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| **Advanced Programme Mathematics TRIALS****Paper 2 Finance and Modelling** |
| **FORM 5****12th September 2017** |
| **TIME: 1 hour TOTAL: 100 marks** |
| **Examiner: Mrs A Gunning** | **Moderated: Ms C Mundy** |
| **PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY BEFORE ANSWERING THE QUESTIONS.*** This question paper consists of 6 pages, plus an Information Booklet. Please check that your question paper is complete.
* Read and answer all questions carefully.
* It is in your own interest to write legibly and to present your work neatly.
* All necessary working which you have used in determining your answers **must** be clearly shown.
* Approved non-programmable calculators may be used except where otherwise stated.
* Where necessary give answers correct to **1 decimal place** unless otherwise stated.
* Diagrams have not necessarily been drawn to scale.
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**Question 1**

Emmanuel invests a cash amount of R10 000 at an annual interest rate of 6,5 %, compounded semi-annually.

Calculate the interest this once off investment will earn over a period of 10 years. (6)

**[6]**

**Question 2**

A loan of R 200 000 is repaid in monthly instalments of R 16 500 at the end of every month. An interest rate of $8,2\%$ p.a., compounded monthly is charged.

1. Find the balance outstanding on this loan at the end of the
	1. first month ie after one repayment (1)
	2. the second month ie after 2 repayments (1)
	3. the third month ie after 3 repayments (1)
2. Hence or otherwise, represent the balance outstanding after each payment as a recursive formula. (4)

**[7]**

**Question 3**

A television is advertised as a special offer for R 20 000.

The interest rate is $15\%$ p.a. The payments are due to start in 4 months time. Determine the monthly payment if you have to repay as follows:

1. In 60 equal payments, with the first payment being made in 4 months time (6)
2. In exactly 5 years’ time from now. (4)

**[10]**

**Question 4**

Mrs Brown repays a loan of R50 000 in equal monthly payments of R 1 500 at the end of each month.

The initial interest rate is $8,36\%$ compounded monthly.

1. How long will it take her to repay the loan? (4)
2. Calculate the amount of her final payment. (6)
3. Assume that her balance outstanding after her 24th payment is R 20 000. Her bank then increases the interest rate to $10\% $p.a. compounded monthly, just after the 24th payment has been made.

If she still wants to pay back her loan in the same time period, calculate her new monthly payment. (4)

**[14]**

**Question 5**

Martin saves for his retirement from the age of 25 years until he retires at the age of 65 years. He starts saving immediately by depositing R 4 000 per month into this retirement annuity.

1. Calculate the value of his capital investment at the age of 65 years, if the interest rate that he obtains is $7,25\% $per year. (5)
2. If he can only start saving at the age of 40 years, what should his monthly payment be in order to accrue the same amount as in (a) at the age of 65 years?

Assume that the saved amount as calculated in (a), the capital investment is

R 10,5 million ie do not use the amount you calculated in (a). (4)

1. At the age of 65 years, he invests this payout in a living annuity until he turns 78 years old. If the interest rate of this living annuity is $6,4\% $p.a. compounded monthly, determine the amount that he will receive monthly from this living annuity. As in (b), assume that the capital investment is R 10,5 million. (4)

**[13]**

**Question 6**

Consider the following Logistic population model:

$\frac{∆P}{P}$ $= -0,000253P+0,3$

1. What is the value of the intrinsic growth rate for this model? (2)
2. Calculate the carrying capacity of this model. (Give your answer correct to the nearest integer.) (4)
3. Calculate the size of the population when the growth rate is $0,08. $(Give your answer correct to the nearest integer.) (4)
4. Calculate $P\_{12}$ if $P\_{0}=6$, if you assume that the carrying capacity is 1 200. (Give your answer correct to the nearest integer.) (5)

**[15]**

**Question 7**

In a reserve in Namibia wild dogs are being bred as part of a reservation project for this endangered wild dog species. They are close to extinction. They live in a camp of about 20 hectares.

A female gives birth once a year. Her litter size is an average of 10 puppies. Usually, twice as many males as females are born and the gestation period is about two and a half months. Their survival rate is low due to exposure and diseases. It is estimated at 40%. They reach an average age of 12 years.

1. Calculate the yearly growth rate of the wild dogs, correct to 2 decimal digits. (6)
2. Express the increase in the wild dog population as a recursive formula by using a yearly growth rate of 1,2. (2)
3. Calculate the wild dog population after 3 years if there are initially 30 wild dogs in the reserve. Use a yearly growth rate of 1,2.

(Give your answer correct to the nearest integer.) (5)

1. The owner of the reserve requests that the game ranger keeps the number of wild dogs at the present level, as calculated after 3 years.

By how many should the wild dogs be reduced on a monthly basis to keep the dogs at the present level, as mentioned above?

Give your answer to the nearest integer. (7)

**[20]**

**Question 8**

Given the formula

$R\_{n+1}= R\_{n}+1,5 R\_{n}(1-$ $\frac{R\_{n}}{700}$ $)-b R\_{n} F\_{n}$ for the rabbit $(R\_{n})$ population

And the formula

$F\_{n+1}= F\_{n}+fbR\_{n}F\_{n}-0,02778 F\_{n}$ for the fox $(F\_{n})$ population

and the following parametres

$R\_{0}=200$ and $F\_{0}=15.$

The cycle is monthly.

1. What does the value of 1,5 represent? (2)
2. What does the 700 stand for? (2)
3. Determine the life span of a fox in years. (3)
4. If the foxes kill 180 rabbits per month, determine the value of b. (Answer correct to 2 decimal places.) (3)
5. If there are 4 new fox kits born every month, determine the value of $f.$

(Answer correct to 3 decimal places.) (3)

1. What is the meaning of $f$? (2)

**[15]**