higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

MATHEMATICS N2

(16030192)

19 November 2020 (X-paper)
09:00–12:00

REQUIREMENTS: **2 sheets of graph paper (BOE 8/9)**

Calculators may be used.

This question paper consists of 7 pages and a formula sheet of 2 pages.

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
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NATIONAL CERTIFICATE
MATHEMATICS N2
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. Show all intermediate steps and simplify where possible
5. Use only blue or black ink
6. Write neatly and legibly.

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QUESTION 1

1.1 Solve the following equations:

1.1.1 $-x^2+3x-2=0$ by factorisation (3)

1.1.2 $6(2-m)-5(4-m)=7$ (3)

1.2 Given: the formula $p=\sqrt[3]{r^2-q^2}$

1.2.1 Make 'r' the subject of the formula (3)

1.2.2 Calculate the value of r if $p=4$ and $q=6$ (1)

1.3 Solve for x and y in the following simultaneous equations:

$5x=6y+3$ and $3y-4x+1=0$ (4)

[14]

QUESTION 2

2.1 Simplify the following algebraic fractions:

2.1.1 $\dfrac{4y^2-4y+1}{4y^2+8y+4}\times\dfrac{2y^2-2}{8y^2-8}\div\dfrac{10}{5y+5}$ (5)

2.1.2 $\dfrac{3}{2x+2y}-\dfrac{4}{x^2-y^2}+\dfrac{1}{7x-7y}$ (5)

2.2 Given the following algebraic expressions:

$3ab(ab-4)$
$2(ab-4)(ab+4)$
$(ab-4)(3x+y)$

2.2.1 Determine the Highest Common Factor (HCF) of all three expressions (1)

2.2.2 Determine the Lowest Common Multiple (LCM) of all three expressions. (3)

2.3 Fully factorise the following expression:

2.3.1 $6x^2y-17xy+12y$ (3)

2.3.2 $x^{16}-81$ (3)

[20]

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QUESTION 3

3.1 Simplify the following expressions using logarithm laws. Do not use a calculator.

3.1.1 $\log_q q - \log_x 1$ (2)

3.1.2 $\log_4 8 + \log_2 32$ (3)

3.2 Simplify the following without using a calculator. Show all workings.

3.2.1 $\left(\frac{1}{8}\right)^{-\frac{2}{3}}$ (2)

3.2.2 $\frac{m^5 n^7 m^{-2} n^{-4}}{\sqrt[3]{\left(m^2 n^2\right)^{\frac{9}{2}}}}$ (2)

3.3 Solve for ' y ' in the following equations:

3.3.1 $\log_y 2 = \log_2 y$ (4)

3.3.2 $\frac{8^y}{4^{2y}} = 64^{-1}$ (2)

[15]

QUESTION 4

4.1 SPAR has added water refilling to its services and customers are served from a transparent cylindrical container (closed at both ends) with a height of 2 m. The container has a maximum capacity of $\frac{\pi}{2}$ m^3.

Calculate the following:

4.1.1 Base radius of the container in m (3)

4.1.2 Surface area of the container in m^2. (2)

4.1.3 If SPAR refills a 1-litre container for R1, how much money will it make from selling all the water if the cylindrical container is filled to full capacity?

HINT: 1 m^3 = 1000 litres (2)

4.2 Given: the function $y = x^2 + 7x + 6$

Determine the following:

4.2.1 The y-intercept (1)

4.2.2 The x-intercept (2)

4.2.3 The axis of symmetry (1)

4.2.4 The y-coordinate of the turning point (1)

4.2.5 Draw (ON GRAPH PAPER) and draw the graph of $y = x^2 + 7x + 6$ on a system of axes. Indicate all intercepts with the axes; the turning point as well as the line of symmetry (with a broken line). (5)

4.3 Draw the graph of $y + x = -6$ on the same system of axes used for QUESTION 4.2.5 above. (2)

4.4 Read the values of x for which $x^2 + 7x + 6 = -x - 6$ from the graphs drawn in QUESTION 4.3. (2)

[21]

QUESTION 5

5.1 Given: the function $y = 2 + \cos x$ for $0° \leq x \leq 360°$

5.1.1 Draw the graph on its own system of axes using graph paper. (4)

5.1.2 Read the values of x for which $y = 1$ from the graph. (1)

5.2 Calculate the value of $\cos(350°25' - 101°12')$ (2)

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5.3 In ΔABC shown below $AC = 69$ cm, $\hat{C} = 31°$ and $\hat{B} = 90°$

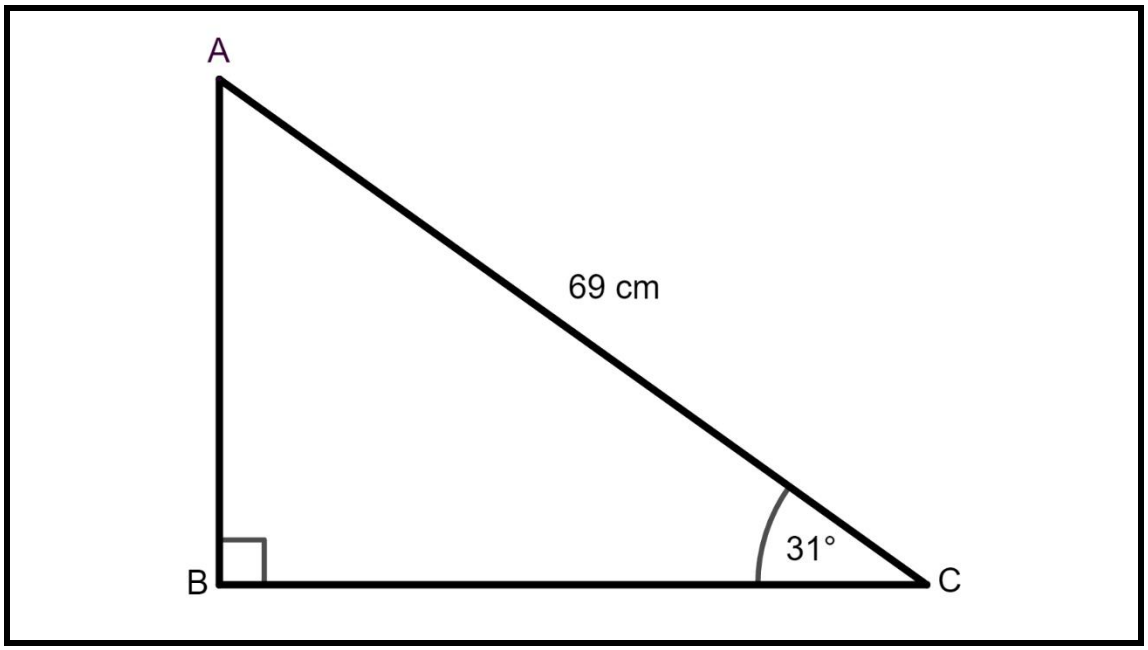


FIGURE 1

Calculate the following values:

5.3.1 BC (2)

5.3.2 AB (2)

5.3.3 $2\sin\hat{A}$ (2)

5.4 If $\sin\alpha = -\frac{3}{5}$ and $180° \leq \alpha \leq 270°$ determine the value of $\cos\alpha$ without using a calculator. (2)

[15]

QUESTION 6

6.1 Convert $27°44'$ to degrees only (1)

6.2 Calculate the area enclosed by a curve that passes through the points:

$$\left\{\left(0;\frac{1}{2}\right);\left(4;\frac{5}{2}\right);\left(8;\frac{7}{2}\right);\left(12;\frac{13}{2}\right);\left(16;\frac{19}{2}\right);\left(20;\frac{15}{2}\right);\left(24;\frac{11}{2}\right);\left(28;\frac{3}{2}\right)\right\}$$ (3)

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6.3 A sector of a circle has a radius of $3,5$ cm and subtends an angle of $1,309$ radians at the centre of the circle.

Calculate the following

6.3.1 Arc length of the sector in cm (1)

6.3.2 Area of the sector in cm^2. (2)

6.4 Given: a wheel completes 1230 revolutions per minute.

Calculate the following:

6.4.1 Number of revolutions completed per second (2)

6.4.2 Angular velocity of the wheel (2)

6.5 A circle whose diameter is $5,5$ cm has a chord of length 5 cm.

Calculate the heights of the major segment and the minor segment in cm. (4)

[15]

TOTAL: 100

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MATHEMATICS N2

FORMULA SHEET

Any applicable formulae not found on this formula sheet may also be used

Right cone

$$\text{Volume} = \frac{1}{3}\pi r^2 h$$

$$\text{Surface area} = \pi r\sqrt{h^2 + r^2} + \pi r^2$$
$$= \pi r l + \pi r^2$$

Cylinder

$$\text{Volume} = \pi r^2 h$$

$$\text{Surface area} = 2\pi r^2 + 2\pi r h$$

Sphere

$$\text{Volume} = \frac{4}{3}\pi r^3$$

$$\text{Area} = 4\pi r^2$$

Right pyramid

$$\text{Volume} = \frac{1}{3}(\text{area of base}) \times (\text{perpendicular height})$$

Prism

$$\text{Volume} = (\text{area of base}) \times (\text{perpendicular height})$$

Degrees and radians

$180° = \pi$ rad

Sector: $\theta = \frac{\text{arc}}{\text{radius}}$; $A = \frac{1}{2} r^2 \theta$

Angular velocity and circumferential velocity

Angular velocity: $\omega = 2\pi n$

Circumferential velocity: $v = \pi D n$

n = rotation frequency (r/s = revolution per second)

Midordinate rule

$$\text{Area} = (\text{distance between ordinates}) \times (\text{sum of other midordinates})$$

$$\text{Area} = \left[\frac{(\text{First ordinate} + \text{Last ordinate})}{2} + \text{Sum of all other ordinates}\right] \times \text{The distance between the ordinates}$$

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Graphs

Straight line: $y = mx + c$

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

Axis of symmetry: $x = \dfrac{-b}{2a}$

Roots: $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Trigonometry

$90° < \theta < 180°$

$\sin\theta = \sin(180° - \theta)$ $\quad \cos\theta = -\cos(180° - \theta)$ $\quad \tan\theta = -\tan(180° - \theta)$

Segment of circles

Chord length = x Height of the segment = h Diameter of circle = D

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

Regular polygons

Angle subtended at centre of circumscribed circle by one side:

$\theta = \dfrac{360°}{\text{number of sides}}$

R = radius of circumscribed by circle
x = length of the side

$x = 2R\sin\left(\dfrac{\theta}{2}\right)$

Annulus: $A = \pi\left(R^2 - r^2\right)$

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