higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

MATHEMATICS N2

(16030192)

26 July 2021 (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
REPUBLIC OF SOUTH AFRICA

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. Start each question on a new page.
5. Only use black or blue pen.
6. Write neatly and legibly.

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QUESTION 1

1.1 Simplify the following without using a calculator:

1.1.1 $\log_a 1$ (1)

1.1.2 $\dfrac{2^{-4}\,p^2q^{-3}}{8p^{-3}q^{-2}}$ (2)

1.2 Simplify the following expression using logarithm laws. SHOW YOUR WORKING

1.2.1 $\log_6 10 - \log_6 9 - \log_6 40$ (4)

1.2.2 $\log_4 8 - \log_9 3$ (3)

1.3 Solve for x in the following:

1.3.1 $\sqrt[5]{x^3} = 125$ (2)

1.3.2 $\log_{\sqrt{x}} \sqrt{x} = 3^{2x-5}$ (3)

[15]

QUESTION 2

2.1 Simplify the following algebraic fractions:

2.1.1 $\dfrac{3x^2 - 2xy - y^2}{2x^2 + xy - 3y^2} \div \dfrac{xy - 3y^2}{2x^2 - 3xy - 9y^2}$ (5)

2.1.2 $\dfrac{2y-1}{6y^2 - 23y + 20} + \dfrac{y+2}{2y^2 - y - 10} - \dfrac{2+y}{3y^2 + 2y - 8}$ (5)

2.2 Given: $6 - a - a^2$
$-7a^2 + 63$
$6b - 3c + 2ab - ac$

2.2.1 Factorise each expression completely. (6)

2.2.2 Determine the Highest Common Factor (HCF) of the three expressions. (1)

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

[20]

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QUESTION 3

3.1 A man deducted 3 from 5 times his age and got his grandmother's age.

If his grandmother is 97 years old, how old is the man? (2)

3.2 Given: $4n^2 - 15n - 47 = 0$

Solve for 'n' the equation using the quadratic formula. (3)

3.3 Given: $H = \frac{7,5U}{273+V}$

3.3.1 Make 'V' the subject of the formula. (3)

3.3.2 Find the value of 'V' if $U = 0,5$ and $H = 0,005$ (1)

3.4 Given: $8p - 1 = -2q$ and $2p + 3q = 4$

Solve for p and q (4)

[13]

QUESTION 4

4.1 A coffee shop intends to start selling cappuccinos in a conical shaped disposable cup with a perpendicular height of 15 cm.

Given that the capacity of the cup is 285 cm3, calculate the following:

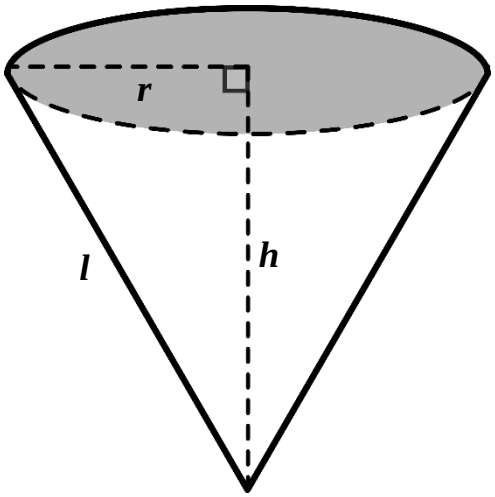


FIGURE 1

4.1.1 The base radius of the cup (3)

4.1.2 The slant height of the cup (2)

4.1.3 The surface area of the cup if it has a circular lid (2)

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4.2 Given: $y = -x^2 - 5x - 6$

Determine the following:

4.2.1 The *y*-intercept of the function (1)

4.2.2 The *x*-intercept(s) of the function (provide only the *x*-values) (2)

4.2.3 The equation of the axis of symmetry of the function (1)

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

4.2.5 Using the GRAPH PAPER provided, draw the graph of $y = -x^2 - 5x - 6$ on a system of axes. Indicate all intercepts with the axes, the turning point, and the axis of symmetry (with a broken line). (5)

4.3 Draw the graph of $y = -2$ on the same system of axes used for QUESTION 4.2.5 above. (1)

4.4 Read from the graphs drawn in QUESTIONS 4.2.5 and 4.3 the value(s) of x for which $-2 = -x^2 - 5x - 6$ (2)

[20]

QUESTION 5

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

5.1.1 Draw the graph on its own system of axes on the GRAPH PAPER provided (5)

5.1.2 Read from the graph in QUESTION 5.1.1 the values of x for which $y = -1$ (1)

5.2 Calculate the value of $7\,\text{cosec}(116°6')$ (1)

5.3 Given: $\tan\theta = -\frac{8}{15}$ for $270° \leq \theta \leq 360°$

Calculate the value of $\sin\theta$. (2)

5.4 In ΔABC shown in FIGURE 2 below; $BC = 17$ cm $\hat{A} = 41°$ and $\hat{B} = 90°$.

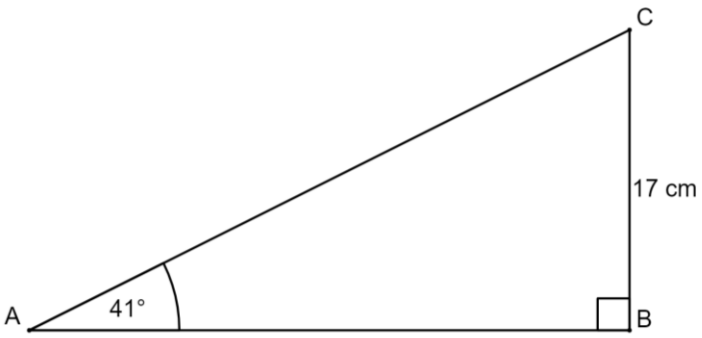


FIGURE 2

Calculate the following:

5.4.1 The value of AC (2)

5.4.2 The value of AB (2)

5.4.3 The value of $\cos^2 \hat{C}$ (3)

[16]

QUESTION 6

6.1 Convert $21,70°$ to degrees and minutes. (1)

6.2 A sector of a circle has an arc length of $\frac{15}{2}$ cm and a radius of $\frac{21}{2}$ cm.

Calculate the following:

6.2.1 The angle subtended at the centre of the circle by the segment (2)

6.2.2 The area of the sector (2)

6.3 A wheel with a peripheral velocity of 95 m/s completed 31 revolutions per second.

Calculate the following:

6.3.1 The number of revolutions per minute (1)

6.3.2 The diameter of the wheel (2)

6.3.3 The radius of the wheel (1)

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6.4 Determine the length of the major segment (H) of circle in FIGURE 3 that has a radius of 4 cm and a chord length of 6,9 cm. (4)

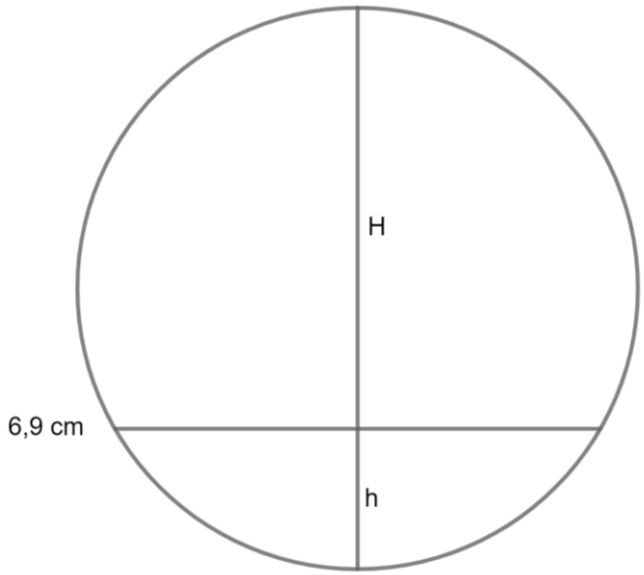


FIGURE 3

6.5 An irregular figure with one horizontal straight side is divided into 8 strips, each 20 mm wide. The ordinates dividing these strips have the following lengths: 120; 139; 148; 163; 154; 148; 136; 127; 118.

Use the mid-ordinate rule to calculate the area of the irregular figure. (3)

[16]

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

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

$90° < \theta < 180°$

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

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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