higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

MATHEMATICS N2

(16030192)

21 November 2023 (X-paper)
09:00–12:00

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

Scientific 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 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. Use only a black or blue pen.
5. Write neatly and legibly.

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QUESTION 1

1.1 Solve for 'q' in the following equation by the factorization method:

$-10q^2 - 11q + 6 = 0$ (3)

1.2 A boy added twice his age to his mother's age and got 50 years. He then subtracted twice his age from 8 times his mother's age and got 220 years. How old is the boy and how old is his mother? (4)

1.3 Solve for 'k' in the following: $k + (k + 3) - 9(k + 2) = 118$ (2)

1.4 Given $F = \sqrt{\frac{7}{e} + h^2}$

1.4.1 Make 'e' the subject of the formula. (4)

1.4.2 Calculate the value of 'e' if $F = 13$ and $h = 3$. (1)

[14]

QUESTION 2

2.1 Simplify the following algebraic fractions:

2.1.1 $\frac{3a - 1}{a + 4} + \frac{8a}{a^2 + 3a - 4}$ (6)

2.1.2 $\frac{n^2 - 9}{n - 2} \div \frac{n^2 - n - 6}{n^2 - 4}$ (4)

2.2 Given the following algebraic expressions:

$3p + 3q - 9 - pq$

$45 - 5p^2$

$p^2 - 9p + 18$

2.2.1 Factorise each expression completely. (7)

2.2.2 Determine the HCF and LCM of all the three expressions. (3)

[20]

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QUESTION 3

3.1 Simplify the following without using a calculator:

3.1.1 $\log_3(\log_2 512) + \sqrt[3]{2\frac{10}{27}}$

3.1.2 $\log_{64} 8$

3.1.3 $\dfrac{(8x^2y)(6xy^3)}{\sqrt[3]{\sqrt[4]{y^{36}x^{18}}}}$

(3 × 3) (9)

3.2 Solve for 'x' if $x^{-3/4} = 27$ (2)

3.3 Use the laws of logarithm to determine the value of 'R' if $R = \frac{31{,}4}{(3{,}02)^5 \times \sqrt[3]{652}}$ (4)

[15]

QUESTION 4

4.1 A lead cylinder is made by melting a lead right circular cone of perpendicular height 9 cm. Given that both shapes have the same radius and that the height of the cylinder is equal to its radius.

4.1.1 Prove that the base radius of the cylinder equals to 3 cm. (3)

4.1.2 Calculate the surface area of the cylinder in cm^2. (2)

4.1.3 Calculate the surface area of the cone in cm^2. (2)

4.2 The ordinates of an irregular metal plate in mm are as follows: 120; 125; 135; 140; 145; 160; 155; 150; 145; 135 and 118.

Calculate the common interval of the ordinates if the area of the plate is $21135 mm^2$. (4)

[11]

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QUESTION 5

5.1 Given the functions $f(x) = -6 + x + x^2$ *and* $g(x) = -2x - 3$

5.1.1 Copy and complete the table below in your ANSWER BOOK:

x	-4	-3	-2	-1	0	1	2	3	4
$f(x)$	6				-6				14
$g(x)$	5				-3				-11

(2)

5.1.2 Use a graph paper to draw the graphs of $f(x)$ and $g(x)$ on the same system of axes. (5)

5.1.3 Use your graphs in QUESTION 5.1.2 above to estimate the values of x for which $g(x) = f(x)$.

[Hint: Use broken lines on the graph page to read off the values of x]. (2)

5.1.4 Calculate the equation of the axis of symmetry of $f(x)$ and draw it with a broken line on your graph in QUESTION 5.1.2 above. (2)

5.1.5 Calculate the $y - ordinate$ of the turning point of $f(x)$. (1)

5.2 Given the functions $v(x) = -\sin x$ *and* $w(x) = \cos x$

5.2.1 Copy and complete the table below in your ANSWER BOOK:

x	0	30	60	90	120	150	180	210	240	270	300	330	360
$v(x)$	0	$-0{,}5$		-1		$-0{,}5$	0	0,5		1		0,5	0
$w(x)$	1		0,5	0	$-0{,}5$		-1		$-0{,}5$	0	0,5		1

(2)

5.2.2 Use graph paper to draw the graphs of $v(x)$ and $w(x)$ on the same system of axes. (4)

5.2.3 Read from your graph in QUESTION 5.2.2 above the values of x for which $v(x) = w(x)$.

[Hint: Use broken lines on the graph page to read off the values of x]. (2)

[20]

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QUESTION 6

6.1 Convert 13,4 $rads$ to degrees and minutes (2)

6.2 The arc length of a sector of a circle is 12,5 cm and the angle sector subtends at the centre of the circle is 1,25 $rads$.

Calculate the following:

6.2.1 The radius of the sector (1)

6.2.2 The area of the sector in cm^2 (2)

6.3 A wheel has an angular velocity of 150 $rads$ per second.

Calculate the number of revolutions the wheel completes

6.3.1 per second. (2)

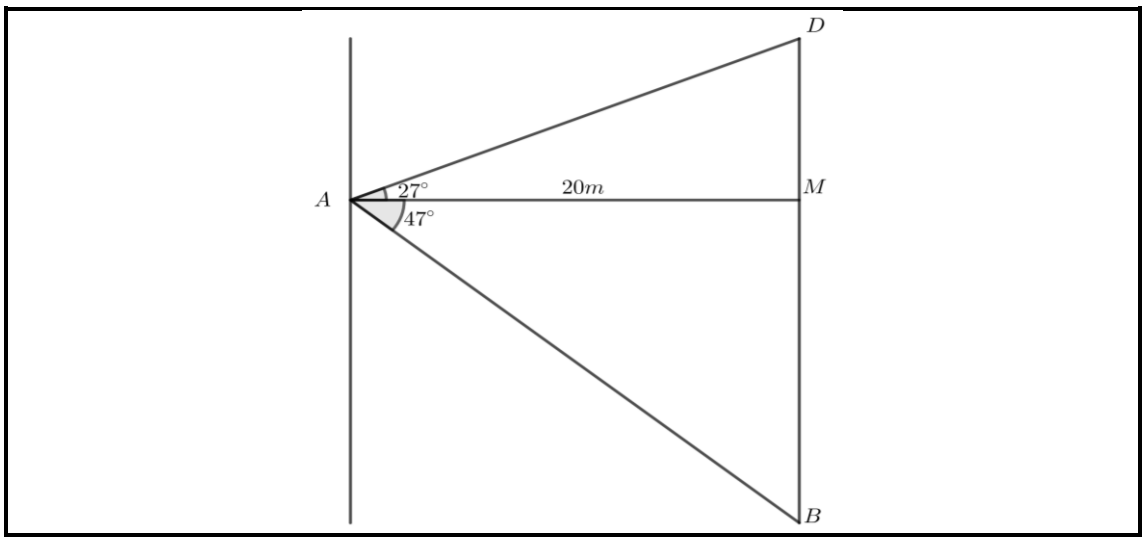
6.3.2 per minute. (1)

6.4 Given that the diameter of a circle is twice the length of a chord of the same circle, calculate the length of the chord as a function of the height of the segment created by the chord. (4)

6.5 Given that $\sin\theta = -\frac{8}{17}$ for $270° \leq \theta \leq 360°$, determine the value of $1 + tan^2\theta$ without using a calculator. (3)

6.6 Two tall buildings of the same height are $20\ m$ apart as shown in the diagram below. From some point A on one of the buildings, the angle of elevation of a dove (D) at the top of the other building is $27°$.

Calculate the height of the buildings if from the same point A, the angle of depression of the base (B) of the other building is $47°$ and $D\widehat{M}A = 90°$.



(5)

[20]

TOTAL: 100

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MATHEMATICS N2

FORMULA SHEET

This sheet must accompany the question paper.

The right cone

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

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

$= \pi r\ell + \pi r^2$

The right pyramid

Volume = α (area of base) × (perpendicular height)

The prism

Volume = (area of base) × (perpendicular height)

The cylinder

Volume = $\pi r^2 h$

Surface area = $2\pi r^2 + 2\pi rh$

The sphere

$V = \frac{4}{3}\pi r^3$; $A = 4\pi r^2$

Degrees and radians

180° = π rad

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

Angular velocity and circumferential velocity

Angular velocity: $w = 2\pi n$

Circumferential velocity: $v = \pi Dn$

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

Mid-ordinate rule

Area = (distance between ordinates) × (sum of mid-ordinates)

$$= \left[\frac{\text{First ordinate} + \text{Last ordinate}}{2} + \text{Sum of other ordinates}\right]$$

Multiply by the distance between the ordinates.

Graphs

Straight line: $y = mx + c$ Parabola: $y = ax^2 + bx + c$

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

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

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Trigonometry

$90° < \theta < 180°$ $\sin \theta = \sin (180° - \theta)$ $\cos \theta = -\cos (180° - \theta)$

$\tan \theta = -\tan (180° - \theta)$

Segments of circles

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

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

Regular polygons

Angle subtended at centre of circumscribed circle by one side:

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

R = radius of circumscribed circle

x = length of side

$$x = 2R \sin \frac{\theta}{2}$$

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

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