education

Department:
Education
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

PROVINCIAL ASSESSMENT

GRADE 12

TECHNICAL MATHEMATICS P2

JUNE 2024

MARKS: 150

TIME: 3 hours

This question paper consists of 14 pages and a 2-page information sheet.

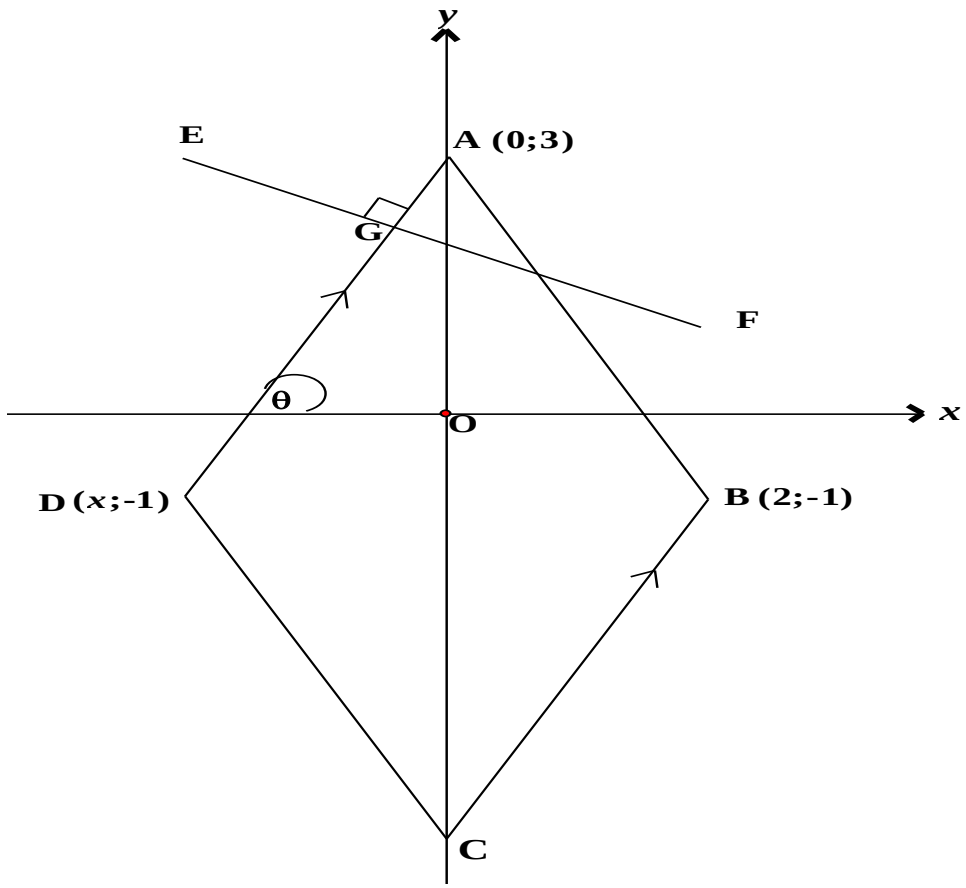
INSTRUCTIONS AND INFORMATION

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 have 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

1.1 In the diagram below, quadrilateral ABCD is given.
The vertices are $A(0;3)$, $B(2;-1)$ and $D(x;-1)$.
$AD \parallel BC$ and $EF \perp AD$, θ is an angle of inclination on the x-axis formed by line AD.



Calculate:

1.1.1 The gradient of AB (2)

1.1.2 The equation of AB (2)

1.1.3 The coordinates of the midpoint of AB (2)

1.1.4 The *x*-coordinate of D if line BD is parallel to the *x*-axis and BD is equal to 4 units (1)

1.1.5 The coordinates of C if the equation of BC is presented as:
$y = 2x - 5$ (1)

1.1.6 The length of AC (1)

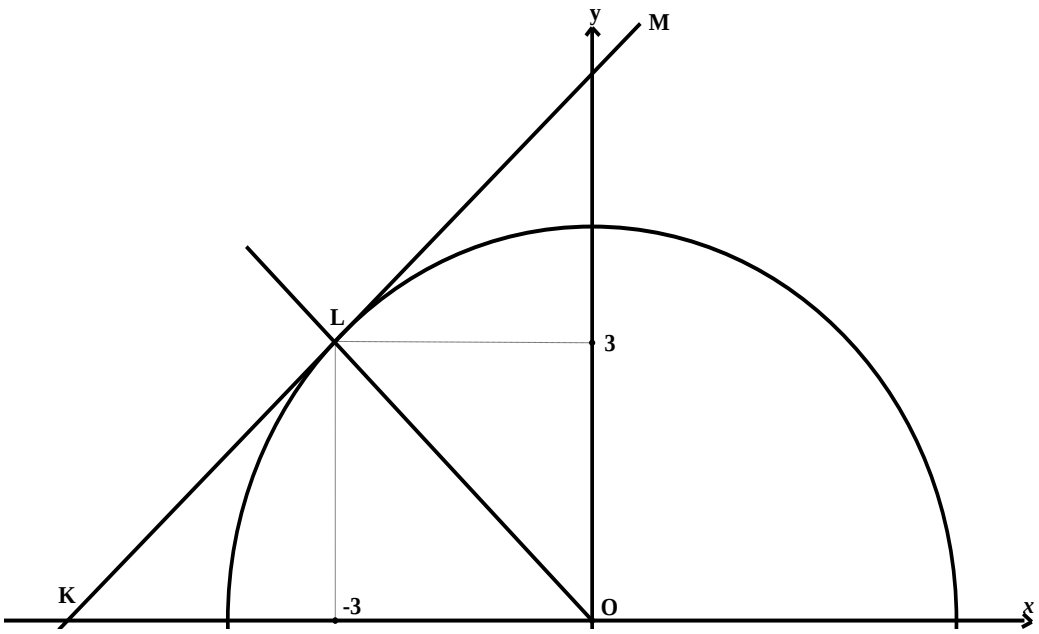
1.2 Determine, with reason the equation of AD. (2)

1.3 Determine, with reason the equation of line EF if $E(-1;3)$. (4)

1.4 Calculate the value of θ. (2)
[17]

QUESTION 2

2.1 In the diagram below, O is the centre of the half circle. OL is the radius and KM is the tangent to the half circle at L.
K is the *x*-intercept of the tangent.



Determine:

2.1.1 The equation of the half circle in the form of $y = \sqrt{r^2 - x^2}$ (3)

2.1.2 The gradient of OL and hence the equation of OL (2)

2.1.3 The equation of KM (3)

2.1.4 The coordinates of K (2)

2.2 Given:

$$\frac{x^2}{36} + \frac{y^2}{64} = 1$$

Draw a sketch graph defined by the equation above. (3)
[13]

QUESTION 3

3.1 Determine the following if $\beta = 63°$ and $\alpha = \frac{\pi}{3}$.
Round off answer to TWO decimal places.

$\sin(2\beta + \alpha)$

(3)

3.2 Given: $\sin\theta + \frac{5}{23} = \frac{-8}{23}$ and $\theta \in [0°; 270°]$

3.2.1 Draw a diagram to illustrate the above ratio. Use the diagram to determine the following, **without the use of a calculator**. (2)

3.2.2 $\tan\theta$ (3)

3.2.3 $23\sin\theta + 23\cos\theta$ (Round off answer to the nearest integer) (3)

3.3 Solve for x in the equation if $x \in [0°; 360°]$
$2tan\,x = -3$ (4)
[15]

QUESTION 4

4.1 Simplify the following:

$$\frac{-\sin(360° - \theta).\cos(180° + \theta).\tan(180° - \theta)}{-\cos(180° - \theta).\tan(\theta).\sin(\pi + \theta)}$$

(6)

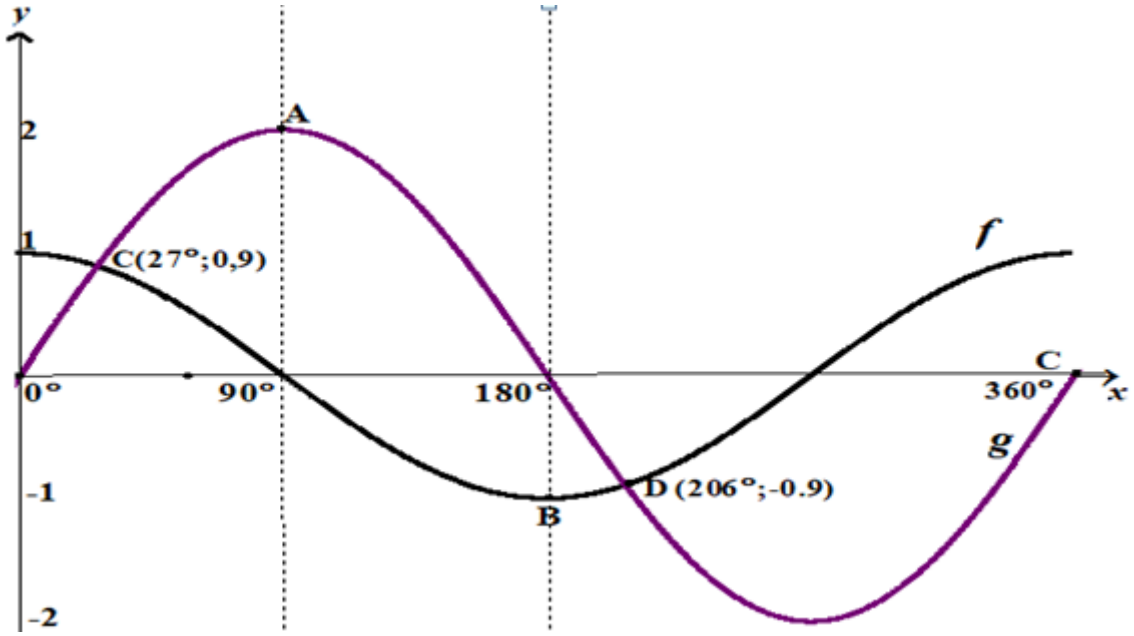
4.2 Show that:

$$\frac{(1 - cos^2\theta).cot^2\theta}{(1 - sin^2\theta)} = 1$$

(4)
[10]

QUESTION 5

In the diagram below are the graphs of: $g(x) = 2\sin x$ and $f(x) = \cos x$ for the domain of $0° \leq x \leq 360°$.



5.1 What is the amplitude of:

5.1.1 *f(x)* (1)

5.1.2 *g(x)* (1)

5.2 Determine the coordinates of the turning points at A and B. (2)

5.3 What is the period of f ? (1)

5.4 Determine by reading from the graph:

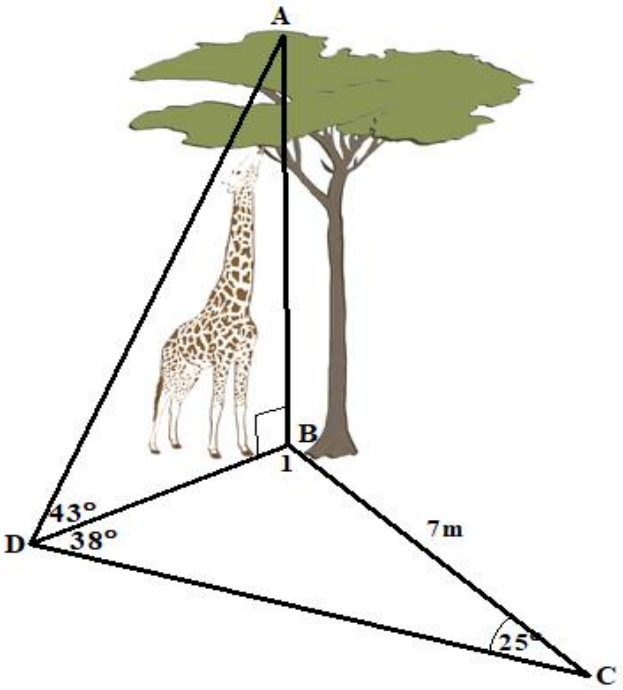
5.4.1 the coordinates where $f(x) = g(x)$ (2)

5.4.2 The *x*-values at which $g(x) \geq f(x)$ (2)

5.5 Write down the range of g. (2)
[11]

QUESTION 6

In the sketch below is a giraffe eating a tree.
AB presents the tree and is perpendicular to the horizontal level BCD that is on ground level.
$BC = 7$ meter, $\hat{C} = 25°$, $C\hat{D}B = 38°$ and the angle of elevation from D to A is 43°.



6.1 Determine the length of BD. (3)

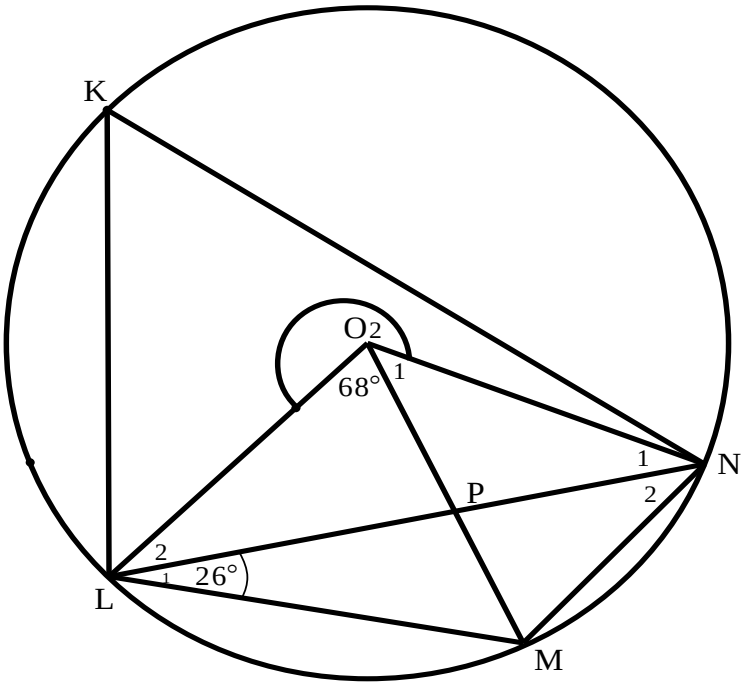
6.2 Determine AB, the estimated height of the tree correct to ONE decimal place. (2)

6.3 If the height of the giraffe in the sketch above is presented by 4/5 of the tree, determine the height of the giraffe. (2)

6.4 Determine the area of ΔBCD. (3)
[10]

QUESTION 7

7.1 In the diagram below is a circle with centre O.
$L\hat{O}M = 68°$ and $\hat{L}_1 = 26°$.
K, L, M and N are on the circumference of the circle and form cyclic quadrilateral KLMN.



Determine, stating a reason, the size of:

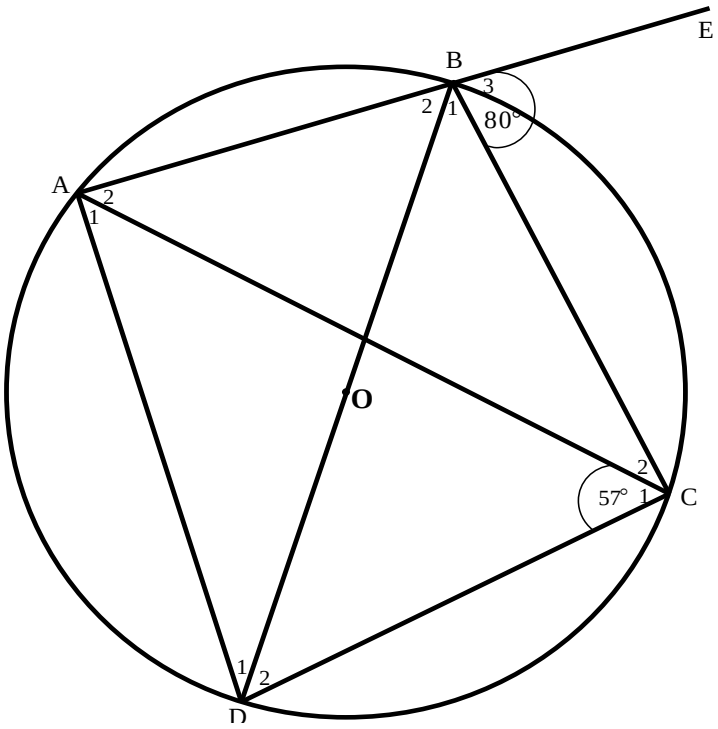
7.1.1 $\hat{O}_1$ (2)

7.1.2 $L\hat{K}N$ (2)

7.1.3 $L\hat{M}N$ (2)

7.1.4 $\hat{N}_1$ (2)

7.2 In the diagram below, is the circle with centre O.
ABCD is cyclic quadrilateral.
$\hat{C}_1 = 57°$ and $\hat{B}_1 = 80°$
AB is extended and forms a straight line to E.



Determine, stating a reason, the following:

7.2.1 Another angle that is also equal to 57°. (2)

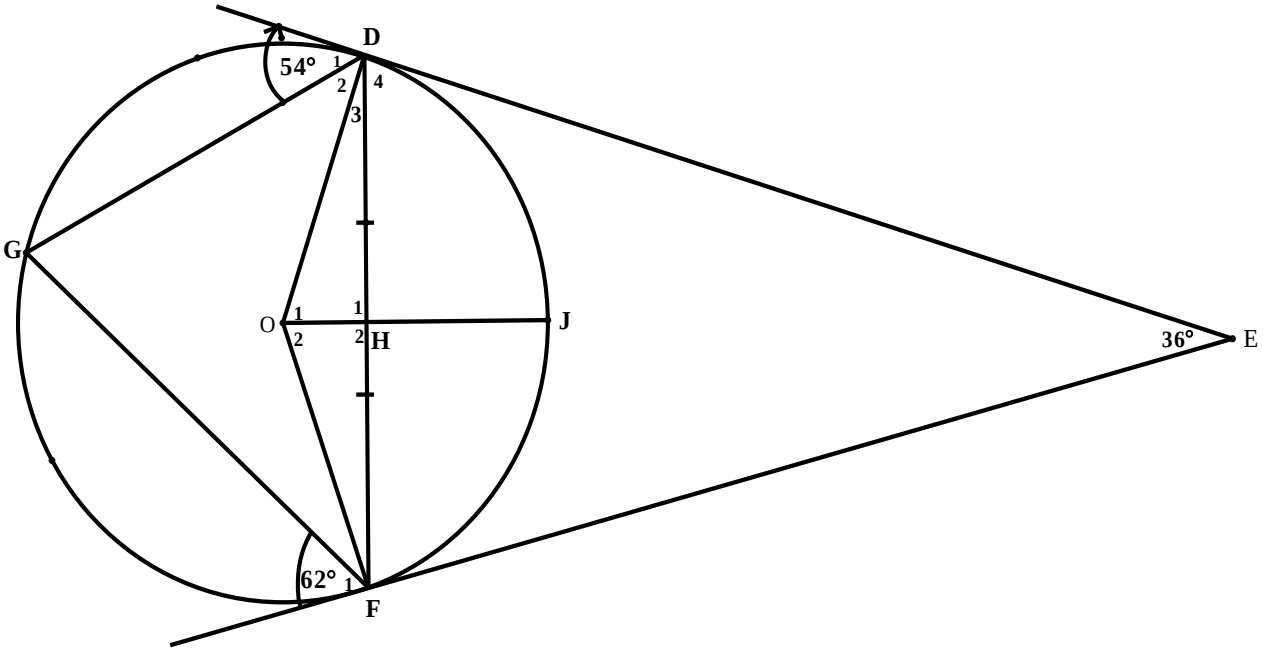
7.2.2 $A\widehat{D}C$ (2)

7.2.3 $\hat{C}_2$ (2)
[14]

QUESTION 8

8.1 Complete the following theorem statement:
Two tangents from the same point outside the circle are … (1)

8.2 In the diagram below, O is the centre of the circle. ED and EF are tangents to the circle.
G is a point on the circumference of the circle and forms chords GD and GF.
$\hat{D}_1 = 54°,\ \hat{F}_1 = 62°$ and $\hat{E} = 36°$
DH = HF



Determine, stating reasons, the size of the following angles:

8.2.1 $E\hat{F}O$ (2)

8.2.2 $D\hat{F}G$ (2)

8.2.3 $\hat{D}_2$ (2)

8.2.4 $\hat{H}_1$ (2)

8.2.5 $\hat{D}_3$ (3)

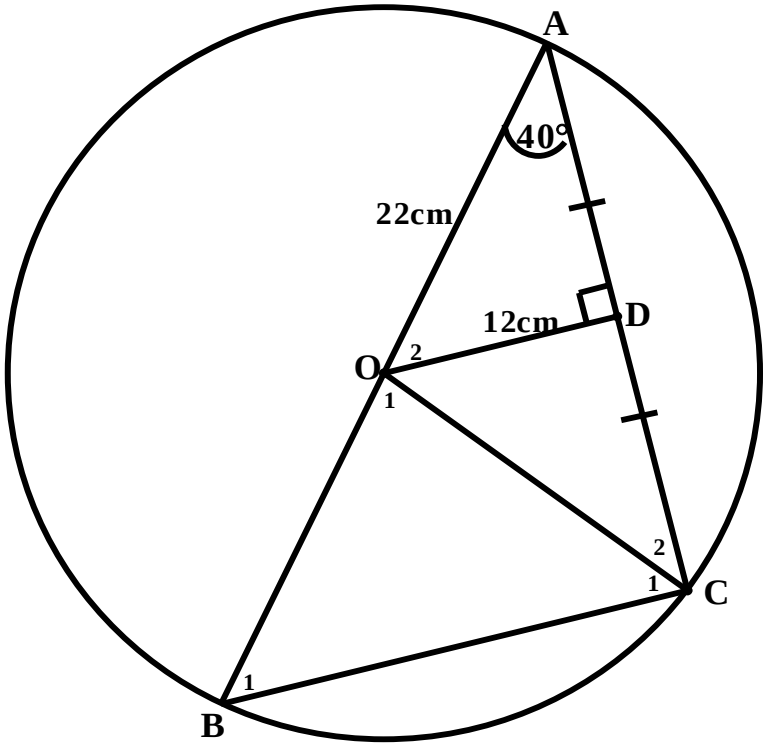
8.2.6 $\hat{O}_1$ (2)

8.2.7 $\hat{G}$ (2)
[16]

QUESTION 9

9.1 Complete the following theorem statement:
The line drawn from the midpoints of two sides of a triangle is equal to … of the third side. (1)

9.2 In the diagram below, O is the centre of the circle with A, B, and C on the circumference of the circle.
$A\hat{D}O = 90°$ and $\hat{A} = 40°$, the radius is 22 cm and OD $= 12$ cm.



Determine the following:

9.2.1 Whether $OD \parallel BC$, give a reason for your answer (2)

9.2.2 The length of BC (1)

9.2.3 The length of AD (2)

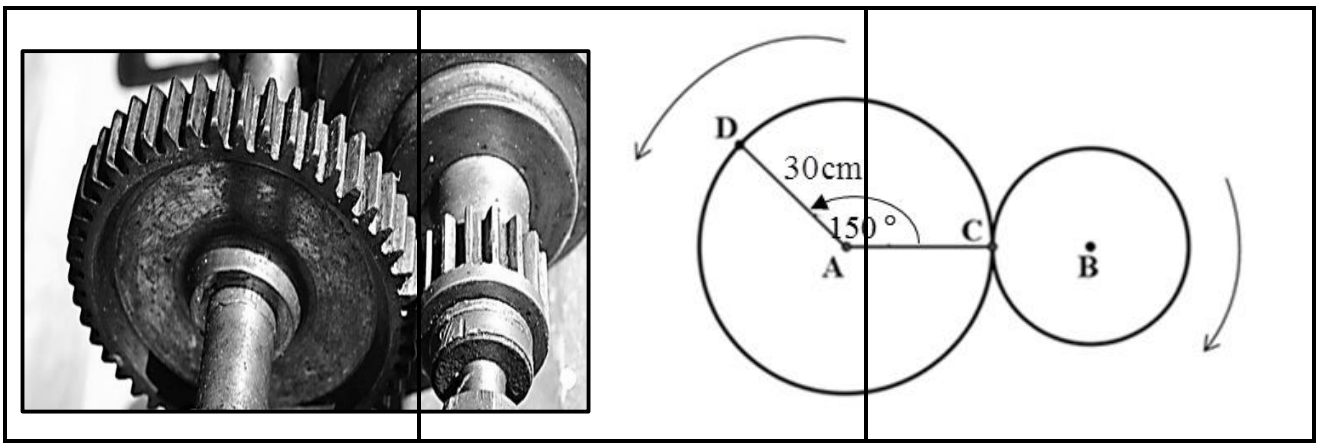
9.3 Determine, stating reasons, the size of $\hat{O}_1$. (2)

9.4 Is $\Delta ADO \equiv \Delta CDO$? Give a reason for your answer. (2)

9.5 Is $\Delta AOD \;|||\; \Delta ABC$? Give a reason for your answer. (2)
[12]

QUESTION 10

10.1 The picture below shows two gears meshed together. The diagram alongside the picture, models the two meshed gears. As the larger gear (center A), with a radius of 30 cm rotates, it causes the smaller gear (center B) to rotate in the opposite direction. The two gears are in contact at point C after a 150° rotation of the larger gear.



10.1.1 Convert 150° to radians. (2)

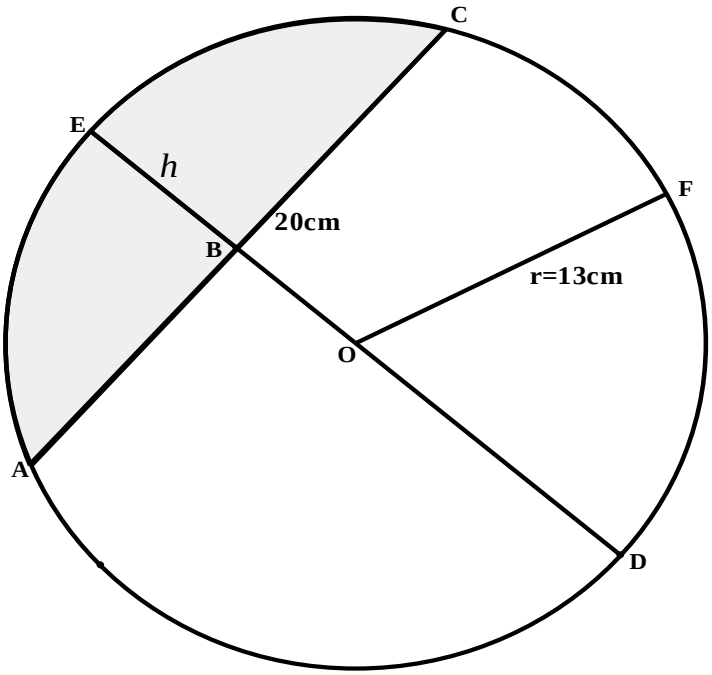
10.1.2 Calculate the area of the minor sector, DAC. (3)

10.1.3 Detemine the length of the minor arc, DC. (3)

10.1.4 Determine the circumferential velocity in meter per second of the larger gear if it rotates at 90 rotations per minute. (4)

10.2 In the diagram below, the height of the shaded segment is h.
The length of chord $AC = 20\ cm$ and $r = 13\ cm$.

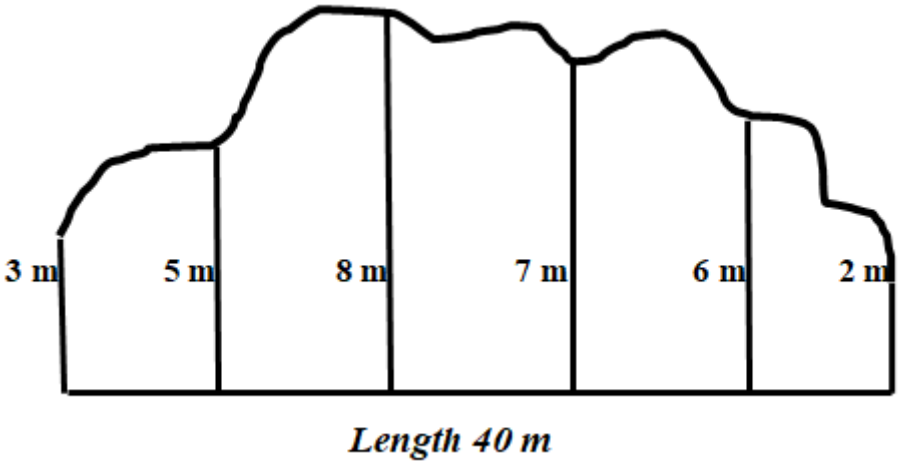
Determine the height *(h)* of the shaded segment. (4)



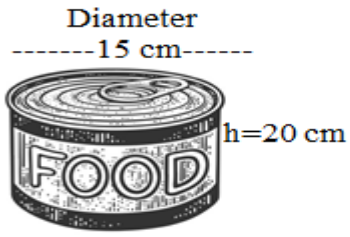
[16]

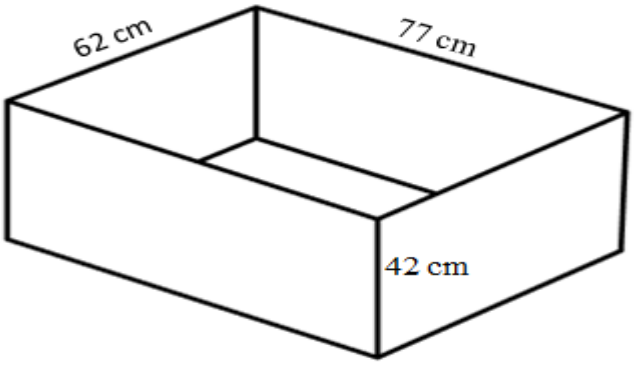
QUESTION 11

11.1 Determine the area of the irregular shape by using the mid-ordinate rule.
The length of 40 m is divided into 5 equal parts. (4)



11.2 Study the two objects below and answer the questions that follow.
The measurements of the tin: diameter $= 15$ cm and height $= 20$ cm
The rectangular open wooden box: $l = 77$ cm , $b = 62$ cm and $h = 42$ cm





Formula:

Cylinder

$\boldsymbol{Area = 2\pi r^2 + 2\pi rh}$

$\boldsymbol{volume = \pi r^2 h}$

Rectangular prism:

$\boldsymbol{Area = 2(l\,b + lh + bh)}$

$\boldsymbol{Volume = l \times b \times h}$

11.2.1 Convert the measurements of the wooden box to meters. (1)

11.2.2 Calculate the total surface area of the wooden box. Answer in m^2. (3)

11.2.3 If: $1\ liter = 1\,000\ cm^3$
Prove that the volume of the tin can be rounded of to 3,5 liter. (3)

11.2.4 Calculate how many tins can be filled with 55 liters of soup. (1)

11.2.5 Calculate the maximum number of tins that will fit into the wooden box. (4)
[16]

INFORMATION SHEET: TECHNICAL MATHEMATICS

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

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

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

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

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

$$\int x^n dx = \frac{x^{n+1}}{n+1} + C \quad , \quad n \neq -1$$

$$\int \frac{1}{x} dx = \ln x + C, \qquad x > 0 \qquad\qquad \int a^x dx = \frac{a^x}{\ln a} + C \quad , \quad a > 0$$

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

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

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

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

$$area\ of\ \Delta ABC = \frac{1}{2} ab \cdot \sin C$$

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

$\pi rad = 180°$

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

Angular velocity $= 360°n$ where n = rotation frequency

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

Cirfumferential 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 sector = $\frac{rs}{2}$ where r = radius, s = arc length

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

$A_T = a(m_1 + m_2 + m_3 + \ldots + m_n)$ where a = width of equal parts, $m_1 = \frac{o_1 + o_2}{2}$ and
n = number of ordinates

OR

$A_T = a\left(\frac{o_1 + o_n}{2} + o_2 + o_3 + o_4 + \ldots + o_{n-1}\right)$ where a = width of equal parts, $o_n = n^{th}$ ordinate and n = number of ordinate