HERSCHEL GIRLS HIGH SCHOOL

ADVANCED PROGRAMME MATHEMATICS- GRADE 12

Paper 2-Financial Maths

DATE: September 2019   **TIME: 1 HOUR**
MARKS: 100

INSTRUCTIONS TO CANDIDATES:

1. This paper consists of 6 questions plus an answer sheet and formula sheet.

2. Answer ALL questions.

3. All the necessary working details must be shown with your answer.

4. Clearly number all your questions correctly.

5. Non-programmable calculators may be used unless the question states otherwise.

6. Round off your answers to TWO decimal digits correctly unless the question states otherwise.

Question 1[18]

Eva decides to take out a retirement annuity starting on her 28th birthday (1st June). Her monthly payments, which are fixed at R 1 500 per month, start on her 28th birthday.

The interest offered on the annuity is 6,5% p.a. compounded monthly.

Two years after opening the annuity, Eva is retrenched and she misses10 payments into the retirement annuity as a result of the retrenchment (from payment number 26).

Seven years before her retirement and on her birthday, Eva withdraws R30 000 from the annuity in order to go on a cruise. She continues to make the usual R1 500 monthly contribution as usual.

1.1   Determine how much money is in Eva's account when she retires on her 65th birthday, straight after she has made her monthly payment of R1 500.

(11)

On retirement, Eva withdraws a lump sum from the annuity in order to pay off her house and buy a new car. The remainder of the money is invested in a living annuity, which offers an interest rate of 7,5% p.a. compounded monthly.

After costs and insurance are deducted, Eva deposits R1 850 000 into the living annuity on her 65th birthday. She decides to make monthly withdrawals from the account, starting 6 months after her 65th birthday and continuing up to and including her 90th birthday when she wants an amount of R650 000 to still be in her account.

1.2   Calculate the monthly payment which Eva will receive.   (7)

Question 2[26]

You take out a loan in order to finance the purchase of a car. The loan is to be fully paid 5 years after the loan is granted. Interest is charged at 18,6% p.a. compounded monthly and payments are due to start one month after the granting of the loan. Due to unforeseen circumstances you only start repaying the loan 4 months after the loan was granted.

As a result, your expected monthly repayments are R10 286,05.

2.1   Determine the value of the loan.   (6)

2.2   Show that the balance outstanding two years after the loan is granted is R282 164. (rounded off to the nearest rand).   (4)

At this stage you renegotiate with the bank and opt to pay quarterly payments of R30 000 for the duration of the loan period. The interest rate remains at 18,6% p.a. compounded monthly and payments start one quarter after the granting of the loan.

2.3.1 Use the new information to write a recursive formula for the outstanding balance on the loan. (6)

Use the recursive formula to determine:

2.3.2 the interest paid to the bank from the start of the new loan agreement up to and including the 7th payment of R30 000. (5)

2.3.3 the number of payments of R30 000 required to clear the loan and the value of the final, lesser payment. (5)

Question 3[6]
A loan of R20 000 is repaid over a period of 3 years with monthly payments of R729,08 being made. Payments start one month after the loan is granted. Interest is charged at 18,6% p.a. compounded monthly.

Draw a **sketch** graph of money in rands vs time in months for the above situation. On the same set of axes, draw graphs of the balance outstanding as well as the monthly payments made over the time period of the loan.

Indicate on the graphs the balance outstanding after 1,5 years as well as the money paid after 1,5 years as well as after 3 years. (6)

Question 4[12]
Jackson chameleons are found mainly in Hawaai and East Africa. They are known for their 3 brown horns which are present on the head of all males. A population of 14 chameleons, 40% of which are females, live in a particular area of Ethiopia. Females lay clutches of 20 eggs every 6 months. The survival of the babies to maturity is low at 25% and the natural lifespan of the Jackson chameleon is 8 years.

4.1   Using a yearly cycle, create a Malthusian difference equation for this population of chameleons and use it to calculate the size of the population after 4 years.   (8)

4.2   In reality, Jackson chameleons are often stolen from their natural habitats and smuggled to other parts of the world as part of the illegal pet trade. If 50 of this population were smuggled out every year, write a new Malthusian difference equation and use it to calculate the population after 4 years.   (4)

Question 5[19]

A population of 52 elephant are kept in a protected reserve. Their population increases before levelling off to a stable population.

The table below records the elephant population at yearly intervals.

n (years)	P_n	ΔP_n	$\dfrac{\Delta P_n}{P_n}$
0	52		
1	57	a	0,1053
2	64	7	d
3	b	7	c
4	78		

5.1   Determine the values of a, b, c and d. Give answers to c and d correct to 4 decimal places.   (4)

5.2   Determine the equation of the equation of the graph representing the relationship between growth rate and the population. [Give the answer for the gradient, not in scientific notation, correct to 5 decimal places and the y-intercept correct to 3 decimal places].   (3)

5.3   Write down the intrinsic growth rate of the population.   (1)

5.4 Draw a labelled, sketch graph of the population versus time for the elephant population. (4)

5.5 Express the growth of the elephant population as a recursive equation. Use it to calculate the elephant population after 10 years. (4)

5.6 How many elephant should be transferred to other reserves each year if it is decided to keep a stable population of 176 at the reserve? (3)

Question 6[19]
21 lion (17 males and 4 females) and 324 zebra live in a private reserve.
The growth of these 2 population groups can be represented by the following recursive formulae, using an annual cycle:

$$Z_{n+1} = Z_n + 0{,}75\, Z_n \left(1 - \frac{Z_n}{670}\right) - bZ_nL_n$$
$$L_{n+1} = L_n + fbZ_nL_n - 0{,}125L_n$$

There are 4 females in this pride but only 75% of them are involved in breeding. The breeding females have litters of 3 cubs every second year.

6.1 Give the carrying capacity of the zebra. (1)

6.2 Calculate the average lifespan of a lion. (2)

6.3 If the rate at which lion are able to convert their food supply into producing babies is 0,022, determine the rate at which the encounters between lion and zebra result in the death of the zebra (give answer to 2 decimal places) and hence determine the number of zebra killed in encounters in the first year. (6)

6.4   Calculate the equilibrium population of the lions.   (3)

The graph below indicates the interaction between the lion and zebra on a yearly basis. Use the graph to answer the questions that follow.

Phase Plot Graph
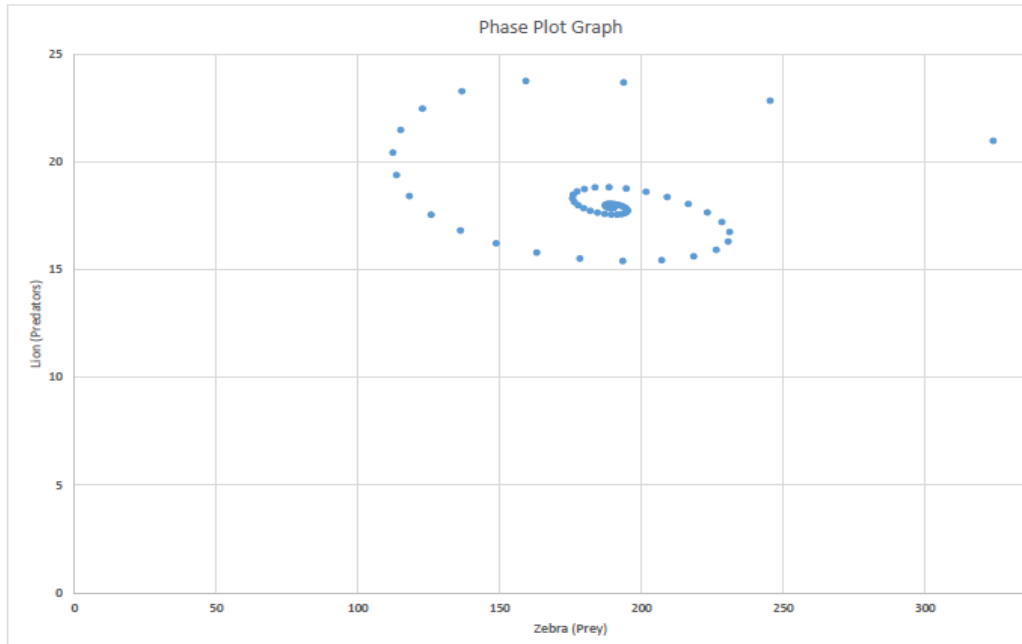
Where required, answers must be indicated on the answer sheet provided.

6.5   Indicate on the graph the cycle where the zebra population increases for the first time. [Use A]. In which cycle does this occur?   (2)

6.6   Using the graph, indicate the range of the zebra population when both the lion and zebra populations are both increasing for the first time. [Use B and C]   (2)

6.7   Why is there a sharp drop in the zebra population in the first cycle?   (1)

6.8   Indicate on the graph where the equilibrium populations for the zebra and lion can be read off. [Use D and E]   (2)

Total: 100

Phase Plot Graph