higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

MATHEMATICS N3

(16030143)

22 November 2024 (X-paper)
09:00–12:00

Scientific calculators may be used.

This question paper consists of 6 pages and a 2-page formula sheet.

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
MATHEMATICS N3
TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer all the questions.
2. Read all the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Questions may be answered in any order, but keep subsections of questions together.
5. Show all calculations and intermediate steps.
6. All final answers must be accurately rounded off to THREE decimals.
7. Diagrams are not drawn to scale.
8. Use only blue or black ink.
9. All graphs must be done in the ANSWER BOOK. A pencil may be used
10. Write neatly and legibly.

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QUESTION 1

1.1 Factorise the following as far as possible in prime factors:

$(3x^2 + 7x)^2 - 4(3x^2 + 7x) - 12$ (6)

1.2 Factorise the following polynomial expression completely with the aid of the factor theorem:

$f(x) = x^3 - 2x^2 - 5x + 6$ (6)

1.3 Solve for x by completing the square:

$2x^2 - 3x = 5$ (6)
[18]

QUESTION 2

2.1 Simplify the following fraction:

$$\frac{x^{\frac{1}{2}} - 64x^{-\frac{1}{2}}}{x^{\frac{1}{2}} - 16 + 64x^{-\frac{1}{2}}}$$ (5)

2.2 Solve for x:

$log_{\frac{1}{2}}(3 - x) = log_2 \frac{1}{x^2} + 2$ (8)
[13]

QUESTION 3

3.1 Make t the subject of the formula:

$A = De^{rt}$ (4)

3.2 When we multiply the square of a number by 3 and add it to the number multiplied by 7, it gives us 20.

Determine the number. (4)

3.3 Solve for x:

$$\frac{3}{x-1} - \frac{1}{x^2 - 4x + 3} - \frac{1}{1-x} = 1$$ (6)
[14]

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QUESTION 4

Consider FIGURE 1 below. $P(2;4)$, $Q(8;2)$ and $R(x;y)$ are points in a Cartesian plane. $M(3\frac{1}{2};\ -2\frac{1}{2})$ is the midpoint of QR.

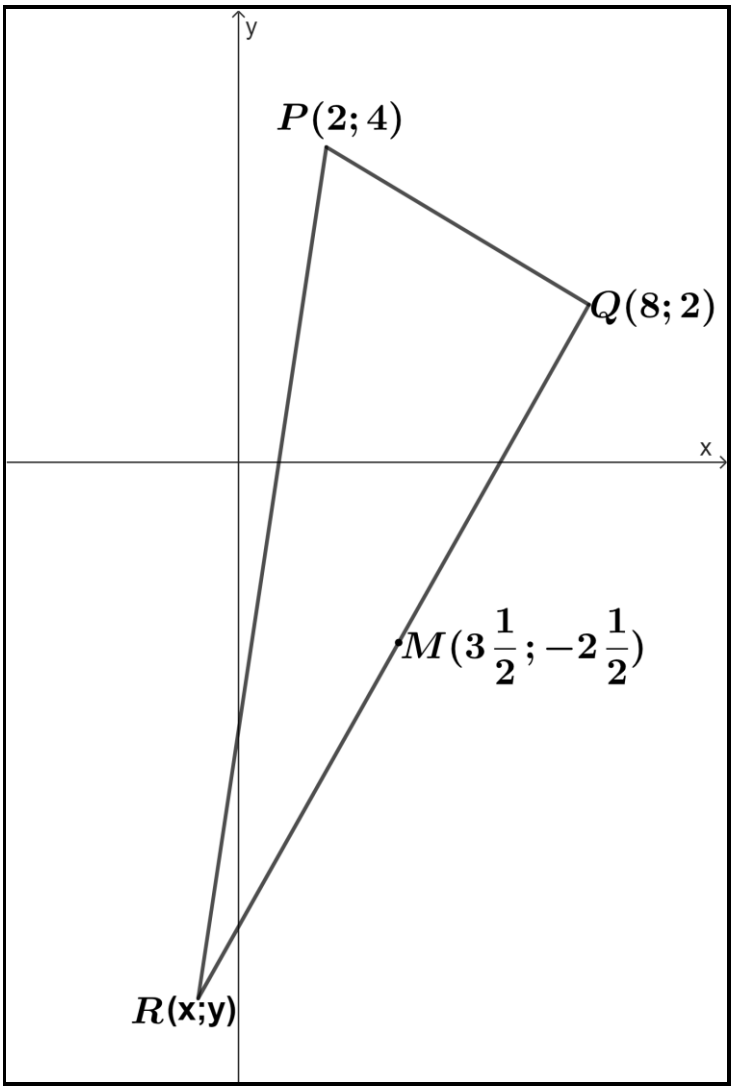

FIGURE 1

Determine the following:

4.1.	The angle of inclination of *PQ* with the positive *x*-axis	(4)
4.2	The values of x and y if $M(3\frac{1}{2};-2\frac{1}{2})$ is the midpoint of QR	(4)
4.3	The length of *PQ*	(2)
4.4	The equation of the perpendicular bisector of *PQ*	(5)
4.5	The equation of MN in the form $ax + by + c = 0$ if MN divides PR and QR in the same ratio.	(4)

[19]

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QUESTION 5

5.1 Draw the graph of $\frac{x^2}{4}+\frac{y^2}{15}=1$ in the ANSWER BOOK, showing the turning point, axis of symmetry and intercepts on both axes (where they exist). (3)

5.2 Determine $\frac{dy}{dx}$ of $y=\frac{\sqrt{x}}{2}+\frac{2}{\sqrt[4]{x}}$ by means of rules of differentiation. Leave the final answer with positive exponents and in surd form where applicable. Show all the steps. (4)

5.3 Consider FIGURE 2 below. The curve represents the graph of $f(x)=x^3+bx^2+cx$. The curve intersects the $x-axis$ at 0, touches the $x-axis$ at 2, and intersects the $y-axis$ at 0.

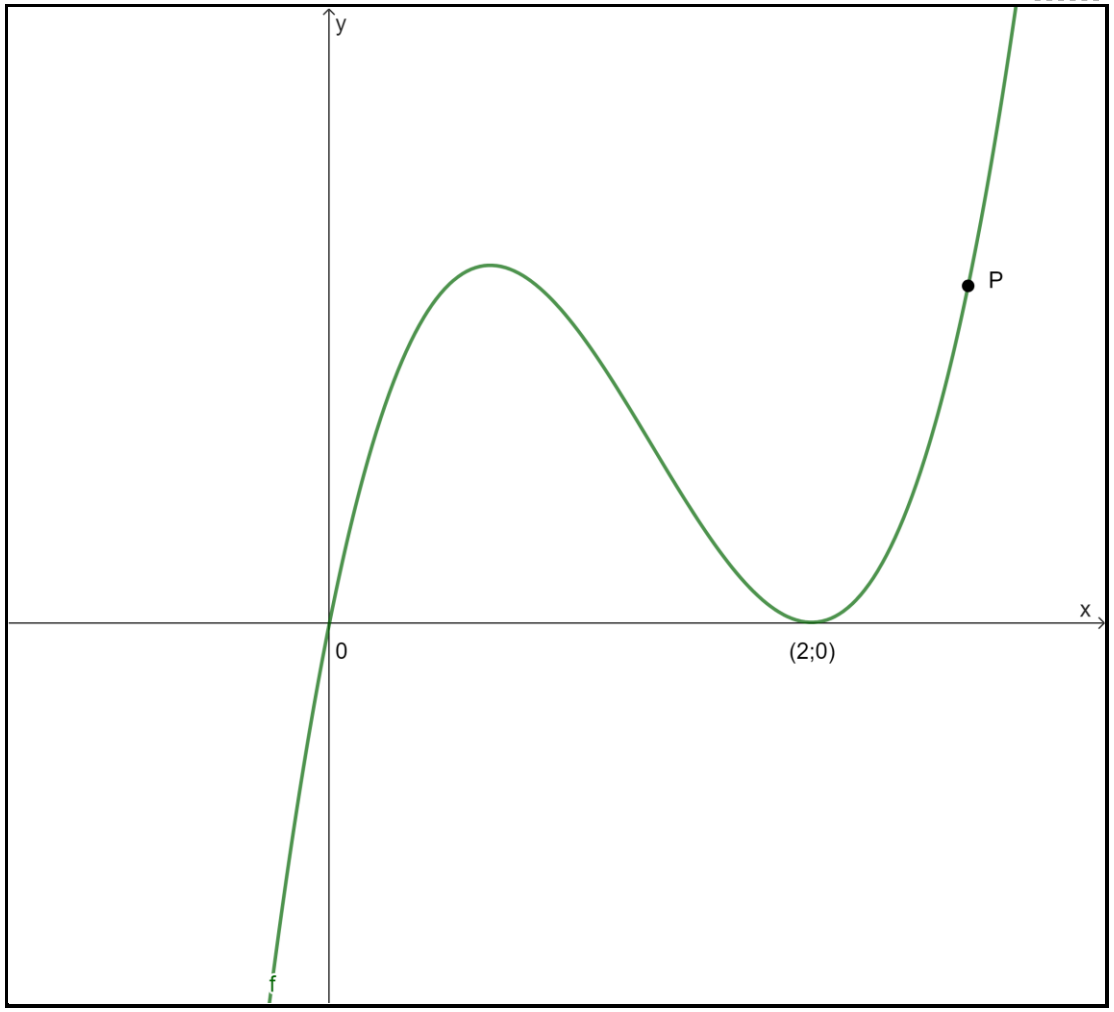

FIGURE 2

5.3.1 Show that $b=-4\ and\ c=4$ (3)

5.3.2 Calculate the coordinates of P if the gradient of the tangent line of the curve at P is 20. (5)

[15]

QUESTION 6

6.1 Use basic trigonometric identities to prove that:

$sin^4x - cos^4x = 1 - 2cos^2x$ (4)

6.2 Calculate the value(s) of θ that will satisfy the equation for $0° \le \theta \le 360°$ if $5\sin\theta = 8\cos\theta$. (4)

6.3 Consider FIGURE 3 below. From a point B in the same horizontal plane as the foot D of a tower, the angle of elevation to the top of the tower is 26°. From C, a point 800 m closer to the tower and in the same line as B and D the angle of elevation is 48°.

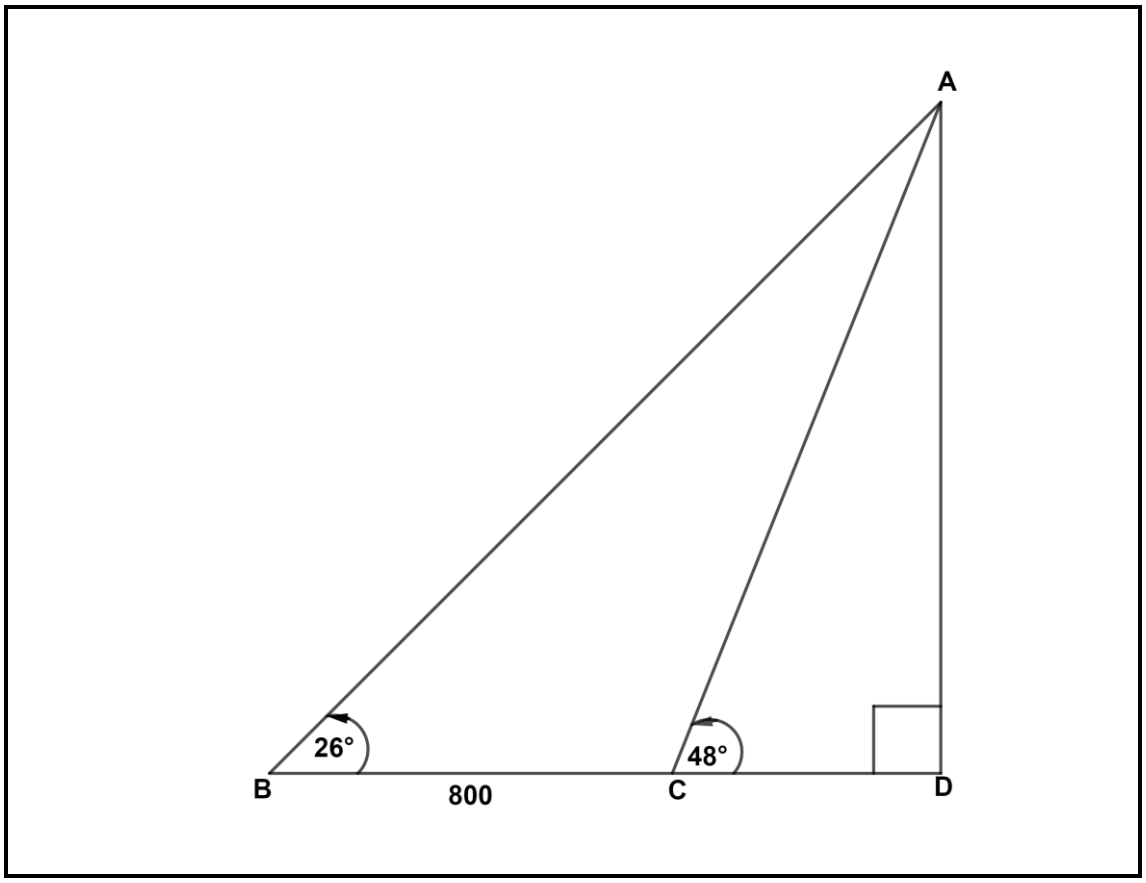

FIGURE 3

Determine:

6.3.1 AD, the height of the tower (5)

6.3.2 The distance from C to the foot of the tower (2)

6.4 Sketch the graph of $f(x) = 2cos2x + 1$ for $0° \le x \le 180°$. Show the coordinates of the turning points and the intercepts with the axes. (6)

[21]

TOTAL: 100

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MATHEMATICS N3

FORMULA SHEET

Any applicable formula may also be used.

1. Factors

$a^3 - b^3 = (a - b)(a^2 + ab + b^2)$
$a^3 + b^3 = (a + b)(a^2 - ab + b^2)$

2. Logarithms

$$\log ab = \log a + \log b$$

$$\log \frac{a}{b} = \log a - \log b$$

$$\log_b a = \frac{\log_c a}{\log_c b}$$

$$\log a^m = m \log a$$

$$\log_b a = \frac{1}{\log_a b}$$

$$\log_a a = 1 \therefore 1n\ e = 1$$

$$a^{\log_a t} = t \therefore e^{1n\, m} = m$$

3. Quadratic formula

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

4. Parabola

$$y = ax^2 + bx + c$$

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

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

5. Circle

$$x^2 + y^2 = r^2$$

$$D = \frac{x^2}{4h} + h$$

$$x = \sqrt{4Dh - 4h^2}$$

6. Straight line

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

Perpendicular: $m_1 \cdot m_2 = -1$

Parallel lines: $m_1 = m_2$

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

Midpoint: $P = \left(\frac{x_1 + x_2}{2} ; \frac{y_1 + y_2}{2} \right)$

Angle of inclination: $\theta = tan^{-1} m$

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

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7. Differentiation

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

$$\frac{d}{dx}\left(x^n\right) = nx^{n-1}$$

Max/Min

For turning points: $f'(x) = 0$

8. Trigonometry

$$\sin\theta = \frac{y}{r} = \frac{1}{\operatorname{cosec}\theta}$$

$$\cos\theta = \frac{x}{r} = \frac{1}{\sec\theta}$$

$$\tan\theta = \frac{y}{x} = \frac{1}{\cot\theta}$$

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

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

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

$$\tan\theta = \frac{\sin\theta}{\cos\theta}$$

$$\cot\theta = \frac{\cos\theta}{\sin\theta}$$

$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$

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

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