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NATIONAL SENIOR CERTIFICATE

GRADE 12

SEPTEMBER 2025

TECHNICAL MATHEMATICS P1

MARKS: 150

TIME: 3 hours

This question paper consists of 11 pages, including a 2-page information sheet and 2 answer sheets.



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INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of NINE questions.
2. Answer ALL the questions.
3. Answer QUESTION 4.2.5 and QUESTION 7.4 on the ANSWER SHEETS provided.
Write your name, surname and class in the spaces provided on the ANSWER SHEETS
and hand in the ANSWER SHEETS with your ANSWER BOOK.
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.

QUESTION 11.1 Solve for x :

$$1.1.1 \quad 2x(1-x) = 0 \quad (2)$$

$$1.1.2 \quad x - 6 = -3x^2 \quad (\text{Correct to TWO decimal places}). \quad (4)$$

$$1.1.3 \quad x^2 - 6x - 16 \leq 0 \quad (x \in N; x \geq 4) \quad (4)$$

1.2 Solve for x and y if:

$$x = 1 - y \text{ and } x^2 + y^2 = 25 \quad (5)$$

1.3 The moment of inertia for a beam is calculated using the formula below:

$$I = \frac{b \cdot h^3}{12}$$

 I = moment of inertia (mm^4) h = height (m) b = base width (m)

$$1.3.1 \quad \text{Make } b \text{ the subject of the formula.} \quad (2)$$

$$1.3.2 \quad \text{Calculate the value of } b \text{ given that } I = 12\,000 \text{ mm}^4; h = 100 \text{ mm.} \quad (2)$$

$$1.3.3 \quad \text{Write the answer in QUESTION 1.3.2 in scientific notation.} \quad (1)$$

$$1.4 \quad 1.4.1 \quad \text{Determine the value of } 1111011_2 \div 3 \quad (2)$$

$$1.4.2 \quad \text{Write the answer in QUESTION 1.4.1 as a binary number.} \quad (1)$$

[23]

QUESTION 2

2.1 The solutions to a quadratic equation are: $x = 5 \pm \sqrt{12 - 3q}$

For which values of q will the equation have non-real roots? (2)

2.2 Consider: $m(x) = x^2 + x(p - 3) + 4$

2.2.1 Write the condition of the discriminant for equal roots. (1)

2.2.2 Hence, determine the values of p for which $m(x)$ has equal roots. (3)

[6]

QUESTION 3

3.1 Simplify the following WITHOUT using a calculator:

3.1.1
$$\frac{(2a^0)^{-1}}{4}$$
 (1)

3.1.2
$$\frac{3 \cdot 2^{x+1} + 2 \cdot 2^{2x}}{2^{2x} + 3 \cdot 2^x}$$
 (3)

3.1.3
$$\frac{\sqrt{243} - 2\sqrt{12}}{\sqrt{75}}$$
 (3)

3.2 Given: $x \log_3 2 - \log 100 = x \log_3 6$

3.2.1 Show that $x \log_3 \left(\frac{1}{3} \right) = 2$ (2)

3.2.2 Solve for x in QUESTION 3.2.1 above. (3)

3.3 Given: $z = a + bi$ and $\bar{z} = -3 + i$

Determine:

3.3.1 The equation of z (2)

3.3.2 The modulus of z (2)

3.3.3 The size of θ , the angle of inclination of z (3)

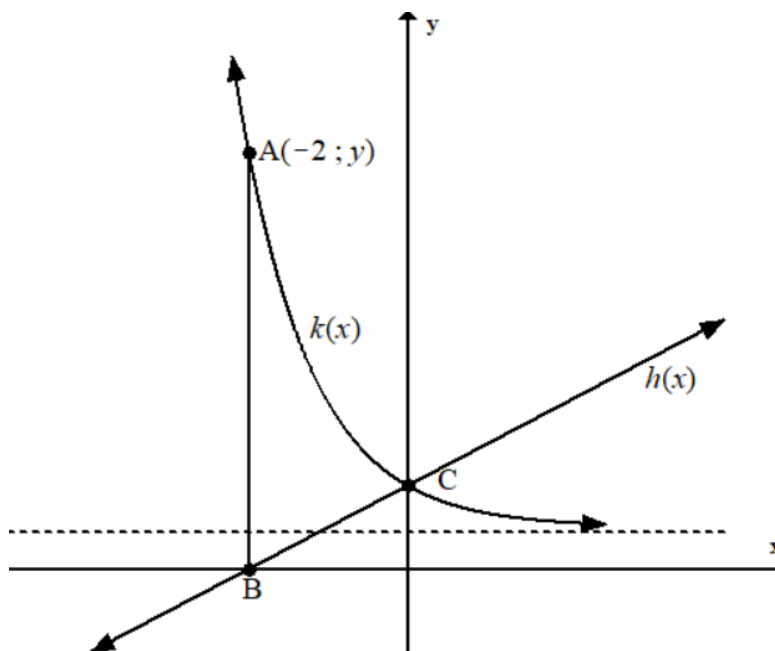
3.3.4 Hence, express z in polar form (1)

3.4 Solve for x and y if $x - 4yi = \frac{3}{i}$ (4)

[24]

QUESTION 4

- 4.1 The sketched graphs below represent the functions defined by: $k(x) = 3^{-x} + 1$ and $h(x) = mx + c$



- 4.1.1 Determine the coordinates of B and C, the intercepts of the graphs. (3)
- 4.1.2 Determine the equation of h . (3)
- 4.1.3 Write down the equation of the asymptote of k . (1)
- 4.1.4 Calculate the distance of AB. (3)
- 4.1.5 Write the new equation of $p(x)$ which resulted from reflecting $k(x)$ about the y -axis. (1)
- 4.2 Consider the functions defined by: $f(x) = -(x-2)^2 + q$ and $g(x) = \sqrt{36-x^2}$
- $f(x)$ has a maximum value at $y = 9$
 - Equation for the axis of symmetry of f is defined by $x = 2$
- 4.2.1 Write down the coordinates of the turning point. (2)
- 4.2.2 Hence, write the equation of f in the form $f(x) = ax^2 + bx + c$ (1)
- 4.2.3 Calculate the x and y -intercepts of f . (3)
- 4.2.4 Write down the range of g . (2)



- 4.2.5 Sketch the graph of f and g on the same set of axes on the ANSWER SHEET for QUESTION 4.2.5 provided. Clearly show the intercepts with the axes and turning point. (5)
- 4.2.6 Use the sketched graphs to determine the values of x where $g(x) \times f(x) \leq 0$ (4)
- 4.3 The graph of a hyperbola with equation $y = \frac{a}{x-p} + q$ has the following properties:
- Domain: $x \in R, x \neq 4$
 - Equation of the horizontal asymptote defined by: $y = 2$
 - Passing through point (5 ; 3)
- 4.3.1 Write down the values of p and q . (2)
- 4.3.2 Determine the equation of the hyperbola described above. (3)
- [33]

QUESTION 5

- 5.1 A city's population is growing at an annual rate of 3% compounded every 3 months. Determine the effective annual growth rate. (3)
- 5.2 Octavia is a young chef who enjoys cooking, but prefers to cook quick and healthy meals. She decides to purchase an air fryer priced at R1 500 on a higher purchase on the following terms.

- 6,7% deposit
- Repayment period of 6 months
- Interest rate charged at 15% per annum



- 5.2.1 Determine how much is 6,7% of the cash price. (1)
- 5.2.2 Determine Octavia's loan amount. (2)
- 5.2.3 Determine the actual amount Octavia pays for the air fryer. (3)
- 5.2.4 Determine Octavia's monthly repayments. (2)
- 5.3 Matumi deposits R8 000 into a fixed savings account for 5 years. The account earns interest at different rates over time.
- 6% per annum compounded quarterly for the first 18 months.
 - 7,5% per annum compounded monthly thereafter.
- Calculate how much will be in the account at the end of the investment period. (5)
- [16]**

QUESTION 6

- 6.1 Determine $f'(x)$ by using FIRST PRINCIPLES if $f(x) = 3 - x$ (5)
- 6.2 Determine:
- 6.2.1 $\frac{dy}{dx}$ if $x = 2y + 1$ (2)
- 6.2.2 $D_x \left[x \left(\sqrt[3]{x} + \frac{1-2x}{x^2} \right) \right]$ (6)
- 6.3 Determine the equation of a tangent to the function $g(x) = 2x^2$ at $x = -3$ with $g'(-3) = -12$ (3)
- [16]**



**QUESTION 7**

Given: $f(x) = (x-2)(ax^2 + bx + c)$. The graph has 3 roots defined by $x = 2$ or $x = 2$ or $x = -3$

- 7.1 Show that $a = 1$; $b = 1$; $c = -6$ (2)
- 7.2 Determine the coordinates of the stationary points of f . (6)
- 7.3 Write down the coordinates of the y -intercept of f . (2)
- 7.4 Sketch the graph of f on the ANSWER SHEET for QUESTION 7.4 provided. Clearly show ALL the coordinates of the turning points and intercepts with the axis. (4)
- 7.5 Use your graph to determine the values of x where f is strictly decreasing. (2)
- [16]**

QUESTION 8

A car moves along a straight road with its velocity given by the function:

$$v(t) = 3t^2 - 12t + 9$$

where v is the velocity in m/s and t is the time in seconds.

- 8.1 Determine the initial velocity of the car. (1)
- 8.2 Determine the minimum velocity of the car. (5)
- [6]**



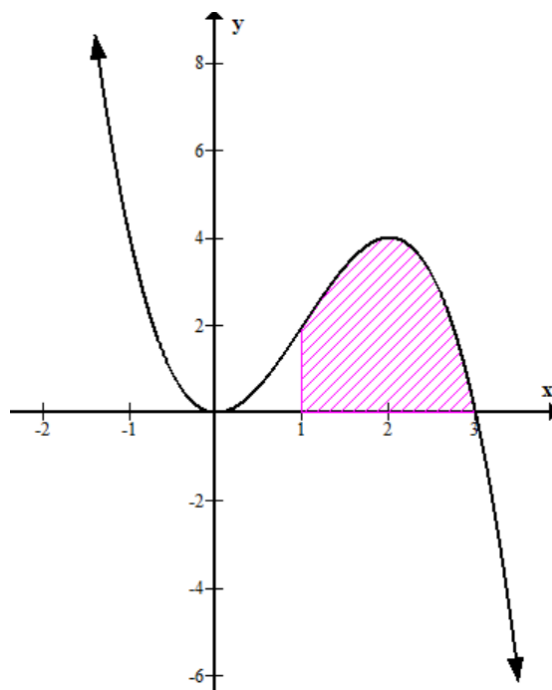
QUESTION 9

9.1 Determine the following integrals:

9.1.1 $\int (-4x + \pi) dx$ (3)

9.1.2 $\int (3^{-2x} - 7x^{-1}) dx$ (2)

9.2 The sketch below represents the shaded area bounded by the curve of the function defined by $h(x) = -x^3 + 2x$ and the x -axis.



Determine the value of the shaded area bounded by the curve and the x -axis. (5)
[10]

TOTAL: 150

INFORMATION SHEET: TECHNICAL MATHEMATICS

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = -\frac{b}{2a}$$

$$y = \frac{4ac - b^2}{4a}$$

$$a^x = b \Leftrightarrow x = \log_a b, \quad a > 0, a \neq 1 \text{ and } b > 0$$

$$A = P(1 + ni)$$

$$A = P(1 - ni)$$

$$A = P(1 + i)^n$$

$$A = P(1 - i)^n$$

$$i_{eff} = \left(1 + \frac{i}{m}\right)^m - 1$$

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

$$\int x^n dx = \frac{x^{n+1}}{n+1} + C, \quad n \neq -1$$

$$\int kx^n dx = k \cdot \frac{x^{n+1}}{n+1} + C, \quad n \neq -1$$

$$\int \frac{1}{x} dx = \ln x + C, \quad x > 0$$

$$\int \frac{k}{x} dx = k \cdot \ln x + C, \quad x > 0$$

$$\int a^x dx = \frac{a^x}{\ln a} + C, \quad a > 0$$

$$\int k a^{nx} dx = k \cdot \frac{a^{nx}}{n \ln a} + C, \quad a > 0$$

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$M\left(\frac{x_2 + x_1}{2}; \frac{y_2 + y_1}{2}\right)$$

$$y = mx + c$$

$$y - y_1 = m(x - x_1)$$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$\tan \theta = m$$

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

$$\text{In } \triangle ABC: \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cdot \cos A$$

$$\text{Area of } \triangle ABC = \frac{1}{2} ab \cdot \sin C$$

$$\sin^2 \theta + \cos^2 \theta = 1$$

$$1 + \tan^2 \theta = \sec^2 \theta$$

$$1 + \cot^2 \theta = \operatorname{cosec}^2 \theta$$



$$\pi \text{ rad} = 180^\circ$$

$$\text{Angular velocity} = \omega = 2\pi n \quad \text{where } n = \text{rotation frequency}$$

$$\text{Angular velocity} = \omega = 360^\circ n \quad \text{where } n = \text{rotation frequency}$$

$$\text{Circumferential velocity} = v = \pi Dn \quad \text{where } D = \text{diameter and } n = \text{rotation frequency}$$

$$\text{Circumferential velocity} = v = 2\pi rn \quad \text{where } r = \text{radius and } n = \text{rotation frequency}$$

$$\text{Arc length} = s = r\theta \quad \text{where } r = \text{radius and } \theta = \text{central angle in radians}$$

$$\text{Area of a sector} = \frac{rs}{2} \quad \text{where } r = \text{radius, } s = \text{arc length and } \theta = \text{central angle in radians}$$

$$\text{Area of a sector} = \frac{r^2 \theta}{2} \quad \text{where } r = \text{radius and } \theta = \text{central angle in radians}$$

$$4h^2 - 4dh + x^2 = 0 \quad \text{where } h = \text{height of segment, } d = \text{diameter of circle and } x = \text{length of chord}$$

$$A_T = a(m_1 + m_2 + m_3 + \dots + m_n) \quad \text{where } a = \text{length of the equal parts, } m_1 = \frac{o_1 + o_2}{2}$$

$$o_n = n^{\text{th}} \text{ ordinate and } n = \text{number of ordinates}$$

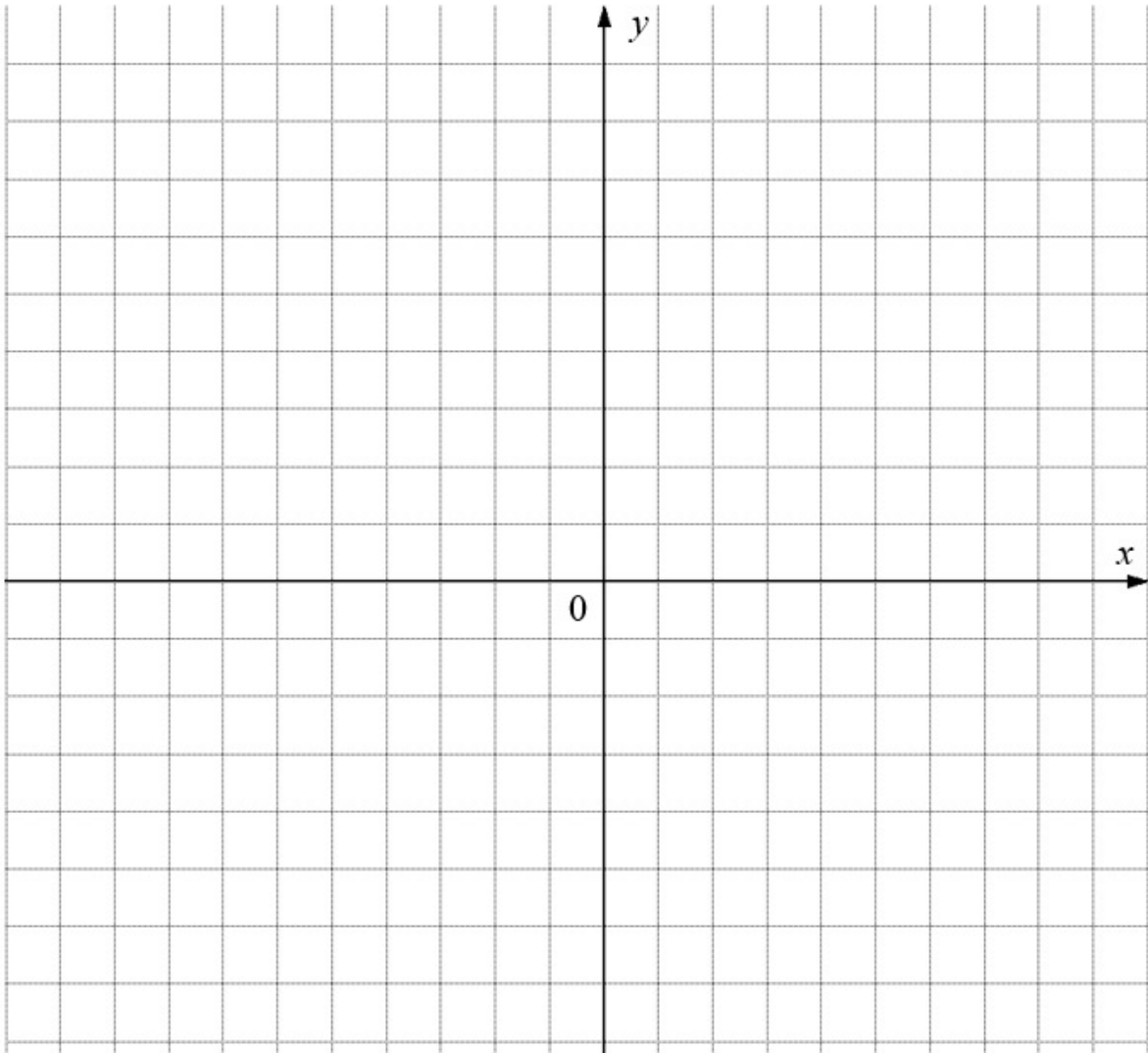
OR

$$A_T = a \left(\frac{o_1 + o_n}{2} + o_2 + o_3 + \dots + o_{n-1} \right) \quad \text{where } a = \text{length of the equal parts, } o_n = n^{\text{th}}$$

$$\text{ordinate and } n = \text{number of ordinates}$$



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QUESTION 4.2.5

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QUESTION 7.4

