higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

MATHEMATICS N3

(16030143)

8 April 2021 (X-Paper)
09:00–12:00

Nonprogrammable calculators may be used.

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

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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 sub-questions must remain together.
5. Show all calculations and intermediary steps.
6. Do all graph work in the answer book, not on graph paper.
7. Round all final answers off to three decimal places.
8. Diagrams are not drawn to scale.
9. Use only a black or blue pen.
10. Write neatly and legibly.

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QUESTION 1

1.1 Factorise as far as possible in prime factors:

$2(p-1)^2 + 7(p-1) - 15$ (4)

1.2 Simplify:

1.2.1 $\frac{2ab}{a^2-b^2} + \frac{a}{b-a} + \frac{a}{a+b} + 1$ (6)

1.2.2 $\frac{4^{\frac{x}{2}} + 4^{\frac{x}{2}-1}}{2^{x+2} + 2^x}$ (5)

1.3 When $f(x) = 2mx^3 + x^2 - x + 2$ is divided by $x - 2$, the remainder is 5.

Determine the value of m. (3)

[18]

QUESTION 2

2.1 Simplify the expression:

$\frac{B^{n+1} + B^n}{B^{3n} - 9B^n}(B^n - 3)$ (4)

2.2 Solve for x:

2.2.1 $\frac{4^{\frac{1}{2}x} \bullet 8^{-x+1}}{16^{x+2}} = 4$ (4)

2.2.2 $2\log_x 4 - \log_x \frac{1}{2} = 3 - \log_x 5\,4$ (4)

[12]

QUESTION 3

3.1 Make c the subject of the formula:

$F = \frac{9c}{5} + 32$ (3)

3.2 Make y the subject of the formula:

$b = bxB^{-ya}$ (4)

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3.3 Bosal South Africa is a leading manufacturer and supplier of quality automotive and industrial products. At Bosal SA, 1 millwright technician and 5 apprentice artisans earn R35 520 per month. However, 3 millwright technicians and 9 apprentice artisans earn R72 000 per month.

Determine how much a technician earns and how much an artisan earns. (5)

3.4 Solve for x by completing the square:

$x^2 = -kx + y$ (4)

[16]

QUESTION 4

FIGURE 1 shows a straight line, AB, with A on the *y*-axis and B on the *x*-axis. AB is extended to C. Line OD is perpendicular to AB and cuts AB at point D (4;-6). E is the midpoint of OD.

Determine the following:

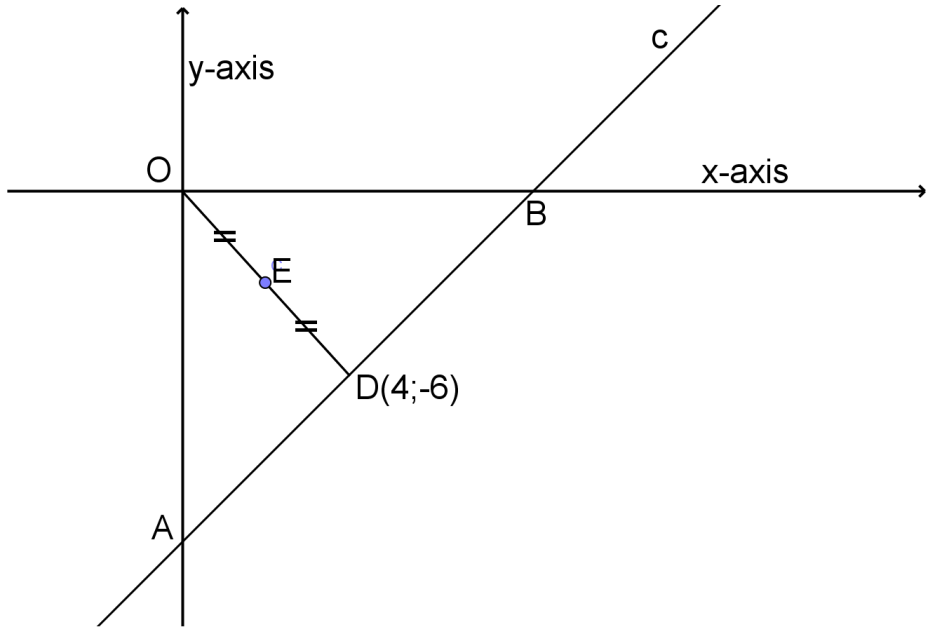

FIGURE 1

4.1 The gradient of OD (2)

4.2 The coordinates of E (2)

4.3 The equation of line AC, which is perpendicular to line OD (3)

4.4 The coordinates of point B (3)

4.5 The size of an acute angle between line AC and the *x*-axis (2)

4.6 The equation of the line passing through E, which is parallel to AC. (3)

4.7 The length of AD (3)

[18]

QUESTION 5

5.1 FIGURE 2 below represent a sketch of the graph defined by $f(x) = 2x^2 + 8x - 10$.

Determine:

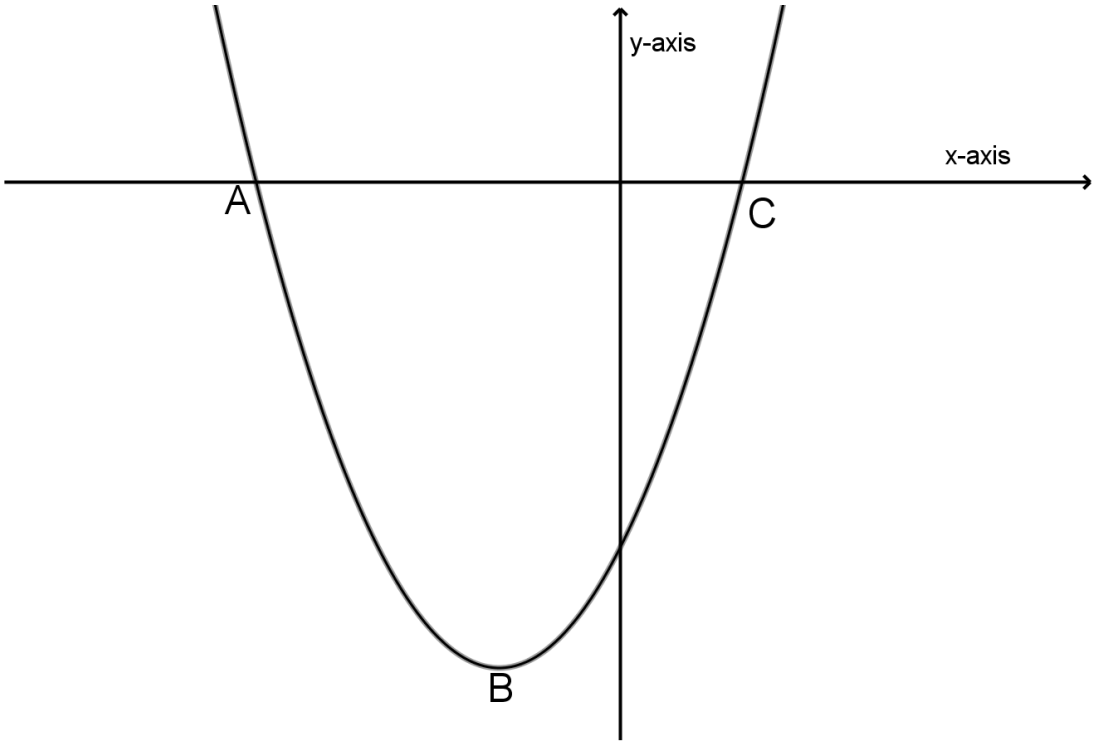

FIGURE 2

5.1.1 The *x*-coordinates of the graph $f(x)$ at point A and point C (3)

5.1.2 The coordinates of the turning point of the graph $f(x)$ at point B (4)

5.2 Sketch the graph defined by $y = -\sqrt{\frac{25}{4} - x^2}$.

Show ALL the intercepts with the axes. (2)

5.3 If $f(x) = 3x^2 - 6$, determine $\frac{dy}{dx}$ from the first principles. (4)

5.4 Determine $\frac{dy}{dx}$ if $f(x) = \sqrt{x}(x_4 - \frac{1}{3x^2})$.

Leave your answer with positive exponents. (3)

[16]

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QUESTION 6

6.1 Prove that $\frac{\sqrt{1+2\cos B+\cos^2 B}}{\sin^4 B+\sin^2 B\cos^2 B} = \frac{1}{1-\cos B}$ (5)

6.2 Calculate the value of β that will satisfy the equation for $0^0 \leq \beta \leq 360^0$.

$$4\cos\beta = 2\sin\beta$$ (4)

6.3 FIGURE 3 below is a sketch of a ΔKLM with $KL = 8{,}6\,m$, $KM = 7\,m$ and $\angle M = 70^0$

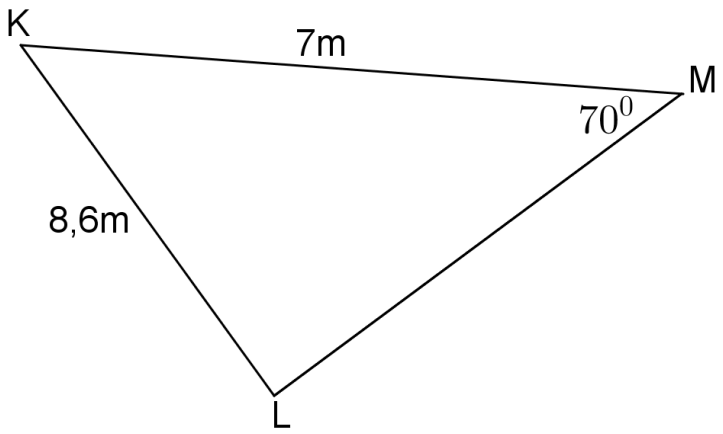

FIGURE 3

Determine the area of ΔKLM. (6)

6.4 Draw the graph which is represented by the following trigonometric equation:

$y = 0{,}5\cos x$ for $0^0 \leq x \leq 360^0$.

Show all the intercepts on the axes. (5)

[20]

TOTAL: 100

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MATHEMATICS N3

FORMULA SHEET

Any applicable formula may 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**

$$log\ ab = log\ a + log\ b$$
$$log\ \frac{a}{b} = log\ a - log\ b$$
$$\boldsymbol{log_b\ a = \frac{log_c\ a}{log_c\ b}}$$
$$\boldsymbol{log\ a^m = m\ log\ a}$$
$$\boldsymbol{log_b\ a = \frac{1}{log_a\ b}}$$
$$\boldsymbol{log_a\ a = 1 \therefore 1n\ e = 1}$$
$$\boldsymbol{a^{log_a t} = t \therefore e^{1n\ m} = m}$$

3. **Quadratic formula**

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

4. **Parabola**

$$\boldsymbol{y = ax^2 + bx + c}$$
$$\boldsymbol{y = \frac{4ac - b^2}{4a}}$$
$$\boldsymbol{x = \frac{-b}{2a}}$$

5. **Circle**

$$\boldsymbol{x^2 + y^2 = r^2}$$
$$\boldsymbol{D = \frac{x^2}{4h} + h}$$
$$\boldsymbol{x = \sqrt{4Dh - 4h^2}}$$

6. **Straight line**

$\boldsymbol{y - y_1 = m(x - x_1)}$ $\quad m = \frac{y_2 - y_1}{x_2 - x_1}$

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

7. **Differentiation**

$$\frac{dy}{dx} = \lim_{h \to 0} \frac{f(x + h) - -f(x)}{h} \qquad \frac{d}{dx}(x^n) = nx^{n-1}$$

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

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8. **Trigonometry**

$\sin\theta = \frac{y}{r} = \frac{1}{\operatorname{cosec}\theta}$ $\quad\quad$ $\cos\theta = \frac{x}{r} = \frac{1}{\sec\theta}$

$\tan\theta = \frac{y}{x} = \frac{1}{\cot\theta}$ $\quad\quad$ $\sin^2\theta + \cos^2\theta = 1$

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

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

$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$ $\quad\quad$ $a^2 = b^2 + c^2 - -2bc\ \cos A$

$$A = \frac{1}{2}ab\sin C$$

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