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basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS/ NATIONAL SENIOR CERTIFICATE EXAMINATIONS

TECHNICAL MATHEMATICS P2

MAY/JUNE 2025

MARKS: 150

TIME: 3 hours

This question paper consists of 15 pages, a 2-page information sheet and a 25-page SPECIAL ANSWER BOOK.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of 11 questions.

2. Answer ALL the questions in the SPECIAL ANSWER BOOK provided.

3. Clearly show ALL calculations, diagrams, graphs, etc. that you used in determining your answers.

4. Answers only will NOT necessarily be awarded full marks.

5. If necessary, round off answers to TWO decimal places, unless stated otherwise.

6. Diagrams are NOT necessarily drawn to scale.

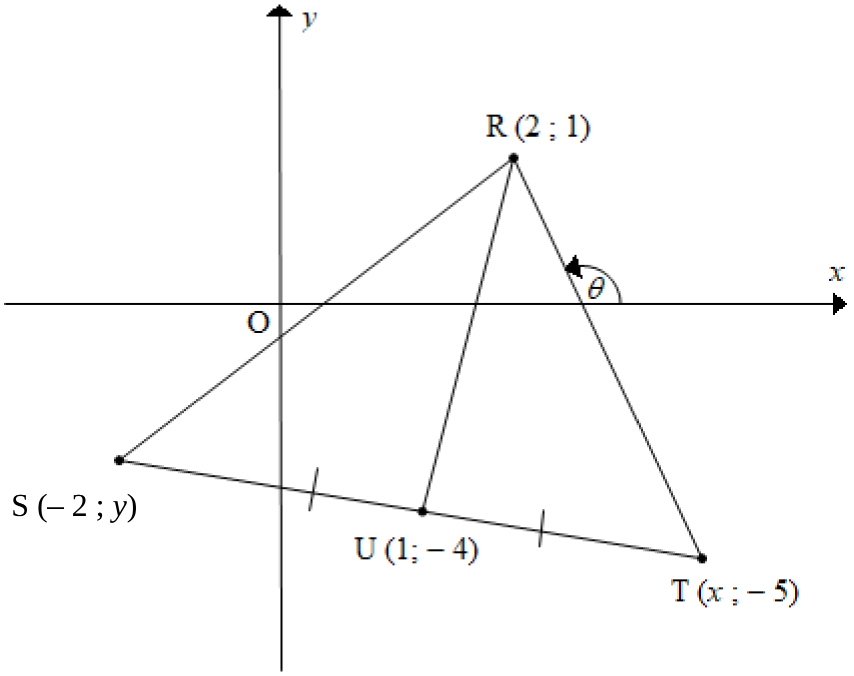
7. You may use an approved scientific calculator (non-programmable and non-graphical), unless stated otherwise.

8. An information sheet with formulae is included at the end of the question paper.

9. Write neatly and legibly.

QUESTION 1

The diagram below shows ΔRST with vertices R(2 ; 1), S(– 2 ; *y*) and T(*x* ; – 5).
The angle of inclination of RT with the positive *x*-axis is θ .
U(1 ; – 4) is the midpoint of ST.
RU is drawn.

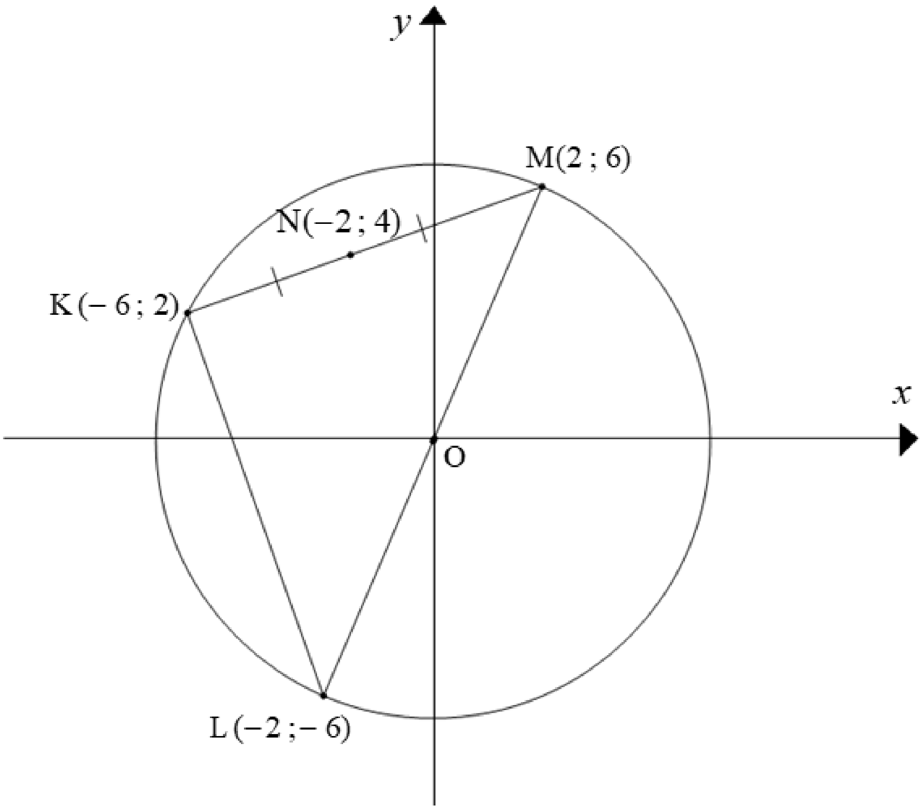


Determine:

1.1	The length of RU (leave the answer in surd form)	(2)
1.2	The values of x and y	(2)
1.3	The gradient of RT	(2)
1.4	The size of θ	(3)
1.5	The equation of the circle with centre O, passing through point S	(2)
		[11]

QUESTION 2

2.1 In the diagram below, O is the centre of the circle KLM with vertices K(– 6 ; 2), L(–2 ; – 6) and M(2 ; 6), as shown.
Point N(– 2 ; 4) is the midpoint of KM.



2.1.1 Determine the equation of the line ML. (3)

2.1.2 Show, using **analytical geometry methods**, that $KL \perp KM$. (4)

2.1.3 Show that $ON = \frac{1}{2}KL$. (3)

2.2 Sketch the graph of the ellipse defined by $\frac{x^2}{16} + \frac{y^2}{7} = 1$. (3)

[13]

QUESTION 3

3.1 Given: $\hat{A} = 103°$ and $\hat{B} = 52°$

Use a calculator to determine the value of:

3.1.1 $\tan(A + B)$ (2)

3.1.2 $\dfrac{2\operatorname{cosec} B}{\cos A}$ (3)

3.2 Given: $3\operatorname{cosec}\theta + 5 = 0$ and $\theta \in [90° ; 270°]$

3.2.1 Make $\operatorname{cosec}\theta$ the subject of the equation. (1)

3.2.2 Hence, determine, **without the use of a calculator**, the value of $\cos\theta - \cot\theta$. (5)

3.3 Solve for x:

$\sin 3x = -0{,}43$ and $3x \in [0° ; 360°]$ (5)

[16]

QUESTION 4

4.1 Complete:

4.1.1 The reduction: $\cos^2(180° + \alpha) = ...$ (1)

4.1.2 The identity: $\sin^2\alpha + \cos^2\alpha = ...$ (1)

4.2 Simplify:

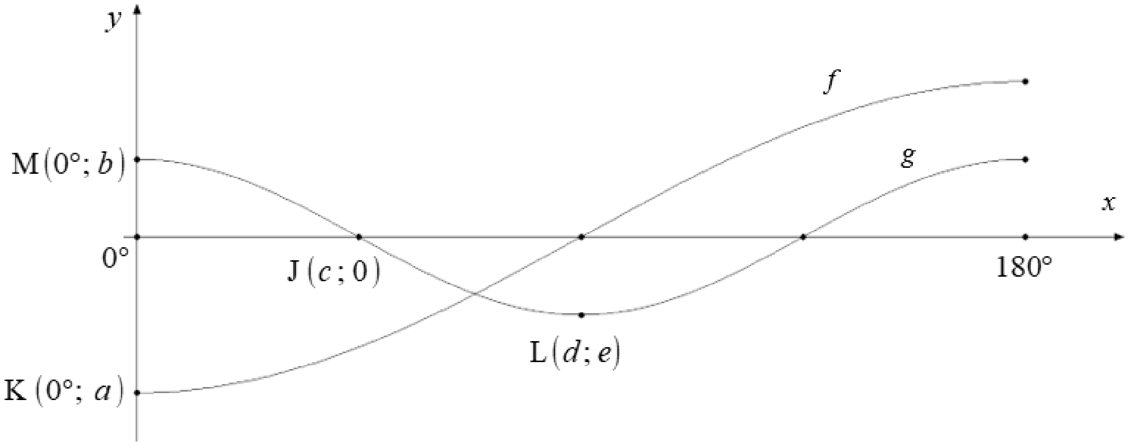
$$\frac{\tan(\pi - \alpha)\cdot\sqrt{1 - \sin^2\alpha}}{\cos^2(180° + \alpha) + \sin^2(360° - \alpha)}$$ (6)

4.3 Prove the identity: $\sec^2\theta + \operatorname{cosec}^2\theta = \operatorname{cosec}^2\theta\cdot\sec^2\theta$ (4)

[12]

QUESTION 5

The graphs below represent the functions defined by $f(x) = -2\cos x$ and $g(x) = \cos 2x$ for $x \in [0°\,;180°]$.
Points $M(0°;b)$ and $J(c\,;0)$ are the y-intercept and x-intercept of g respectively.
$L(d\,;e)$ is the turning point of g.
$K(0°\,;a)$ is the y-intercept of f.



Write down:

5.1 The values of a, b, c, d and e (5)

5.2 The amplitude of f (1)

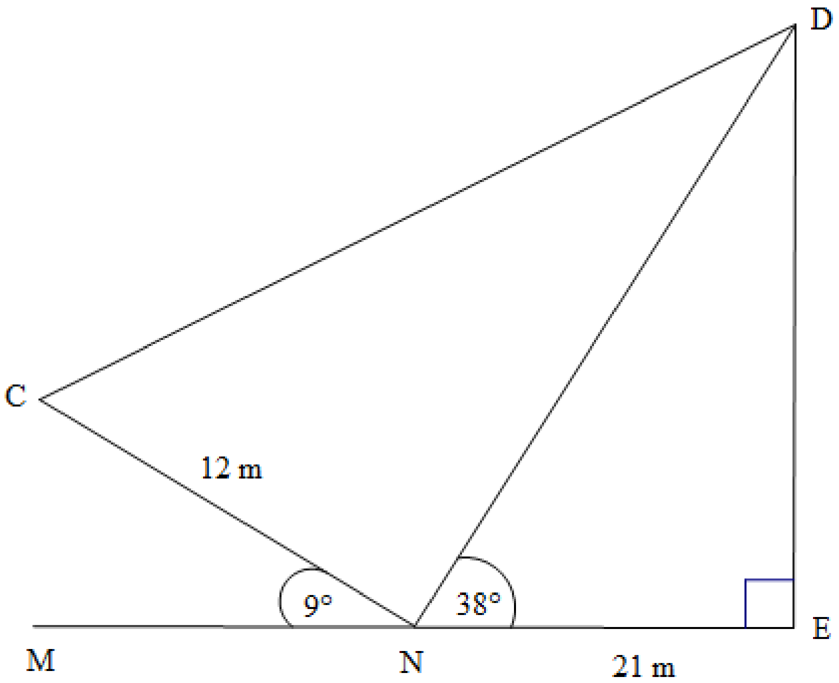
5.3 The period of g (1)

5.4 The value(s) of x for which $f(x) \times g(x) > 0$ (4)
[11]

QUESTION 6

The diagram below shows two triangles, ΔNDE and ΔCDN.

In ΔNDE, NE = 21 m, $D\hat{N}E = 38°$ and $\hat{E} = 90°$.
EN is produced to M.
CN = 12 m
$C\hat{N}M = 9°$



6.1 Determine the length of ND. (3)

6.2 Calculate the size of $C\hat{N}D$. (1)

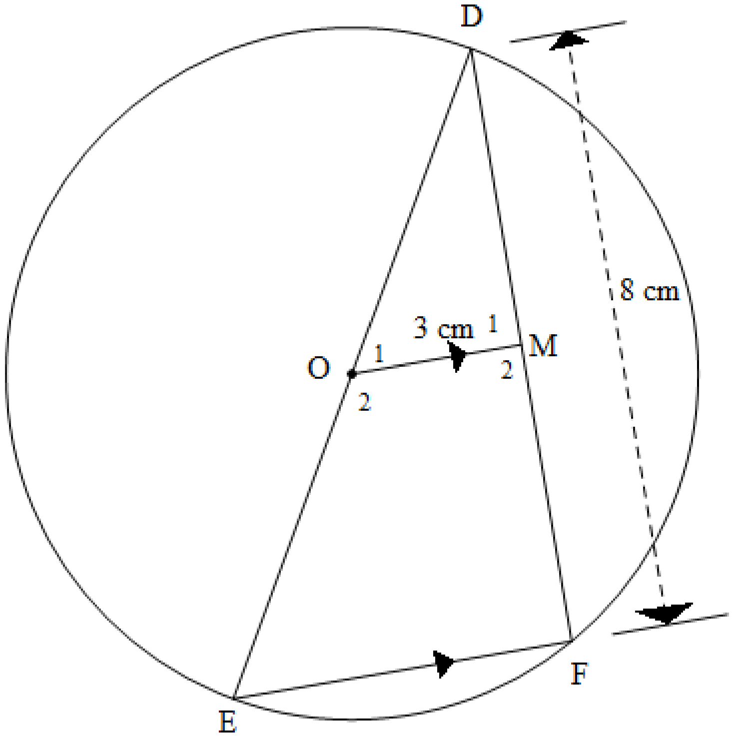
6.3 Determine the length of CD. (4)

6.4 Determine the area of ΔCDN. (3)
[11]

Give reasons for your statements in QUESTIONS 7, 8 and 9.

QUESTION 7

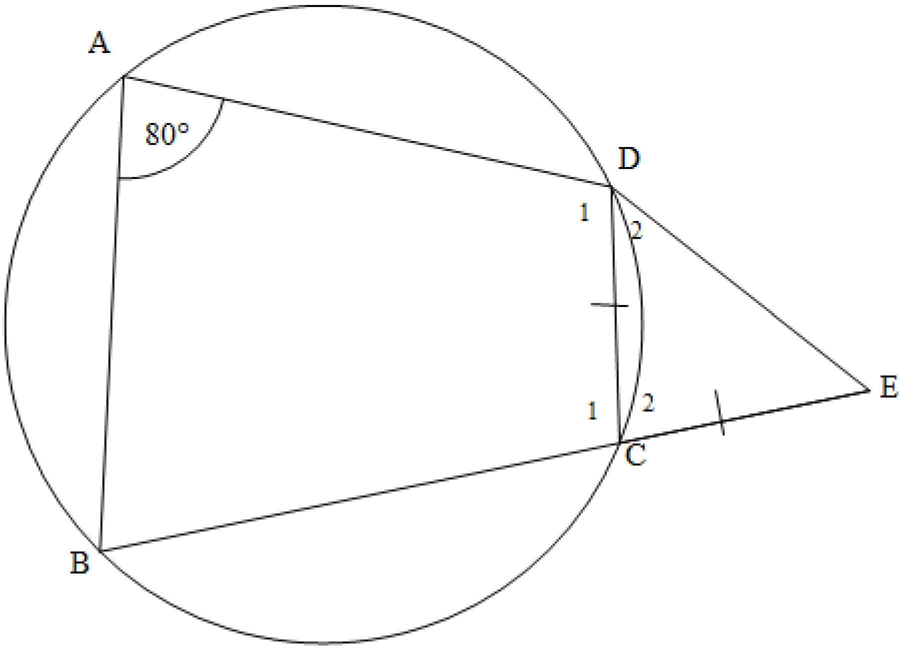
In the diagram below, O is the centre of the circle DEF.
DE is a diameter and M is a point on DF such that OM || EF.
DF = 8 cm and OM = 3 cm.



7.1	Give a reason why $\hat{F} = 90°$.	(1)
7.2	Name, giving a reason, another right angle in the diagram.	(2)
7.3	Give a reason why DM = MF.	(1)
7.4	Calculate, giving reasons, the length of the diameter of the circle.	(4)
		[8]

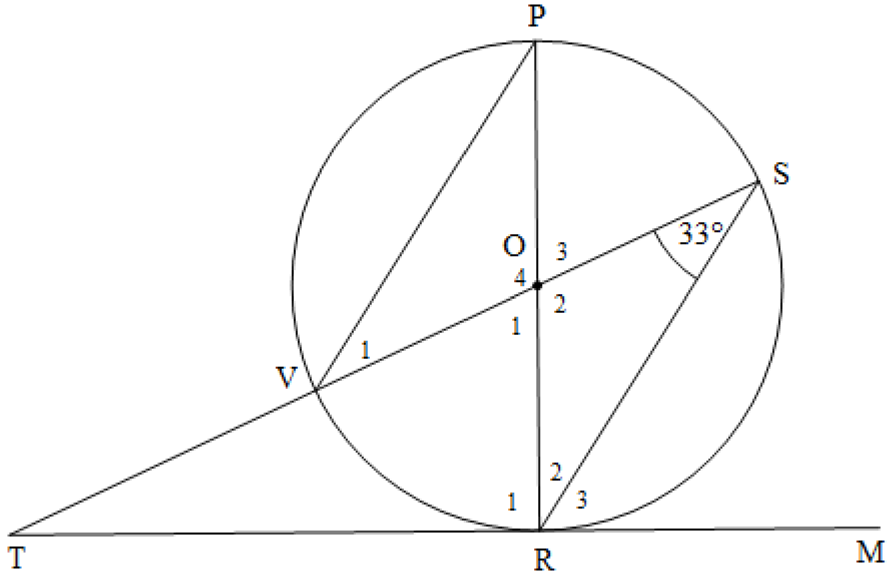
QUESTION 8

8.1 In the diagram below, ABCD is a cyclic quadrilateral.
BC is extended to meet DE at E such that DC = CE.
$\hat{A} = 80°$



Determine, giving reasons, the size of $\hat{E}$. (6)

8.2 In the diagram below, O is the centre of circle PVRS.
PR and SV are diameters.
The tangent MR to the circle at R meets SV produced at T.
$R\hat{S}V = 33°$



8.2.1 Calculate, giving reasons, the sizes of the following angles:

(a) $\hat{P}$ (2)

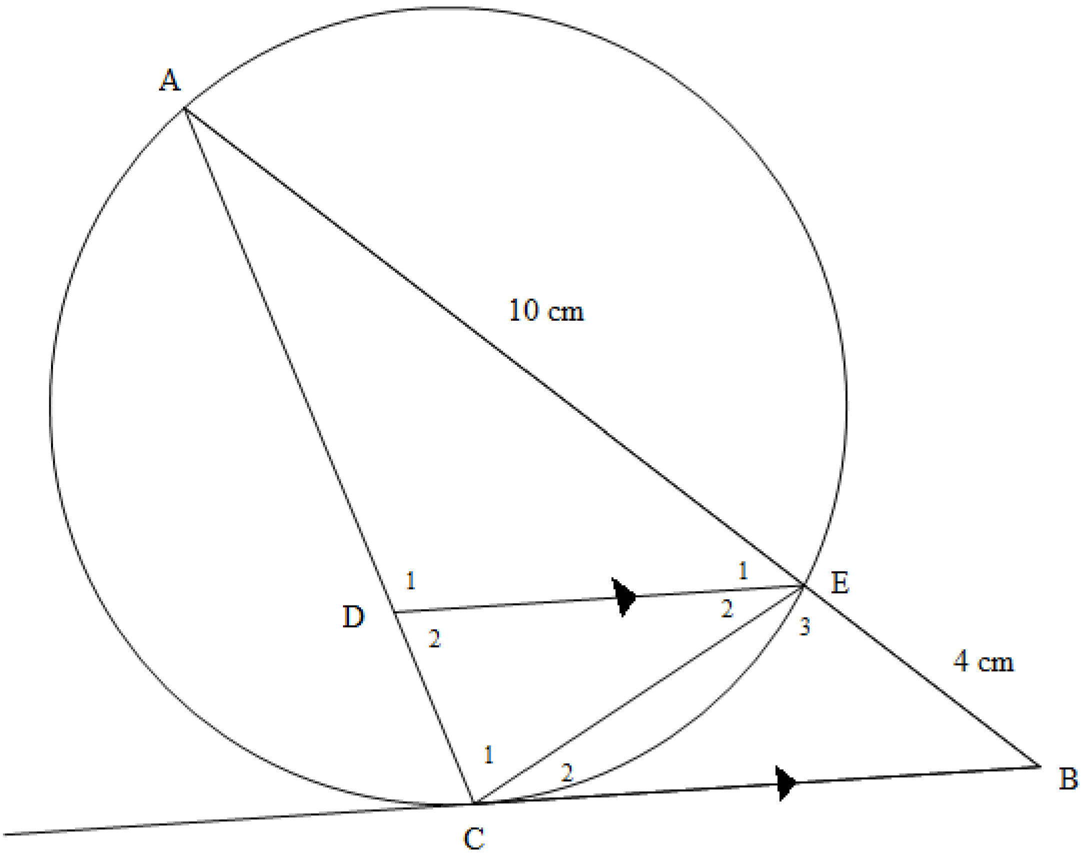
(b) $\hat{O}_1$ (2)

(c) $\hat{T}$ (3)

8.2.2 Show that PV || SR. (3)
[16]

QUESTION 9

In the diagram below, A, E and C are points on the circle.
Tangent CB meets AE produced at B.
D is a point on AC such that DE || CB.
AE = 10 cm and BE = 4 cm.



9.1 Show that $\Delta ABC \parallel\!| \Delta CBE$. (4)

9.2 Hence, show, giving a reason, that $BC^2 = AB \cdot BE$. (2)

9.3 Hence, calculate the length of BC. (2)

9.4 Calculate, with reasons:

9.4.1 $\frac{AD}{AC}$ (3)

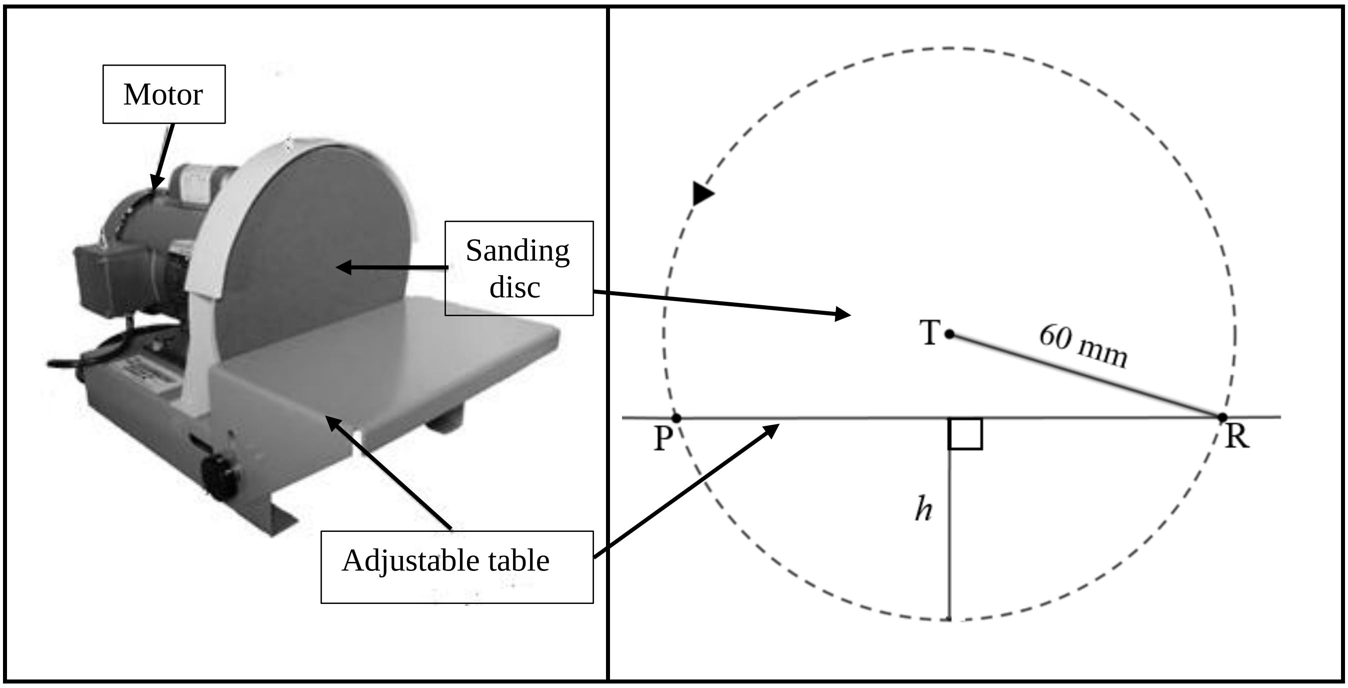
9.4.2 $\frac{AC}{CE}$ (3)

[14]

QUESTION 10

10.1 The picture below shows an industrial wood-sanding machine. The motor causes the sanding disc to rotate at varying speeds. The diagram alongside models the circular path when the disc (with centre T) rotates and chord PR models the height at which the adjustable table is set.

- A particle on the circumference of the sanding disc is rotating at a circumferential velocity of 1 200 cm/min.
- The radius TR of the disc is 60 mm.
- h represents the minor height of the segment in relation to chord PR.



10.1.1 Convert the radius of 60 mm to metres. (1)

10.1.2 Hence, write down the length of the diameter of the disc in metres. (1)

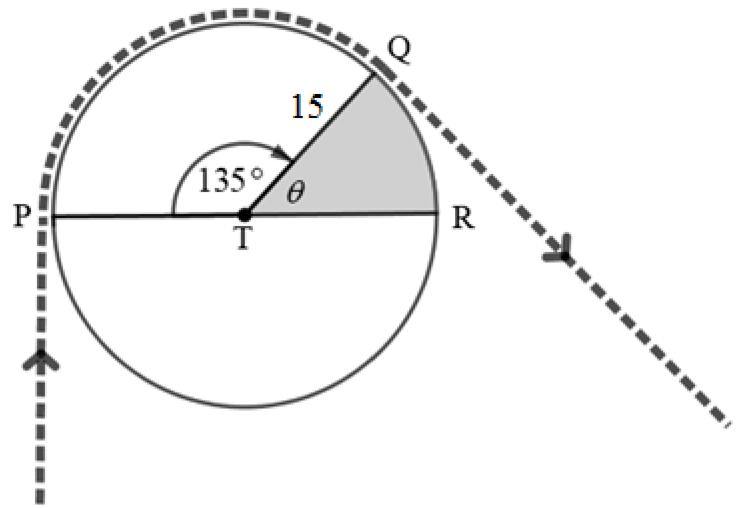
10.1.3 Convert the circumferential velocity of 1 200 cm/min to m/s. (2)

10.1.4 Hence, determine the angular velocity of the disc in radians per second. (3)

10.1.5 If it is further given that PR = 115 mm, determine the value of h in mm. (4)

10.2 The picture below shows a pulley system used to draw water from a well. The diagram below the picture models this scenario.

- The pulley has centre T and a radius of 15 cm.
- Minor arc PQ, subtended by a central angle of 135°, is in contact with the rope.
- The shaded sector QTR has a central angle of θ .
- PTR is a diameter of the circle.



10.2.1 Convert 135° to radians. (1)

10.2.2 Hence, calculate the length of minor arc PQ. (3)

10.2.3 Calculate the value of θ . (1)

10.2.4 Hence, calculate the area of the shaded sector QTR. (3)

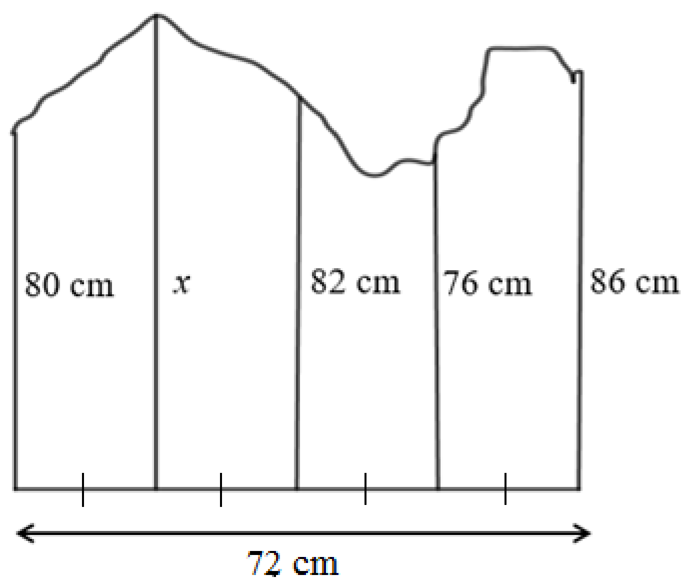
10.2.5 The pulley makes 24 revolutions in order for the bucket to reach the water below. The length of the rope must be 3 m longer to draw water from the well.

Determine the length of the rope. (6)

[25]

QUESTION 11

11.1 The diagram below shows an irregular shape with one straight side of 72 cm, that is divided into 4 equal parts. The ordinates dividing these parts are 80 cm, x cm, 82 cm, 76 cm and 86 cm respectively.

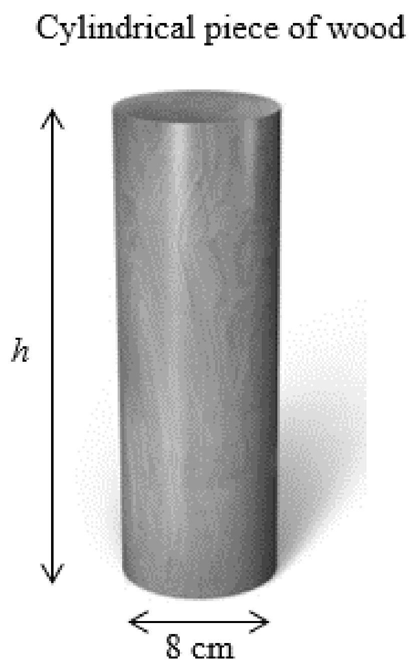


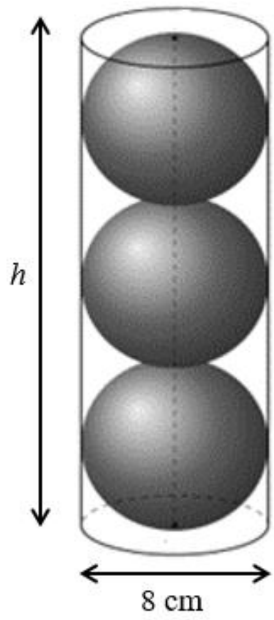
11.1.1 Calculate the value of the width of each equal part. (1)

11.1.2 Hence, determine the value of x, using the mid-ordinate rule, if the area of the irregular shape is 5 940 cm^2 . (4)

11.2 The picture below shows a cylindrical piece of wood, carved to form 3 identical spheres, as shown in the diagram alongside.

- The diameter of each sphere is 8 cm and is equal to the diameter of the cylinder.
- The 3 spheres, stacked one above each other, is equal to the height of the cylinder, *h*.





Formulae:

Surface area of cylinder $= 2\pi r^2 + 2\pi r h$

Volume of cylinder $= \pi r^2 h$

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

11.2.1 Calculate the value of h, the vertical height of the cylinder. (1)

11.2.2 If the mass of the cylinder is 1,5 kg, determine the mass of the wood that is carved off (not used) in order to form the 3 spheres. (7)
[13]

TOTAL: 150

INFORMATION SHEET: TECHNICAL MATHEMATICS

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

$a^x = b \Leftrightarrow x = \log_a b$, $a > 0$, $a \neq 1$ and $b > 0$

$A = P(1 + ni)$ $A = P(1 - ni)$ $A = P(1 + i)^n$ $A = P(1 - i)^n$

$i_{eff} = \left(1 + \frac{i}{m}\right)^m - 1$

$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$

$\int k x^n dx = \frac{k x^{n+1}}{n+1} + C$, $n, k \in \mathbb{R}$ with $n \neq -1$ and $k \neq 0$

$\int \frac{k}{x} dx = k \ln x + C$, $x > 0$ and $k \in \mathbb{R}$; $k \neq 0$

$\int k a^{nx} dx = \frac{k a^{nx}}{n \ln a} + C$, $a > 0$; $a \neq 1$ and $k, a \in \mathbb{R}$; $k \neq 0$

$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ $M\left(\frac{x_2 + x_1}{2} ; \frac{y_2 + y_1}{2}\right)$

$y = mx + c$ $y - y_1 = m(x - x_1)$ $m = \frac{y_2 - y_1}{x_2 - x_1}$ $\tan\theta = m$

$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

In ΔABC: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$ $a^2 = b^2 + c^2 - 2bc \cdot \cos A$

Area of Δ ABC $= \frac{1}{2} ab \cdot \sin C$

$\sin^2\theta + \cos^2\theta = 1$ $1 + \tan^2\theta = \sec^2\theta$ $1 + \cot^2\theta = \operatorname{cosec}^2\theta$

$\pi \, rad = 180°$

Angular velocity $= \omega = 2\pi n$ where n = rotation frequency

Circumferential velocity $= v = \pi D n$ where D = diameter and n = rotation frequency

Circumferential velocity $= v = \omega r$ where ω = angular velocity and r = radius

Arc length $= s = r\theta$ where r = radius and θ = central angle in radians

Area of a sector $= \dfrac{r s}{2}$ where r = radius, s = arc length

Area of a sector $= \dfrac{r^2 \theta}{2}$ where r = radius and θ = central angle in radians

$4h^2 - 4dh + x^2 = 0$ where h = height of segment, d = diameter of circle and x = length of chord

$A_T = a\left(m_1 + m_2 + m_3 + ... + m_n\right)$ where $a =$ length of the equal parts, $m_1 = \dfrac{o_1 + o_2}{2}$

$o_n = n^{th}$ ordinate and n = number of ordinates

OR

$A_T = a\left(\dfrac{o_1 + o_n}{2} + o_2 + o_3 + ... + o_{n-1}\right)$ where $a =$ length of the equal parts, $o_n = n^{th}$ ordinate and $n =$ number of ordinates