higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T860(E)(N24)T

NOVEMBER EXAMINATION

NATIONAL CERTIFICATE

MATHEMATICS N2

(16030192)

24 November 2016 (X-Paper)
09:00–12:00

Scientific calculators may be used.

This question paper consists of 6 pages and 1 information sheet of 2 pages.

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. Show ALL formulae and intermediate steps and simplify where possible.
5. ALL final answers must be rounded off to THREE decimal places.
6. Questions may be answered in any order but subsections of questions must be kept together.
7. Use only BLUE or BLACK ink.
8. Write neatly and legibly.

QUESTION 1

1.1 Determine the highest common factor(HCF) and the lowest common multiple(LCM) of the following expressions:

$x^2 - 4$
$8x^2 - 14x - 4$
$x^3 + 2x^2 - 4x - 8$

(8)

1.2 Simplify the following fractions:

1.2.1 $\dfrac{1}{4x-4} + \dfrac{6}{8(x-1)} - \dfrac{1}{x^2-1}$ (4)

1.2.2 $\dfrac{x^2-9}{4x^2-9} \div \dfrac{8x+12}{4x^2-9} \times \dfrac{8x+12}{4x-12}$ (4)

[16]

QUESTION 2

2.1 Solve for x in the following equation by using the quadratic formula:
$x(5x-6) = 2(3+x)$ (4)

2.2 Solve for x and y in the following equations simultaneously:
$y = x - 1$ and $\dfrac{x}{4} + y = 4$ (4)

2.3 Change the subject of the formula to the symbol in brackets:

$\dfrac{3}{x} = A - \dfrac{5}{y} \ldots\ldots\ldots\ldots\ldots\ldots (y)$ (3)

2.4 In a two-digit number the tens-digit is 2 more than the units digit. If the digits are interchanged the sum of the new number and the original number is 88. Find the original number. (4)

[15]

QUESTION 3

3.1 Simplify the following:

3.1.1 $\dfrac{3^{x-1}\times 9^{x+2}}{27^{x+1}}$ (3)

3.1.2 $\sqrt{\sqrt[3]{64x^8x^4}}$ (3)

3.2 Solve for x in the following equations:

3.2.1 $16^{x+1}-4^3=0$ (3)

3.2.2 $3^{4x^2-1}=1$ (5)

3.3 Solve for x in the following equation by using logarithmic laws:

$\log_2(x^2-2x)=3$ (5)

[19]

QUESTION 4

4.1 A wheel turns at 2106 revolutions per minute.

Calculate the following:

4.1.1 The revolutions per second (1)

4.1.2 The circumferential velocity of the wheel in meters per second if the wheel has a diameter of 28 cm. (3)

4.2 Calculate the length of the chord of a circle of which the radius is 21mm, and the height of the segment is 10mm. (4)

4.3 Determine the value of the following:

$e^{-0,5}\cos\left(\ln\dfrac{\pi}{4}\right)+\sin 270^o-\tan\pi$ (1)

4.4 A closed cylindrical water tank in FIGURE 1 has a diameter of 560 mm and height of h cm respectively. The water tank has a surface area of 7891 cm^2.

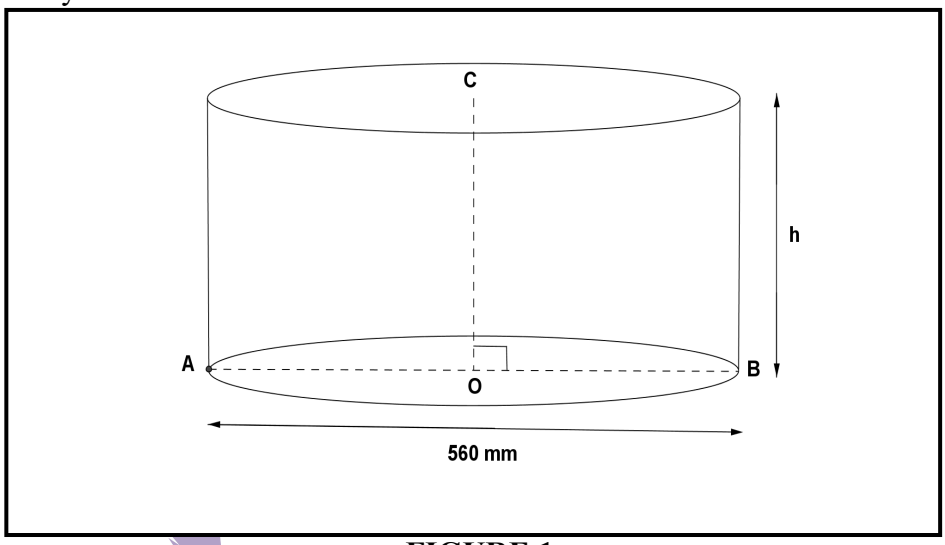

FIGURE 1

4.4.1 Calculate the height of the water tank in cm. (4)

4.4.2 How many litres of water will the water tank hold? (4)

4.5 A lead ball with a diameter of 120 mm is melted and cast into the shape of smaller cubes with 2 cm height. How many of these smaller cubes can be formed? (4)

[21]

QUESTION 5

5.1 Consider FIGURE 2 below. AD, a vertical cliff, is 65,8 m high. B and C are two boats in the same horizontal plane as the foot of the cliff. The angle of elevation from C to D is y°. DC = 104 m and AB = 49,7 m.
D, B, C and A are all in the same vertical plane.

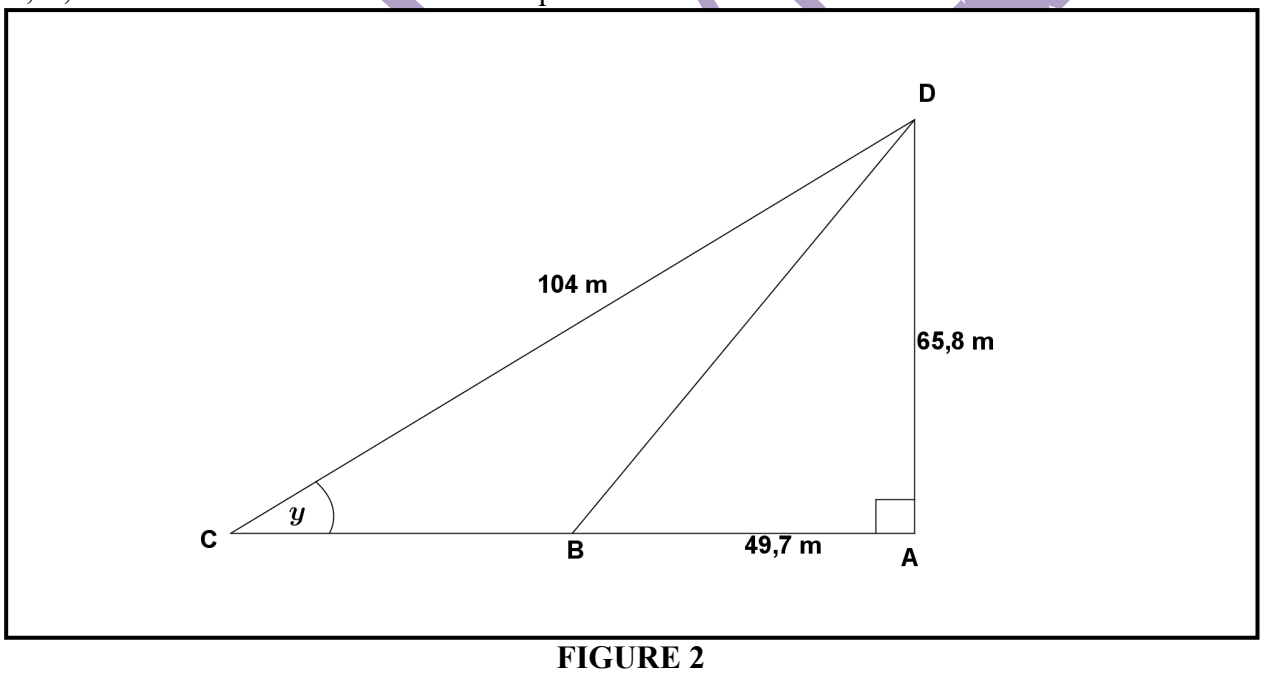

FIGURE 2

5.1.1 Calculate the length of the side DB. (3)

5.1.2 Calculate the magnitude of the angle y. (2)

5.1.3 Calculate the length of the side BC. (4)

5.2 If $\sin\theta = m$ and $\theta \leq 90^{\circ}$, express the following values in terms of m.

5.2.1 $\tan\theta$ (2)

5.2.2 $\sin^2\theta + \cos^2\theta$ (2)

[13]

QUESTION 6

6.1 6.1.1 Sketch, on ONE system of axes, the graphs of the following:

$g(x) = 2\cos x$ and $h(x) = \sin x + 2$ for $0^o \leq x \leq 180^o$ (5)

6.1.2 Read from the graph the co-ordinates if

$2\cos x = \sin x + 2$ (1)

6.2 Given: $f(x) = -x^2 + 7$, $g(x) = 7 - x$ and $h(x) = 7$

6.2.1 By calculating the roots, the y-intercept and the turning point, sketch the graph of $f(x) = -x^2 + 7$

Clearly indicate ALL calculated values on the graph. (5)

6.2.2 Now, on the same system of axes, sketch the graphs of

$g(x) = 7 - x$ and $h(x) = 7$ (3)

6.2.3 Read from the graph the co-ordinates of the point(s) where all three the graphs in QUESTION 6.2.2 intersect each other. (2)

[16]

TOTAL: 100

MATHEMATICS N2

INFORMATION SHEET

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

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

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

Right pyramid
Volume = $\frac{1}{3}$ (area of base) × (perpendicular height)

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

Cylinder
Volume = $\pi r^2 h$
Surface area = $2\pi r^2 + 2\pi rh$

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
$$A = \left[\frac{\text{First ordinate+last ordinate}}{2} + \text{sum of other ordinates}\right] \times \text{common distance}$$

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

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

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

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