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EDUCATION

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# NATIONAL SENIOR CERTIFICATE

## GRADE 12

## SEPTEMBER 2026

# TECHNICAL MATHEMATICS P2

**MARKS:** **150**

**TIME:** **3 hours**

This question paper consists of 16 pages, including a 2-page information sheet and a 27-page SPECIAL ANSWER BOOK.

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## INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

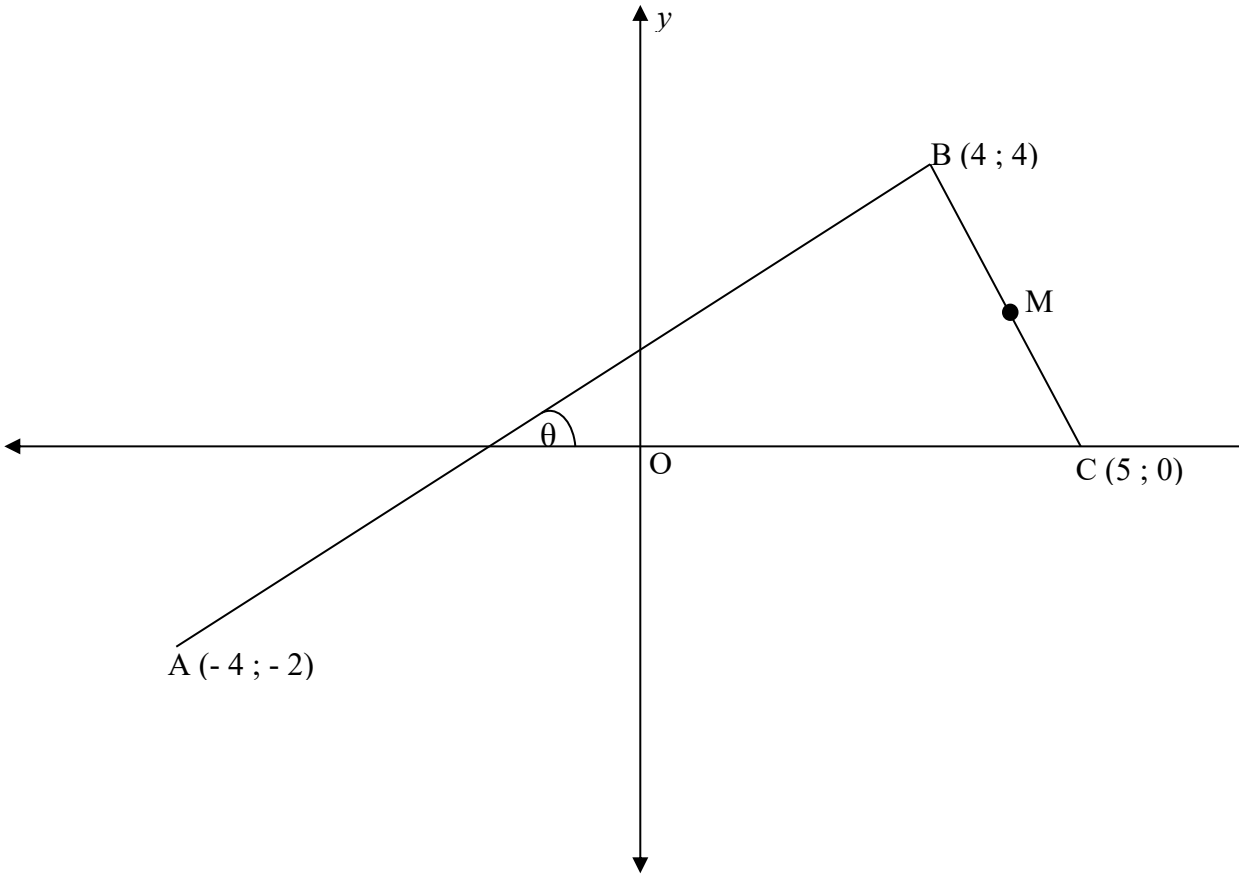
1. This question paper consists of ELEVEN questions.
2. Answer ALL the questions in the SPECIAL ANSWER BOOK provided.
3. Clearly show ALL calculations, diagrams, graphs, et cetera which you have used in determining the answers.
4. Answers only will NOT necessarily be awarded full marks.
5. You may use an approved scientific calculator (non-programmable and non-graphical) unless stated otherwise.
6. If necessary, round off your answers to TWO decimal places, unless stated otherwise.
7. Diagrams are NOT necessarily drawn to scale.
8. An information sheet with formulae is included at the end of the question paper.
9. Write neatly and legibly.

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## QUESTION 1

In the diagram below line AB is inclined at an angle θ to the *x*-axis. A(- 4 ; - 2) and B(4 ; 4). M is a midpoint of BC and point C(5 ; 0) lies on the *x*-axis.




1.1 Determine the gradient of AB. (2)

1.2 Calculate the midpoint M of BC. (2)

1.3 Calculate the length of AM. (3)

1.4 Calculate θ the angle of inclination of AB. (3)

1.5 Determine the equation of the line passing through D, and parallel to AB. The point D is in the second quadrant and has the same *x*-coordinate as A and same *y*-coordinate as the midpoint of BC. (5)

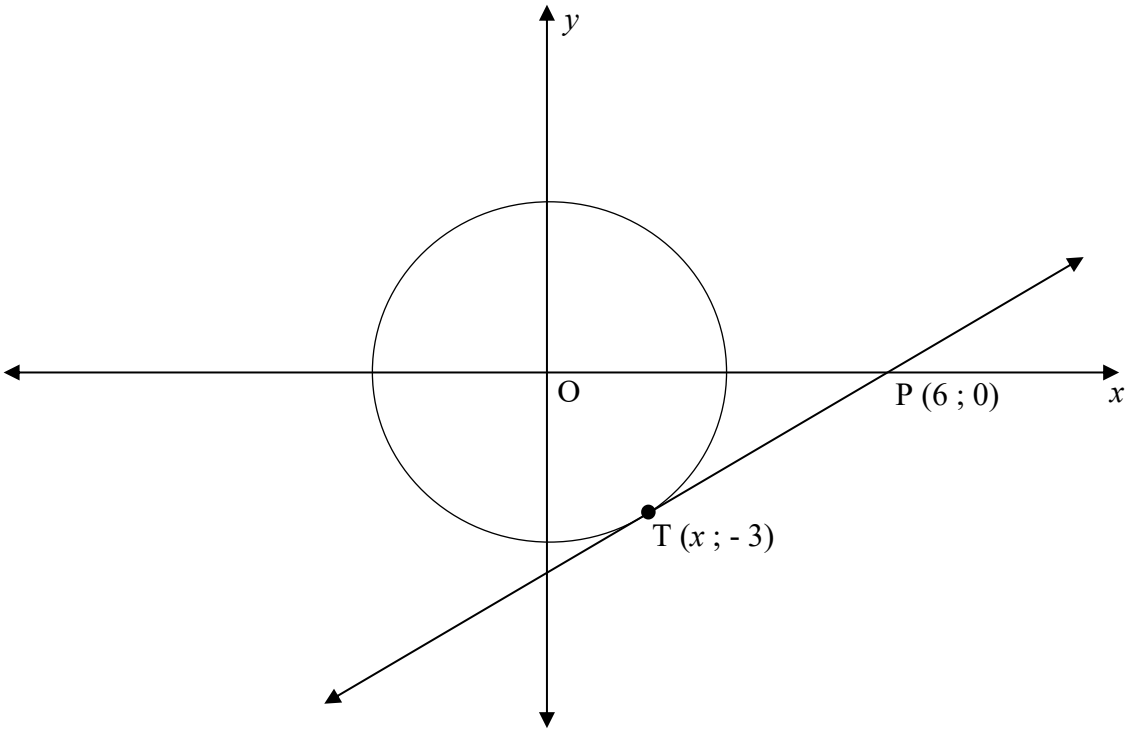
**[15]**



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## QUESTION 2

2.1 In the diagram below, O(0 ; 0) is the centre of the circle defined by $x^2 + y^2 = r^2$.
PT is a straight line with equation $4y - 3x + 18 = 0$, it touches the circle at point T($x$ ; - 3).
P is the $x$-intercept of PT.




2.1.1 What is the name of line PT? (1)

2.1.2 Write equation $4y - 3x + 18 = 0$ in the form y = … (2)

2.1.3 Determine the $x$-coordinate of T. (3)

2.1.4 Write the equation the circle. (3)

2.2 Sketch the graph defined by equation: $\frac{x^2}{25} + \frac{y^2}{9} = 1$. (3)
**[12]**

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## QUESTION 3

3.1 Given that: X = 27° and Y = 123,57°

Determine the numerical value of: $\frac{cosec\ X}{\tan Y}$ (3)

3.2 Given that $2 + 3\cos\theta = 0$ and $\sin\theta > 0$. Determine without the use of a calculator, the numerical value of the following:

3.2.1 $\sin\theta$ (4)

3.2.2 $\sec\theta + \tan^2\theta$ (3)

3.3 Solve for $x$ if $3\sin x = -2$ and $x \in [0° ; 270°]$. (3)
**[13]**

## QUESTION 4

4.1 Simplify the following:

$$\frac{\cos^2(\pi - \theta)\cdot\cos 180°}{\sin(180° + \theta)\cdot\cos(-\theta)\cdot\tan(360° + \theta)}$$ (7)

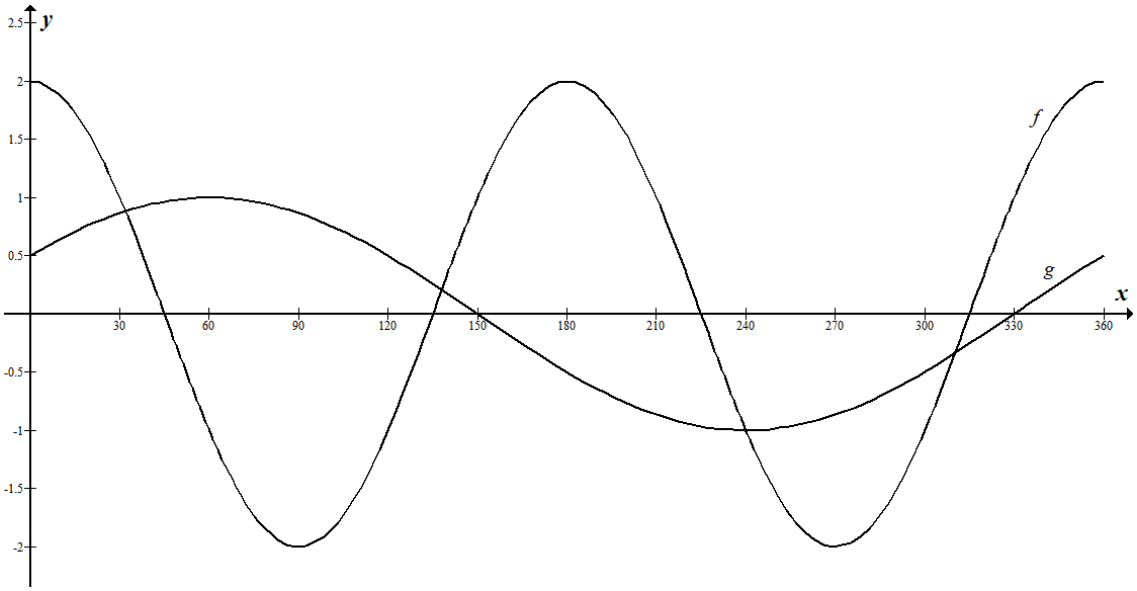
4.2 Prove that: $\sin^2 x\left(\frac{1}{1+\cos x} + \frac{1}{1-\cos x}\right) = 2\left(\cos^2 x + \sin^2 x\right)$ (5)
**[12]**

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## QUESTION 5

The following functions are defined by $f(x) = a\cos 2x$ and $g(x) = b\sin(x + p)$ for $x \in [0° ; 360°]$.




5.1 Use the graph to determine the numerical values of a, b and p. (3)

5.2 Write down the period of *f*. (2)

5.3 Determine the values of $x$ for which $f(x) - g(x) = 1,5$. (2)
**[7]**

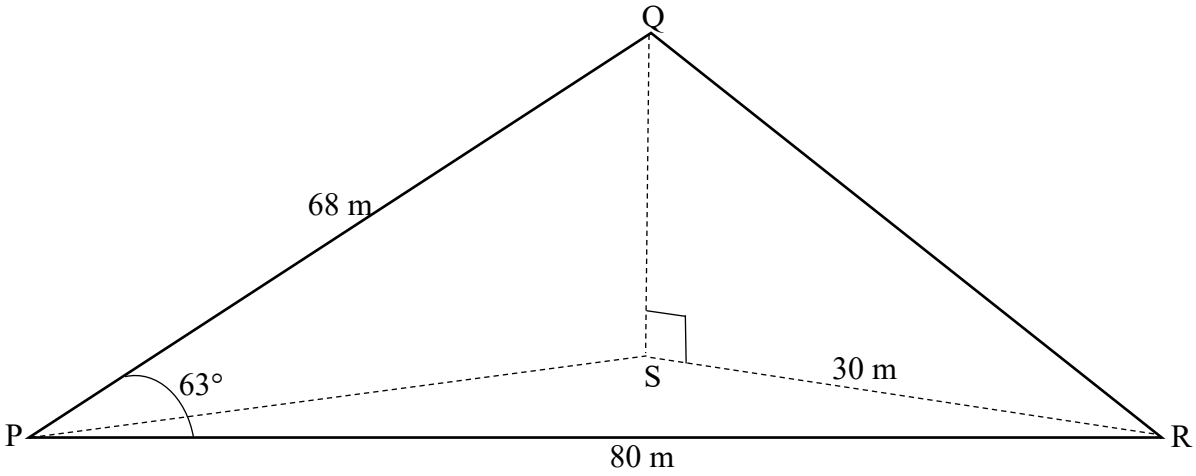


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## QUESTION 6

The picture below shows a triangular roof top for a dog house. Below it is a diagram giving the cross-sectional drawing detailing the dimensions. PR = 80 m, PQ = 68 m and SR = 30 m. It is also given that $Q\hat{P}R = 63°$ and $R\hat{S}Q = 90°$.




6.1 Calculate the length of QR. (4)

6.2 Calculate SQ. (2)

6.3 Determine the area of ΔPQR. (3)
**[9]**

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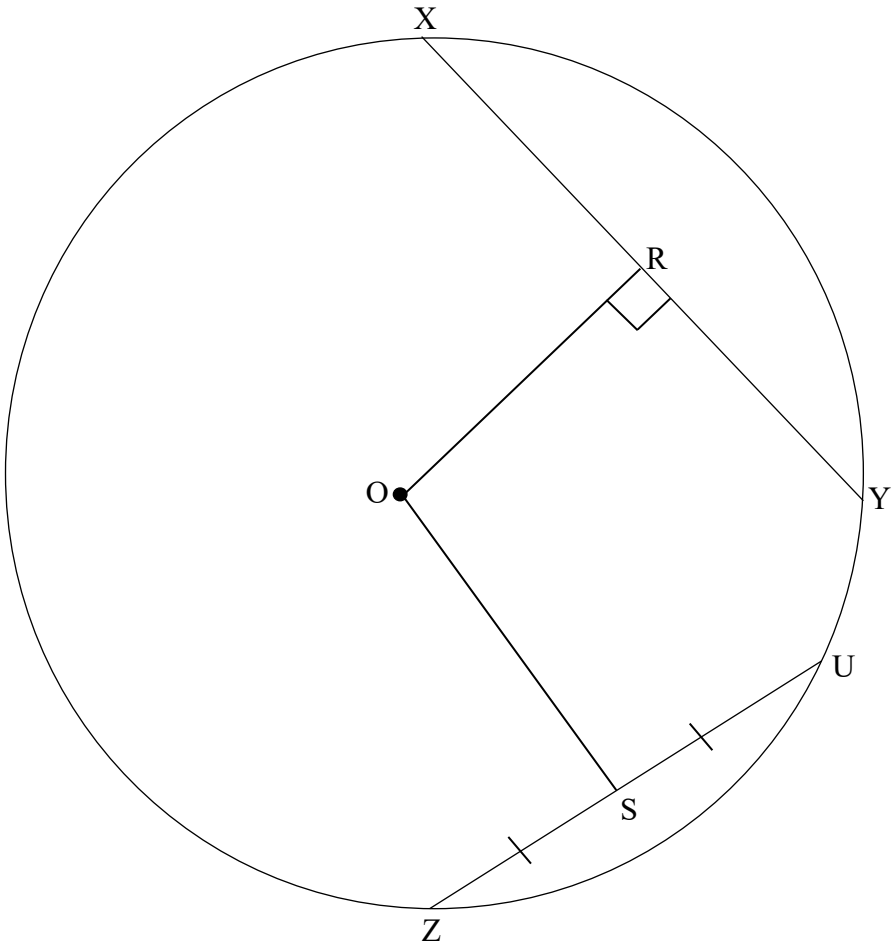
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## QUESTION 7

7.1 Complete the following theorem:

The line drawn from the centre of a circle … (i) … to the chord … (ii) … the chord. (2)

7.2 In the diagram below O is the centre with points X, Y, U and Z are on the circumference. ZS = SU
OR = 4 cm
OS = 5 cm
ZU = 14 cm
OR ⊥ XY




7.2.1 Calculate, stating reasons, the length OZ. (3)

7.2.2 Determine, with reasons, the length of XY. (4)

7.2.3 Determine the length of the diameter of the circle. (1)

7.2.4 OY > OU true or false, justify your answer. (2)
**[12]**



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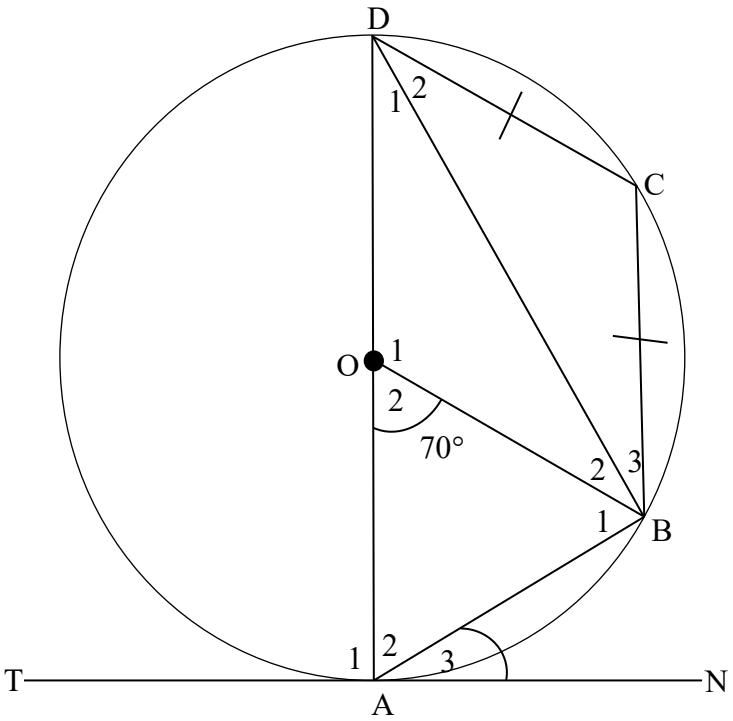
## QUESTION 8

8.1 Complete the following theorem:

The tangent to a circle is … to the radius / diameter of the circle at the point of contact. (1)

8.2 In the diagram below O is a centre of the circle with points A, B, C and D on the circumference of the circle. It is given that:

- $\hat{O}_2 = 70°$
- TAN is a tangent to the circle at A.
- CD = CB




8.2.1 Give the reason why $T\hat{A}D = 90°$ (1)

8.2.2 Write down, stating reasons, TWO more angles with the same size as $T\hat{A}D$. (3)

8.2.3 Determine the sizes of the following angles and give reasons:

(a) $\hat{D}_1$ (3)

(b) $\hat{A}_3$ (2)

(c) $\hat{B}_2$ (2)

(d) $\hat{B}_1$ (2)

(e) $\hat{C}$ (3)

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

8.3 Is OBCD a cyclic quad? Justify your answer. (4)

**[23]**

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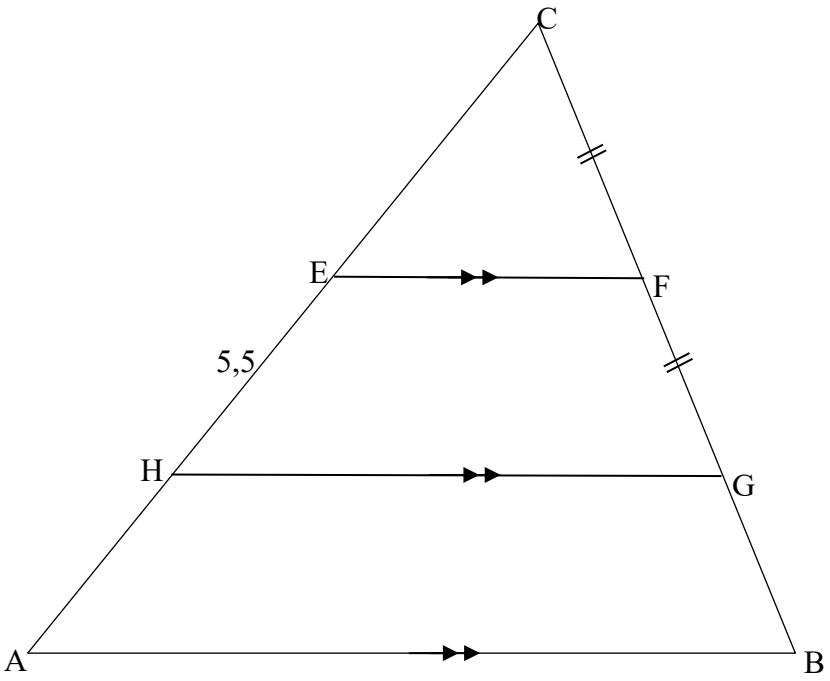
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## QUESTION 9

9.1 Complete the following statement:

A line drawn … (i) ... to one side of a triangle divides the other two sides in … (ii) … (2)

9.2 In the diagram AB ∥ HG ∥ EF, F is the midpoint of CG and AH = $\frac{2}{5}$AC.




Determine the numerical value of the following, stating reasons.

9.2.1 EC (3)

9.2.2 AH (3)

9.2.3 GB if FG = 4 units (4)

**[12]**

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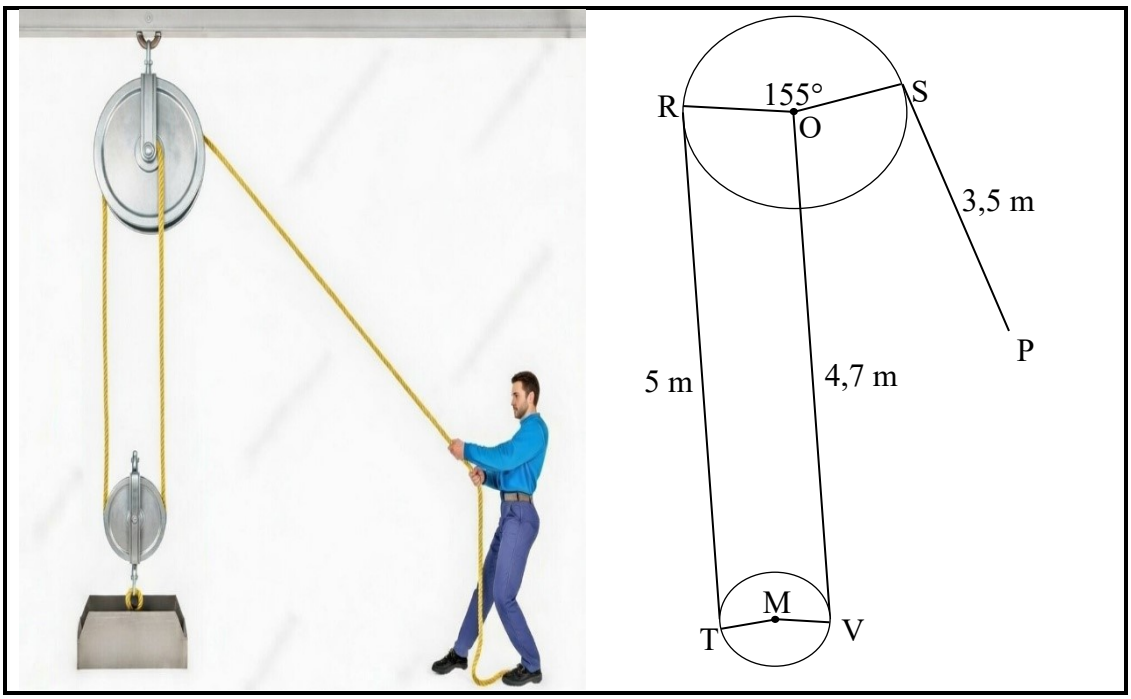
## QUESTION 10

10.1 A wheel of a motor bike rotates at 320 rev / min.

10.1.1 Calculate its angular velocity of the wheel in radians per second. (4)

10.1.2 Calculate the peripheral velocity of the wheel in meters per second if the radius of the wheel is 34 cm. (5)

10.2 A system of pulleys is used to carry weight and heavy objects and shown on the picture to the left. The diagram on the right depicts the scenario. It is given that RS = 5 m; OV = 4,7 m and SP = 3,5 m. A rope moves around the two pulleys as shown on the diagram. The pulley with centre O has a radius of 1,12 m and the pulley with centre M has a radius of 0,92 m.




10.2.1 Write 155° in radians. (1)

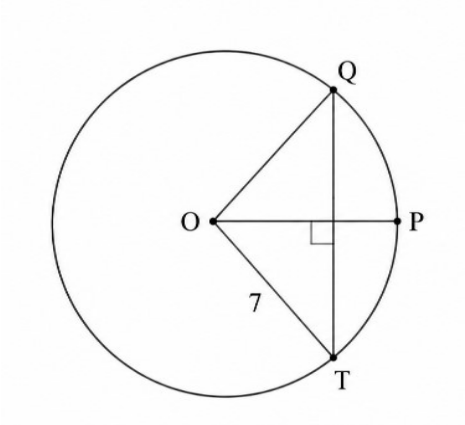
10.2.2 Determine the length of the major arc RS. (3)

10.2.3 Determine the total length of the rope if arc TV is 2,1 m. (2)



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10.3 The diagram below is a circle with centre O, points T; P and Q are on the circle. It is given OP ⊥ TQ; OT = 7 cm and TQ = 12 cm.




Calculate the height of the major segment. (6)

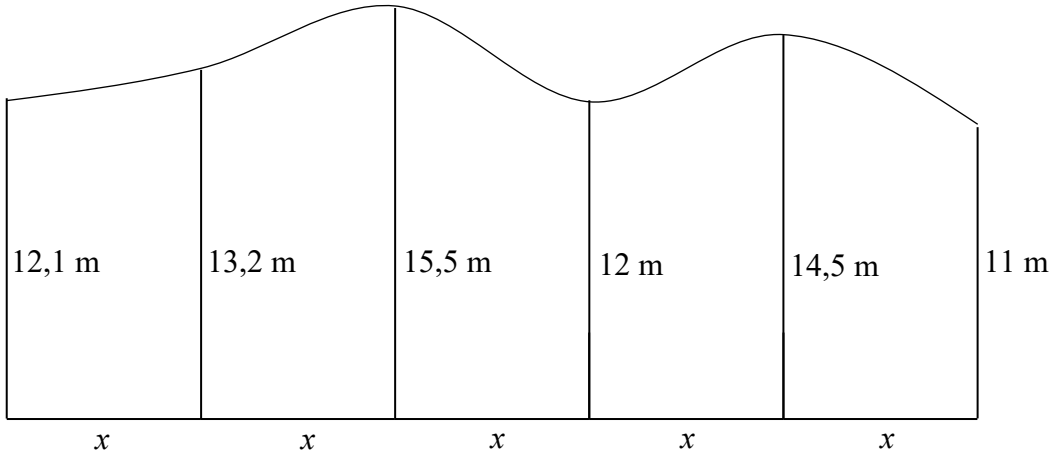
**[21]**



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## QUESTION 11

11.1 The diagram below shows an irregular figure with one straight side divided into five equal parts each of length $x$ m. The lengths of the ordinates resulting from dividing the straight side are: 12,1 m; 13,2 m; 15,5 m 12 m 14,5 m; 11 m.




11.1.1 Calculate the numerical value of $x$ if the area of the irregular shape is 234,75 $m^2$. (4)

11.1.2 Hence, determine the length on the straight side. (1)



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11.2 As part of a school project, as Technical Mathematics Grade 12 learners, with your team you decide to make juice, and call it TMATH Juice. The picture below shows a sample of a 400 m$\ell$ can of juice. The can has a height of 12 cm.




**The following formulae may be used if necessary:**

**Surface area of a cylinder = $2\pi r^2 + 2\pi rh$**

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

11.2.1 Convert 400 m$\ell$ to cm$^3$.
HINT: 1 m$\ell$ = 1 cm$^3$. (1)

11.2.2 Calculate the radius of the can in cm. (3)

11.2.3 Calculate the surface area of the can. (2)

11.2.4 Your project is supposed to last for five days. Every day you have 80 $\ell$ of juice to make and put in cans. How many cans of juice will you have after five days? (3)

**[14]**

**TOTAL: 150**



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## INFORMATION SHEET

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

$$a^x = b \Leftrightarrow x = \log_a b, \quad a > 0,\ a \neq 1 \text{ and } b > 0$$

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

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

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

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

$$\int \frac{1}{x} dx = \ln(x) + C, \quad x > 0 \qquad \int \frac{k}{x} dx = k \cdot \ln(x) + C, \quad x > 0$$

$$\int a^x dx = \frac{a^x}{\ln a} + C \quad , \quad a > 0 \qquad \int ka^{nx} dx = k \cdot \frac{a^{nx}}{n \ln a} + C \quad , \quad a > 0$$

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

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

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

In $\Delta$ABC:

$$\frac{a}{\sin \text{A}} = \frac{b}{\sin \text{B}} = \frac{c}{\sin \text{C}} \qquad a^2 = b^2 + c^2 - 2bc\cos \text{A} \qquad \text{Area} = \frac{1}{2}ab.\sin \text{C}$$

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

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$\pi rad = 180°$

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

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

Circumferential velocity = $v = \omega r$ where $\omega$ = Angular velocity and $r$ = radius

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

Area of a sector $= \frac{rs}{2}$ where $r$ = radius and $s$ = arc length

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

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

$A_T = a\left(m_1 + m_2 + m_3 + \ldots + m_{n-1}\right)$ 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, $o_i = i^{th}$ ordinate and $n$ = number of ordinates

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