higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

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NATIONAL CERTIFICATE

MATHEMATICS N2

(16030192)

27 March 2018 (X-Paper)
09:00–12:00

Calculators may be used.

This question paper consists of 6 pages, a formula sheet of 2 pages and 2 sheets of graph paper.

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 intermediary steps and simplify where possible.
5. ALL final answers must be rounded off to THREE decimal places (unless indicated otherwise).
6. Questions may be answered in any order, but subsections of questions must NOT be separated.
7. Questions must be answered in BLUE or BLACK ink.
8. All graph work must be done on the attached graph paper.
9. Write neatly and legibly.

QUESTION 1

1.1 Simplify each of the following expressions using exponential laws. The use of a calculator is restricted. Show all the steps.

1.1.1 $$\frac{32^{\frac{3}{5}} \times 81^{-\frac{3}{4}}}{\left(2\frac{1}{4}\right)^{-\frac{3}{2}}}$$ (4)

1.1.2 $$\frac{2^{n+4} - 6.2^{n+1}}{2^{n+2} \times 5}$$ (3)

1.2 Given: $2 = 10^a$ and $9 = 10^b$. Determine the values of the following:

1.2.1 $\log 4$ (4)

1.2.2 $\log 6$ (2)

1.3 Solve for x:

1.3.1 $9^x = \frac{1}{3}\sqrt{3}$ (3)

1.3.2 $\log_5(x+3) - \log_5(2x+1) = 1 - \log_5 9$ (4)

1.4 Given $b = \sqrt{\frac{3pR}{2\pi Q}}$

1.4.1 Make Q the subject of the formula (2)

1.4.2 Hence, calculate the value of Q if $b = 11$, $R = 16$ and $p = 12$ (2)

[24]

QUESTION 2

2.1 Factorise the following expression:

$16p^2 - 25q^2 - 4p - 5q$ (3)

2.2 Determine the lowest common multiple (LCM) of the following three expressions:

$x^3 - xy^2$

$2x^2 + xy - 3y^2$

$2x^2 - 4xy + 2y^2$

(7)

2.3 Simplify each of the following:

2.3.1 $\dfrac{a^2c - b^2c}{a^2 - 2ab + b^2} \div \dfrac{ac + bc}{a - b}$ (5)

2.3.2 $\dfrac{4}{x+4} + \dfrac{x}{x-4} - \dfrac{8x}{x^2 - 16}$ (7)

[22]

QUESTION 3

3.1 A bag contains 60 green and white pool balls. Twice the number of green balls is 9 more than the white balls.

Calculate the number of green and white balls respectively. (4)

3.2 Solve for x:

$5x^2 - 3x - 3 = 0$ (4)

3.3 Given: A wheel of a motorcycle with a diameter of 75 cm rotates at 10,54 r/s.

Calculate:

3.3.1 The angular velocity in radians per second (2)

3.3.2 The peripheral velocity in m/s (3)

3.4 A sector of a circle has an area of 184 cm^2 and an angle of 68^o.

Calculate the arc length of the circle. (5)

[18]

QUESTION 4

4.1 An ice cream cone has a base diameter of 50 mm and a slant height of 135 mm.

Calculate the following:

4.1.1 The surface area of the cone (2)

4.1.2 The volume of the cone (4)

4.2 The ordinates in cm of an irregular plate are as follows: 120; 127; 139; 143; 147; 163; 157; 148; 153; 148; 136 and 118. The area of the plate is 18 960 cm^2.

Determine the common interval in cm. (3)

4.3 Calculate the volume of a sphere with a surface area of 125 m^2. (4)

[13]

QUESTION 5

5.1 Given: $y = -2\cos x$ and $y = 1 + \sin x\ (0° \leq x \leq 180°)$

5.1.1 Use the ATTACHED graph paper and draw the given graphs in 5.1 on the same system of axes. (6)

5.1.2 Read the value(s) of x for which $-2\cos x - 1 = 0$ from the graph. (1)

5.2 Consider FIGURE 1 below.

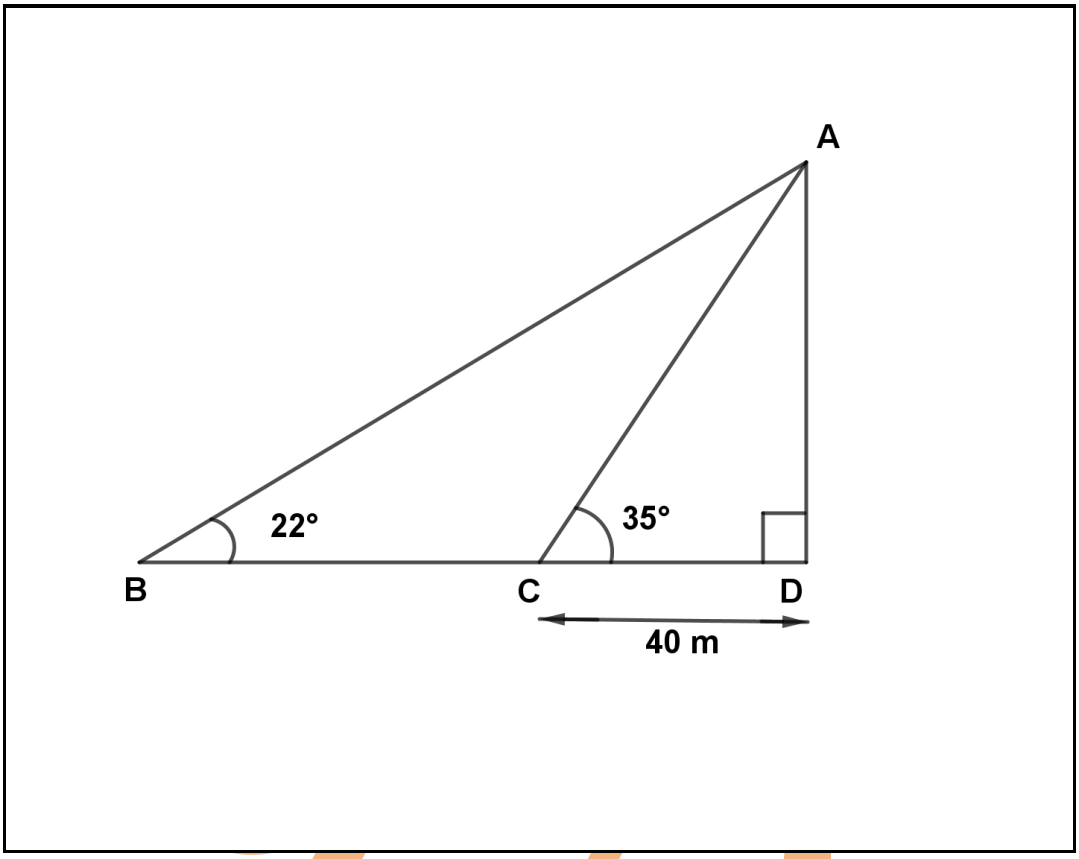


FIGURE 1

The angle of elevation from a point C on the ground to the top of a building AD is 35^{o}. The point C is 40 m from the foot of the building. From a point B slightly further away from the building, the angle of elevation to the top of the building is 22^{o}. If BCD is a straight line, determine:

5.2.1 The height AD of the building (3)

5.2.2 The distance between the points B and C (5)

[15]

QUESTION 6

Given: $y+x^2+4x=0$ and $y-2x-8=0$

6.1 Use the ATTACHED graph paper and use one system of axes to sketch the given graphs. Clearly indicate the roots, the *x*-intercept(s), *y*-intercept(s) and coordinates of the turning point(s) of the graphs where applicable. (6)

6.2 From the graph, give the coordinates of the points where the graphs intersect. (2)

[8]

TOTAL: 100

MATHEMATICS N2

FORMULA SHEET

Right cone

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

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

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

Cylinder

Volume = $\pi r^2 h$

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

Sphere

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

Area = $4\pi r^2$

Right pyramid

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

Prism

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

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) x (sum of other mid-ordinates)

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

Graphs

Straight line: $y = mx + c$

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

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

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

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

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

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

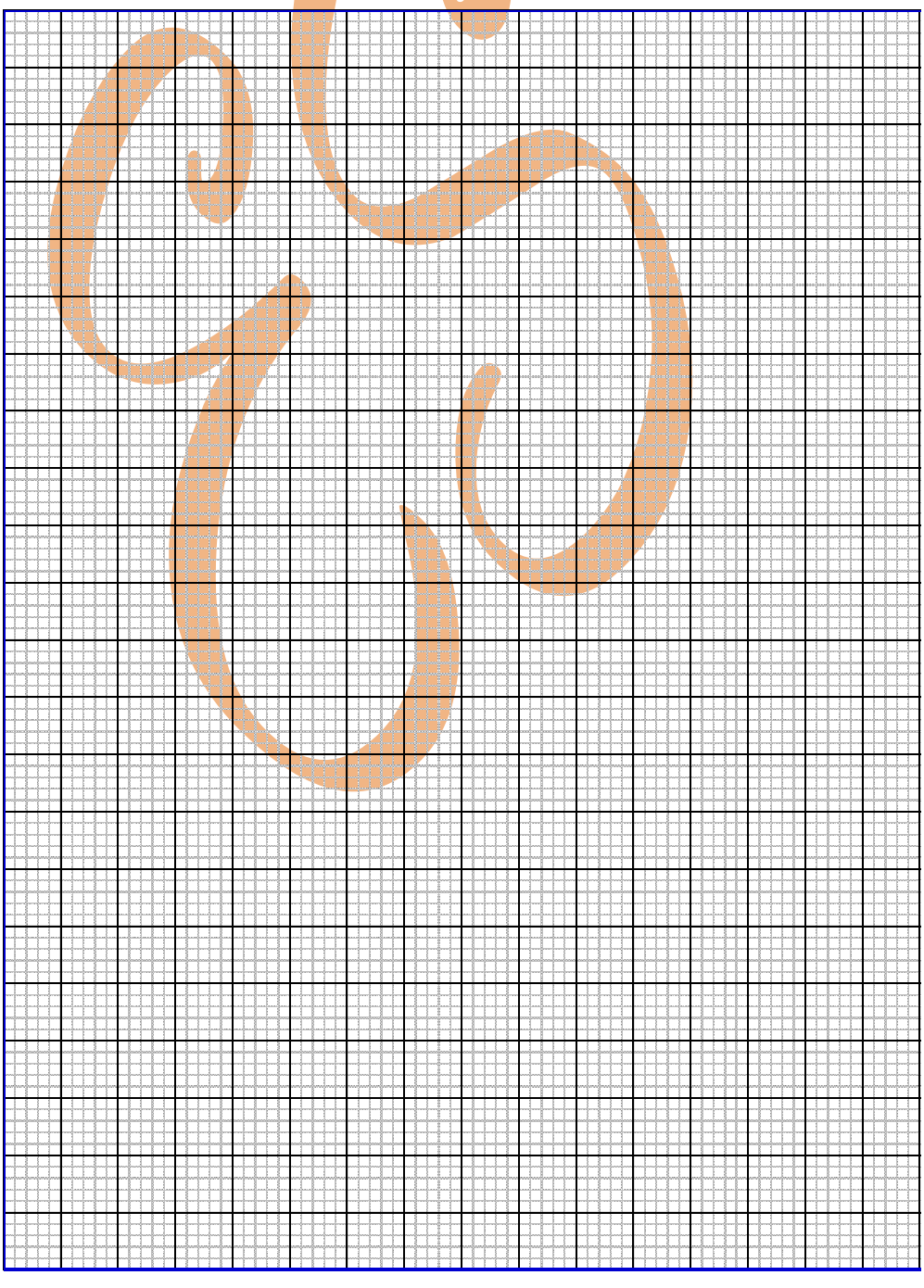
MATHEMATICS N2
GRAPH PAPER

Complete and staple the page in your ANSWER BOOK after the front page.

CENTRE NUMBER

EXAMINATION NUMBER:

Q5.1.1



CENTRE NUMBER:

EXAMINATION NUMBER:

Q6.1