LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

MATHEMATICS PAPER 2

SEPTEMBER 2026

MARKS: 150

TIME: 3 HOURS

PEMATHP2

This question paper consists of 14 pages including an information sheet.

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INSTRUCTIONS AND INFORMATION

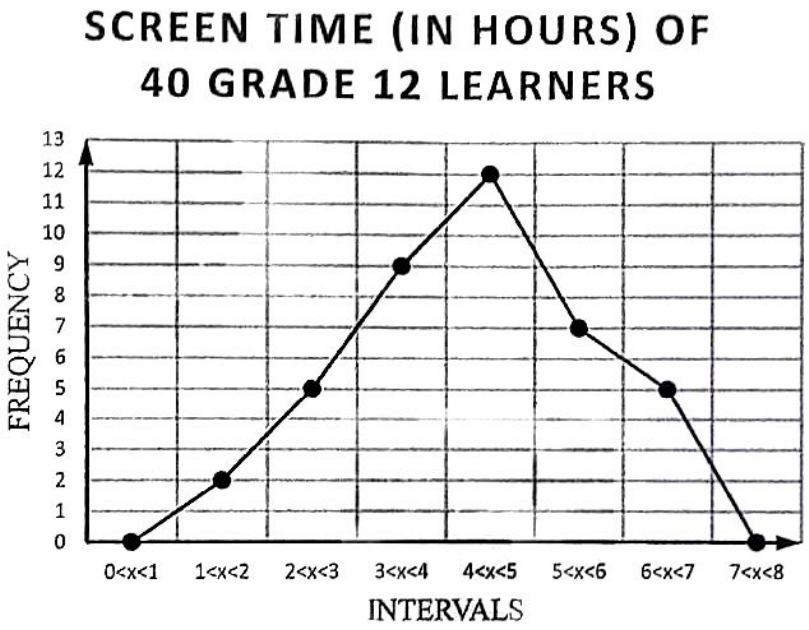
Read the following instructions carefully before answering the questions.

1. This question paper consists of 11 questions.
2. Answer ALL the questions.
3. Clearly show ALL calculations, diagrams, graphs, et cetera that you have used in determining your 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 answers off to TWO decimal places, unless stated otherwise.
7. Diagrams are NOT necessarily drawn to scale.
8. Number the answers correctly according to the numbering system used in this question paper, if necessary.
9. Write legibly and present your work neatly.

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QUESTION 1

The following diagram shows the daily screen time (in hours) of 40 Grade 12 learners during a weekday.



1.1 Complete the cumulative frequency table in the answer book. (2)

1.2 Draw the ogive in the answer book. (2)

1.3 Find the median value from the graph. (1)

1.4 If the average screen time is 4,04, comment on the skewness of the data. Motivate your answer with a reason. (2)

1.5 The parents of the community stick together and decide to reduce the screen time of the learners spending more than 4 hours to a maximum of 4 hours. What will the new average screen time be? (2)

[9]

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QUESTION 2

The following dataset was collected at the G20 summit held in South Africa during the year 2025. It represents the Gross Domestic Product (GDP) per capita versus the per capita CO_2 (carbon dioxide) emissions of 8 of the 20 countries. GDP is the total value of all final goods and services produced within a country's geographical boundaries over a period.

Country	GDP per capita (USD)	CO_2 emissions per capita (tonnes/person)
United States	66 682	13,9
Germany	44 109	6,95
Australia	61 212	14,02
India	2 397	2,05
China	13 122	9,4
South Korea	34 121	11,09
Saudi Arabia	24 917	18,48
Italy	34 398	5,18

2.1 Draw a scatterplot with GDP per capita on the $x-$axis and CO_2 emissions per capita on the $y-$axis for these 8 countries. (2)

2.2 Calculate the equation of the least-squares regression line in the form $y = a + bx$. All digits rounded to 4 decimal places. (3)

2.3 Calculate the correlation coefficient between GDP per capita and CO_2 emissions per capita for these 8 countries. (1)

2.4 Comment about the association between GDP and CO_2. (1)

2.5 Use your regression line to predict what the CO_2 emissions per capita would be for a hypothetical G20 country with a GDP per capita of 40 000 USD. (2)

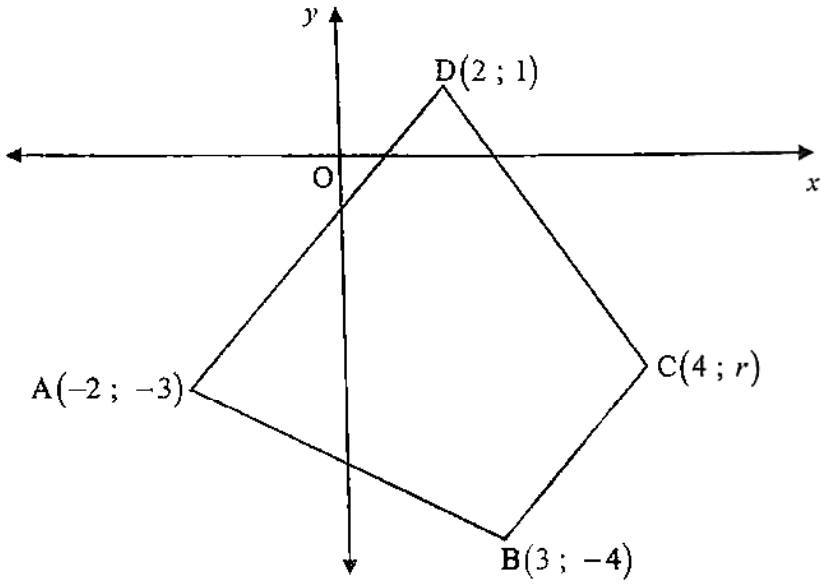
2.6 Do you think this is a good model for predicting emissions based on GDP per capita? Give a reason for your answer. (1)

[10]

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QUESTION 3

In the diagram $A(-2\ ;\ -3)$, $B(3\ ;\ -4)$, $C(4\ ;\ r)$ and $D(2\ ;\ 1)$ are the vertices of quadrilateral ABCD.



3.1 Calculate the coordinates of M, the midpoint of AD. (2)

3.2 Determine the equation of BM, the median of ΔABD. (3)

3.3 Prove that $BM \perp AD$. (2)

3.4 Determine the value of r if $AD \parallel BC$. (3)

3.5 Calculate the size of the angle that BD forms with the positive $x-$axis. (4)

3.6 Calculate the coordinates of S, the point of intersection of AC and BD. (5)

3.7 Prove that ΔABD is isosceles. (4)

3.8 State, with a reason, what type of quadrilateral is ABCD. (2)

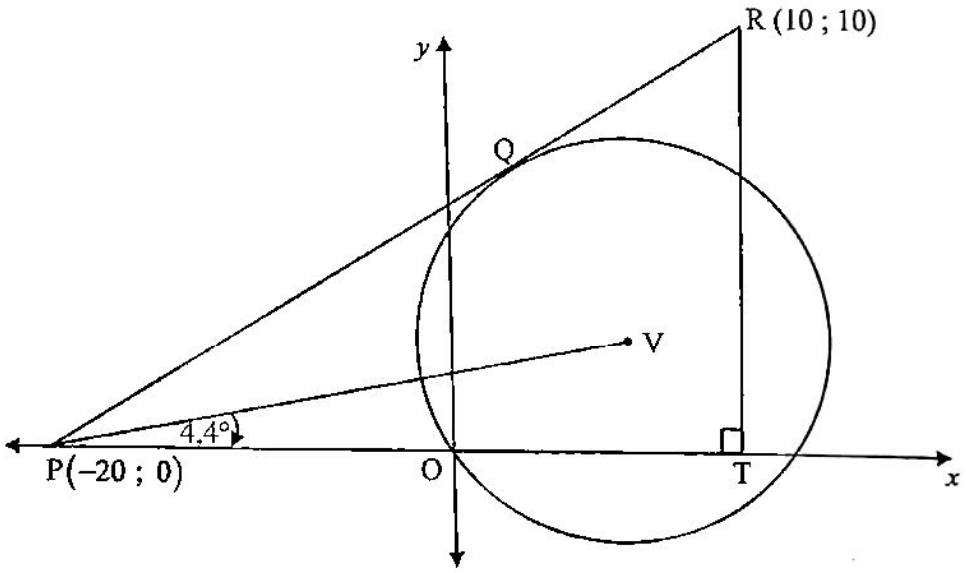
[25]

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QUESTION 4

In the diagram, PR is a tangent to circle, with centre V, at Q. The equation of PR is $y=\frac{1}{3}x+\frac{20}{3}$. RT is parallel to the $y-$axis. The circle passes through the origin.

$V\hat{P}T=4,4°$ and $PQ=8\sqrt{10}$.



4.1 Determine $Q\hat{P}V$. (4)

4.2 Hence, calculate the length of the radius of the circle. (3)

4.3 The point V is 4 units left of RT. Determine the coordinates of the centre of the circle, rounded off to the nearest whole number. (4)

4.4 Determine the coordinates of S if PVTS is a parallelogram. (2)

[13]

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QUESTION 5

5.1 Given: $\tan\theta = -\frac{5}{4}$ and $\theta \in (0° ; 180°)$. Calculate the following without using a calculator:

5.1.1 $\sin(180° + \theta)$ (3)

5.1.2 $\sqrt{41}\cos\theta - 4\sin(-150°).\cos 180°$ (4)

5.2 Complete the following: The equation $\cos\theta = a$ is soluble if a is an element of ..... (1)

5.3 If $\tan 36° = t$, express the following in terms of t:

5.3.1 $\frac{1}{\sin 306°}$ (3)

5.3.2 $\tan 81°$ (5)

[16]

QUESTION 6

6.1.1 Prove the identity: $2\cos\theta.\cos 2\theta + \frac{\sin^2 2\theta}{\cos\theta} = 2\cos\theta$ (6)

6.1.2 For which value(s) of θ will the identity be undefined, if $\theta \in [0° ; 180°]$? (1)

6.2 Find the general solution of $\cos\theta = \frac{1}{\cos\theta} + \frac{5}{6}$. (6)

6.3 If area Δ PQR $= \frac{1}{2}pq\sin R$, show that the area Δ PQR can also be expressed as $\frac{q^2 \sin P \sin R}{2\sin Q}$. (2)

[15]

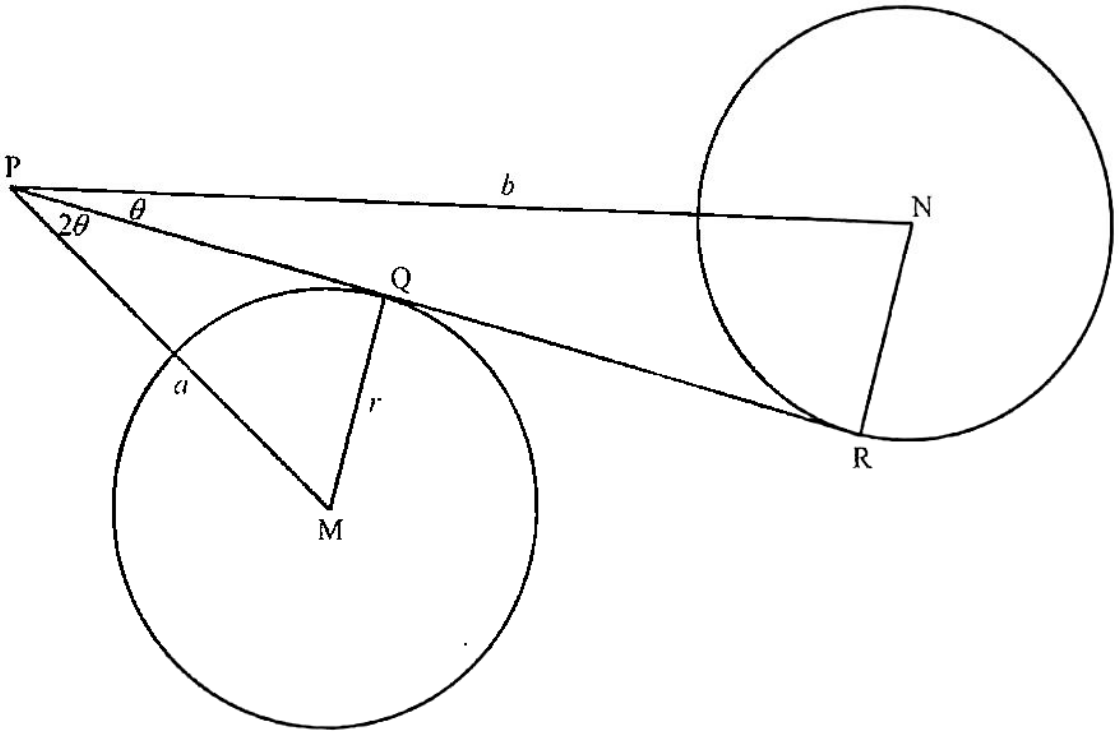
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QUESTION 7

7.1 7.1.1 Complete: $\cos(\alpha-\beta)=...$ (1)

7.1.2 Hence, derive a formula for $\sin 2\alpha$. (3)

7.2 PQR is a common tangent at Q and R to circles with centres M and N. Each circle has a radius of r units. $M\hat{P}Q = 2\theta$, $R\hat{P}N = \theta$, $PM = a$ and $PN = b$.



7.2.1 Express r in terms of b and θ. (2)

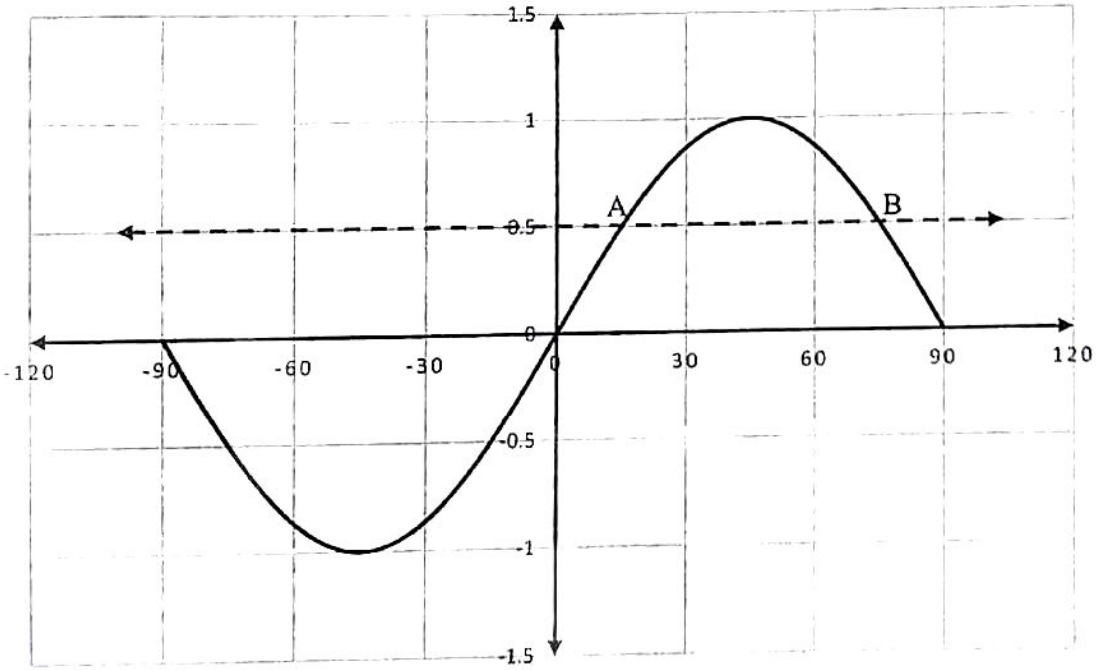
7.2.2 If it is also given that $r = a\sin 2\theta$, express b in terms of a and θ. Leave the answer in the simplest form. (3)

7.2.3 Hence, prove that $QR = a$. (4)

[13]

QUESTION 8

The diagram below shows the graph of $f(x)=\sin ax$ for $x\in[-90°\ ;\ 90°]$ and $y=\frac{1}{2}$.



8.1 Determine the value of a. (1)

8.2 Write down the period of $f\left(\frac{3x}{2}\right)$. (2)

8.3 Write down the maximum value of $\sqrt{\sin ax-1}$. (1)

8.4 If the $x-$axis is shifted to $y=\frac{1}{2}$ to form a new graph $h(x)$, determine the equation of $h(x)$. (1)

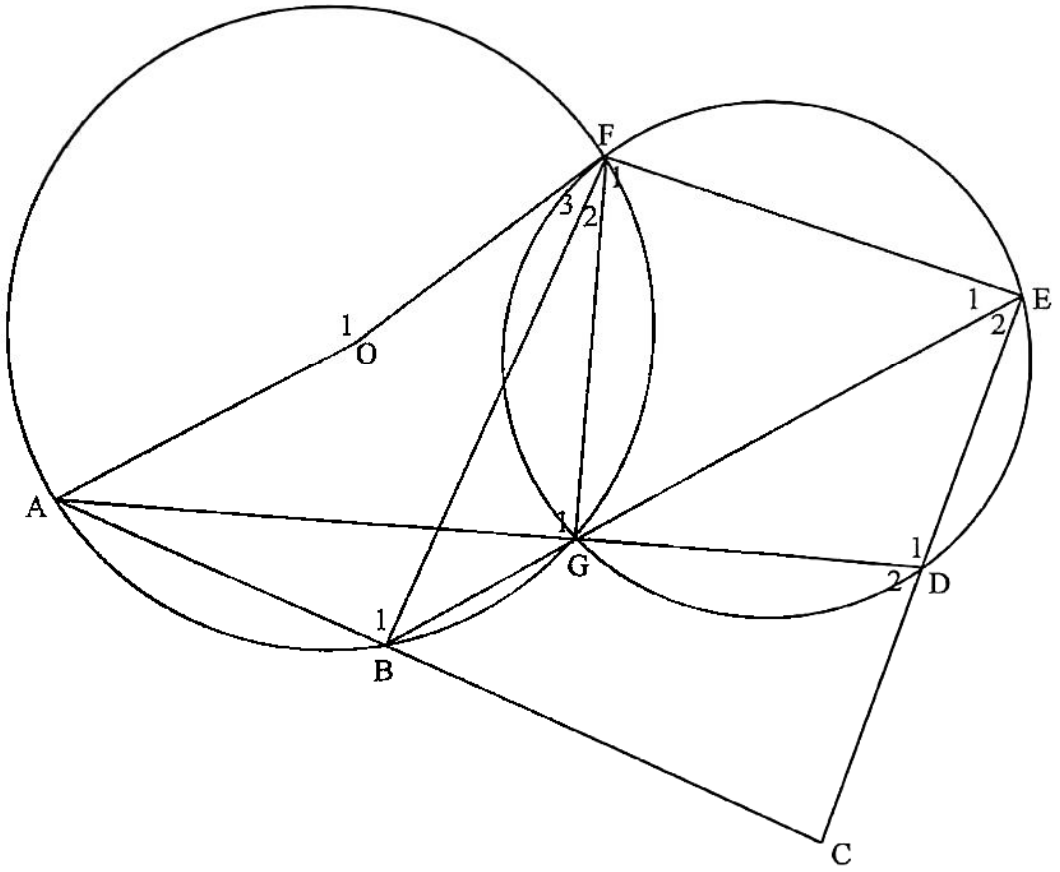
8.5 The $x-$intercepts of $h(x)$ is at A and B. Determine the coordinates of A and B without the use of a calculator. (2)

[7]

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QUESTION 9

The diagram shows 2 circles. O is the centre of the circle drawn through ABGF, and the points E, F, G and D lies on the circumference of the other circle.



If $\hat{O}_1 = 162°$ and $F\hat{E}D = \hat{D}_1$, calculate the following angles, providing reasons:

9.1 $\hat{B}_1$ (2)

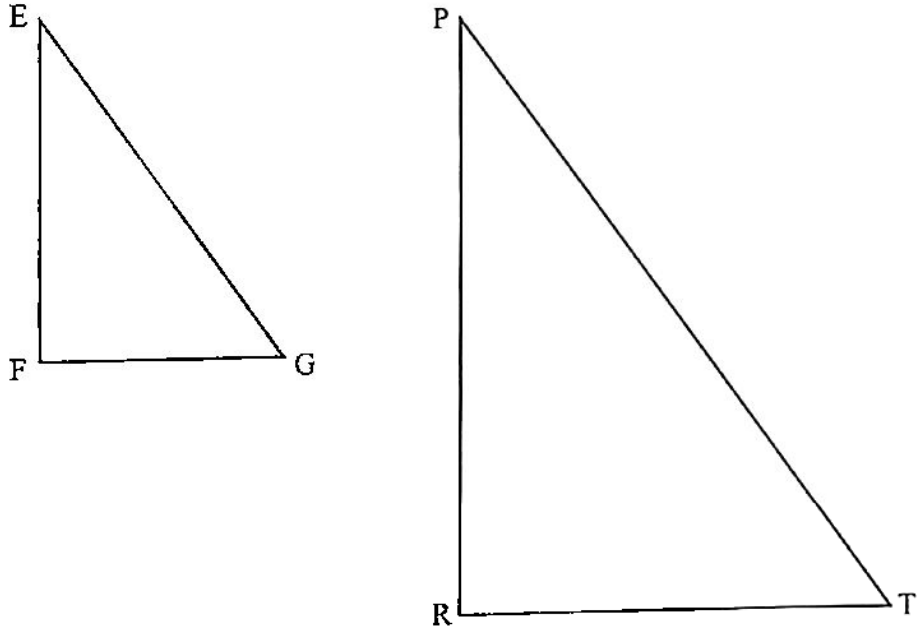
9.2 $\hat{G}_1$ (2)

9.3 $\hat{D}_1$ (3)

[7]

QUESTION 10

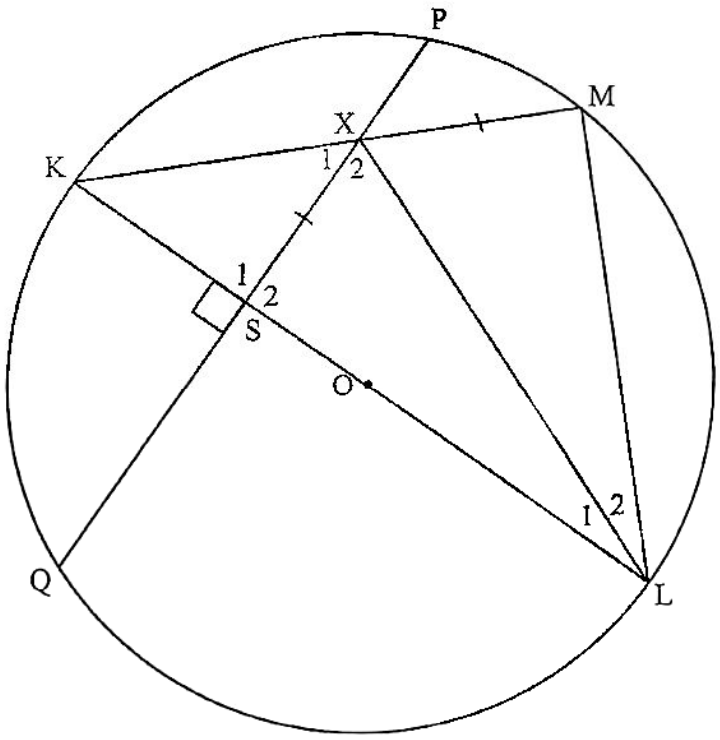
10.1 In ΔEFG and ΔPRT in the diagram, $\hat{E} = \hat{P}$ and $\hat{F} = \hat{R}$.



Use the diagram to proof the theorem stating that $\frac{EF}{PR} = \frac{EG}{PT}$ (6)

10.2 In the diagram KL is a diameter of the circle with centre O. The radius is 10 units, and M is a point on the circumference such that ML = 12 units.

The bisector of $K\hat{L}M$ meets KM at X. $\Delta KSX \equiv \Delta KML$ and the chord PXQ cuts KL at S such that PXQ ⊥ KL.



10.2.1 Name 2 congruent triangles. (1)

10.2.2 Calculate, with reasons:

(a) KM (3)

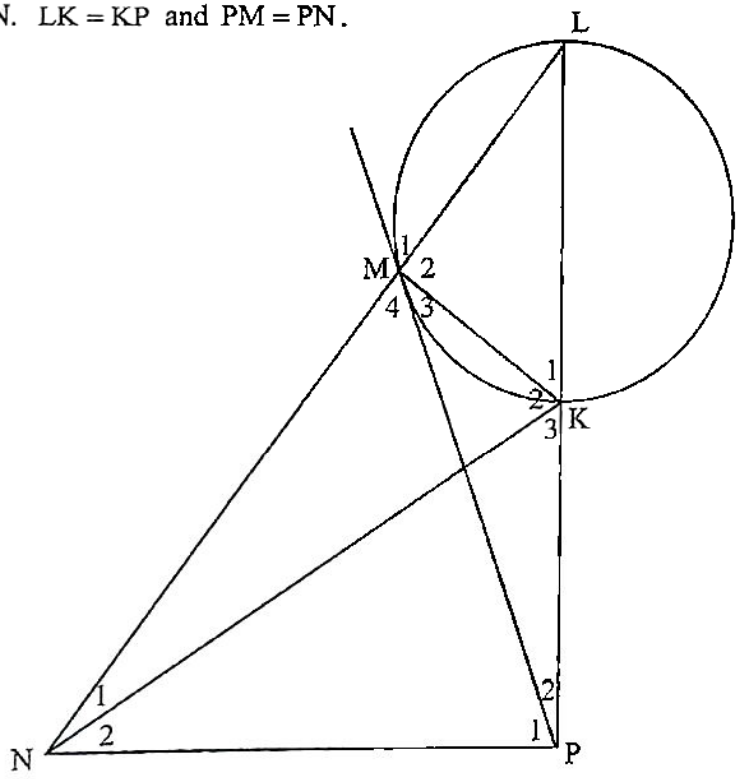
(b) $\frac{KX}{XS}$ (3)

(c) XM (5)

[18]

QUESTION 11

In the diagram PM is a tangent to the circle through L, M and K. LP ⊥ NP. LM produced meets NP in N. LK = KP and PM = PN.



Prove that:

11.1 KMNP is a cyclic quadrilateral. (4)

11.2 LK is the diameter of the circle. (2)

11.3 $\Delta MKP \text{ III } \Delta LMP$ (3)

11.4 $PM^2 = PK.PL$ (1)

11.5 $LN = \sqrt{6}.PK$ (4)

11.6 If it is further given that $\Delta NLP \text{ III } \Delta KLM$, prove that $PN = \sqrt{6}.MK$ (3)

[17]

TOTAL: 150

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INFORMATION SHEET: MATHEMATICS

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \qquad A = P(1+ni) \quad A = P(1-ni) \qquad A = P(1-i)^n \quad A = P(1+i)^n$$

$$\sum_{i=1}^{n} 1 = n \qquad \sum_{i=1}^{n} i = \frac{n(n+1)}{2} \qquad T_n = a + (n-1)d \qquad S_n = \frac{n}{2}\left(2a + (n-1)d\right)$$

$$T_n = ar^{n-1} \qquad S_n = \frac{a\left(r^n - 1\right)}{r-1} \; ; \quad r \neq 1 \qquad S_\infty = \frac{a}{1-r} \; ; \; -1 < r < 1$$

$$F = \frac{x\left[(1+i)^n - 1\right]}{i} \qquad P = \frac{x[1-(1+i)^{-n}]}{i} \qquad f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

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

$$y - y_1 = m(x - x_1) \qquad m = \frac{y_2 - y_1}{x_2 - x_1} \qquad m = \tan\theta \qquad (x-a)^2 + (y-b)^2 = r^2$$

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

$$area\,\Delta ABC = \frac{1}{2}ab.\sin C$$

$$\sin(\alpha + \beta) = \sin\alpha.\cos\beta + \cos\alpha.\sin\beta \qquad \sin(\alpha - \beta) = \sin\alpha.\cos\beta - \cos\alpha.\sin\beta$$

$$\cos(\alpha + \beta) = \cos\alpha.\cos\beta - \sin\alpha.\sin\beta \qquad \cos(\alpha - \beta) = \cos\alpha.\cos\beta + \sin\alpha.\sin\beta$$

$$\cos 2\alpha = \begin{cases} \cos^2\alpha - \sin^2\alpha \\ 1 - 2\sin^2\alpha \\ 2\cos^2\alpha - 1 \end{cases} \qquad \sin 2\alpha = 2\sin\alpha.\cos\alpha$$

$$(x\,;\,y) \to (x\cos\theta + y\sin\theta\,;\, y\cos\theta - x\sin\theta)$$
$$(x\,;\,y) \to (x\cos\theta - y\sin\theta\,;\, y\cos\theta + x\sin\theta)$$

$$\bar{x} = \frac{\sum fx}{n} \qquad \sigma^2 = \frac{\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2}{n}$$

$$P(A) = \frac{n(A)}{n(S)} \qquad P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

$$\hat{y} = a + bx \qquad b = \frac{\sum(x - \bar{x})(y - \bar{y})}{\sum(x - \bar{x})^2}$$

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