education

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NATIONAL SENIOR CERTIFICATE

GRADE 12

MATHEMATICS P1

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Stanmorephysics.com

MARKS: 150

TIME: 3 hours

This question paper consists of 11 pages and 1 information sheet.

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INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of 11 questions.
2. Answer ALL the questions.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Clearly show ALL calculations, diagrams, graphs, etc. that you have used in determining your answers.
5. Answers only will NOT necessarily be awarded full marks.
6. You may use an approved scientific calculator (non-programmable and non-graphical), unless stated otherwise.
7. If necessary, round off answers to TWO decimal places, unless stated otherwise.
8. Diagrams are NOT necessarily drawn to scale.
9. An information sheet with formulae is included at the end of the question paper.
10. Write neatly and legibly.

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QUESTION 1

1.1 Solve for x:

1.1.1 $(3x - 1)(x + 2) = 0$ (2)

1.1.2 $5x^2 - 7x - 11 = 0$ (correct to TWO decimal places) (3)

1.1.3 $x^2 + 2x - 15 \geq 0$ (4)

1.2 Solve simultaneously for x and y:

$x + 2y = 3$ and $x^2 - y^2 = x + y$ (6)

1.3 Given: $f(x) = \dfrac{3x - x^2}{2^x - 4}$. Determine the values of x for which:

1.3.1 $f(x) = 0$ (3)

1.3.2 $f(x)$ undefined (2)

1.3.3 $f(x) \leq 0$ (3)

[23]

QUESTION 2

2.1 The sum of a series is given by the following formula: $S_n = 3n^2 + 2n$

2.1.1 Calculate the sum of the first ten terms. (2)

2.1.2 Calculate the first three terms of the series. (4)

2.1.3 Is the given series arithmetic or geometric? (1)

2.1.4 If the last term is 161, calculate the number of terms in the series. (3)

2.2 In a convergent geometric series, the sum to infinity is 18 and the sum of the first four terms, S_4, is $\dfrac{130}{9}$. Calculate the value of the constant ratio. (6)

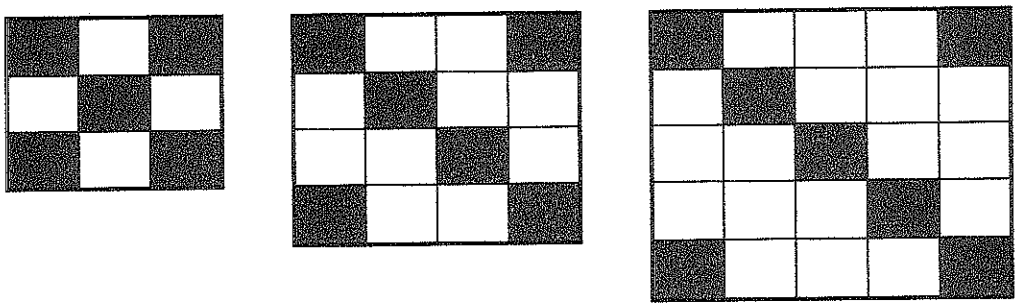
[16]

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QUESTION 3

Black and white blocks are used to create patterns. The first three patterns are shown below:



Pattern 1 Pattern 2 Pattern 3

3.1 Write down the number of black blocks in each pattern. (1)

3.2 Write down a formula for the number of black blocks that will be used in Pattern n. (1)

3.3 How many white blocks will be used to create the fourth pattern? (2)

3.4 Determine a formula for the number of white blocks in Pattern n. (3)

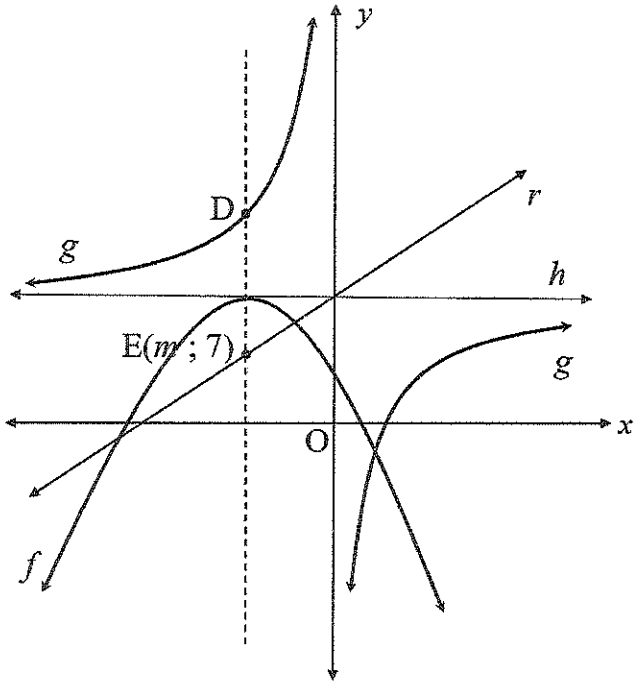
3.5 Calculate how many white blocks will be in a pattern with 32 black blocks. (3)
[10]

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QUESTION 4

Below are the graphs of $f(x) = -2(x + p)^2 + q$ and $g(x) = \frac{-3}{x} + n$.

- $h(x) = n$, an asymptote of g, is also a tangent to f.
- The line $r(x) = x + 8$ is an axis of symmetry of g.
- $r(x) = x + 8$ also intersects the axis of symmetry of f in the point E(m ; 7).



4.1 Write down the domain of g. (2)

4.2 Calculate the value of m. (2)

4.3 Write down the value of n. (1)

4.4 Given: $f(x) = -2(x + p)^2 + q$. Write down the values of p and q. (2)

4.5 If it is given that $f(x) = -2x^2 - 4x + 6$, calculate the x-intercepts of f. (3)

4.6 The axis of symmetry of f intersects the graph of g at point D. Determine the coordinates of D. (2)

4.7 Determine the equation of the tangent to g at point D. Write down your answer in the form $y = bx + c$. (5)

4.8 Determine the equation of $k(x)$ in the form $k(x) = \frac{a}{x + t} + s$ if k is the reflection of g about the line $x = 2$. (3)

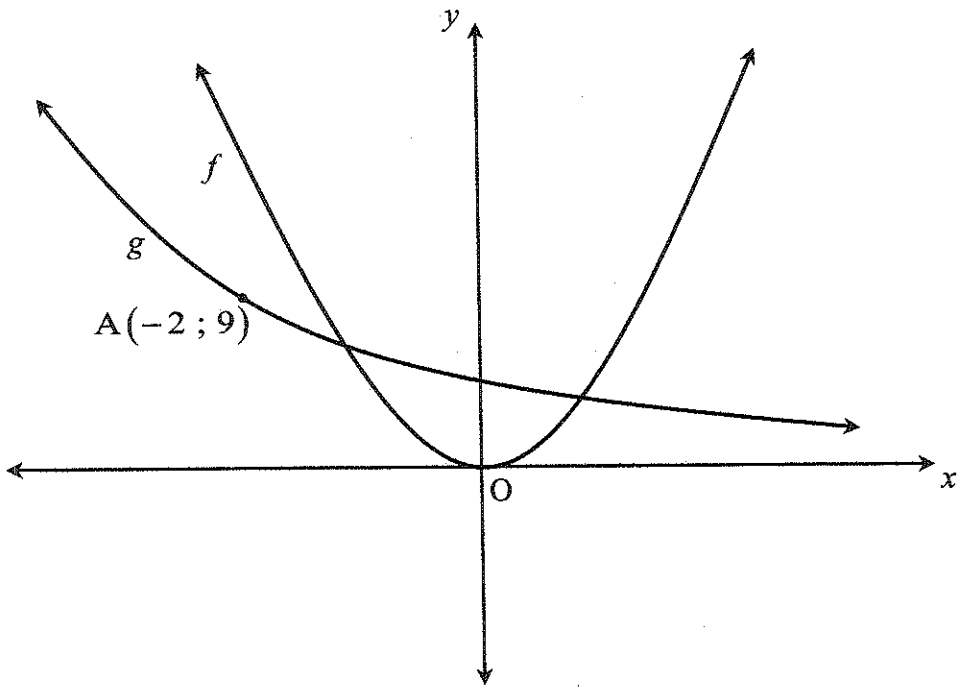
4.9 Determine the value(s) of k for which the equation of $g(x + 4) + k = 0$ will have a root that is less than -5. (3)

[23]

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QUESTION 5

Sketched below are the graphs of $f(x) = 2x^2$ and $g(x) = \left(\frac{1}{3}\right)^x$. The point $A(-2\ ;\ 9)$ lies on the graph of g.



5.1 Determine the equation of $f^{-1}(x)$, the inverse of f, in the form $y = ...$ (3)

5.2 For which values of x will $-2 \leq \log_{\frac{1}{3}} x \leq 0$. (3)

5.3 Simplify the following: $f\left(\frac{1}{x}\right) + \frac{1}{f(x)} + \left[f^{-1}(x)\right]^2$. (3)

[9]

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QUESTION 6



On 1 January 2022, Pete decided that he will buy a cottage near the sea in 11 years' time on 31 December 2032. The cottage will cost R1 800 000. He opened a savings account in order to save to buy the cottage. The bank offered an interest rate of 13% per annum compounded monthly. Pete made his first payment into the account on 1 January 2022 and continues with payments at the end of each month thereafter until 31 December 2032.

6.1 Calculate the effective yearly interest rate of the savings account. (3)

6.2 Calculate his monthly payment. (4)

6.3 Pete decides that he will go on holiday to the Kruger National Park on 31 December 2026, 31 December 2028 and 31 December 2030. He will withdraw R20 000 from the savings account each time he goes on holiday. These withdrawals will result in Pete not having the required amount to buy the cottage on 31 December 2032. How much will he be short of to buy the cottage? (5)

6.4 Calculate the new monthly payment into the savings account over the 11 years that will allow Pete to go on his holidays and buy the cottage. (3)

[15]

QUESTION 7

7.1 Given: $f(x) = 5x^2 - x + 3$

Determine $f'(x)$ from first principles. (6)

7.2 Determine: $\frac{d}{dt}\left[(2t-1)(t+4)\right]$ (3)

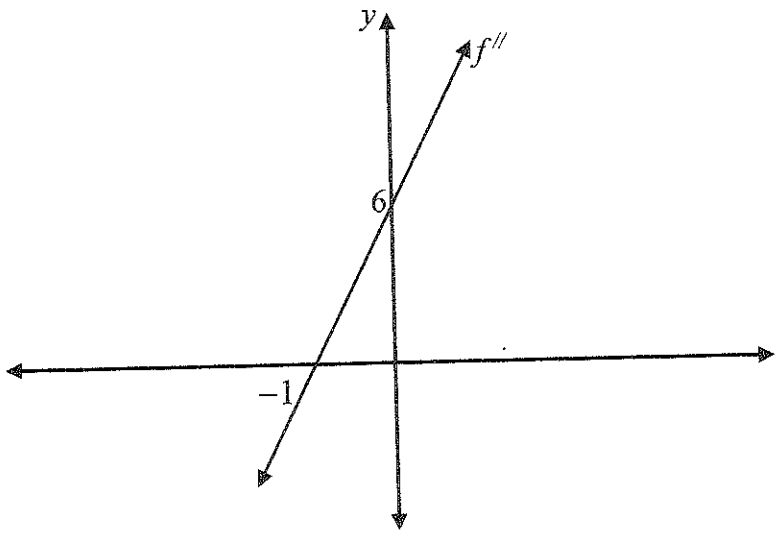
7.3 Determine $\frac{dq}{dp}$ if $9p^2 - 3pq - q = 1$. (4)

[13]

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QUESTION 8

The graph of $f''(x) = mx + c$ is sketched below, where $f(x) = px^3 + qx^2 + rx - 27$.
The graph of f is decreasing where $t \leq x \leq 1$.



8.1 Determine the equation of $f''(x)$. (2)

8.2 Write down the x-value of the point of inflection of f. (1)

8.3 Use the graph of $f''(x)$ to determine the values of x for which f is concave up. Give a reason for your answer. (2)

8.4 Show that $p = 1, q = 3$ and $r = -9$. Show all calculations. (5)

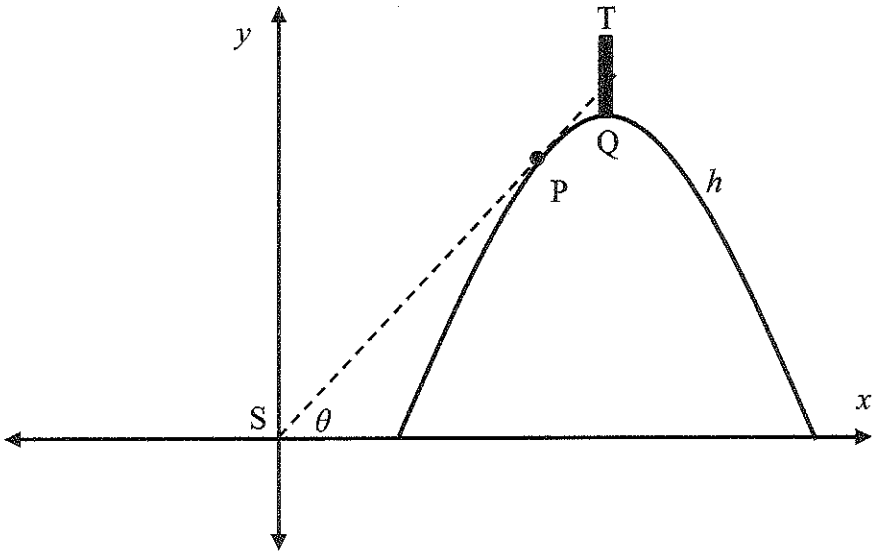
8.5 Hence, or otherwise determine the value of t. (3)

8.6 For which values of x will $f(x).f''(x) \geq 0$? (5)
[18]

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QUESTION 9

The soldier (S) shoots at a fixed target TQ on the crest (highest point) of the hill. The height of the hill is represented by the equation $h(x) = -x^2 + 4x - 3$ for $1 \leq x \leq 3$.
P is a point on the hill.



9.1 Write an expression for the gradient of the hill in terms of x. (1)

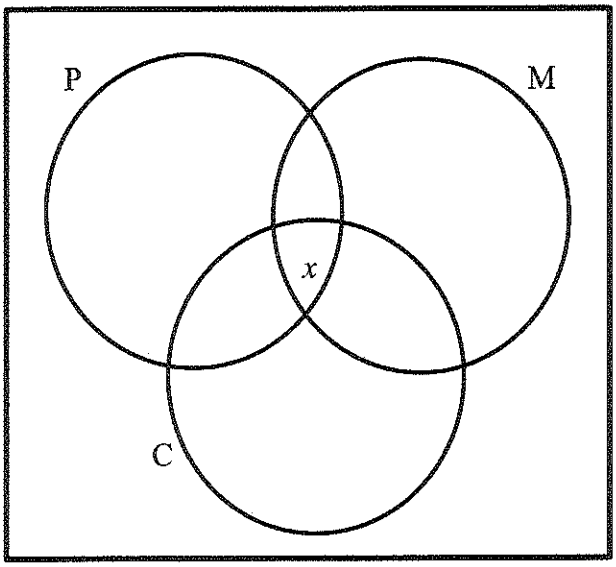
9.2 What is the smallest angle (θ) that the soldier can aim to shoot the target? (6)
[7]

QUESTION 10

A survey was conducted among 220 students at a university. The results are shown below:

40 students study Physical Sciences (P)
117 students study Mathematics (M)
90 students study Commercial Sciences (C)
21 students study Physical Sciences and Commercial Sciences
53 students study Mathematics and Commercial Sciences
12 students study Physical Sciences and Mathematics
50 students do not study Physical Sciences, Mathematics or Commercial Sciences
x students study Physical Sciences, Mathematics and Commercial Sciences

10.1 Copy the Venn-diagram given below in your ANSWER BOOK and then represent the above information on it.



(4)

10.2 Calculate the value of x, the number of students that study all three courses. (2)

10.3 If a student was selected at random, calculate the probability that he/she studies only one of the courses: Physical Sciences, Mathematics or Commercial Sciences. (2)

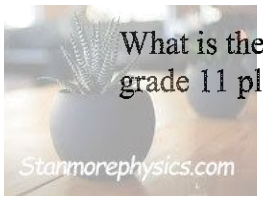
[8]

QUESTION 11

The coach of a first hockey team wants to take a photo of his team. There are 11 players in his team where the captain, vice-captain and another 5 players are in grade 12 and the other 4 are in grade 11. The 11 players are placed randomly in a row to take a photo.

11.1 In how many different ways can the coach move the 11 players for the first photo if the captain should not sit at one of the ends? (2)

11.2 For the second photo, the captain and vice-captain must sit in any order on the 5^{th} and 6^{th} chair.



What is the probability that a grade 12 player will sit on the first chair and a grade 11 player on the last chair? (6)
[8]

TOTAL: 150

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