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Grade 12

Core Mathematics: Paper I

August 2021

Time: 3 hours

Marks: 150

Please read the following instructions carefully:

1. This question paper consists of 16 pages and an Information sheet. Please check that your question paper is complete.
2. **Answer all the questions on the question paper.**
3. You may use an approved non-programmable and non-graphical calculator.
4. All necessary working details must be clearly shown.
5. Round off answers to **1 decimal place** where necessary, unless otherwise stated.
6. Ensure that your calculator is in **DEGREE** mode.
7. Diagrams may not be drawn to scale.
8. **A mark is not necessarily allocated to the correct answer** but rather the working. Show all working.

	SECTION A					SECTION B			
	Equations	Financial Maths	Number patterns	Functions	Probability	Functions	Calculus	Calculus	Calculus
Question	1	2	3	4	5	6	7	8	9
Mark									
Total	27	14	24	14	11	24	11	18	7
Total									
							150		
Percentage									
							100		

IEB exam number: _____

Name: _____

Teacher: _____

Question 1

1.1 Solve for x and show ALL relevant working:

1.1.1 $(2 - 3x)(x - 4) = 0$ (2)

1.1.2 $-2x^2 + 4x = -5$ (correct to TWO decimal places) (3)

1.1.3 $3^x - 3^{x-1} = 162$ (4)

1.1.4 $\sqrt{3-x} = \frac{x^2-x-6}{\sqrt{3-x}}$ (5)

1.2 If $\log_3 m = k$, determine in terms of k

1.2.1 $\log_3 3m$ (2)

1.2.2 $\log_3 \sqrt[3]{m}$ (2)

1.3 Solve for x if $\log x^3 - \log x = 4$ (3)

1.4 The roots of a quadratic equation are given by the following:

$$x = \frac{6 \pm \sqrt{p(5-p)}}{4}$$

1.4.1 Describe the nature of roots if $p = 4$ (3)

1.4.2 For which values of p will the roots be non-real? (3)

Question 2

- 2.1 A car is bought for R125 000 and its value depreciates at a rate of 17% p.a.
Calculate the book value of the car in 6 years' time using the reducing-balance method. (2)

- 2.2 Calculate the effective interest rate per annum if an investment earns interest at a rate of 9,5% p.a. compounded monthly. (3)

- 2.3 An entrepreneur made an initial deposit of R40 000 into an investment account earning interest at 8% p.a. compounded monthly. Two years later, she made another deposit of R60 000 into the account and the interest rate changed to 10% p.a. compounded quarterly. Calculate the value of her investment account at the end of 5 years. (5)

- 2.4 A company took out a loan that was paid back in two instalments.
At the end of the first year, an amount of R45 000 was repaid.
At the end of the second year, a final amount of R56 824,94 was repaid.
The loan earned interest of 8% p.a. compounded monthly.
Calculate the loan amount. (4)

Question 3

3.1 The sequence 2 ; 6 ; 10 ; 14 ; ... ; 130 is an arithmetic sequence.

3.1.1 Determine the n^{th} term of the sequence. (2)

3.1.2 How many terms are in the sequence? (2)

3.1.3 It is further given that the above sequence forms the row of the first differences for a quadratic sequence $T_n = an^2 + bn + c$ where $T_5 = 33$. Determine the values of a , b and c . (5)

3.2 Given:

$$S_n = \frac{3(1 - 2^n)}{-8}$$

3.2.1 Calculate S_6 and leave your answer as a fraction. (2)

3.2.2 Calculate T_7 (3)

3.3 Given:

$$\sum_{k=1}^n (3k + 4) = m \quad \text{and} \quad \sum_{k=1}^{22} (3k + 4) = 847$$

Determine, in terms of m , the value of: (2)

$$\sum_{k=23}^n (3k + 4)$$

3.4 Given:

$$\sum_{p=1}^n 64 \cdot 2^{1-p}$$

3.4.1 Determine the first 3 terms of the series:

(2)

3.4.2 If $n \in \mathbb{N}$, calculate the smallest value of n for which:

(3)

$$\sum_{p=1}^n 64 \cdot 2^{1-p} > 127$$

3.4.3 Calculate:

(3)

$$\sum_{p=1}^{\infty} 64 \cdot 2^{1-p}$$

[24]

Question 4

Given: $f(x) = -\frac{4}{x-2} + 1$

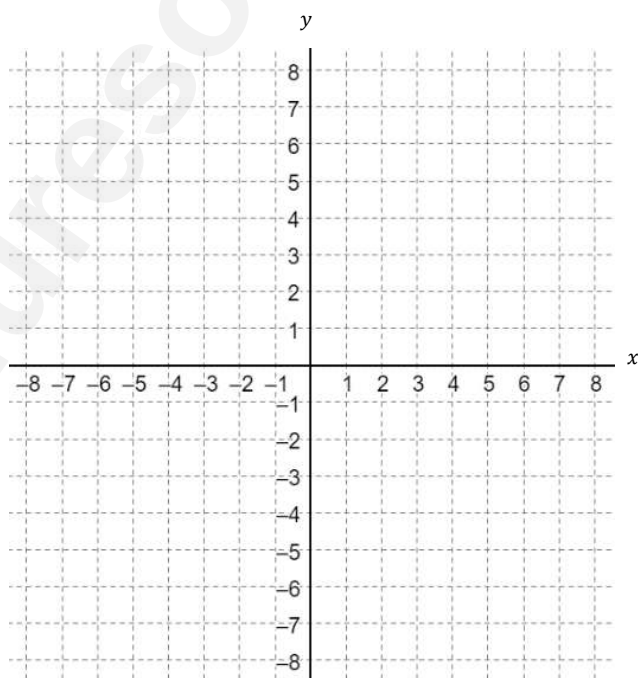
4.1 Write down the equations of the asymptotes of f . (2)

4.2 Calculate:

4.2.1 the y -intercept of f (2)

4.2.2 the x -intercept of f (2)

4.3 Sketch the graph of f showing clearly the asymptotes and the intercepts of the axes. (3)



- 4.4 Determine the equation of the line of symmetry of f that has a negative gradient.
Leave your answer in the form $y = \dots$

(3)

- 4.5 Give the equation of the graph g if it is the translation of f two units right and 3 units down.

(2)

Total of section A [14]
[77]

Question 5

5.1 For any two events, A and B, it is given that $P(A) = 0,48$ and $P(B) = 0,26$.

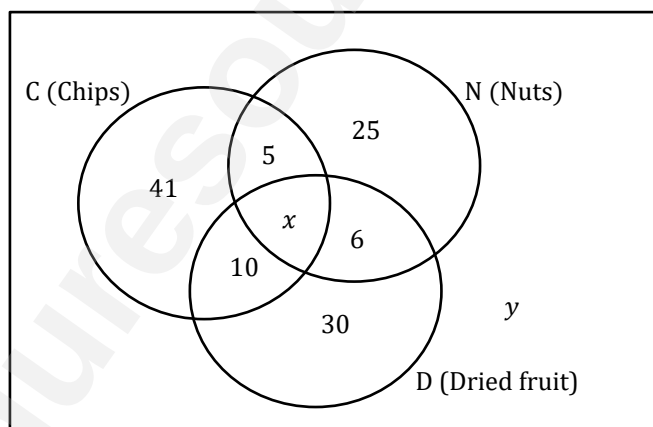
Determine, to 2 decimal places:

5.1.1 $P(A \text{ and } B)$ if A and B are independent events. (2)

5.1.2 $P(A \cup B)$ if $P(A \cap B) = 0,12$ (2)

5.1.3 $P(A \text{ or } B)$ if A and B were mutually exclusive events. (2)

5.2 A survey was conducted among 130 Grade 12 learners to establish which snack they prefer to eat while they watch television. The results were summarised in the Venn diagram below. However, some information is missing.



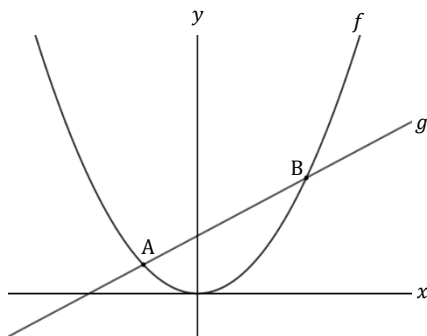
5.2.1 If 29 learners prefer at least two types of snacks, calculate the value of x and y . (3)

5.2.2 Determine the probability that a learner who does not eat nuts will have at least one other snack while watching television. (2)

Question 6

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6.1 The functions $f(x) = \frac{1}{4}x^2$ and $g(x) = \frac{1}{2}x + 2$ are drawn in the diagram below.



6.1.1 Determine the **coordinates** of A and B, the points of intersection of graphs f and g . (4)

6.1.2 For what value/s of x is:

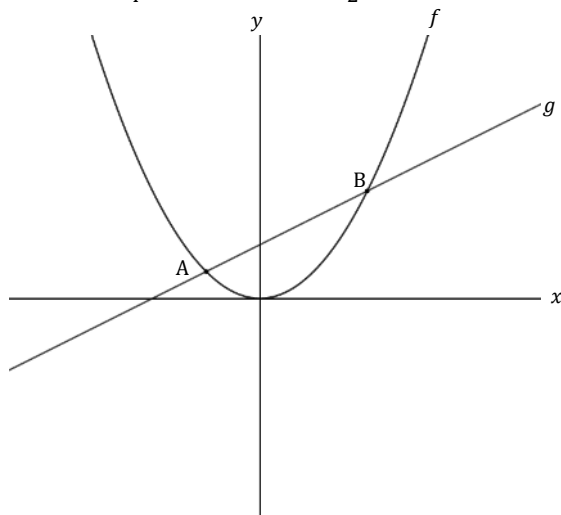
(i) $f(x) > g(x)$ _____ (2)

(ii) $f(x) \cdot g(x) \geq 0$ _____
 _____ (3)

6.1.3 Determine the equation of a tangent to $f(x)$ where $f'(x) = -3$ (5)

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6.2 The same functions $f(x) = \frac{1}{4}x^2 + 1$ and $g(x) = \frac{1}{2}x + 2$ are shown on the diagram below.



6.2.1 Determine the equation of $f^{-1}(x)$. (3)

6.2.2 Draw a rough sketch of $f^{-1}(x)$ on the same set of axes above. Show the intercept/s with the axes and 2 other coordinates. (3)

6.2.3 Show that $g(x)$ is a tangent to $f^{-1}(x)$. (4)

[24]

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(5)

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7.2 Determine the following leaving your answers with **positive, rational** exponents:

$$6.2.1 \quad D_x \left[\frac{x^3 + 3x + 1}{x} \right] \quad (3)$$

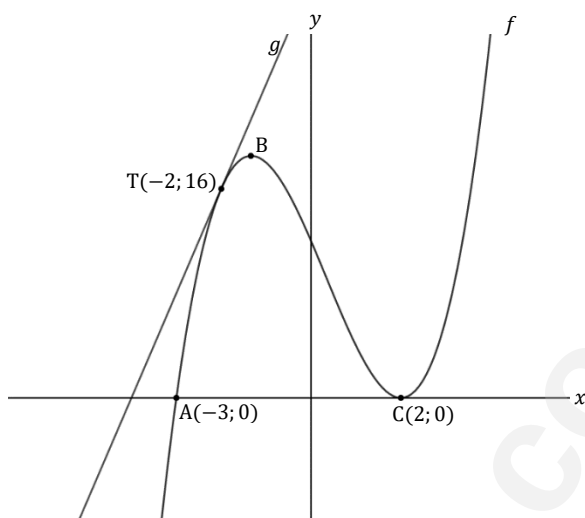
[illegible]

$$7.2.2 \quad \frac{dy}{dp} \text{ if } y = (3k - 2p)^2 \quad (3)$$

Question 8

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The function $f(x) = x^3 + bx^2 + cx + d$ and its tangent, $g(x) = mx + 32$ are drawn in the sketch below. The x -intercepts are at $A(-3; 0)$ and $C(2; 0)$, the turning points are at B and $C(2; 0)$. The tangent touches the curve at $T(-2; 16)$



8.1 Show that the equation of $f(x) = x^3 - x^2 - 8x + 12$ (3)

8.2 Calculate the coordinates of B. (5)

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8.3 For what value/s of k will $x^3 - x^2 - 8x + 12 = k$ have one real solution? (2)

8.4 For what value/s of x is $f''(x) < 0$? (3)

8.5.1 Show that $m = 8$ for the equation of the tangent, $g(x) = mx + 32$ (2)

8.5.2 For what x -value will another tangent be parallel to the tangent at $T(-2; 16)$? (3)

[18]

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A 3D diagram of a rectangular prism. The vertical edge on the left is labeled h . The bottom-left edge is labeled x . The bottom-right edge is labeled x . Hidden edges are shown as dashed lines.

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