PQRS represents Sita's Outstanding Balance over the 25 year period.

The ideal curve of Outstanding Balance is given by the dotted curve PS. (8)

With reference to the time periods labelled A,B,C and D, interpret the shape of the cure and suggest possible reasons why Sita's curve of Outstanding Balance did not follow the recommended path.



[8]

QUESTION 3

Hendrik takes out a bank loan of R 12 000 000 to finance a new car. The bank charges him 9,34% p.a., compounded monthly, and he agrees to pay R 250 000 at the end of each month for the next five years.

(a) Calculate Hendrik's outstanding balance on his loan after 4 years. (4)

(b) Hendrik skips the 49th, 50th and 53rd payments. Calculate the lump sum he would need to pay into the account at the end of five years in order to make up for the loss of the missed payments. This lump sum excludes his regular monthly payments. (7)

(c) Hendrik does not like the above option and decides that from the 54th month he will increase his instalments to R 630 000 per month. Taking the missed payments into account, accept his outstanding balance at the end of the 53rd month as R 3 700 000. Calculate the value of his final payment, which will be less than R 630 000. (6)

[17]

QUESTION 4

Bonga's parents decided to save in order to buy him a car for his 18th birthday. They made the first payment into an account, earning interest of 2 % per month, one month after Bonga's 8th birthday and continued to make regular monthly payments until Bonga's 18th birthday. They have estimated that they would need R 160 000 to buy the type of car they had considered.

(a) Determine the value of the monthly payments they needed to make. (4)

(b) Calculate how much would be in the account after 7 years. (4)

(c) A family crisis arose after 7 years which required them to withdraw R 10 000 from the savings account. At the same time, the interest rate increased to 11% p.a., compounded monthly. Calculate the increase in their monthly payments in order that there would still be R 160 000 in the account on Bonga's 18th birthday. (6)

[14]

QUESTION 5

Parktown Prawns are horrendous creatures that are almost impervious to extermination. Their current population in a suburb is 3000, and is expected to grow increase to 10 000 in one year's time.

(a) Calculate the intrinsic monthly population growth rate as a percentage, correct to one decimal place. (3)

(b) Calculate what the population was four months ago. Use a monthly population growth rate of 0,1. (3)

(c) Exterminators manage to kill 350 prawns per month. Determine how many months it will take to completely eliminate the initial population of 3 000. Use a population growth rate of 0,1 per month. (5)

(d) What model does this represent? (1)

[12]

QUESTION 6

The table below represents a Logistic model for South Africa's population (P_n in millions)

	Pn	ΔP	$\frac{\Delta P}{P}$
2010	38,457		
2011	40,529	A	0,0514
2012	42,626	B	0,0449
2013	44,356	1,8715	0,0422
2014	46,369	1,8310	0,0395
2015	48,018	1,6920	0,0352
2016	49,753	1,4805	P
2017	50,979	1,1650	Q
2018	52,083		

(a) Calculate, to four decimals, the values of A,B,P and Q. (6)

(b) Find the equation of the line of best fit for the data. Give your answer correct to six decimal places. (4)

(c) Hence find the carrying capacity, to the nearest million, that this model assumes for South Africa's population. (2)

[12]

QUESTION 7

A game park introduces 10 cheetahs (5 females and 5 males) to an area where there are 40 baboons as their prey. Each female cheetah has on average 5 surviving cubs per year.

Baboons have on average two babies every 18 months, with a 50% chance of the babies being female. The survival rate of the babies is high.

The following recursive formulae show the growth of each population using a monthly cycle.

$$B_{n+1} = B_n + 0{,}05.B_n\left(1 - \frac{B_n}{300}\right) - 0{,}0075.B_n.C_n$$

$$C_{n+1} = C_n + f.b.B_n.C_n - 0{,}0069.C_n$$

(a) (i) Determine the monthly survival rate of the baboons to maturity. (3)

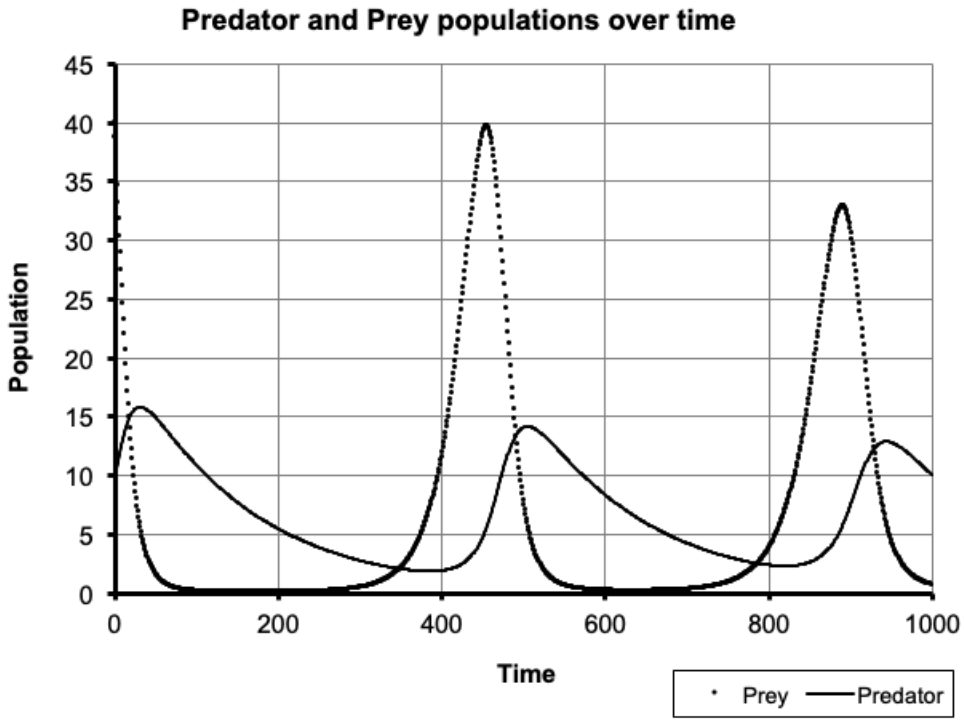
(ii) Determine how many baboons were killed in the first month. (3)

(iii) Calculate the life expectancy for a cheetah in years. (2)

(iv) Determine the monthly rate at which cheetah convert their food supply into producing offspring, correct to three decimal places. (3)

(v) Calculate the equilibrium of the cheetahs if it is assumed that the baboon population reaches an equilibrium of 24. (3)

(b) The graph below represents the Predator-Prey model of the cheetahs and baboons at the park. Answer the questions that follow:



(i) How does this graph indicate that the population will reach an equilibrium? (1)

(ii) After how many months was the rate of increase of baboons at a maximum for the first time? (1)

(iii) After approximately how many months after the recovery of the baboon population does the cheetah population recover? (1)

[17]

QUESTION 8

Robben Island can support 25 000 penguins, but there are now only about 6 000. Females form half of the population and lay two eggs each year. Only 60% of the hatchlings survive. (10)
It is predicted that about 4 500 penguins will be killed by seals this year. Seals can live for 20 years, and there are currently 1 500 in the waters near the Island. In the first population cycle about 100 seals were born.

Calculate the parameters $a, b, c, f, and\ K$ of this Lotka Volterra model. Assume that there is only one predator with one prey.

[10]

TOTAL 100

Finance & Modelling

$$F = P(1+in) \qquad F = P(1-in) \qquad F = P(1+i)^n \qquad F = P(1-i)^n$$

$$F = x\left[\frac{(1+i)^n - 1}{i}\right] \qquad P = x\left[\frac{1-(1+i)^{-n}}{i}\right] \qquad r_{eff} = \left(1+\frac{r}{k}\right)^k - 1$$

$$P_{n+1} = P_n + rP_n\left(1-\frac{P_n}{K}\right)$$

$$R_{n+1} = R_n + aR_n\left(1-\frac{R_n}{K}\right) - bR_nF_n \qquad F_{n+1} = F_n + f.bR_nF_n - cF_n$$