



Education

KwaZulu-Natal Department of Education
REPUBLIC OF SOUTH AFRICA

MATHEMATICS P2

COMMON TEST

JUNE 2017

**NATIONAL
SENIOR CERTIFICATE**

GRADE 11

MARKS: 100

TIME: 2 hours

This question paper consists of 8 pages and 4 diagram sheets.

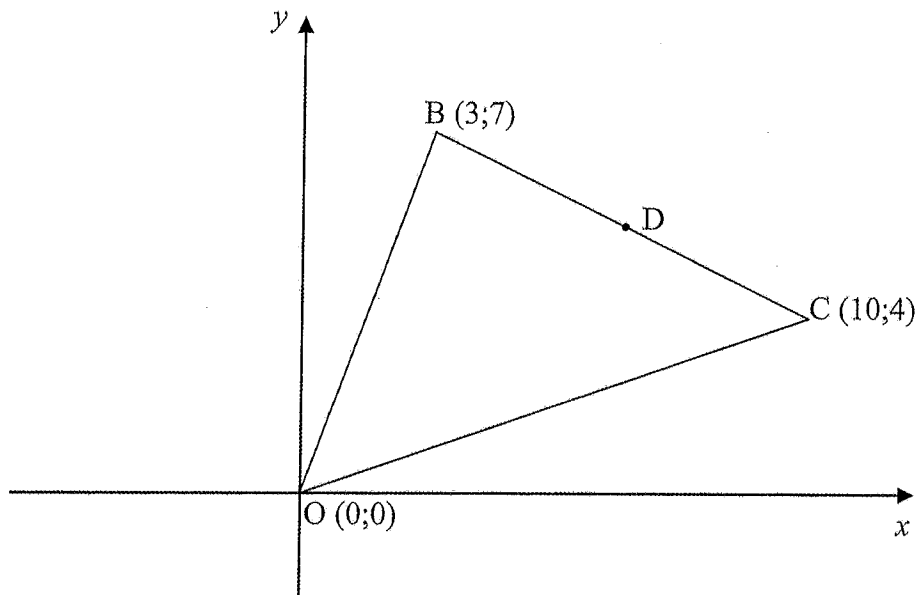
INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of 6 questions.
2. Answer ALL the questions.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Clearly show ALL calculations, diagrams, graphs, et cetera that you have used in determining your answers.
5. Answers only will not necessarily be awarded full marks.
6. You may use an approved scientific calculator (non-programmable and non-graphical), unless stated otherwise.
7. If necessary, round off answers to TWO decimal places, unless stated otherwise.
8. Diagrams are NOT necessarily drawn to scale.
9. FOUR diagram sheets are attached at the end of this question paper. Write your name on these diagram sheets in the spaces provided and hand your diagram sheets in together with your ANSWER BOOK.
10. Write neatly and legibly.

QUESTION 1

In the diagram B (3;7), C(10;4) and O (0;0) are the vertices of $\triangle BCO$.
D is the midpoint of BC.



- 1.1 Calculate the lengths of BO and BC. Leave your answers in surd form. (4)
- 1.2 Determine the gradients of BO and BC. (4)
- 1.3 Prove that $\hat{OBC} = 90^\circ$. (2)
- 1.4 Calculate the area of $\triangle BCO$. (3)
- 1.5 Calculate the coordinates of D. (2)
- 1.6 A straight line passes through the point (5 ; 2) and is parallel to BO.
- 1.6.1 Determine the equation of this line in the form $ax + by + c = 0$. (5)
- 1.6.2 Hence, show that D lies on this line. (2)

[22]

QUESTION 2

2.1

Given the points P $(-1; 4)$, S $(3; a)$ and W $\left(t; \frac{17}{2}\right)$. $a > 0$

The length of PS is $2\sqrt{13}$.

P, S and W are collinear points.

2.1.1 Calculate the value of a . (5)

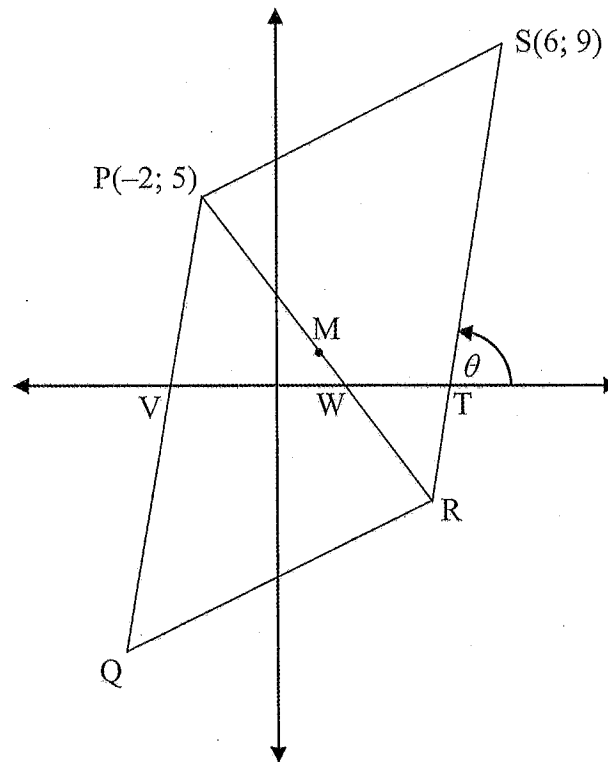
2.1.2 If $a = 10$, calculate the value of t . (4)

2.2

In the diagram, PQRS is a parallelogram with vertices P $(-2; 5)$, Q, R and S $(6; 9)$.

M is the midpoint of diagonal PR. θ is the angle of inclination of SR.

PQ, PR and SR cut the x -axis at V, W and T respectively.



2.2.1 Show, by calculation, that the coordinates of R are $(4; -3)$. (2)

2.2.2 Calculate the size of angle θ . (3)

2.2.3 Calculate the size of \widehat{QPR} . (5)

2.2.4 Determine the coordinates of Q. (2)

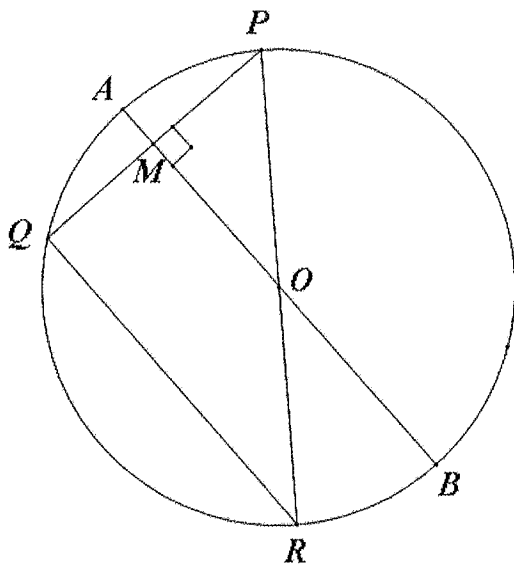
[21]

GIVE REASONS FOR YOUR STATEMENTS AND CALCULATIONS IN QUESTIONS 3 – 6.

QUESTION 3

3.1 Complete the statement so that it is valid:
The line drawn from the centre of a circle perpendicular to a chord (1)

3.2 In the diagram PQ and QR are chords of the circle with centre O.
Diameter AB intersects chord PQ perpendicularly at M.
AM = 2cm and MB = 32cm.



Calculate the length of the following, with reasons:

3.2.1 OP (2)

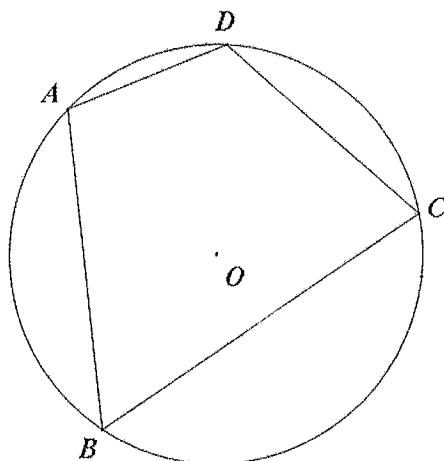
3.2.2 PQ (5)

3.2.3 QR (3)

[11]

QUESTION 4

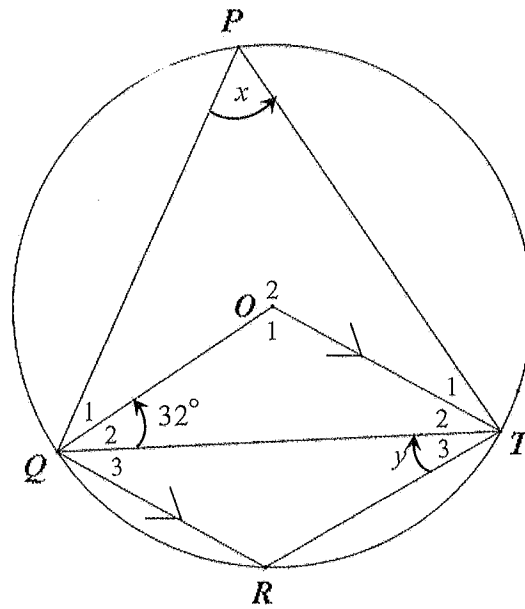
4.1 In the diagram O is the centre of the circle ABCD.



Prove the theorem which states that $\hat{B} + \hat{D} = 180^\circ$. (6)

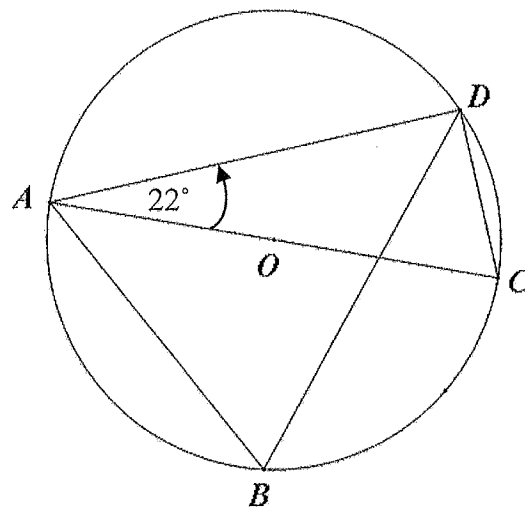
GR 11 MATHS P2

- 4.2 In the diagram O is the centre of a circle which passes through P, Q, R and T . QT, OQ and OT are joined. OT is parallel to QR . $\hat{Q}_2 = 32^\circ, \hat{P} = x$ and $\hat{T}_3 = y$.



Determine, with reasons, the size of x and y . (8)

- 4.3 In the diagram A, B, C and D are points on the circumference of the circle with centre O . AOC is a diameter. $\hat{D}AC = 22^\circ$.

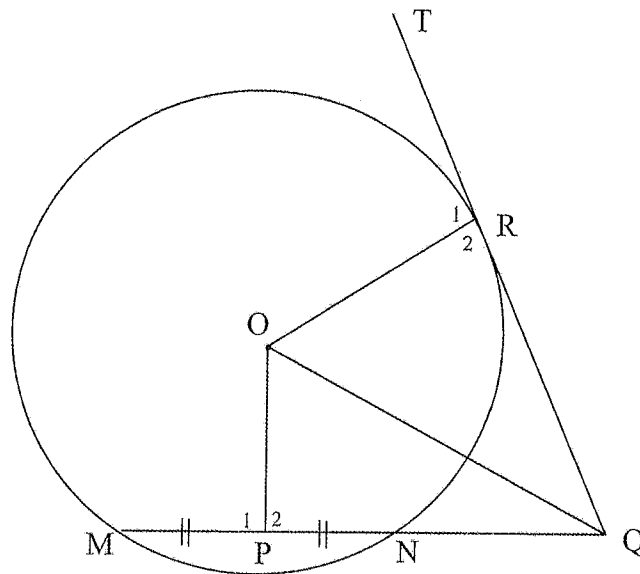


Calculate, with reasons, the size of \hat{B} . (5)

[19]

QUESTION 5

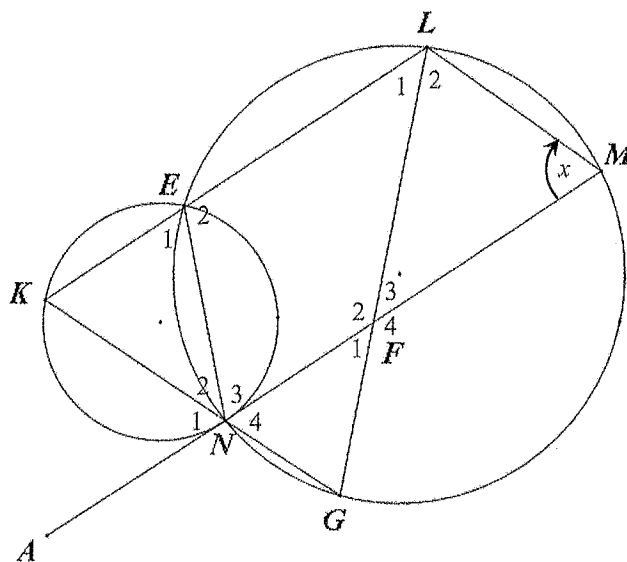
- 5.1 In the diagram, O is the centre of the circle. QRT is a tangent to the circle at R. MN is a chord of the circle and MNQ is a straight line. P is the midpoint of MN.



Prove that OPQR is a cyclic quadrilateral.

(5)

- 5.2 In the diagram, two circles cut in E and N. K, L and M are points on the circles such that KLMN is a parallelogram and the chords MN and LG intersect at F. MN is produced to A. KNG and KEL are straight lines. Let $\hat{M} = x$.



5.2.1 Prove that $KN = EN$.

(4)

5.2.2 Prove that MNA is a tangent to circle KEN.

(3)

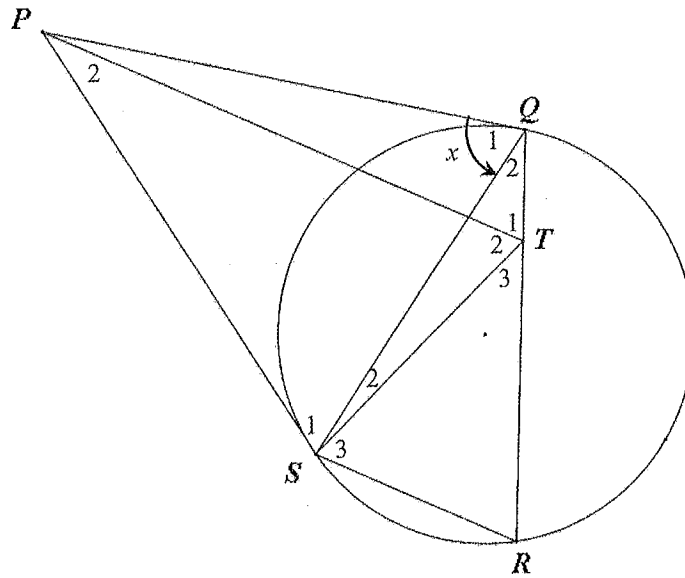
5.2.3 Prove that $KL = LG$.

(4)

[16]

QUESTION 6

In the diagram PQ and PS are tangents to the given circle, and R is a point on the circumference. T is a point on QR such that $\hat{T}_1 = \hat{Q}_1$. SQ, TS and SR are joined. Let $\hat{Q}_1 = x$.



Prove that

- 6.1 $PT \parallel SR$ (4)
- 6.2 TQPS is a cyclic quadrilateral. (4)
- 6.3 PT bisects \hat{STQ} . (3)

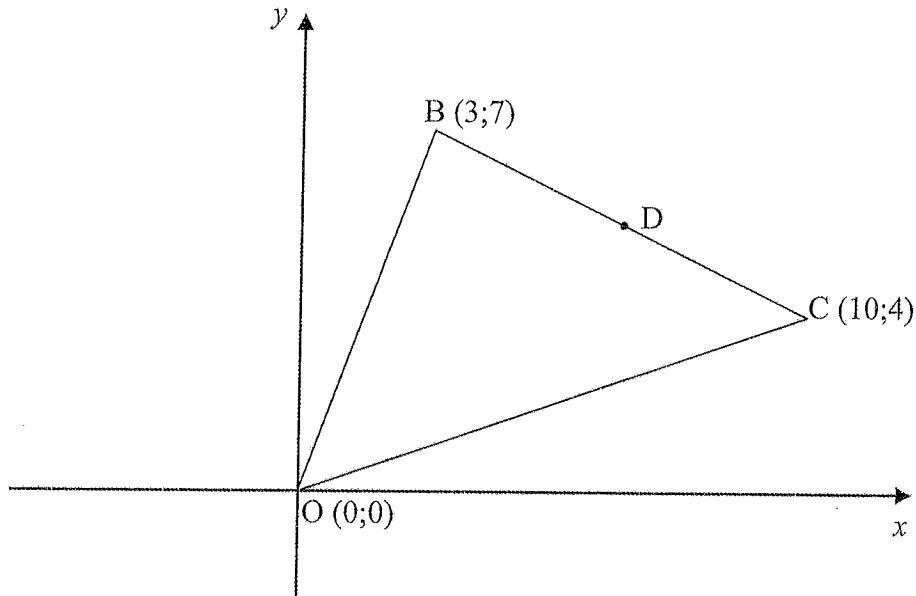
[11]

TOTAL 100

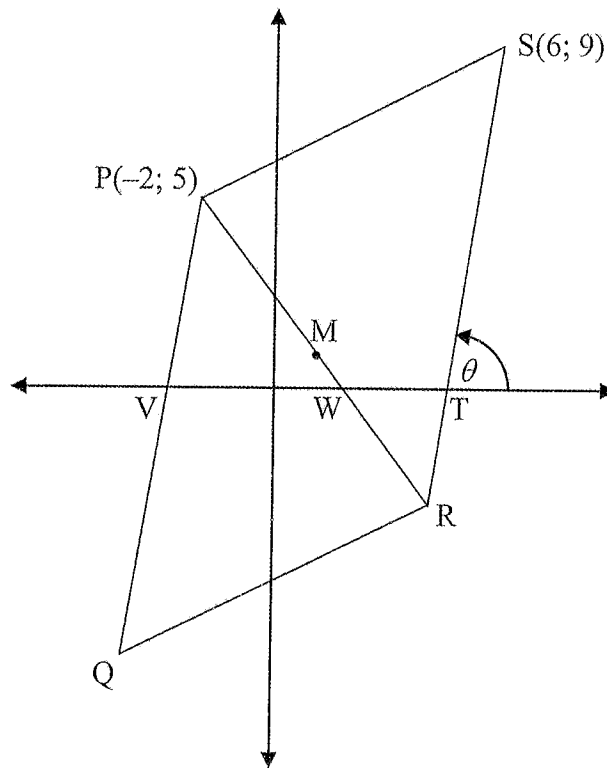
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DIAGRAM SHEET 1

QUESTION 1



QUESTION 2.2

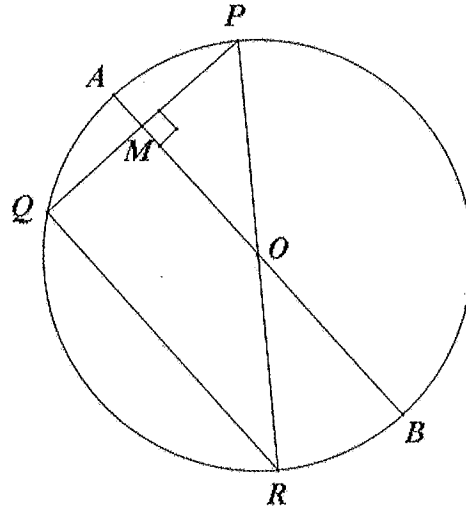


TEAR-OFF SHEET

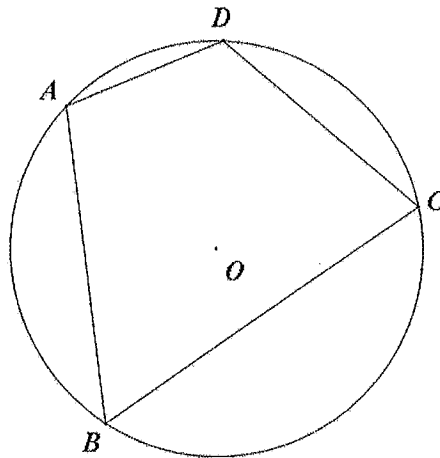
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DIAGRAM SHEET 2

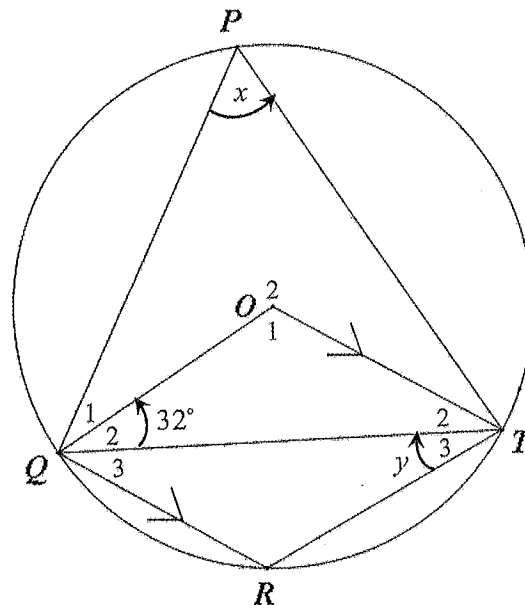
QUESTION 3.2



QUESTION 4.1



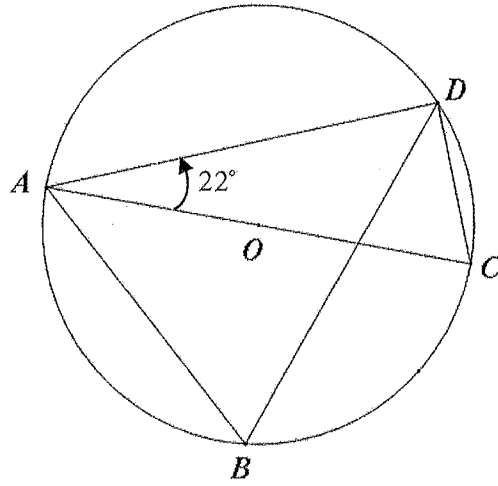
QUESTION 4.2



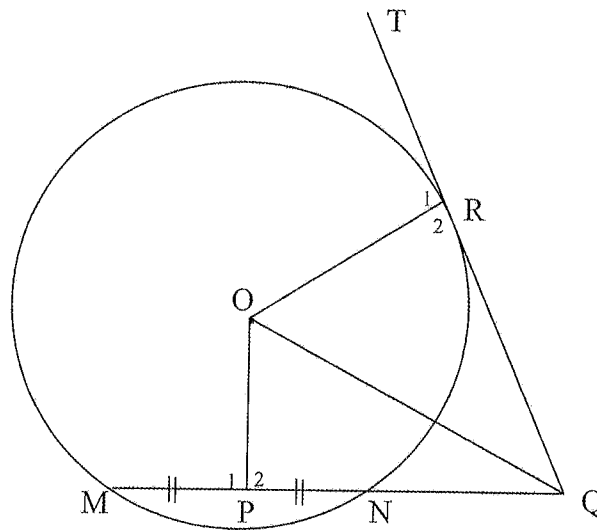
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DIAGRAM SHEET 3

QUESTION 4.3



QUESTION 5.1

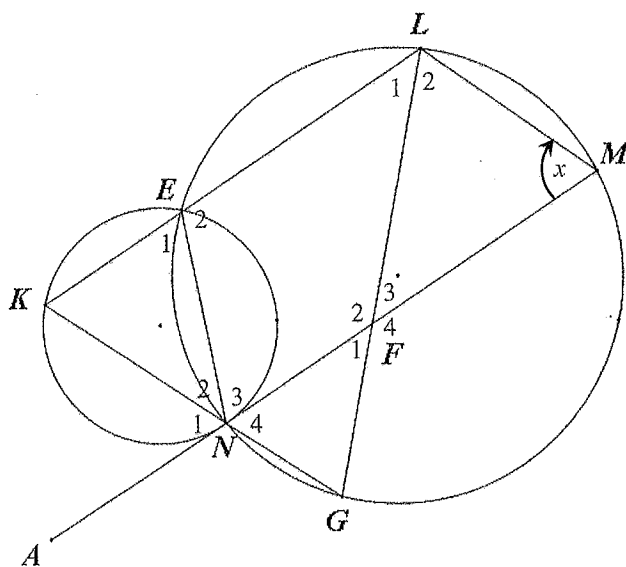


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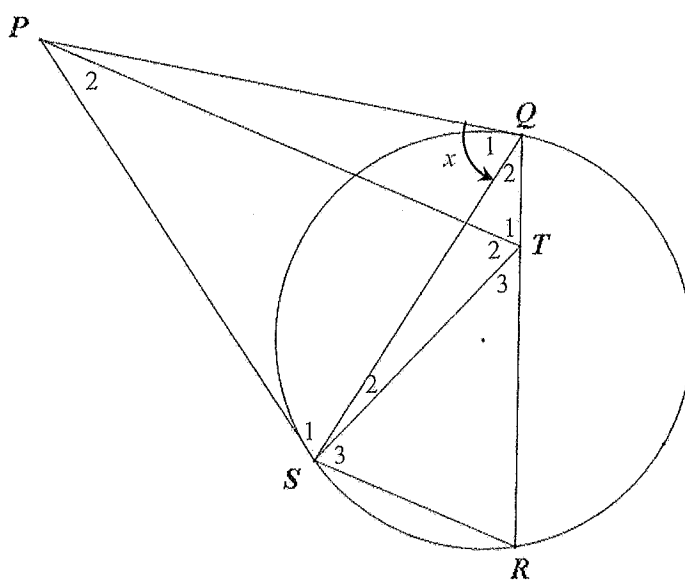
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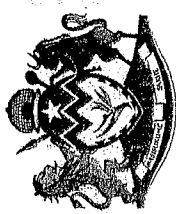
DIAGRAM SHEET 4

QUESTION 5.2



QUESTION 6





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MATHEMATICS P2
 MARKING GUIDELINE
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GRADE 11

MARKS: 100

N.B. This marking guideline consists of 8 pages.

QUESTION 1

1.1	$BO = \sqrt{(3-0)^2 + (7-0)^2}$ $= \sqrt{58}$ $BC = \sqrt{(3-10)^2 + (7-4)^2}$ $= \sqrt{58}$	1A for substitution ICA for answer 1A for substitution ICA for answer (4)
1.2	$\text{Gradient of } BO = \frac{7-0}{3-0} = \frac{7}{3}$ $\text{Gradient of } BC = \frac{7-4}{3-10} = \frac{-3}{-7} = \frac{3}{7}$	1A for substitution ICA for answer 1A for substitution ICA for answer (4)
1.3	$M_{BO} \times M_{BC} = \frac{7}{3} \times \frac{-3}{-7} = -1$ $\therefore \angle BOC = 90^\circ$	1 A for product 1A for -1 (2)
1.4	$\text{Area of } \triangle BCO = \frac{1}{2} \times b \times h$ $= \frac{1}{2} \times \sqrt{58} \times \sqrt{58}$ $= 29 \text{ square units}$	1A for formula ICA for substitution ICA for answer (3)
1.5	$D = \left(\frac{3+10}{2}, \frac{7+4}{2} \right)$ $= \left(\frac{13}{2}, \frac{11}{2} \right)$	1A for $\frac{13}{2}$ 1A for $\frac{11}{2}$ (2)
1.6.1	$\text{Gradient of the line} = \frac{7}{3}$ $y = mx + c$ $2 = \frac{7}{3}(5) + c$ $c = \frac{-29}{3}$ $y = \frac{7}{3}x - \frac{29}{3}$	1 CA for gradient ICA for substitution of point ICA for c - value ICA for equation ICA for $ax + by + c = 0$ form (5)
1.6.2	$7x - 3y - 29 = 0 \text{ is the equation}$ $7\left(\frac{13}{2}\right) - 3\left(\frac{11}{2}\right) - 29$ $= \frac{91}{2} - \frac{33}{2} - 29$ $= \frac{91 - 33 - 58}{2}$ $= 0$ $\therefore D \text{ lies on the line}$	ICA for substitution ICA for simplification (2)

QUESTION 2

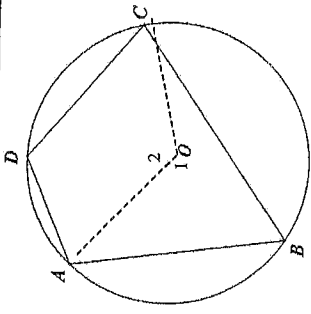
2.1.1	$PS = \sqrt{(3+1)^2 + (a-4)^2}$ $\sqrt{16+a^2-8a+16} = 2\sqrt{13}$ $32+a^2-8a=52$ $a^2-8a-20=0$ $(a-10)(a+2)=0$ $a=10 \text{ or } a=-2$ $\therefore a=10$	1A for substitution in distance formula 1A for equating to $2\sqrt{13}$ 1CA for squaring both sides 1CA standard form 1CA factors (5)
2.1.2	$m_{PS} = m_{SW}$ $\frac{10-4}{4} = \frac{17}{t-3} - 10$ $\frac{6}{4} = \frac{-3}{t-3}$ $6t-18=6$ $t=2$ OR $m_{PS} = m_{TW}$ $\frac{10-4}{4} = \frac{17}{t+1} - 4$ $\frac{6}{4} = \frac{9}{t+1} - 4$ $6t+6=18$ $t=2$	1A for equating gradients 1A for substitution 1CA for simplification OR 1A for equating gradients 1A for substitution 1CA for simplification 1CA for answer (4)
2.2.1	$1 = \frac{x+(-2)}{2}$ $x=4$ $1 = \frac{y+5}{2}$ $y=-3$	1A for substitution 1A for substitution (2)
2.2.2	$\tan \theta = m_{SR}$ $\tan \theta = \frac{9-(-3)}{6-4}$ $= 6$ $\theta = 80,54^\circ$	1A for $\tan \theta = m_{SR}$ 1A for 6 1CA for answer (3)

2.2.3	$\hat{P}\hat{V}\hat{W}$ = Angle of inclination of PQ = $80,54^\circ$ [opp. sides of parm. PQRS are parallel.] $\tan \hat{P}\hat{V}\hat{T} = m_{PR}$ $= \frac{5-(-3)}{-2-4}$ $= -\frac{4}{3}$ $\hat{P}\hat{W}\hat{T} = 180^\circ - 53,13^\circ$ $= 126,87^\circ$ $\hat{Q}\hat{P}\hat{R} = \hat{P}\hat{V}\hat{T} - \hat{P}\hat{V}\hat{W}$ [ext. \angle of $\Delta P\hat{V}\hat{W}$] $= 126,87^\circ - 80,54^\circ$ $= 46,33^\circ$	1A for $\hat{P}\hat{V}\hat{W} = 80,54^\circ$ 1A for $m_{PR} = -\frac{4}{3}$ 1CA for size of $\hat{P}\hat{W}\hat{T}$ 1CA for subtracting 1CA for answer (5)
2.2.4	$Q(-4,-7)$	1A for -4 1A for -7 (2)

QUESTION 3

3.1	bisects the chord	IA for answer	(1)
3.2.1	AB = 34cm OP = 17cm	IA for length of diameter IA for length of OP	(1)
3.2.2	$PM^2 = OP^2 - OM^2$ [Theorem of Pythagoras] $= 17^2 - 15^2$ $= 64$ FM = 8cm PQ = $2 \times PM$ [line from centre \perp to chord] $= 16$ cm	IS for $PM^2 = OP^2 - OM^2$ or $PM^2 = 17^2 - 15^2$ IR (for Theorem of Pythagoras) ICA for length of FM ICA for length of PQ IR (for line from centre \perp to chord)	(2)
3.2.3	$\hat{Q} = 90^\circ$ [\angle in semicircle] $QR^2 = PR^2 - PQ^2$ [Theorem of Pythagoras] $= 34^2 - 16^2$ $= 900$ QR = 30cm OR QR = $2 \times OM$ [midpoint theorem] $= 30$ cm	IS/R ICA for applying Theorem of Pythagoras ICA for answer OR IS IR ICA for answer	(3) [11]

QUESTION 4

4.1	 <p>Construct AO and OC $\hat{O}_1 = 2\hat{D}$ [\angle at centre = $2 \times \angle$ at circumference] $\hat{O}_2 = 2\hat{B}$ [\angle at centre = $2 \times \angle$ at circumference] but $\hat{O}_1 + \hat{O}_2 = 360^\circ$ [\angles around a pt] $2\hat{D} + 2\hat{B} = 360^\circ$ $\hat{B} + \hat{D} = 180^\circ$</p>	IA construction IS IR IS/R IS/R IA for substitution	(6)
4.2	$\hat{T}_2 = 32^\circ$ [\angle s opp equal sides] $\hat{O}_1 = 118^\circ - 2(32^\circ)$ [sum of \angle 's of a triangle] $= 116^\circ$ $\hat{P} = \frac{1}{2}(\hat{O}_1)$ [\angle at centre = $2 \times \angle$ at circumference] $= 58^\circ$ $= x$ $\hat{R} = 180^\circ - 58^\circ$ [opp \angle 's of cyclic quad] $= 122^\circ$ $\hat{Q}_3 = \hat{T}_2$ [alt \angle 's; OT \parallel QR] $= 32^\circ$ $y = 180^\circ - (122^\circ + 32^\circ)$ [sum of \angle 's of a triangle] $= 26^\circ$	IS/R IS I S IR IS IR IS/R IA answer	(8)
4.3	$\hat{A}\hat{D}\hat{C} = 90^\circ$ [\angle in a semicircle] $\hat{C} = 180^\circ - (90^\circ + 22^\circ)$ [sum of \angle 's of Δ] $= 68^\circ$ $\hat{B} = \hat{C}$ [\angle 's in same segment] $= 68^\circ$	IS IR IS/R IS IR	(5) [19]

QUESTION 5

5.1	$\hat{P}_2 = 90^\circ$ [line from centre to midpoint of chord] $\hat{R}_2 = 90^\circ$ [radius \perp tangent] \therefore OPQR is a cyclic quadrilateral [converse: opp \angle s of cyclic quad are supplementary]	IS IR IS IR IR	
	OR $\hat{P}_1 = 90^\circ$ [line from centre to midpoint of chord] $\hat{R}_2 = 90^\circ$ [radius \perp tangent] \therefore QPQR is a cyclic quadrilateral [converse: ext \angle of a cyclic quad = opp. interior angle]	OR IS IR IS IR IR	(5)
5.2.1	$\hat{K} = \hat{M}$ [opp. \angle 's of parm.] $= x$ $\hat{E}_1 = \hat{M}$ [ext. \angle of cyclic quad] $\hat{K} = \hat{E}_1$ [both = \hat{M}] $KN = NE$ [sides opp. = angles]	IS/R IS IR IS/R	(4)
5.2.2	$\hat{N}_2 = \hat{E}_1$ [alt. \angle 's; $KL \parallel MN$] MFN is a tangent to circle KEN [converse: tan - chord - theorem]	IS IR IR	(3)
5.2.3	$\hat{G} = \hat{M}$ [\angle 's in the same segment] $= x$ $= \hat{K}$ [proved] $KL = LG$ [sides opp. to = angles]	IS IR IS IS/R	(4) [16]

QUESTION 6

6.1	$\hat{Q}_1 = \hat{R}$ [tan - chord - theorem] $= x$ $= \hat{T}_1$ [given] $PT \parallel SR$ [corresponding \angle 's are equal]	IS IR IS IS/R	(4)
6.2	$PQ = PS$ [2 tangents from same point] $\hat{S}_1 = \hat{Q}_1$ [\angle 's opp to = sides] $= x$ $\hat{S}_1 = \hat{T}_1$ [both = x] TQPS is a cyclic quadrilateral [converse: \angle 's in same segment]	IS/R IS/R IS IS/R	(4)
6.3	$\hat{T}_2 = \hat{Q}_1$ [\angle 's in same segment] $= x$ $\hat{T}_1 = \hat{Q}_1$ [given] $\hat{T}_1 = \hat{T}_2$ \therefore PT bisects $S\hat{T}Q$	IS IR IS	(3) [11]

TOTAL: 100