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basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

TECHNICAL MATHEMATICS P1

NOVEMBER 2025

MARKS: 150

TIME: 3 hours

This question paper consists of 12 pages, a 2-page information sheet and a 22-page SPECIAL ANSWER BOOK.

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

QUESTION 1

1.1 Solve for x:

1.1.1 $2x\left(x-\frac{4}{9}\right)=0$ (2)

1.1.2 $6+(2x-5)(x+2)=0$ (correct to TWO decimal places) (4)

1.1.3 $(3-x)(x+2)>0$ (2)

1.2 Given: $y-x+1=0$ and $x^2+xy=3$

1.2.1 Make y the subject of the equation $y-x+1=0$ (1)

1.2.2 Solve for x and y simultaneously. (5)

1.3 The formula used to determine brake power (BP) when rotational frequency (N) and torque (T) are given is:

$$BP = 2\pi NT$$

Where: BP = brake power (W)
N = rotational frequency (r/s)
T = torque (Nm)

1.3.1 Make N the subject of the formula. (1)

1.3.2 Hence, calculate the numerical value of N if
BP = 117 366,54 W and T = 560,44 Nm (2)

1.4 Express 81 as a binary number. (1)

1.5 Evaluate $81 \div 11011_2$ and leave your answer as a decimal number. (2)
[20]

QUESTION 2

2.1 Given: $x^2 - 2x + 2 = 0$

2.1.1 Write down the formula for the discriminant (Δ). (1)

2.1.2 Determine the numerical value of the discriminant of the equation. (2)

2.1.3 Hence, or otherwise, describe the nature of the roots of the equation. (1)

2.2 Determine the numerical value of m for which the equation $x^2 + 2x - 4 = m$ will have equal roots. (4)

[8]

QUESTION 3

3.1 Simplify the following, **showing ALL calculations**, where applicable:

3.1.1 $\sqrt[3]{27p^{12}}$ (2)

3.1.2 $\dfrac{3 \times 2^{x}}{2^{x+2} - 2^{x}}$ (3)

3.2 Given: $2 \log_a \sqrt{a}$

3.2.1 Convert $\sqrt{a}$ to exponential form. (1)

3.2.2 Hence, or otherwise, simplify the expression. (2)

3.3 Given: $\log 2 = p$ and $\log 3 = q$

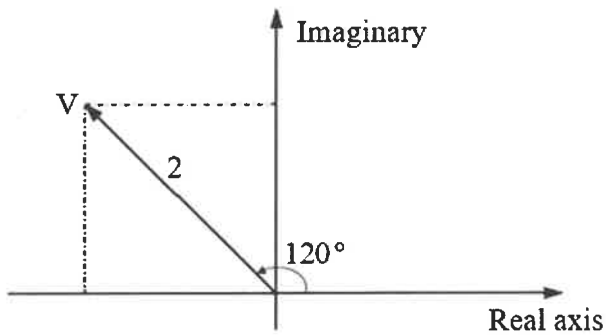
Determine the following in terms of p and q:

3.3.1 $\log 27$ (2)

3.3.2 $\log 60$ (3)

3.4 Solve for x: $\log_3 x + \log_3(x+2) = 1$ (5)

3.5 The voltage (V) in an alternating current circuit is represented by the Argand diagram below.



3.5.1 Use the Argand diagram above to write down the voltage in the form $V = r \text{ cis } \theta$ (1)

3.5.2 Hence, or otherwise, express V in rectangular form. Leave your answer in simplest surd form. (2)

3.6 Write down the numerical values of a and b if $a + 7bi = -21i^2 + 21i$ (3)

[24]

QUESTION 4

4.1 Given the functions f and g defined by $f(x)=\frac{3}{x}+3$ and $g(x)=3x+3$ respectively.

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

4.1.2 Write down the domain of f. (1)

4.1.3 Determine the x- and y-intercepts of g. (2)

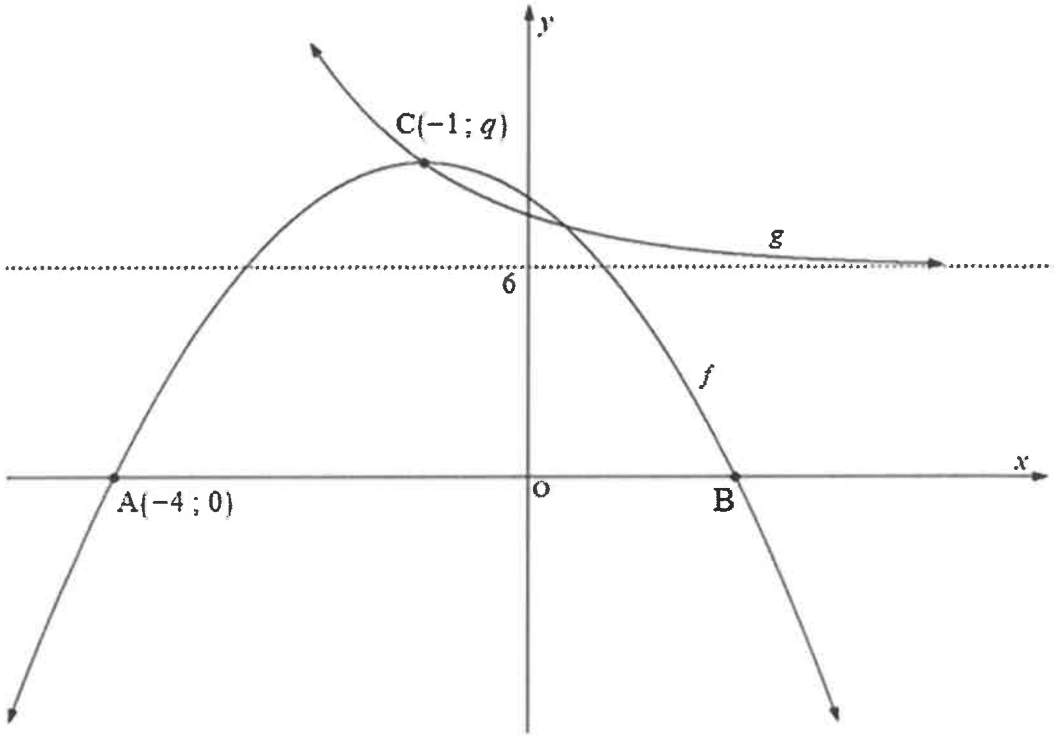
4.1.4 Determine the x-intercept of f. (2)

4.1.5 Sketch the graphs of f and g on the same set of axes provided in the SPECIAL ANSWER BOOK. Clearly show ALL the intercepts and asymptotes. (5)

4.1.6 Hence, use your graph to determine the values of x for which $f(x) \leq g(x)$, where $x < 0$ (2)

4.2 The graphs below represent functions f and g defined by $f(x) = -(x+p)^2 + q$ and $g(x) = a^x + 6$

- A $(-4 ; 0)$ and B are the x-intercepts of f.
- C $(-1 ; q)$ is the turning point of f and also the point of intersection of f and g.



4.2.1	Write down the equation of the axis of symmetry of the parabola.	(1)
4.2.2	Write down the coordinates of B.	(2)
4.2.3	Hence, determine the numerical value of q.	(3)
4.2.4	Hence, write down the range of f.	(1)
4.2.5	Write down the equation of the asymptote of g.	(1)
4.2.6	Hence, determine the equation of g.	(2)

[24]

QUESTION 5

5.1 A machine, initially valued at R4 990, depreciates over a period of n years at a rate of 5,89% per annum, on a straight-line method.

5.1.1 Write down the formula to calculate simple depreciation. (1)

5.1.2 Determine the value of the machine at the end of 7 years. (2)

5.2 Determine the value of an investment at the end of 4 years, if R32 000 is invested at a rate of 7,15% per annum, compounded annually. (3)

5.3 5 000 litres of water is released from a container at a rate of r% per minute, using the reducing-balance method. After 35 minutes, the water in the container is half of the original volume.

5.3.1 How many litres of water remain in the container after 35 minutes? (1)

5.3.2 Hence, determine the rate at which the water is released from the container. (4)

5.3.3 Determine whether there will be more than 1 500 litres of water left in the container after 1 hour, if it continues to be released at the same rate calculated in QUESTION 5.3.2. (4)

[15]

QUESTION 6

6.1 Determine $f'(x)$ using FIRST PRINCIPLES if $f(x) = 4 + \frac{1}{3}x$ (5)

6.2 Given: $y = \frac{-3x^6}{x^4}$

6.2.1 Simplify y. (1)

6.2.2 Hence, determine $\frac{dy}{dx}$. (1)

6.3 Determine:

6.3.1 $D_x\left(5x^8 - 11\right)$ (2)

6.3.2 $\frac{d}{dx}\left(-\frac{10}{x}\right)$ (2)

6.3.3 $f'(x)$ if $f(x) = -\frac{4x}{3} + \sqrt[4]{x^{-5}}$ (3)

6.4 The equation of a tangent to the function $h(x) = ax^3 + 6x^2$ is $y = 100 + 15x$

6.4.1 Write down the gradient of the tangent. (1)

6.4.2 Determine the value of a if the y-value at the point of contact of the tangent to the curve is 25. (5)

[20]

QUESTION 7

Given: $g(x) = ax^3 - 2x^2 - 19x + 20$

7.1 Write down the y-intercept of g. (1)

7.2 If $(x-5)$ is a factor of g, show that the numerical value of $a = 1$ (2)

7.3 Hence, determine the x-intercepts of g. (4)

7.4 Determine the coordinates of the turning points of g. (5)

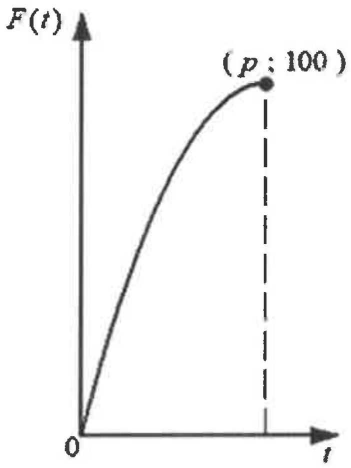
7.5 Sketch the graph of g on the system of axes provided in the SPECIAL ANSWER BOOK. Clearly show ALL intercepts with the axes, as well as the turning points. (4)

[16]

QUESTION 8

The number of fat cakes sold by Madlamini during break is given by the equation: $F(t)=20t-t^2$, where $0 \leq t \leq p$

The point $(p\ ;100)$ is on the graph of F, as shown below.



8.1 Write down the total number of fat cakes sold by Madlamini during break. (1)

8.2 Determine how many fat cakes were sold at the end of the first 5 minutes of break. (2)

8.3 Calculate the amount of money Madlamini will earn for the fat cakes sold in the interval $5 < t \leq p$ of break, if one fat cake costs R2,50. (2)

8.4 Determine the numerical value of p, the time (minutes) taken to sell ALL the fat cakes. (3)

[8]

QUESTION 9

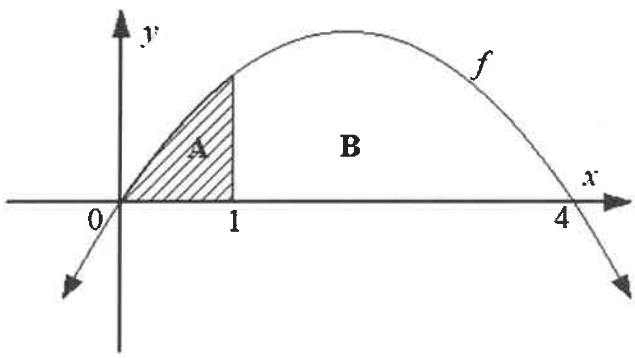
9.1 Determine:

9.1.1 $\int x^3 \ dx$ (2)

9.1.2 $\int \left[2^{3x} + \frac{1}{x^2}(x-2) \right] dx$ (5)

9.2 The sketch below shows a curve f defined by $f(x) = -2x^2 + 8x$

- The shaded area A is bounded by the curve f and the x-axis between $x = 0$ and $x = 1$
- The unshaded area B is bounded by the curve f and the x-axis between $x = 1$ and $x = 4$



Determine whether $\frac{\text{A}}{\text{B}} \leq 0{,}2$ (clearly show ALL working). (8)

[15]

TOTAL: 150

INFORMATION SHEET: TECHNICAL MATHEMATICS

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

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

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

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

$f^{/}(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$

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

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

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

$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ $M\left(\frac{x_2 + x_1}{2} ; \frac{y_2 + y_1}{2}\right)$

$y = mx + c$ $y - y_1 = m(x - x_1)$ $m = \frac{y_2 - y_1}{x_2 - x_1}$ $\tan \theta = m$

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

In ΔABC: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$ $a^2 = b^2 + c^2 - 2bc \cdot \cos A$

Area of Δ ABC $= \frac{1}{2} ab. \sin C$

$\sin^2 \theta + \cos^2 \theta = 1$ $1 + \tan^2 \theta = \sec^2 \theta$ $1 + \cot^2 \theta = \text{cosec}^2 \theta$

π rad $= 180°$

Angular velocity $= \omega = 2\pi n$ where n = rotation frequency

Circumferential velocity $= v = \pi D n$ where D = diameter and n = rotation frequency

Circumferential velocity $= v = \omega r$ where ω = angular velocity and r = radius

Arc length $= s = r\theta$ where r = radius and θ = central angle in radians

Area of a sector $= \dfrac{rs}{2}$ where r = radius, s = arc length

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

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

$A_T = a(m_1 + m_2 + m_3 + \ldots + m_n)$ where a = width of equal parts, $m_1 = \dfrac{o_1 + o_2}{2}$

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

OR

$A_T = a\left(\dfrac{o_1 + o_n}{2} + o_2 + o_3 + \ldots + o_{n-1}\right)$ where a = width of equal parts, $o_n = n^{th}$ ordinate and n = number of ordinates