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PRELIMINARY EXAMINATION 2018

MATHEMATICS GRADE 12

PAPER 1

Time: 3 hours

Total: 150

Examiner: P R Mhuka

Moderators: J Scalla
E Zachariou

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 6 pages, and a separate formula sheet. Please check that your paper is complete.
2. Read the questions carefully
3. Answer all the questions.
4. Number your answers exactly as the questions are numbered.
5. You may use an approved non-programmable and non-graphical calculator, unless otherwise stated.
6. Answers must be rounded off to the first decimal place, unless otherwise stated.
7. All the necessary working details must be clearly shown.
8. It is in your own interest to write legibly and to present your work neatly.

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SECTION A**QUESTION 1:**

a) Solve for x and show all your working:

1) $3^{x^2-3x} = 81$ (4)

2) $\sqrt{2x-1} - x + 2 = 0$ (4)

b) Given $y = a(x^2 + 2x - 8)$ where a is a positive constant.

1) Find the set of values of x for which y is negative. (4)

2) Find the value of a if this function has a minimum value of -27. (4)

c) The line $y = 2x - 6$ meets the curve $4x^2 + 2xy - y^2 = 124$ at the points A and B . Find the length of the line AB . (7)

[23]

QUESTION 2:

a) Consider the function $g(x) = -\log_2(x + 2)$

1) Draw a neat sketch of $g(x)$. Clearly show the asymptote and intercepts with the axes. (4)

2) Determine the range of $g^{-1}(x)$. (2)

3) For which values of x would $g^{-1}(x) > 0$ (2)

b) Given $f(x) = -1 - \frac{1}{x-3}$

1) Write down the asymptotes of $f(x)$ (2)

2) Make a neat drawing of $f(x)$. Clearly show the asymptote and intercepts with the axes. (4)

3) Write down the values of x for which $f'(x) > 0$. (2)

[16]

QUESTION 3:

- a) The n th term of a sequence is $na + d$. Prove that the sequence is linear. (3)
- b) The first three terms of a sequence are given by $T_1 = -4, 4$; $T_2 = -4, 1$; $T_3 = -2, 6$. Given that T_n is a quadratic sequence,
- 1) Calculate T_n in terms of n . (5)
 - 2) Find the set of values of n for which T_n is more than 15. (3)
- [11]**

QUESTION 4:

- a) Determine $f'(x)$ from first principles if $f(x) = x^2 - x$ (5)
- b) Determine the derivative of the following:
- 1) $y = \frac{x-3}{3}$ (2)
 - 2) $y = (2\sqrt[3]{t})^{-1} + \frac{4}{t^{\frac{5}{2}}}$ (4)
- c) Calculate the values of b , c and d so that two parabolas $y = x^2 + bx + c$ and $y = dx - x^2$ are tangential to each other at point $(1 ; 0)$ (6)
- [17]**

QUESTION 5:

Using the letters from the word **ABPENCILS**.

- a) Determine the number of 5 letter arrangements (3)
 - b) How many nine-letter arrangements are possible if N must be the first letter and the letters AB must be together at the end? (3)
- [6]**

SECTION B

QUESTION 6:

A bag contains 5 white balls and n black balls.

- a) Two balls are drawn randomly from the bag with replacement. Find in terms of n , the probability that the two balls are of different colours. (3)
- b) It is now given that $n = 10$. An ordinary fair die is rolled. If a '1' or '6' is obtained, two balls are drawn randomly from the bag with replacement. Otherwise, two balls are drawn randomly from the bag without replacement. Find the probability that two white balls are drawn. (6)
- [9]**

QUESTION 7:

- a) Mrs Zach has R843 owing on her credit card account. The bank charges 1,7% interest per month on an outstanding balance. She pays R500 into the account just before the bank adds interest to her account. Calculate the amount of interest that will be added to her account. (3)
- b) You invest R1 000 annually (at the end of each year) for 5 successive years in a savings account at 9% per annum compounded annually. At the end of the fifth year you withdraw R984,71 and the balance is invested at 13% interest per annum, compounded semi-annually for four years. Calculate the balance in the account at the end of investment period. (6)
- c) Denis takes out a loan to buy a house. He pays back the loan over a period of 20 years with monthly payments of R6 890. Denis qualifies for an interest rate of 12% per year compounded monthly. He makes his first payment three months after the loan was granted. Calculate the amount Denis borrowed. (5)
- [14]**

QUESTION 8:

- a) The 4th and the 9th term of a geometric sequence are 8 and 256 respectively. Find the sum of all the terms between the 4th and 12th term. (5)
- b) The ratio of the 5th term to the 12th term of an arithmetic sequence is $\frac{6}{13}$. If each term of this sequence is positive, and the product of the first term and third term is 32, find the sum of the first 100 terms of this sequence. (7)
- [12]**

QUESTION 9:

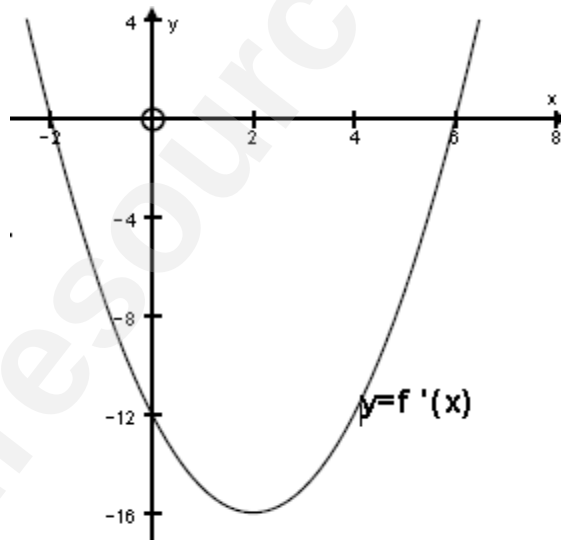
Given $h(x) = \frac{1}{2}(x - 4)^2 - 2$

- a) Sketch the graph of $g(x)$ indicating all intercepts and turning point. (4)
- b) Use the graph to find the values of p for which:
 - 1) $h(x) + p = 0$ has two roots of different signs. (3)
 - 2) $h(x - p) = 0$ has 2 negative roots. (2)
- c) Write down the values of the constants a and b such that the curve with equation $y = a + h(x - b)$ has a minimum point at the origin. (2)

[11]

QUESTION 10:

- a) The diagram below represents the graph of $y=f'(x)$, the derivative of f .



- 1) Write down the x -values of the turning point of f . (2)
- 2) Write down the x -value of the point of inflection of f and state where the graph is concave upward. (3)
- 3) For which values of x will $f(x)$ decrease? (2)

b) Given $t(x) = \frac{x(x-3)(x-8)}{7}$

1) Find the local greatest and least values of $t(x)$ (6)

2) Sketch $t(x)$ indicating all intercepts with the axis and turning points. (5)

3) For which values of x is $\frac{t''(x)}{t'(x)} \leq 0$ (3)

c) The curve C has equation $y = -x^3 + 2kx^2 - kx + k$, where k is a real constant. Find the range of values of k for which C has no turning point. (4)
[25]

QUESTION 11:

The manufacturer produces cylindrical containers using sheet of negligible thickness. The cylindrical container has an open top, and a base and curved sides made up of the sheet metal.

It is given that the volume of the cylindrical container is fixed at $k \text{ cm}^3$. Show that when the amount of sheet metal used for the cylindrical container is a minimum, the ratio of its height to its radius is 1 : 1. [6]