higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T1000**(E)**(J26)T

NATIONAL CERTIFICATE

MATHEMATICS N2

(16030192)

26 July 2019 (X-Paper)
09:00–12:00

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

A scientific calculator 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
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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. Keep subsections of questions together.
6. Use BLUE or BLACK ink only.
7. Sketches must be large, neat and fully labelled
8. Scientific calculators may be used.
9. Do all graph work on the graph paper provided.
10. Write neatly and legibly.

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QUESTION 1

1.1 Simplify the following:

1.1.1 $$\frac{\sqrt{9x^{36}} \times \left(-3x^2\right)^3}{\left(3x^3\right)^6 \times \sqrt[3]{-27x^{27}}}$$ (3)

1.1.2 $$\log_4 64 + \log_3 \frac{1}{81} + \log_2 \frac{1}{8}$$ (3)

1.1.3 $$\log_3 \left(\log_2 8\right)^{-1}$$ (4)

1.2 Use natural logarithms to calculate the numerical value of the following:

$$A = \frac{1{,}15^2 \times \sqrt{5{,}4}}{6{,}21}$$

Show ALL calculations. Answers only are not acceptable (4)

1.3 Solve for x in the following equations: $8^x = \frac{1}{4}.\sqrt{2}$ (3)

1.4 Given: $Z = \sqrt{R^2 + w^2 L^2}$; $R = 12$; $Z = 90$ and $w = 120$

1.4.1 Make L the subject of the formula. (4)

1.4.2 Calculate the value of L (2)

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QUESTION 2

2.1 Factorise the following expressions:

2.1.1 $18x^2 + 3x - 6$ (2)

2.1.2 $54x^2 - 6y^2$ (2)

2.1.3 $4x^2 + 20x - 3xy - 15y$ (3)

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2.2 Factorise the following expressions and then give the lowest common multiple (LCM) and highest common factor (HCF) of:

$3x^2 - x - 14$
$3x^2 - 13x + 14$
$x^2 - 4$ (7)

2.3 Simplify the following expressions:

2.3.1 $3x + \frac{1}{x-2}$ (2)

2.3.2 $\frac{x^2-9}{3y^2+y} \times \frac{3y^2-2y-1}{x^2+x-6}$ (3)

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QUESTION 3

3.1 Solve for x and y in the following equations algebraically:

$x - 6y = -32$ and $x + 5y = 12$ (4)

3.2 The length of a rectangle is double the breadth. The perimeter of the rectangle is 120cm. Determine the area of the rectangle (4)

3.3 A polishing wheel moves at 150 revolutions per minute.

Calculate the angular velocity of the polishing wheel. (3)

3.4 A circle sector has a radius of 2 m and an arc of 5 m.

Calculate the following:

3.4.1 The angle subtended by the arc in degrees (3)

3.4.2 The area of the sector (2)

3.5 A lead cast in the shape of a cone with a base diameter of 210 mm and a perpendicular height of 110 mm is melted and recast in the shape of a sphere.

Calculate the following:

3.5.1 The diameter of the sphere (4)

3.5.2 The surface area of the sphere (2)

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3.6 Determine the diameter of cylinder with a volume of 1178 cm^3 and perpendicular height of 15 cm (3)

[25]

QUESTION 4

4.1 The area of an irregular metal sheet is 89,4 m^2. The ordinates are 3m; 3,5 m; 3,8 m; 4,5 m; 4,9 m; 5,6 m; 4,2 m and 3.6 m.

Calculate the constant interval between the ordinates. (3)

4.2 Given: $\cos\beta = \frac{2}{3}$ and $0° \leq \beta \leq 360°$

Determine the following trigonometric ratios without using a calculator:

4.2.1 $1 + \tan^2\beta$ (3)

4.2.2 $\text{cosec}\beta.\sin\beta + 2$ (2)

4.3 Draw the graphs of $f(x) = -\cos x - 1$ and $g(x) = -\sin x$; where $0° \leq x \leq 360°$; on the same system of axes.

Use the graphs to determine the value(s) of x from $0°$ to $360°$ if: (6)

4.3.1 $f(x) = g(x)$ (2)

4.3.2 $-\cos x - 1 = 0$ (1)

4.4 Mrs Wessie is standing on top of a building, looking at a park in the distance. The building is 100 m tall. The angle of depression is $53°$.

Calculate how far away the park is. (3)

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QUESTION 5

5.1 Given: $g(x) = -x + 5$ and $f(x) = x^2 - 6x + 9$

Determine the following:

5.1.1 The equation of the axis of symmetry of $f(x)$ (1)

5.1.2 The roots of $f(x)$ (1)

5.1.3 The coordinates of the turning point of $f(x)$ (2)

5.1.4 The y-intercept of the function of $f(x)$ (1)

5.2 Use the information in QUESTION 5.1 to draw the graphs of $f(x)$ and $g(x)$ on the same system of axes. (6)

5.3 Read from the graphs in QUESTION 5.2 the value(s) of x for which $f(x) = g(x)$. (2)

[13]

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

$90° < \theta < 180°$

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

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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