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EASTERN CAPE
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**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

SEPTEMBER 2012

MATHEMATICS P1

MARKS: 150

TIME: 3 hours



This question paper consists of 8 pages, 3 diagram sheets and an information sheet.

INSTRUCTIONS AND INFORMATION

1. This question paper consists of 12 questions.
2. Answer ALL the questions.
3. Clearly show ALL calculations, diagrams, graphs, etc that you have used in determining the answers.
4. Answer only will not necessarily be awarded full marks.
5. An approved calculator (non-programmable and non-graphical) may be used unless stated otherwise.
6. If necessary, answers should be rounded off to TWO decimal places, unless stated otherwise.
7. Number the answers correctly according to the numbering system used in this question paper.
8. Diagrams are NOT necessarily drawn to scale.
9. An information sheet with formulae included at the end of the paper.
10. A diagram sheet is supplied for QUESTION 6.2; QUESTION 7.2 and QUESTION 12.2. Write your name in the space provided and then hand the diagram sheet in with your ANSWER SHEET.
11. Write legibly and present your work neatly.

QUESTION 1

1.1 Solve for x:

$$1.1.1 \quad a + \frac{1}{a} = 2 \quad (4)$$

$$1.1.2 \quad 1 - 2x + \sqrt{5x - 1} = 0 \quad (5)$$

$$1.1.3 \quad \frac{x}{x-3} \leq 2 \quad (4)$$

1.2 Solve for x and y in the simultaneous equations:

$$y - 2x + 1 = 0 \text{ and } xy = 2y + x^2 + 3x - 10 \quad (5)$$

1.3 Show that:

$$\frac{10^n + 4.2^n}{5^{2n} + 4.5^n} = \frac{2}{5} \quad (5)$$

1.4 Hence or otherwise calculate the value of:

$$\frac{{}_n 10^n + 4.2^n}{5^{2n} + 4.5^n} \quad (2)$$

[25]

QUESTION 2

Consider the following sequence of numbers:

1; 4; 11; 22; 37; ...

2.1 If the sequence behaves consistently, determine the next TWO terms of the sequence. (2)2.2 Calculate a formula for the n -th term of the sequence. (6)
[8]

QUESTION 3

3.1 Given: $\sum_{k=1}^n (4 - 3k) = -125$

Determine:

3.1.1 the type of sequence. (2)

3.1.2 d if it is an arithmetic sequence, or r if it is a geometric sequence. (1)

3.1.3 the value(s) of n . (5)

3.2 Evaluate, round off your answer to two decimal places:

$$\sum_{n=1}^8 (0,2)^{n-1} \quad (4)$$

3.3 Study the following geometric series:

$$(x - 1) + (x - 1)^2 + (x - 1)^3$$

3.3.1 For which value(s) of x will the series converge? (3)

3.3.2 If $x = \frac{4}{3}$, determine the sum of the infinite series. (3)

[18]

QUESTION 4

4.1 Michael saved R400 during the first month of his working life. In each subsequent month, he saved 10% more than what he had saved in the previous month.

4.1.1 How much did he save in the 7th working month? (3)

4.1.2 How much did he save altogether in his first 7 working months? (3)

4.2 A certain annuity investment in a bank is presented as a geometric series for the first 240 months:

$$R1\,900 \left(1 + \frac{0,075}{12}\right) + R1\,900 \left(1 + \frac{0,075}{12}\right)^2 + R1\,900 \left(1 + \frac{0,075}{12}\right)^3 + \dots \text{ to 240 months:}$$

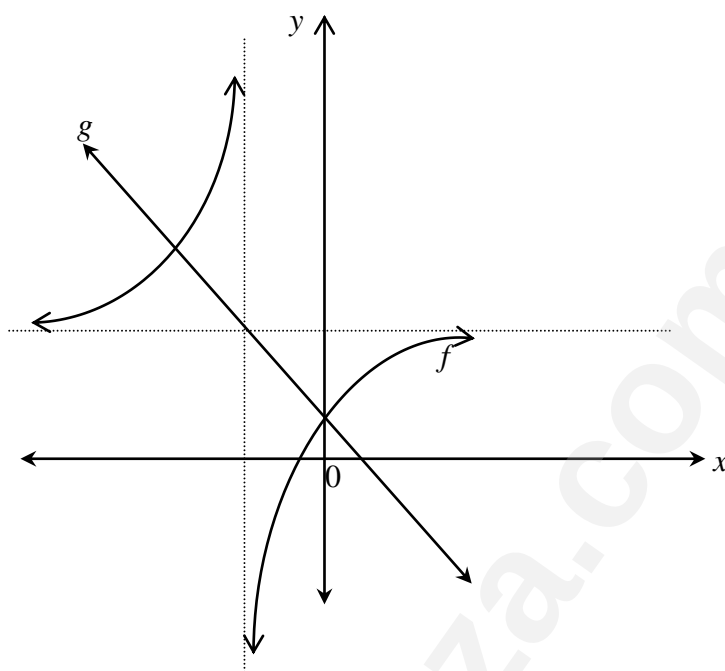
4.2.1 Calculate the value of the investment after 240 months. (4)

4.2.2 What was the interest rate for this investment per annum? (1)

4.2.3 Convert the nominal interest rate of this investment into an effective annual interest rate. (3)

[14]

QUESTION 5



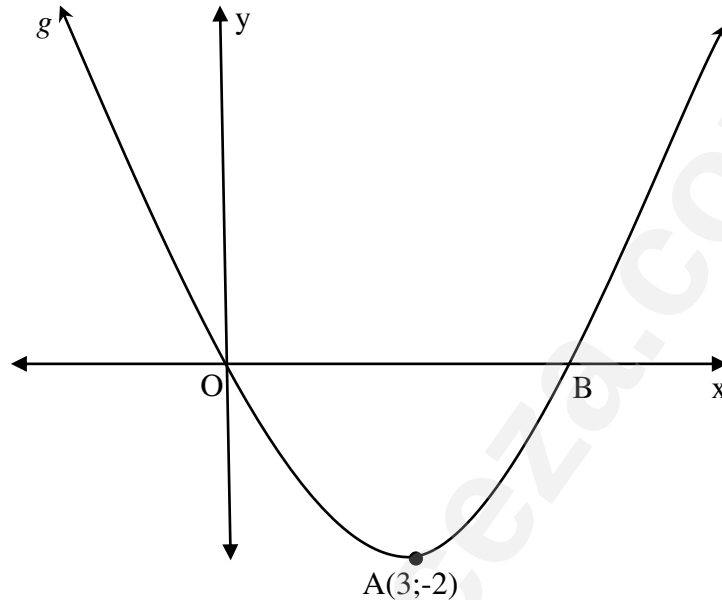
The graphs of $f(x) = \frac{-3}{x+1} + 5$ and $g(x) = -3x + 2$ are sketched.

- 5.1 Write down the range of $f(x)$. (1)
- 5.2 Determine the coordinates of the points of intersection of f and g . (7)
- 5.3 Describe the transformation of f to h if $h(x) = \frac{3}{x+1} + 5$. (1)
- [9]

QUESTION 6

The diagram show the curve of $g(x)$ which is a quadratic function with a turning point at $A(3; -2)$ and passes through the origin.

- 6.1 Show that the equation of $g(x) = \frac{2}{9}(x - 3)^2 - 2$. (3)



- 6.2 Write down the coordinates of B. (1)
- 6.3 Is $g(x)$ a one-to-one function or a one-to-many function? Substantiate your answer. (2)
- 6.4 Draw a sketch graph of g^{-1} . On this graph indicate the coordinates of the turning point as well as all intercepts with the axes. (3)
- 6.5 Determine the range of g^{-1} so that g^{-1} will be a function. (1)
- 6.6 Determine the equation of the graph in the form $y = \dots$ if the graph of g is shifted horizontally to the left by 2 units. (2)
- [12]**

QUESTION 7

Given: $g(x) = 2^{-x}$

- 7.1 Write down the equation that defines g^{-1} in the form $y = \dots$ (2)
- 7.2 Draw sketch graphs of g and g^{-1} on the same system of axes. Clearly label the graphs as well as all possible intercepts with the axes. (4)
- 7.3 By means of a dotted line, draw the axes of symmetry of g and g^{-1} . (1)
- 7.4 Write down the axes of symmetry. (1)
- 7.5 Use the letter P to indicate on the graph where you would read of the value of x for the solution of the equation $g(x) = g^{-1}(x)$. (1)
- [9]**

QUESTION 8

- 8.1 R2 000 was invested in a fund paying $i\%$ interest compounded monthly. After 18 months the value of the fund was R2 860,00. Calculate i , the interest rate. (3)
- 8.2 On 31 January 2008 Ayanda banked R100 in an account that paid 8% interest per annum, compounded monthly. She continues to deposit R100 on the last day of every month until 31 December. She was hoping to have enough money on 1 January 2009 to buy a bike for R1 300. Determine whether she will be able to do so, or not. (3)
- 8.3 George plans to buy a car for R125 000,00. He pays a deposit of 15% and takes out a bank loan for the balance. The bank charges 12,5% p.a. compounded monthly.
- Calculate:
- 8.3.1 The value of the loan borrowed from the bank. (1)
- 8.3.2 The monthly repayment on the car if the loan is repaid over 6 years. (3)
- [10]**

QUESTION 9

- 9.1 Determine: $\lim_{h \rightarrow 0} \frac{2h}{h}$. (1)
- 9.2 If $V = \frac{1}{2}Ar - \pi r^3$, determine $\frac{dV}{dr}$. (2)
- 9.3 Determine $D_x a^2x^2 + \bar{x}$. (2)
- 9.4 If $f(x) = x^3$, determine the derivative $f'(x)$, from first principals. (4)
- [9]**

QUESTION 10

- 10.1 Determine the coordinates of the turning points of the curve of the function with equation $y = x(x^2 - 27)$. (4)

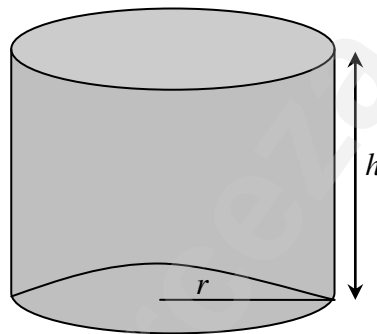
- 10.2 Given the function f with equation $y = 4 + 12x - 3x^2 - 2x^3$. (5)

Determine the coordinates of the point of inflection of the curve f .

- 10.3 The curve of $y = mx^3 - 3x^2 - 12x + n$ has a relative minimum value at the point $(2 ; -3)$. Calculate the value of m and n . (5)

[14]**QUESTION 11**

A solid cylinder is cast from 10 litres of molten metal. The cylinder is then covered with a layer of rust-proof paint. (h and r are in cm.)



- 11.1 Find the height of the cylinder, h , in terms of π and r . (3)

- 11.2 Now show that the Total surface area (A) of the cylinder can be written as:

$$A = 2\pi r^2 + \frac{20\,000}{r} \quad (2)$$

- 11.3 Hence, calculate the radius and height (in cm) so that the minimum quantity of paint can be used. (4)

[9]**QUESTION 12**

A doctor advises a patient to take at least 10 units of vitamin B and at least 15 units of vitamin C daily. Each tablet contains 2 units of B and 1 unit of C while each capsule contains 1 unit of B and 3 units of C.

- 12.1 Suppose the patient uses x tablets and y capsules daily. Determine a system of four inequalities in x and y . (4)

- 12.2 Sketch this system of constraints on a set of axes and show clearly the feasible region. (6)

- 12.3 The patient wants to take a few capsules and tablets as possible. How many of each should the patient take? (3)

[13]**TOTAL: 150**