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PREPARATORY EXAMINATION 2026

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MATHEMATICS (10612)

PAPER 2



MATHEMATICS: Paper 2



10612E

X05





PREPARATORY EXAMINATION 2026

NAME OF SCHOOL:													
CANDIDATE'S NAME:													
DATE:	D	D	M	M	2	0	2	6	BOOK NUMBER		OF		BOOK(S)
TEACHER:									PAPER NUMBER	2			
SUBJECT:	MATHEMATICS (10612)												

ANSWER ALL THE QUESTIONS IN THE QUESTION PAPER.

	MARKER				MODERATOR(S)					
QUESTION	MARKS			MARKER'S INITIALS	MARKS			MODERATORS' INITIALS		
1	0				0					
2	0				0					
3	0				0					
4	0				0					
5	0				0					
6	0				0					
7	0				0					
8	0				0					
9	0				0					
10	0				0					
11	0				0					
				TOTAL						

TIME: 3 hours

MARKS: 150

34 pages + 1 information sheet

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of 11 questions. Answer ALL the questions in the spaces provided.
2. Clearly show ALL calculations, diagrams, graphs, etc. that you have used in determining your answers.
3. Answers only will NOT necessarily be awarded full marks.
4. You may use an approved scientific calculator (non-programmable and non-graphical), unless stated otherwise.
5. If necessary, round-off answers correctly to TWO decimal places, unless stated otherwise.
6. Diagrams are NOT necessarily drawn to scale.
7. An INFORMATION SHEET with formulae is included at the end of the question paper.
8. No pages may be torn from this question paper.
9. Candidates may not retain a question paper or remove it from the examination room. Question papers must be returned to the invigilator at the end of the examination session.
10. Answers must be written in black/blue ink as distinctly as possible. Do NOT write in the margins.
11. Indicate the questions that you have answered by drawing a circle around the relevant numbers on the front cover of the question paper where marks are to be recorded.
12. Draw a neat line through any work/rough work that must NOT be marked.
13. In the event that you use the additional space provided:
 - 13.1 Write down the number of the question.
 - 13.2 Leave a line open and rule off after your answer.
14. Write neatly and legibly.



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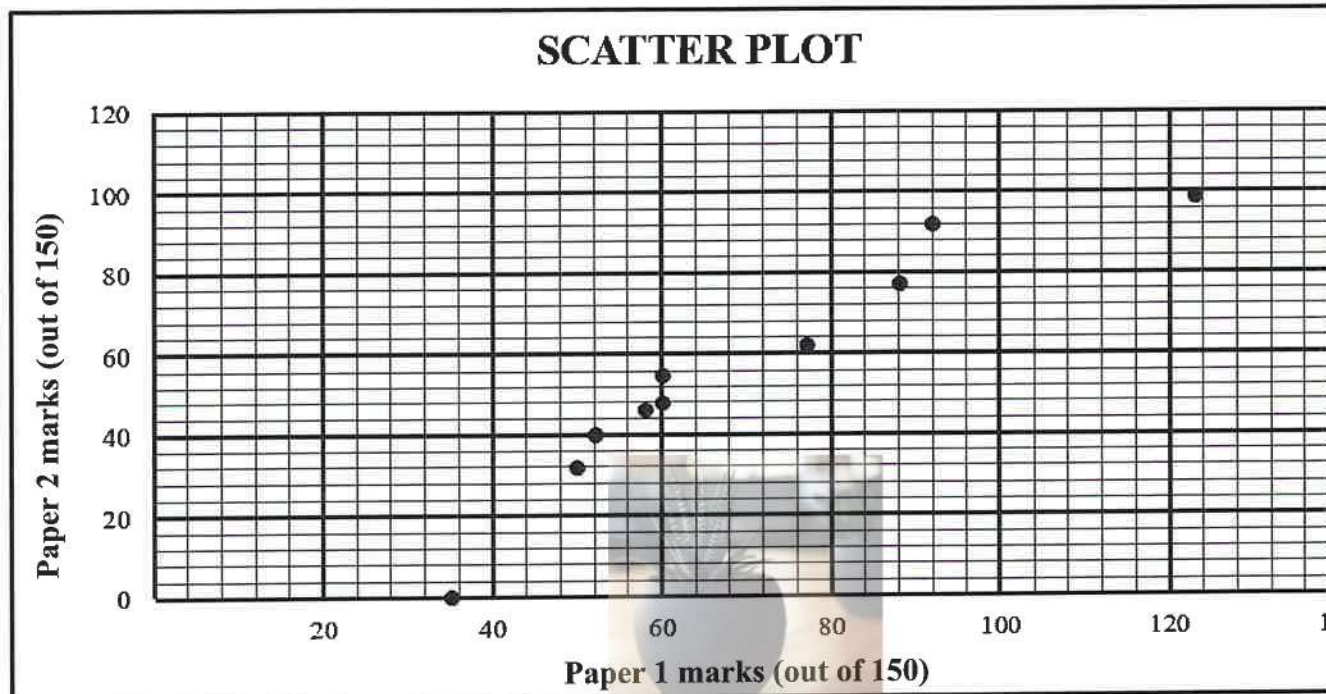


QUESTION 1

The table below shows the marks obtained by 10 Grade 12 learners in Mathematics Paper 1 and Mathematics Paper 2 in their Preparatory Examination. All marks are out of 150.

Paper 1 (out of 150 marks)	35	50	52	58	60	60	77	88	92	123
Paper 2 (out of 150 marks)	0	32	40	46	48	55	62	77	92	99

The data is represented on the scatter plot below.

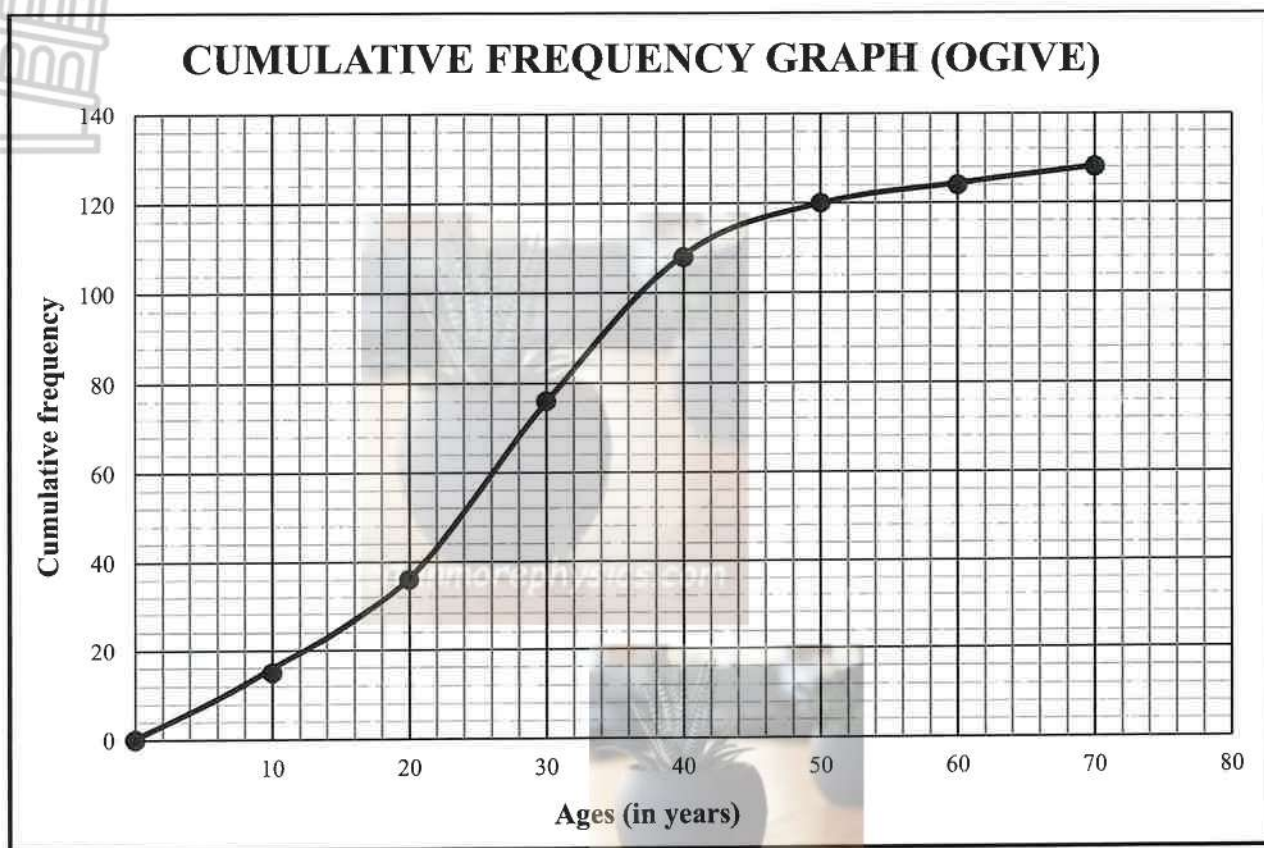


1.1	Determine the equation of the least squares regression line for the data given in the table above.	(3)
1.2	Calculate the correlation coefficient.	(1)
1.3	Comment on the strength of the correlation coefficient between the marks of both papers.	(1)

1.4	If a learner scored 75 for Paper 1, predict the learner's mark for Paper 2.																
		(2)															
1.5	Calculate the value (A) in the table below.																
	<table><tr><td></td><td>Mean</td><td>Median</td><td>Standard deviation</td><td>Range</td></tr><tr><td>Paper 1</td><td>69,5</td><td>60</td><td>24,41</td><td>88</td></tr><tr><td>Paper 2</td><td>55,1</td><td>51,5</td><td>A</td><td>99</td></tr></table>		Mean	Median	Standard deviation	Range	Paper 1	69,5	60	24,41	88	Paper 2	55,1	51,5	A	99	
	Mean	Median	Standard deviation	Range													
Paper 1	69,5	60	24,41	88													
Paper 2	55,1	51,5	A	99													
		(1)															
1.6	All learners received 4 additional marks in Paper 1 due to a technical error.																
1.6.1	Calculate the mean for Paper 1 after the mark adjustment.																
		(1)															
1.6.2	Explain how the standard deviation of Paper 1 will be affected by this change.																
		(1)															
1.7	After the marks had been recorded, a new learner John, wrote both papers. John obtained 52 marks in Paper 1 and 51 marks in Paper 2. In which paper did John rank higher? Justify your answer.																
		(2)															
		[12]															

QUESTION 2

A clothing store recorded the number of T-shirts that have been sold per age group. The data is represented in the ogive (cumulative frequency graph) below.



2.1

Use the ogive above to complete the following table:

AGE GROUPS	NUMBER OF T-SHIRTS SOLD
$0 < x \leq 10$	15
$10 < x \leq 20$	
$20 < x \leq 30$	
$30 < x \leq 40$	
$40 < x \leq 50$	
$50 < x \leq 60$	
$60 < x \leq 70$	

(2)

2.2

Write down the modal class.

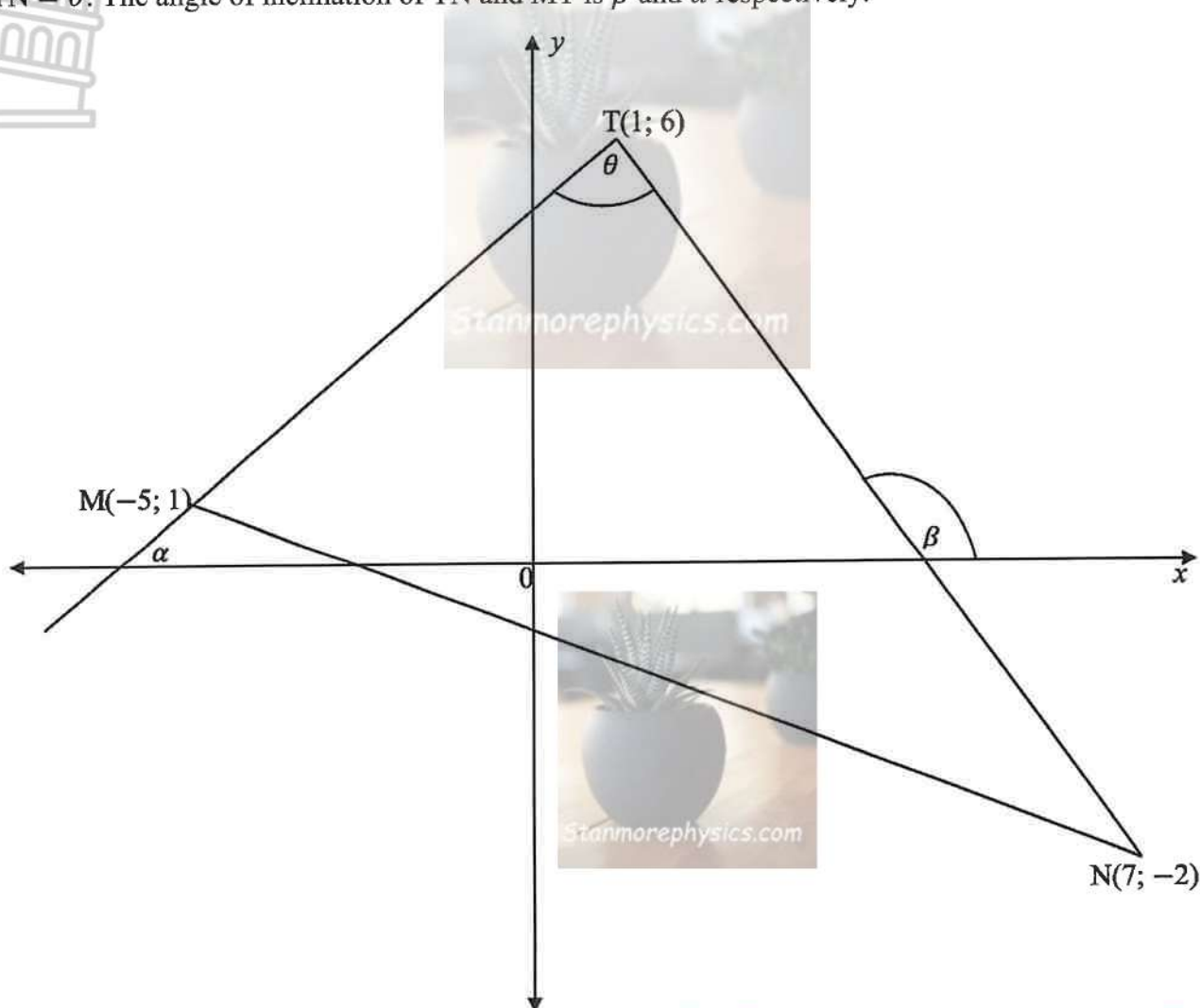
(1)

2.3	Determine the interquartile range of the data.	(3)
2.4	The owner plans a sale on all T-shirts for adults over 50, which is expected to increase sales in this category. Describe the effect that this will have on the ogive.	(2)
		[8]

QUESTION 3

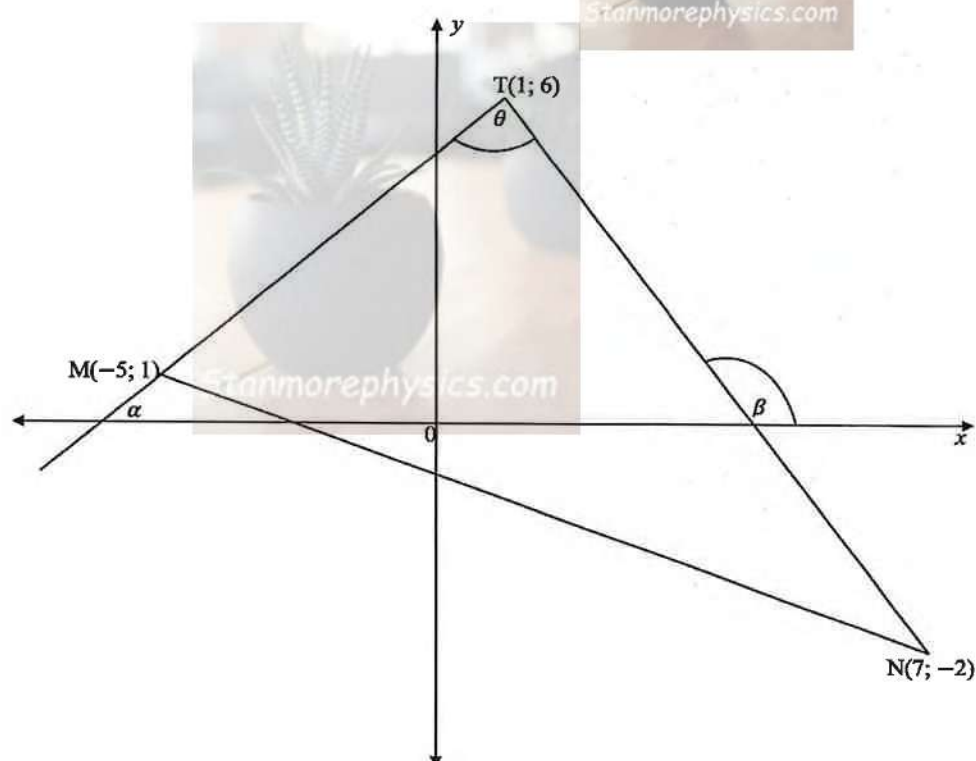
$M(-5; 1)$, $T(1; 6)$ and $N(7; -2)$ are the vertices of $\triangle MTN$, as show in the diagram below.

$\widehat{MTN} = \theta$. The angle of inclination of TN and MT is β and α respectively.



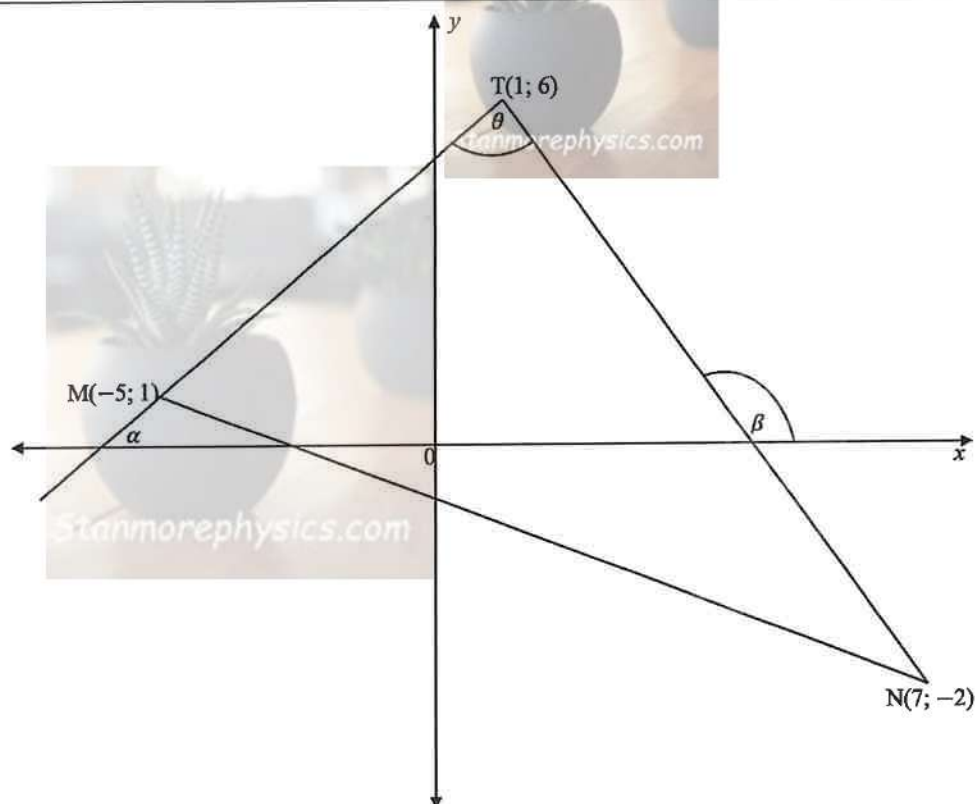
3.1	Calculate the length of MT.	(2)
3.2	Calculate the gradient of TN.	(2)

3.3	Determine the equation of TN.	(2)
3.4	Calculate the size of θ .	
		(4)



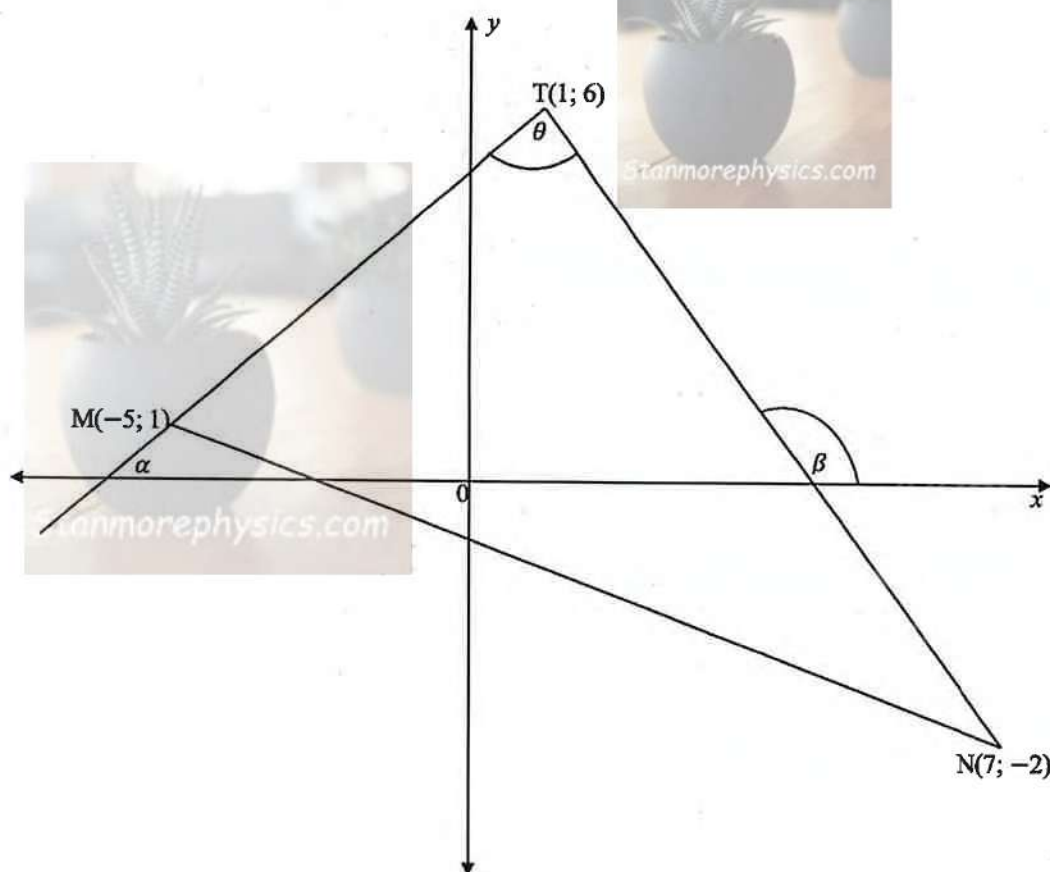
3.5 $P(r; 9)$ is a point in the first quadrant such that $TN \perp TP$. Calculate the value of r .

(3)



3.6 Determine the equation of the circle passing through points T, N and P.

(4)
[17]



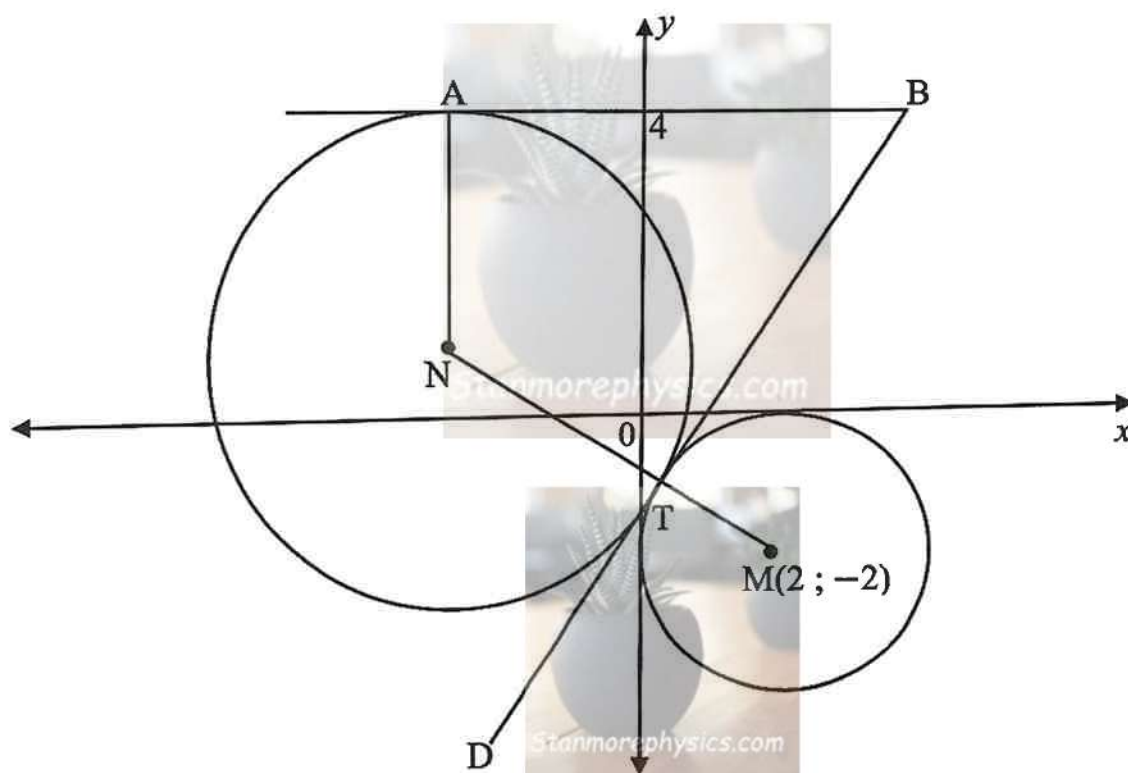
QUESTION 4

In the diagram below, N is the centre of the larger circle defined by $x^2 + y^2 + 4x - 2y + k = 0$.

AB is a tangent to the circle with centre N at point A and is parallel to the x -axis.

A second circle with centre M(2 ; -2) and radius of 2 units is drawn.

Both circles touch externally at point T and DTB is a common tangent to both circles.

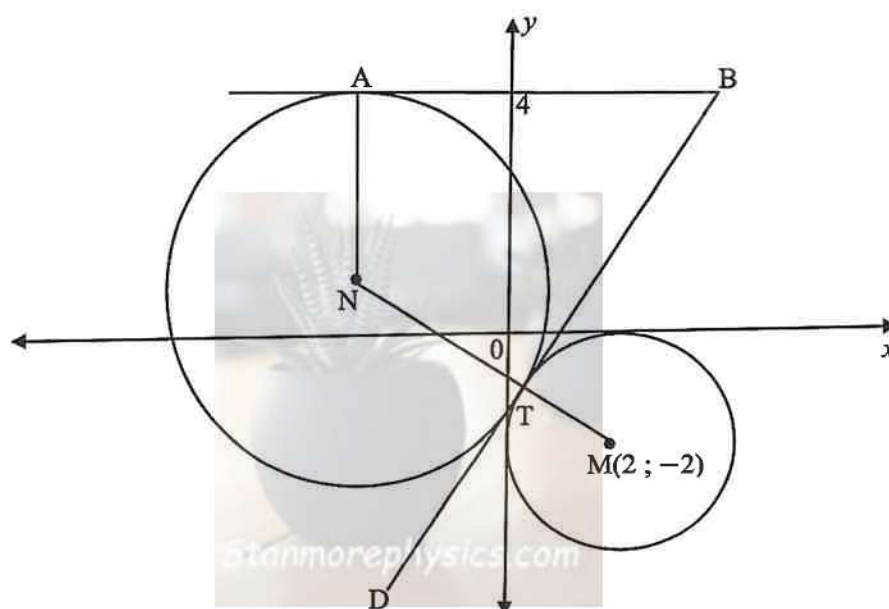


4.1	Determine the radius of the circle with centre N in terms of k .	(3)
4.2	Write down the coordinates of N.	(2)
4.3	Calculate the length of NM.	(2)

4.4	Calculate the value of k . 	(3)
4.5	If the coordinates of T are $\left(\frac{2}{5}; -\frac{4}{5}\right)$, show that the coordinates of B, are $(4; 4)$.  	(6)

- 4.6 The circle centred M is translated 3 units up to form circle M'.
Calculate the area of quadrilateral ANM'B.

(5)
[21]



QUESTION 5

5.1	Given: $\sin 2\theta = \frac{\sqrt{17}}{9}$, where $2\theta \in [0^\circ; 90^\circ]$. Without using a calculator , determine the value of:	
5.1.1	$\cos 2\theta$	(2)
5.1.2	$\sin(2\theta - 45^\circ)$	(3)
5.1.3	$\cos \theta$	(3)

5.2	Given: $\sin 18^\circ = p$ Without using a calculator , determine EACH of the following in terms of p :	
5.2.1	$\sin 198^\circ$	(2)
5.2.2	$\tan 522^\circ$	(3)
5.2.3	$\sin 9^\circ \cos 9^\circ$	(3)

[16]

6.1

$$\frac{\sin 100^\circ \tan^2 225^\circ}{\cos 10^\circ \sin 30^\circ}$$

6.2

$$\frac{\cos^2 \theta - \cos \theta - \sin^2 \theta}{2 \sin \theta \cos \theta + \sin \theta} = \frac{1}{\tan \theta} - \frac{1}{\sin \theta}$$

P.T.O.

6.3 If $\sin 76^\circ = x$ and $\cos 76^\circ = y$, show that $x^2 - y^2 = \sin 62^\circ$.

(4)

[12]

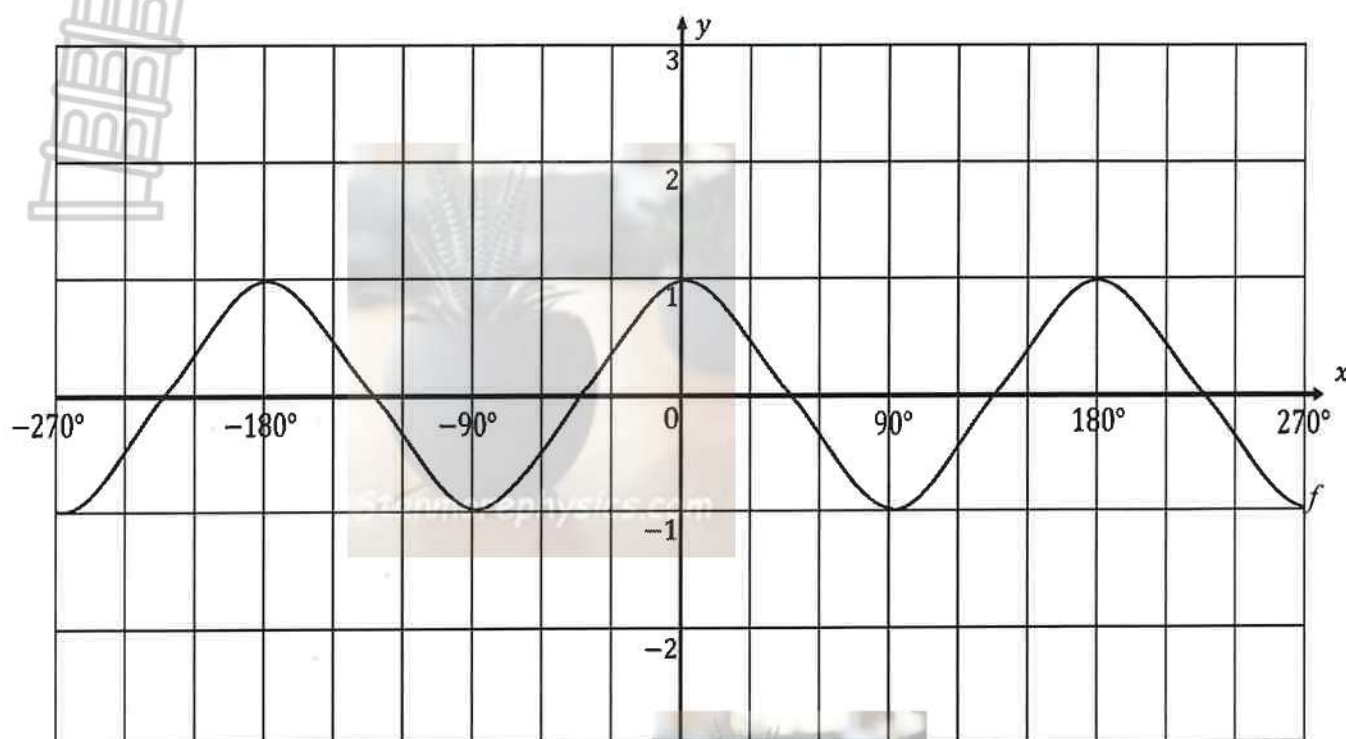


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QUESTION 7

In the diagram below, the graph of $f(x) = \cos 2x$ for the interval $x \in [-270^\circ; 270^\circ]$ is drawn.



7.1	Write down the period of f .	
		(1)
7.2	Write down the range of $3f(x)$.	
		(2)
7.3	On the same set of axes as f above , sketch the graph of $g(x) = 1 - \sin x$. Show ALL turning points and intercepts with the axes.	(3)
7.4	Determine the general solution of $f(x) = g(x)$.	
		(6)

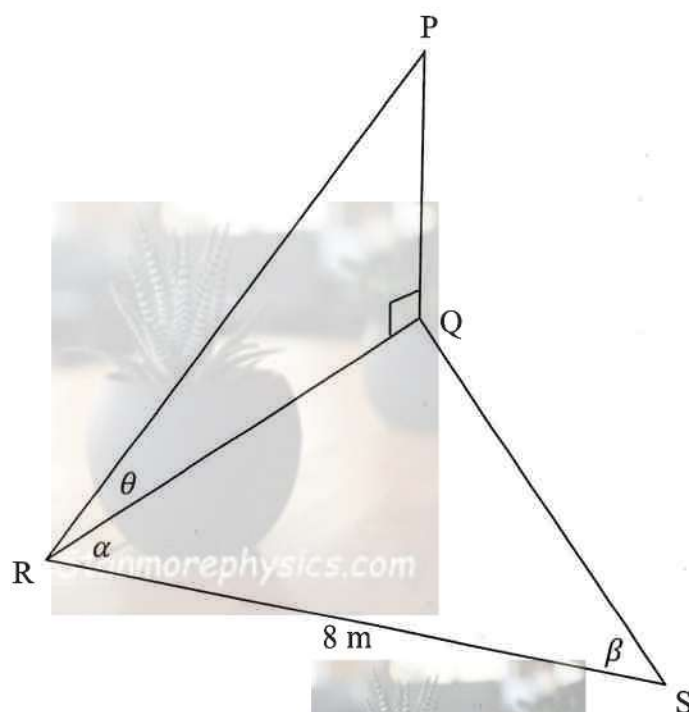
7.5	Determine the value(s) of x in the interval $0^\circ < x \leq 270^\circ$ for which:	
7.5.1	$f'(x) = 0$	(2)
7.5.2	$f(x + 30^\circ) - 1 = 0$	(1)

[15]



QUESTION 8

PQ is a vertical tower and the angle of elevation of P from R is θ . Points Q, R and S are in the same horizontal plane. $\widehat{QRS} = \alpha$, $\widehat{QSR} = \beta$ and $RS = 8$ metres



8.1	Express PQ in terms of QR and θ .	(2)
8.2	Show that $QR = \frac{8 \sin \beta}{\sin(\alpha + \beta)}$.	(2)

8.3	It is further given that $\alpha = \beta$. Prove that $PQ = \frac{4 \sin \theta}{\cos \beta \cos \theta}$.	
8.4	If $\beta = 67^\circ$ and $\theta = 25^\circ$, determine the length of PQ.	(4)

(2)

[10]

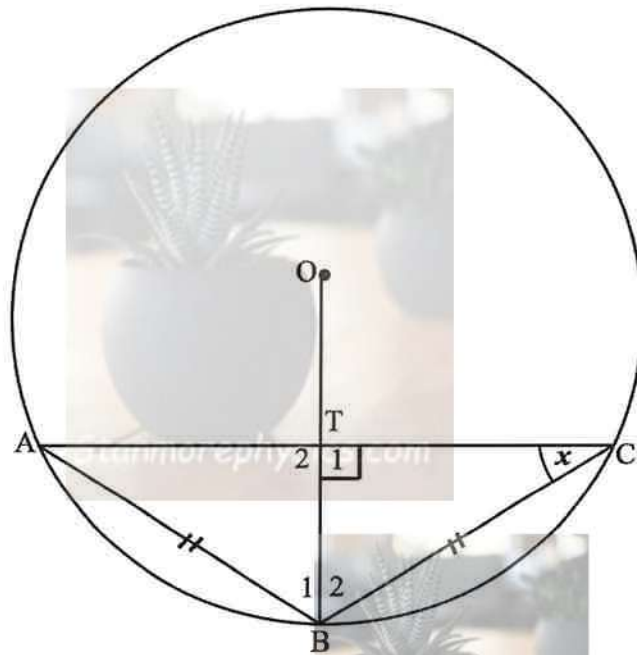
Provide reasons for your statements in QUESTIONS 9, 10 and 11.

QUESTION 9

In the diagram below, O is the centre of the circle A, B and C.

T is a point on OB such that $OB \perp AC$.

$AB = BC$ and $\widehat{TCB} = x$.



9.1	Write down the size of $\widehat{B}_2$ in terms of x .	(2)
9.2	Prove that OB bisects $\widehat{ABC}$.	(2)

9.3

It is further given that $OA = r$ and the ratio of $OT : TB$ is $1 : 3$. Determine the length of AC in terms of r .

(4)

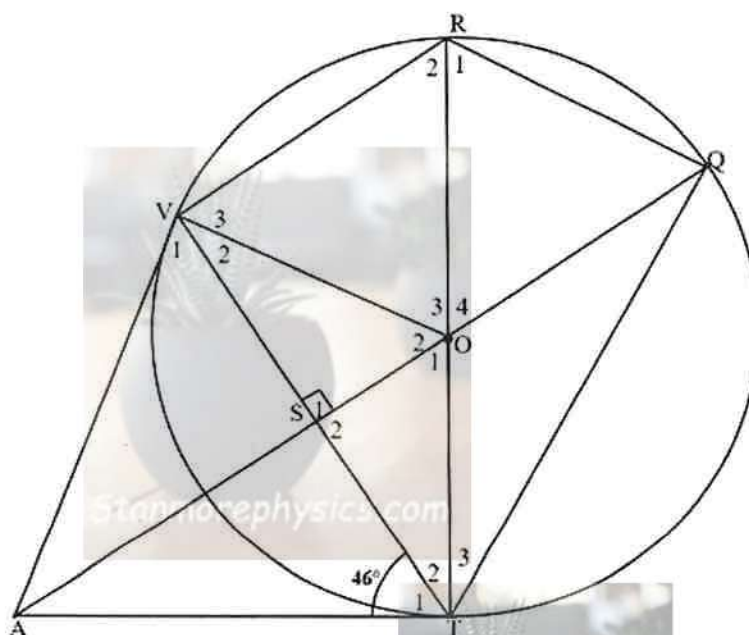
[8]

QUESTION 10

In the diagram below, R, Q, T and V are points on the circle with centre O.

AT is a tangent to the circle at T. QO is produced to A. S is a point on chord VT such that $OS \perp VT$.

OV and OT are joined. $\hat{T}_1 = 46^\circ$.



10.1	Calculate, with reasons, the size of the following angles:	
10.1.1	$\hat{R}_2$	(2)
10.1.2	$\hat{T}_3$	(5)

(2)



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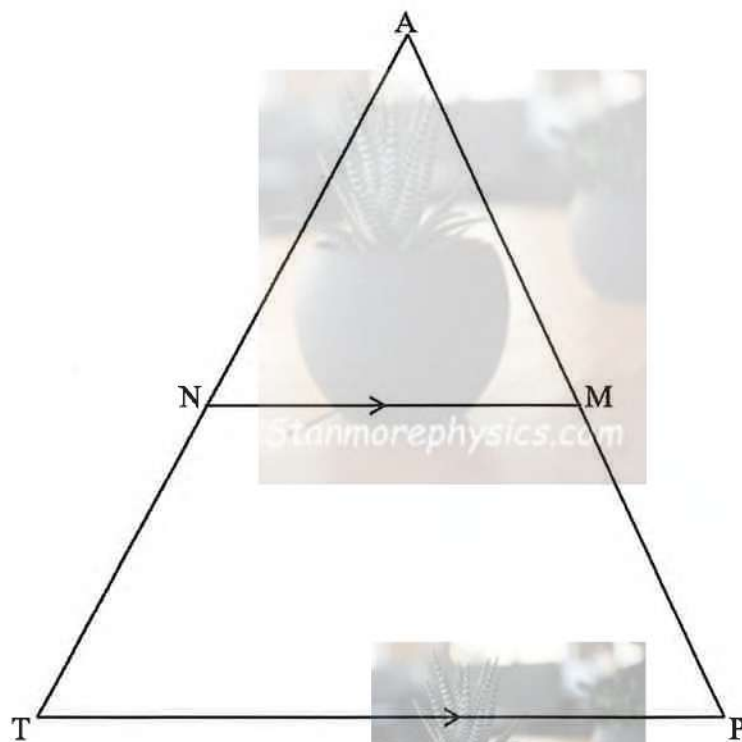
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QUESTION 11

- 11.1 In the diagram below $\triangle ATP$ is drawn. Line NM intersects AT and AP at N and M respectively such that $NM \parallel TP$.

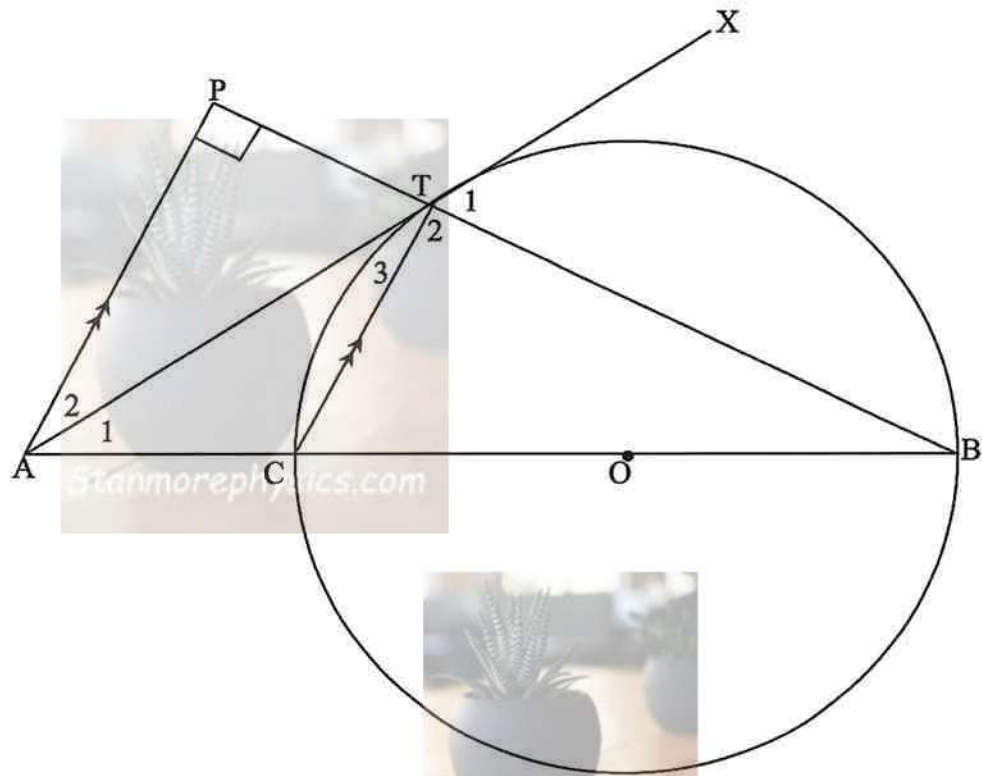


Use the diagram above to prove the theorem that states that a line drawn parallel to one side of a triangle divides the other two sides proportionally, that is, prove that $\frac{AN}{NT} = \frac{AM}{MP}$.

(5)

P.T.O.

- 11.2 In the diagram below, BC is a diameter of the circle with centre O. ATX is a tangent to the circle at T. BT is produced to P such that $BP \perp PA$. BC is produced to A. $PA \parallel TC$.



11.2.1 Prove that $\Delta\text{APT} \equiv \Delta\text{BPA}$.

(4)

11.2.2	Prove that $AC = \sqrt{\frac{PT \cdot CB}{3}}$, if $BT = 3AC$. 	(3)
11.2.3	Given that $\Delta TBC \parallel \Delta PBA$, prove that $PT = \frac{PB \cdot TC^2}{TB^2}$.  	(6)

[18]

ADDITIONAL SPACE



ADDITIONAL SPACE



ADDITIONAL SPACE



TOTAL: 150

END

INFORMATION SHEET

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

$$A = P(1 + ni)$$

$$A = P(1 - ni)$$

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

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

$$T_n = a + (n - 1)d$$

$$S_n = \frac{n}{2} [2a + (n - 1)d]$$

$$T_n = ar^{n-1}$$

$$S_n = \frac{a(r^n - 1)}{r - 1} ; r \neq 1$$

$$S_\infty = \frac{a}{1 - r} ; -1 < r < 1$$

$$F = \frac{x[(1 + i)^n - 1]}{i}$$

$$P = \frac{x[1 - (1 + i)^{-n}]}{i}$$

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

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$M\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$$

$$y = mx + c$$

$$y - y_1 = m(x - x_1)$$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$m = \tan \theta$$

$$(x - a)^2 + (y - b)^2 = r^2$$

In $\triangle ABC$:

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$\text{area } \triangle ABC = \frac{1}{2} ab \sin C$$

$$\sin(\alpha + \beta) = \sin \alpha \cos \beta + \cos \alpha \sin \beta$$

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

$$\sin(\alpha - \beta) = \sin \alpha \cos \beta - \cos \alpha \sin \beta$$

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

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

$$\sin 2\alpha = 2 \sin \alpha \cos \alpha$$

$$\bar{x} = \frac{\sum_{i=1}^n x_i}{n}$$

$$\sigma^2 = \frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n}$$

$$P(A) = \frac{n(A)}{n(S)}$$

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

$$\hat{y} = a + bx$$

$$b = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sum (x - \bar{x})^2}$$



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MARKING GUIDELINES

MATHEMATICS PAPER 2 (10612)

23 pages



INSTRUCTIONS AND INFORMATION**NOTE:**

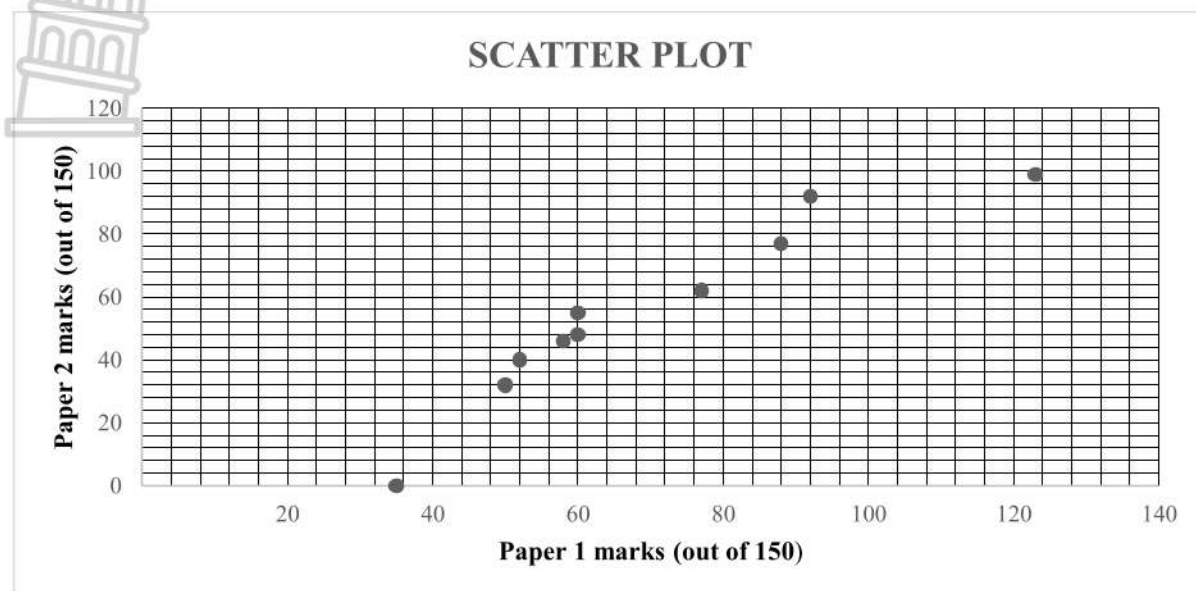
- If a candidate answers a question TWICE, only mark the FIRST attempt.
- If a candidate has crossed out an attempt to a question and not redone the question, mark the crossed out version.
- Consistent accuracy applies in ALL aspects of the marking guidelines. Stop marking at the second calculation error.
- Assuming answers/values to solve a problem is NOT acceptable.

GEOMETRY	
S	A mark for a correct statement (A statement mark is independent of a reason.)
R	A mark for a correct reason (A reason mark may only be awarded if the statement is correct.)
S/R	Award a mark if the statement AND reason are both correct.



QUESTION 1

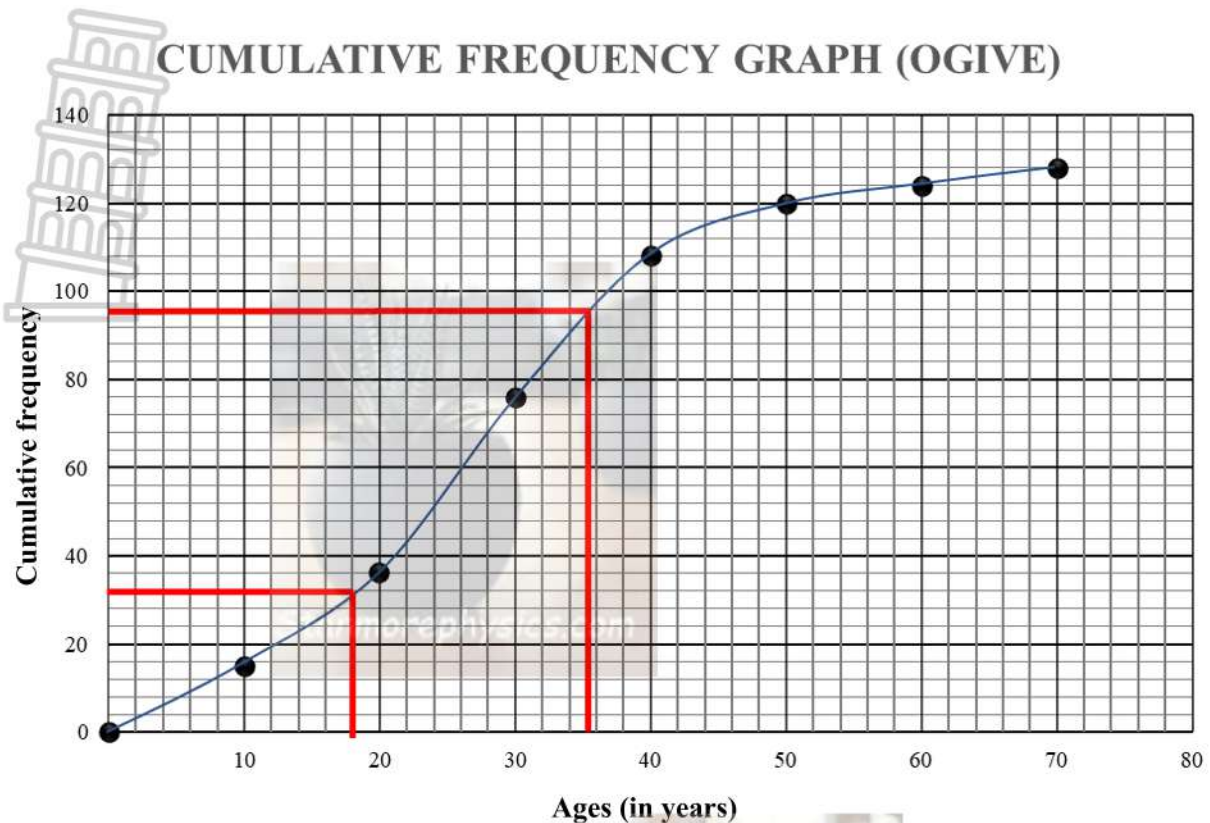
Paper 1 (out of 150 marks)	35	50	52	58	60	60	77	88	92	123
Paper 2 (out of 150 marks)	0	32	40	46	48	55	62	77	92	99



	SOLUTIONS	MARK DESCRIPTIONS	MARKS
1.1	$a = -19,86$ $b = 1,08$ $\therefore y = -19,86 + 1,08x$ Answer Only Full marks	$\checkmark a = -19,86$ $\checkmark b = 1,08$ $\checkmark$ equation	(3)
1.2	$r = 0,95$	$\checkmark r = 0,95$	(1)
1.3	Strong positive correlation	$\checkmark$ answer	(1)
1.4	$y = -19,86 + 1,08 (75)$ $y = 61,14$ OR $y = 61,03$ (calculator) Answer Only Full marks	$\checkmark$ substitution $\checkmark$ answer OR $\checkmark \checkmark$ answer	(2) (2)
1.5	$\sigma = 27,83$	$\checkmark$ answer	(1)
1.6.1	$\bar{x} = 69,5 + 4$ $\therefore \bar{x} = 73,5$	$\checkmark$ answer	(1)
1.6.2	The standard deviation will remain the same as all data changed with the same value.	$\checkmark$ answer	(1)
1.7	He ranked higher in paper 2. 52 is the first quartile for paper 1 and 51 is the median for paper 2, He ranked higher in paper 2. OR Using the given table, he ranked 8 th in paper 1 and 6 th in paper 2.	$\checkmark$ answer $\checkmark$ explanation	(2)

[12]

QUESTION 2

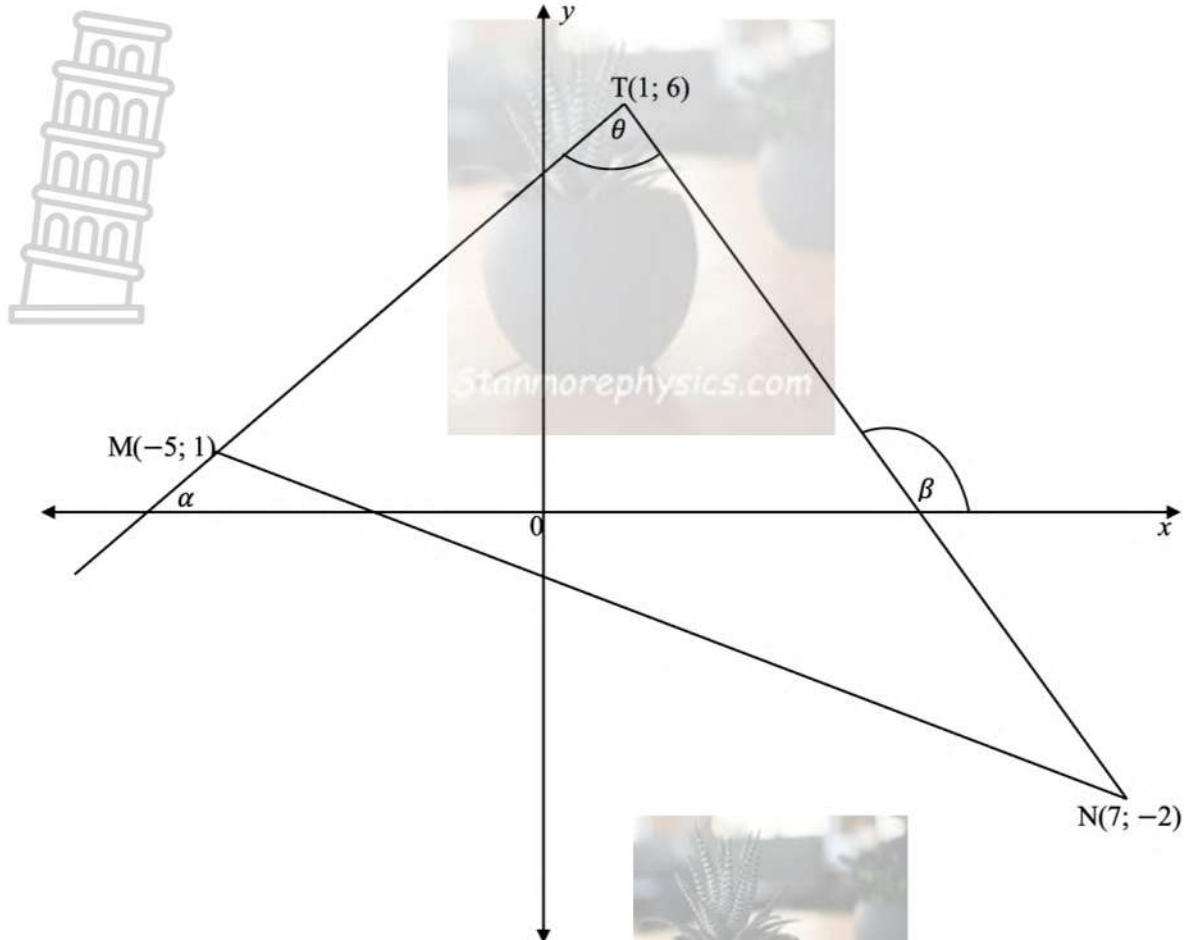


	SOLUTIONS		MARK DESCRIPTIONS	MARKS
2.1	Age groups:	Number of T-shirts Sold:	✓ 21; 40; 32	(2)
	$0 < x \leq 10$	15	✓ 12; 4; 4	
	$10 < x \leq 20$	21		
	$20 < x \leq 30$	40		
	$30 < x \leq 40$	32		
	$40 < x \leq 50$	12		
	$50 < x \leq 60$	4		
	$60 < x \leq 70$	4		

2.2	$20 < x \leq 30$	✓ answer	(1)
2.3	$Q_1 = 18$ $Q_3 = 35$ (Accept 36) $\therefore \text{IQR} = 35 - 18$ $= 17$ (Accept 18)	✓ 18 ✓ 35 ✓ answer	(3)
2.4	Cumulative graph will become steeper. OR The last two points will be higher.	✓ ✓ correct reason	(2)

[8]

QUESTION 3



	SOLUTIONS	MARK DESCRIPTIONS	MARKS
3.1	$MT = \sqrt{(1 + 5)^2 + (6 - 1)^2}$ $\therefore MT = \sqrt{61} = 7,81 \text{ units}$	✓ substitution ✓ answer	(2)
3.2	$m_{TN} = \frac{6+2}{1-7}$ $\therefore m_{TN} = -\frac{4}{3}$	✓ substitution ✓ answer	(2)

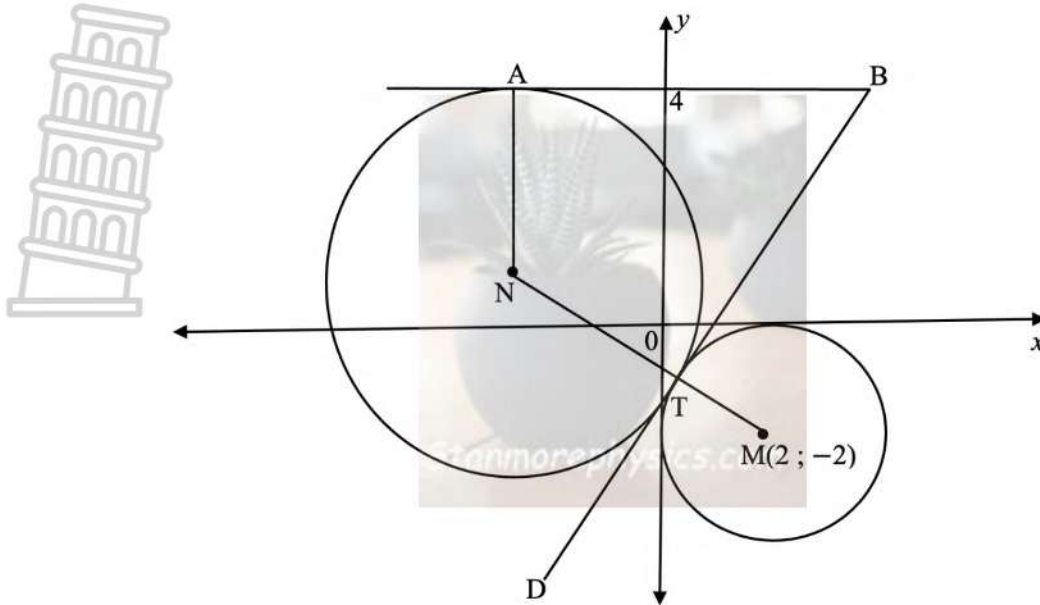
3.3	$y = -\frac{4}{3}x + c$ subs point T(1; 6) $6 = -\frac{4}{3}(1) + c$ $\therefore c = \frac{22}{3}$ OR $y - y_1 = -\frac{4}{3}(x - x_1)$ $y - 6 = -\frac{4}{3}(x - 1)$ $y - 6 = -\frac{4}{3}x + \frac{4}{3}$ $\therefore y = -\frac{4}{3}x + \frac{22}{3}$ $y = -\frac{4}{3}x + c$ subs point N(7; -2) $-2 = -\frac{4}{3}(7) + c$ $\therefore c = \frac{22}{3}$ OR $y - y_1 = -\frac{4}{3}(x - x_1)$ $y - (-2) = -\frac{4}{3}(x - 7)$ $y + 2 = -\frac{4}{3}x + \frac{28}{3}$ $\therefore y = -\frac{4}{3}x + \frac{22}{3}$	✓ substitution of gradient and point T(1; 6) ✓ answer OR (2) ✓ substitution of gradient and point N(7; -2) ✓ answer (2)
3.4	$\tan \beta = -\frac{4}{3}$ $\therefore \beta = 126,87^\circ$ $m_{TM} = \frac{6-1}{1+5}$ $\therefore m_{TM} = \frac{5}{6}$ $\tan \alpha = \frac{5}{6}$ $\therefore \alpha = 39,81^\circ$ $\theta = 126,87^\circ - 39,81^\circ$ [ext $\angle$ of a Δ] $\therefore \theta = 87,06^\circ$ OR $MN^2 = MT^2 + NT^2 - 2(MT)(NT)\cos \theta$ $153 = 61 + 100 - 2(\sqrt{61})(\sqrt{100})\cos \theta$ $-8 = 20\sqrt{61}\cos \theta$ $\cos \theta = \frac{-8}{20\sqrt{61}}$ $\theta = 87,06^\circ$	✓ value of β ✓ $m_{TM} = \frac{5}{6}$ ✓ value of α ✓ answer (4) OR ✓ correct use of cosine rule ✓ MN & NT ✓ simplification ✓ answer (4)

3.5	$m_{TN} \times m_{TP} = -1$ $\therefore m_{TP} = \frac{3}{4}$ $\frac{3}{4} = \frac{9-6}{r-1}$ $3r-3 = 12$ $3r = 15$ $r = 5$ OR $m_{TP} = \frac{9-6}{r-1}$ $\therefore m_{TP} = \frac{3}{r-1}$ $m_{TN} \times m_{TP} = -1$ $\therefore \left(-\frac{4}{3}\right) \times \left(\frac{3}{r-1}\right) = -1$ $\frac{-12}{3r-3} = -1$ $-3r+3 = -12$ $-3r = -15$ $\therefore r = 5$ OR $m_{TN} = -\frac{4}{3}$ $m_{TN} \times m_{TP} = -1$ $\therefore m_{TP} = \frac{3}{4}$ $y-6 = \frac{3}{4}(x-1)$ $y = \frac{3}{4}x + \frac{21}{4}$ $(r; 9)$ $9 = \frac{3}{4}r + \frac{21}{4}$ $\frac{3}{4}r = \frac{15}{4}$ $r = 5$	$\checkmark m_{TP} = \frac{3}{4}$ $\checkmark$ correct substitution into gradient formula $\checkmark$ answer OR $\checkmark m_{TP} = \frac{9-6}{r-1}$ $\checkmark \left(-\frac{4}{3}\right) \times \left(\frac{3}{r-1}\right) = -1$ $\checkmark$ answer OR $\checkmark$ substituting m and point T $\checkmark$ substitution of point P $\checkmark$ answer	(3) (3) (3)
-----	---	---	----------------------------------

3.6	$\widehat{NTP} = 90^\circ$ [given] $\therefore$ PN is a diameter [conv $\angle$ in semi circle/ chord subtends 90°] P(5; 9) N(7; -2) $x = \frac{5 + 7}{2} \quad y = \frac{9 - 2}{2}$ $x = 6 \quad y = \frac{7}{2}$ $\therefore$ Centre of the circle is $\left(6; \frac{7}{2}\right)$ $PN = \sqrt{(7 - 5)^2 + (-2 - 9)^2}$ $\therefore$ PN = $5\sqrt{5}$ units $\therefore r = \frac{5\sqrt{5}}{2}$ units $\therefore r^2 = \frac{125}{4}$ $\therefore (x - 6)^2 + \left(y - \frac{7}{2}\right)^2 = \frac{125}{4}$	✓ identifying PN as diameter ✓ coordinates of centre ✓ r^2 ✓ equation of the circle	(4)
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[17]

QUESTION 4



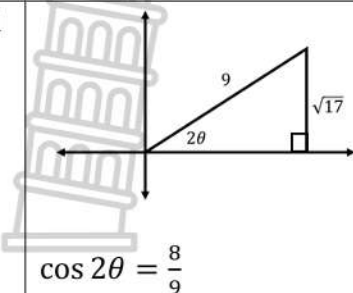
	SOLUTIONS	MARK DESCRIPTIONS	MARKS
4.1	$x^2 + 4x + y^2 - 2y = -k$ $x^2 + 4x + 4 + y^2 - 2y + 1 = 4 + 1 - k$ $(x + 2)^2 + (y - 1)^2 = 5 - k$ Radius: $r = \sqrt{5 - k}$	✓ $-k$ ✓ r^2 ✓ answer	(3)
4.2	N(-2; 1)	✓ x - value ✓ y - value	(2)
4.3	$NM = \sqrt{(2 + 2)^2 + (-2 - 1)^2}$ NM = 5 units	Answer Only Full marks ✓ substitution ✓ answer	(2)
4.4	NT = 5 - 2 = 3 $\sqrt{5 - k} = 3$ $5 - k = 9$ $\therefore k = -4$ OR MN = TN + TM $5 = \sqrt{5 - k} + 2$ $(\sqrt{5 - k})^2 = (3)^2$ $5 - k = 9$ $\therefore k = -4$	✓ NT = 3 ✓ equating ✓ answer ✓ applying rule for circle ✓ squaring both sides ✓ answer	(3)

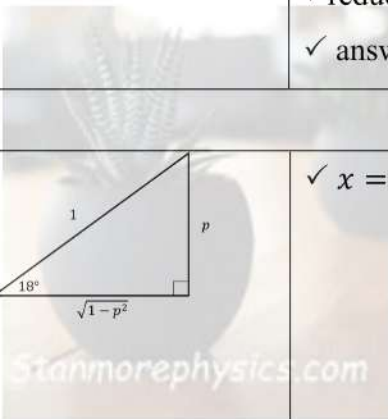
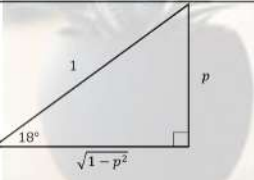
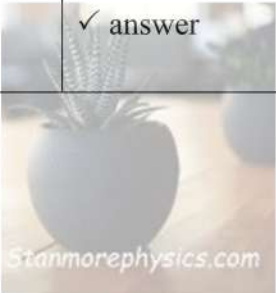
4.5	$m_{TM} = \frac{-2 + \frac{4}{5}}{2 - \frac{2}{5}}$ OR $m_{NT} = \frac{1 + \frac{4}{5}}{-2 - \frac{2}{5}}$ $\therefore m_{TM} = -\frac{3}{4}$ $\therefore m_{NT} = -\frac{3}{4}$ $m_{TM} \times m_{BT} = -1$ $m_{NT} \times m_{BT} = -1$ $\therefore m_{BT} = \frac{4}{3}$ $\frac{4}{3} = \frac{4 + \frac{4}{5}}{x - \frac{2}{5}}$ $4x - \frac{8}{5} = \frac{72}{5}$ $4x = 16$ $x = 4$ $y = 4$ OR $m_{TM} = \frac{-2 + \frac{4}{5}}{2 - \frac{2}{5}}$ OR $m_{NT} = \frac{1 + \frac{4}{5}}{-2 - \frac{2}{5}}$ $\therefore m_{TM} = -\frac{3}{4}$ $\therefore m_{NT} = -\frac{3}{4}$ $m_{TM} \times m_{BT} = -1$ $m_{NT} \times m_{BT} = -1$ $\therefore m_{BT} = \frac{4}{3}$ $y = \frac{4}{3}x + c$ subs point T $\left(\frac{2}{5}; -\frac{4}{5}\right)$ $-\frac{4}{5} = \frac{4}{3}\left(\frac{2}{5}\right) + c$ OR $y + \frac{4}{5} = \frac{4}{3}\left(x - \frac{2}{5}\right)$ $\therefore c = -\frac{4}{3}$ $y = \frac{4}{3}x - \frac{4}{3}$ $y = \frac{4}{3}x - \frac{4}{3}$ (1) $y = 4$ (2) $\frac{4}{3}x - \frac{4}{3} = 4$ $4x - 4 = 12$ $4x = 16$ $\therefore x = 4$ $\therefore B(4; 4)$ OR	$\checkmark m_{TM} = -\frac{3}{4}$ or $m_{NT} = -\frac{3}{4}$ $\checkmark m_{BT} = \frac{4}{3}$ $\checkmark$ value of y $\checkmark$ substitution into gradient formula $\checkmark$ simplify $\checkmark$ value of x OR $\checkmark m_{TM} = -\frac{3}{4}$ or $m_{NT} = -\frac{3}{4}$ $\checkmark m_{BT} = \frac{4}{3}$ $\checkmark y = 4$ $\checkmark$ substitute gradient and point T $\checkmark y = \frac{4}{3}x - \frac{4}{3}$ $\checkmark$ simplification OR	(6) (6)
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	AB = BR tangent from same point $y = 4$ $\sqrt{(-2-x)^2 + (4-4)^2} = \sqrt{\left(x - \frac{2}{5}\right)^2 + \left(4 + \frac{4}{5}\right)^2}$ $4 + 4x + x^2 = x^2 - \frac{4}{5}x + \frac{4}{25} + \frac{576}{25}$ $\frac{24}{5}x = \frac{96}{5}$ $x = 4$	✓ AB = BR ✓ $y = 4$ ✓ substitution for AB ✓ substitution for BR ✓ simplification ✓ simplification	(6)
4.6	$M' (2; 1)$ AB = 6 units NM' = 4 units AN = 3 units Area of trapezium = $\frac{1}{2} (AB + NM')AN$ $= \frac{1}{2} (6 + 4)3$ = 15 square units	✓ $M' (2; 1)$ ✓ length of AB ✓ length of NM' and AN ✓ substitution into the formula ✓ answer	(5)

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QUESTION 5

	SOLUTIONS	MARK DESCRIPTIONS	MARKS
5.1.1	 $\cos 2\theta = \frac{8}{9}$ $x^2 = 9^2 - (\sqrt{17})^2$ $x^2 = 64$ $x = 8$	✓ $x = 8$ ✓ answer	(2)
5.1.2	$\sin(2\theta - 45^\circ) = \sin 2\theta \cos 45^\circ - \cos 2\theta \sin 45^\circ$ $= \left(\frac{\sqrt{17}}{9}\right)\left(\frac{\sqrt{2}}{2}\right) - \left(\frac{8}{9}\right)\left(\frac{\sqrt{2}}{2}\right)$ $= \frac{\sqrt{34}}{18} - \frac{8\sqrt{2}}{18}$ $= \frac{\sqrt{34} - 8\sqrt{2}}{18}$	✓ correct compound expansion ✓ substitution ✓ answer	(3)
5.1.3	$\cos 2\theta = 2 \cos^2 \theta - 1$ $2 \cos^2 \theta = \cos 2\theta + 1$ $\cos \theta = \sqrt{\frac{\cos 2\theta + 1}{2}}$ $= \sqrt{\frac{\left(\frac{8}{9}\right) + 1}{2}}$ $= \frac{\sqrt{34}}{6} \text{ or } \sqrt{\frac{17}{18}}$ OR $\cos 2\theta = 2 \cos^2 \theta - 1$ $\frac{8}{9} = 2 \cos^2 \theta - 1$ $\frac{17}{9} = 2 \cos^2 \theta$ $\frac{17}{18} = \cos^2 \theta$ $\therefore \cos \theta = \sqrt{\frac{17}{18}}$	 ✓ substitution of $\cos 2\theta$ ✓ answer OR ✓ double angle ✓ substitution of $\cos 2\theta$ ✓ answer	(3)

5.2.1	$\sin 198^\circ = \sin(180^\circ + 18^\circ)$ $= -\sin 18^\circ$ $= -p$	 ✓ reduction ✓ answer	(2)
5.2.2	$x^2 = 1^2 - p^2$ Pyth $x = \sqrt{1 - p^2}$ $\tan 522^\circ = \tan 162^\circ$ $= -\tan 18^\circ$ $= -\frac{p}{\sqrt{1-p^2}}$	 $\checkmark x = \sqrt{1 - p^2}$ $\checkmark -\tan 18^\circ$ $\checkmark$ answer	(3)
5.2.3	$\sin 9^\circ \cos 9^\circ = \frac{1}{2} (2 \sin 9^\circ \cos 9^\circ)$ $= \frac{1}{2} \sin 2(9^\circ)$ $= \frac{1}{2} \sin 18^\circ$ $= \frac{p}{2}$	 $\checkmark \frac{1}{2} (2 \sin 9^\circ \cos 9^\circ)$ $\checkmark \frac{1}{2} \sin 18^\circ$ $\checkmark$ answer	(3)

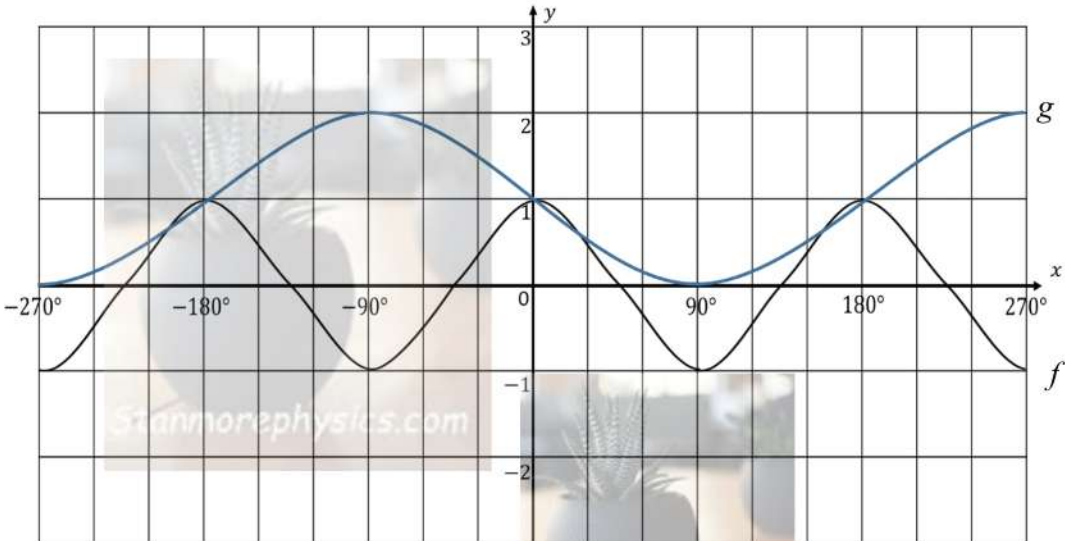
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QUESTION 6

	SOLUTIONS	Mark descriptions	Marks
6.1	$\frac{\sin 100^\circ \tan^2 225^\circ}{\cos 10^\circ \sin 30^\circ}$ $= \frac{\cos 10^\circ \tan^2 45^\circ}{\cos 10^\circ \sin 30^\circ} \quad \text{OR} \quad = \frac{\sin 80^\circ \tan^2 45^\circ}{\sin 80^\circ \sin 30^\circ}$ $= \frac{1}{\frac{1}{2}}$ $= 2$	✓ $\cos 10^\circ / \sin 80^\circ$ ✓ $\tan 45^\circ$ ✓ substitution ✓ answer	(4)
6.2	$\text{LHS} = \frac{\cos^2 \theta - \cos \theta - \sin^2 \theta}{2 \sin \theta \cos \theta + \sin \theta}$ $= \frac{\cos^2 \theta - \cos \theta - (1 - \cos^2 \theta)}{\sin \theta (2 \cos \theta + 1)}$ $= \frac{2 \cos^2 \theta - \cos \theta - 1}{\sin \theta (2 \cos \theta + 1)}$ $= \frac{(2 \cos \theta + 1)(\cos \theta - 1)}{\sin \theta (2 \cos \theta + 1)}$ $= \frac{\cos \theta - 1}{\sin \theta}$ $= \frac{\cos \theta}{\sin \theta} - \frac{1}{\sin \theta}$ $= \frac{1}{\tan \theta} - \frac{1}{\sin \theta}$ OR $\text{RHS: } \frac{1}{\tan \theta} - \frac{1}{\sin \theta}$ $= \frac{\cos \theta}{\sin \theta} - \frac{1}{\sin \theta}$ $= \frac{\cos \theta - 1}{\sin \theta}$ $\text{LHS: } = \frac{\cos^2 \theta - \cos \theta - \sin^2 \theta}{2 \sin \theta \cos \theta + \sin \theta}$ $= \frac{\cos^2 \theta - \cos \theta - (1 - \cos^2 \theta)}{\sin \theta (2 \cos \theta + 1)}$ $= \frac{2 \cos^2 \theta - \cos \theta - 1}{\sin \theta (2 \cos \theta + 1)}$ $= \frac{(2 \cos \theta + 1)(\cos \theta - 1)}{\sin \theta (2 \cos \theta + 1)}$ $= \frac{\cos \theta - 1}{\sin \theta}$	✓ $1 - \cos^2 \theta$ ✓ $\sin \theta (2 \cos \theta + 1)$ ✓ $(2 \cos \theta + 1)(\cos \theta - 1)$ ✓ $\frac{\cos \theta - 1}{\sin \theta}$ ✓ $\frac{\cos \theta - 1}{\sin \theta}$ ✓ $1 - \cos^2 \theta$ ✓ $\sin \theta (2 \cos \theta + 1)$ ✓ $(2 \cos \theta + 1)(\cos \theta - 1)$	(4)

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QUESTION 7

	SOLUTIONS	MARK DESCRIPTIONS	MARKS
7.1	180°	✓ 180°	(1)
7.2	$y \in [-3; 3]$ OR $-3 \leq y \leq 3$	✓✓ answer OR ✓✓ answer	(2) (2)
7.3	✓ turning points ✓ intercepts ✓ shape 		(3)
7.4	$\cos 2x = 1 - \sin x$ $1 - 2 \sin^2 x = 1 - \sin x$ $2 \sin^2 x - \sin x = 0$ $\sin x (2 \sin x - 1) = 0$ $\sin x = 0 \quad \text{or} \quad 2 \sin x - 1 = 0$ $\sin x = \frac{1}{2}$ For $\sin x = 0$: $x = k \cdot 180^\circ; k \in \mathbb{Z}$ or $x = k \cdot 360^\circ; k \in \mathbb{Z} \quad \text{or} \quad x = 180^\circ + k \cdot 360^\circ; k \in \mathbb{Z}$ For $\sin x = \frac{1}{2}$: $x = 30^\circ + k \cdot 360^\circ; k \in \mathbb{Z}$ or $x = 150^\circ + k \cdot 360^\circ; k \in \mathbb{Z}$	✓ $\cos 2x = 1 - 2 \sin^2 x$ ✓ standard form ✓ both equations for $\sin x$ ✓ $x = k \cdot 180^\circ; k \in \mathbb{Z}$ $x = k \cdot 360^\circ; k \in \mathbb{Z} \quad \text{or}$ $x = 180^\circ + k \cdot 360^\circ; k \in \mathbb{Z}$ ✓ $x = 30^\circ \text{ \& } 150^\circ$ ✓ $k \cdot 360^\circ \quad k \in \mathbb{Z}$	(6)

7.5.1	$x \in \{90^\circ; 180^\circ; 270^\circ\}$	$\checkmark 90^\circ; 180^\circ \checkmark 270^\circ$	(2)
7.5.2	$x = 150^\circ$	$\checkmark$ answer	(1)

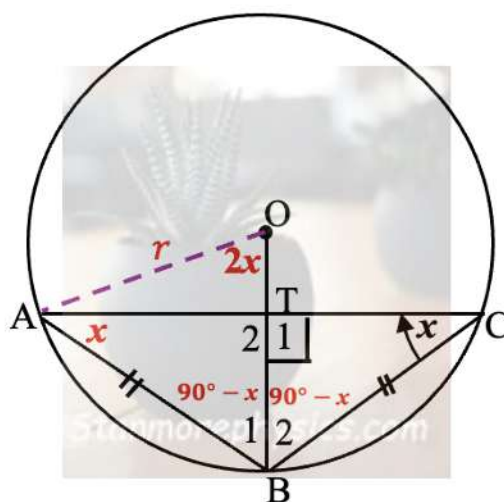
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QUESTION 8

	SOLUTIONS	MARK DESCRIPTIONS	MARKS
8.1	$\tan \theta = \frac{PQ}{QR}$ $PQ = QR \tan \theta$	$\checkmark$ correct trig ratio $\checkmark$ answer	(2)
8.2	$\frac{QR}{\sin \beta} = \frac{8}{\sin(180^\circ - (\alpha + \beta))}$ $QR = \frac{8 \sin \beta}{\sin(\alpha + \beta)}$	$\checkmark$ correct use of sine rule $\checkmark \hat{Q} = 180^\circ - (\alpha + \beta)$	(2)
8.3	$PQ = QR \tan \theta$ $PQ = \frac{8 \sin \beta}{\sin(\alpha + \beta)} \times \tan \theta$ $PQ = \frac{8 \sin \beta}{\sin 2\beta} \times \frac{\sin \theta}{\cos \theta}$ $PQ = \frac{8 \sin \beta \sin \theta}{2 \sin \beta \cos \beta \cos \theta}$ $PQ = \frac{4 \sin \theta}{\cos \beta \cos \theta}$	$\checkmark$ substitution of QR $\checkmark \frac{\sin \theta}{\cos \theta}$ $\checkmark \sin 2\beta$ $\checkmark \sin 2\beta = 2 \sin \beta \cos \beta$	(4)
8.4	$PQ = \frac{4 \sin \theta}{\cos \beta \cos \theta}$ $PQ = \frac{4 \sin 25^\circ}{\cos 67^\circ \cos 25^\circ}$ $PQ = 4,77\text{m}$	$\checkmark$ correct substitution of θ and β $\checkmark$ answer	(2)

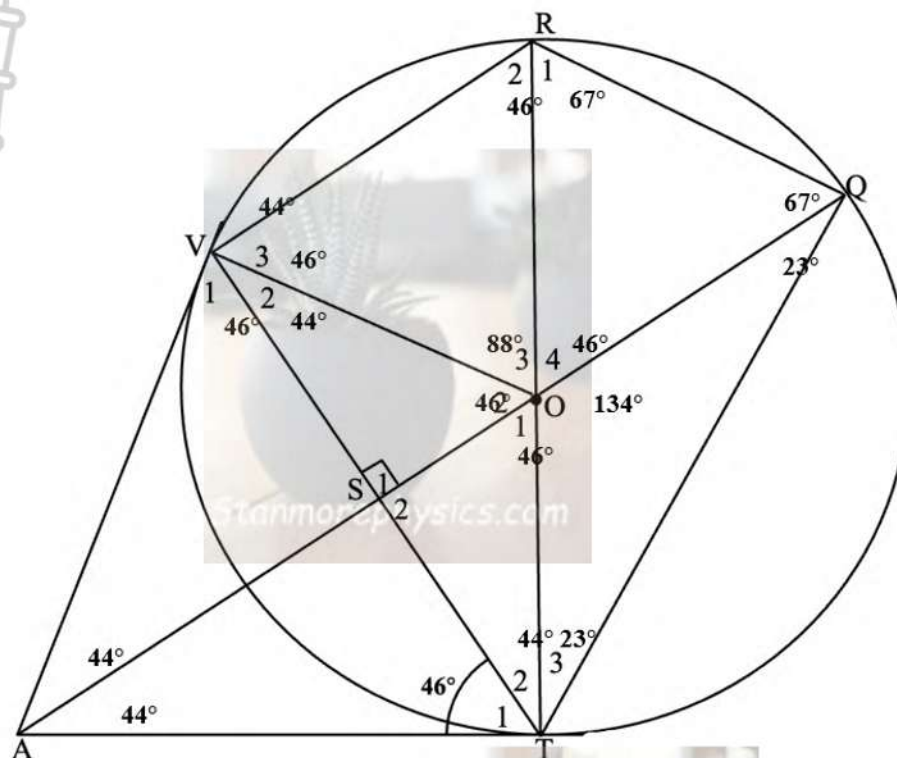
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QUESTION 9



	SOLUTIONS	MARK DESCRIPTIONS	MARKS
9.1	$\hat{B}_2 = 90^\circ - x$ [sum of angles of Δ]	✓ S ✓ R	(2)
9.2	$\hat{A} = \hat{C} = x$ [$\angle$ s opp equal sides] $\hat{B}_1 = \hat{B}_2 = 90^\circ - x$ [exterior $\angle$ of Δ] $\therefore \hat{B}_1 = \hat{B}_2$ $\therefore OB$ bisects $\widehat{ABC}$	✓ S ✓ S/R	(2)
9.3	$AT = TC$ [line from centre perpendicular to chord] In ΔAOT $OB = OA = r$ [radii] $\therefore OT = \frac{r}{4}$ $AT^2 = (r)^2 - \left(\frac{r}{4}\right)^2$ [Pythagoras] $AT^2 = r^2 - \frac{r^2}{16}$ $AT = \sqrt{\frac{15r^2}{16}}$ $\therefore AT = TC = \frac{\sqrt{15}}{4}r$ $\therefore AC = \frac{\sqrt{15}}{2}r$	✓ S/R ✓ $OT = \frac{r}{4}$ ✓ length of AT ✓ answer	(4)

[8]

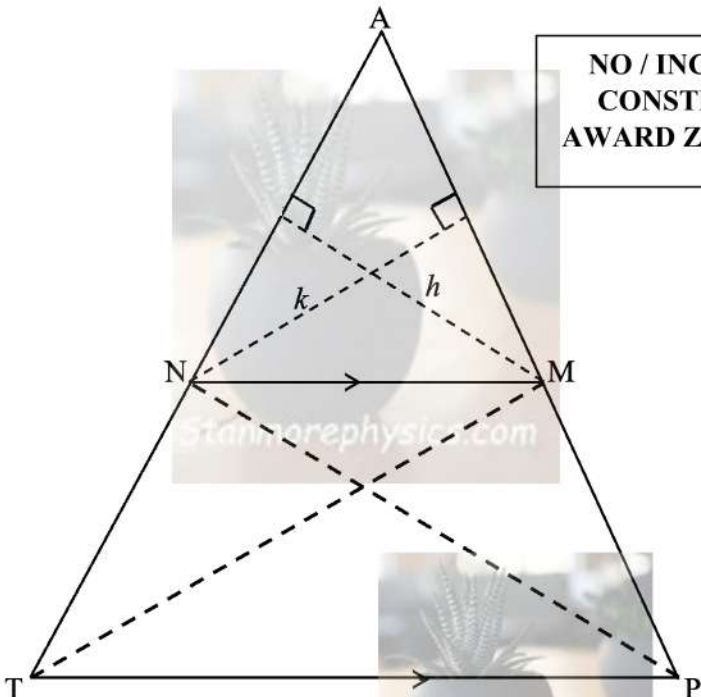


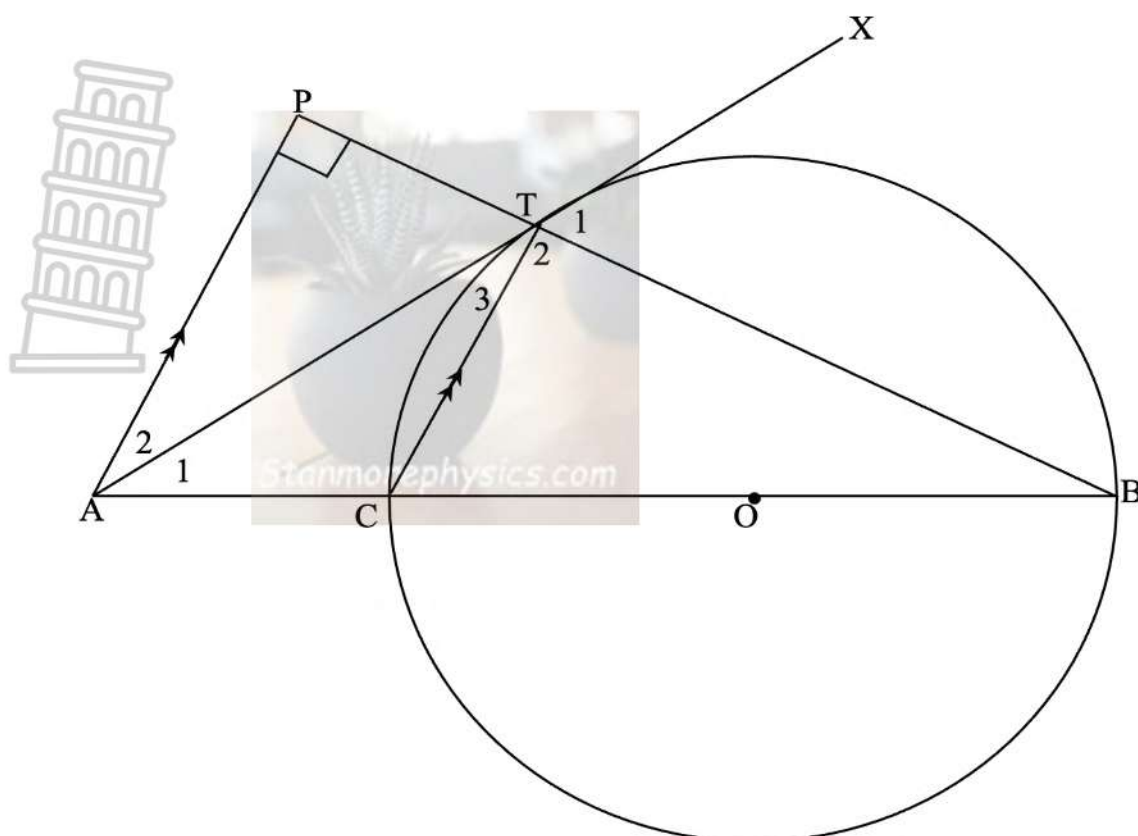
	SOLUTIONS	MARK DESCRIPTIONS	MARKS
10.1.1	$\widehat{R}_2 = 46^\circ$ [tan chord theorem]	✓ S ✓ R	(2)
10.1.2	$\widehat{T}_1 + \widehat{T}_2 = 90^\circ$ [tangent $\perp$ radius OR tangent $\perp$ diameter] $\widehat{T}_2 = 44^\circ$ $\therefore \widehat{O}_1 = 46^\circ$ [ext $\angle$ of Δ] $\widehat{O}_4 = 46^\circ$ [vert opp $\angle$ s] $\therefore \widehat{T}_3 = 23^\circ$ [$\angle$ at centre = $2 \times \angle$ at circumference] OR $\widehat{V}_2 + \widehat{V}_3 = 90^\circ$ [$\angle$ s in a semi circle] $\widehat{V}_2 + \widehat{V}_3 + \widehat{S}_1 = 90^\circ$ $\therefore RV \parallel SO$ [co-int $\angle$ s sup] $\widehat{O}_4 = 46^\circ$ [alt $\angle$ s; $RV \parallel SO$] $\widehat{T}_3 = 23^\circ$ [$\angle$ at centre = $2 \times \angle$ at circ]	✓ S/R ✓ S ✓ S ✓ R OR ✓ S/R ✓ S ✓ S ✓ S ✓ R	 (5) (5)

$\hat{S}_1 = 90^\circ$
 $\hat{O}_2 = 46^\circ$
 $\therefore \hat{O}_2 =$
 $\therefore \text{TAVO}$

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QUESTION 11

	SOLUTIONS	MARK DESCRIPTIONS	MARKS
11.1	Construction: In ΔATP, draw perpendicular height k with base AM and perpendicular height h with base AN. Join TM and NP. 		
	Proof: $\frac{\text{Area } \Delta ANM}{\text{Area } \Delta TNM} = \frac{\frac{1}{2} \cdot AN \cdot h}{\frac{1}{2} \cdot NT \cdot h}$ $= \frac{AN}{NT}$ $\frac{\text{Area } \Delta ANM}{\text{Area } \Delta PNM} = \frac{\frac{1}{2} \cdot AM \cdot k}{\frac{1}{2} \cdot MP \cdot k}$ $= \frac{AM}{MP}$ Area $\Delta ANM = \text{Area } \Delta ANM$ But Area $\Delta TNM = \text{Area } \Delta PMN$ (same base and height) $\therefore \frac{\text{Area } \Delta ANM}{\text{Area } \Delta TNM} = \frac{\text{Area } \Delta ANM}{\text{Area } \Delta PNM}$ $\therefore \frac{AN}{NT} = \frac{AM}{MP}$	✓ construction $\checkmark \frac{\text{Area } \Delta ANM}{\text{Area } \Delta TNM} = \frac{\frac{1}{2} \cdot AN \cdot h}{\frac{1}{2} \cdot NT \cdot h}$ $\checkmark \frac{AN}{NT}$ $\checkmark \frac{\text{Area } \Delta ANM}{\text{Area } \Delta PNM} = \frac{AM}{MP}$ ✓ S/R	(5)



	SOLUTIONS	MARK DESCRIPTIONS	MARKS
11.2.1	In ΔAPT and ΔBPA (i) $\hat{P} = \hat{P}$ [common] ✓ S (ii) $\hat{A}_2 = \hat{T}_3$ [alt. $\angle$s ; $PA \parallel TC$] ✓ S $\hat{T}_3 = \hat{B}$ [tan chord theorem] ✓ S/R $\therefore \hat{A}_2 = \hat{B}$ (iii) $\hat{ATP} = \hat{PAB}$ [sum of $\angle$s in Δ] ✓ 3rd S or R ($\angle \angle \angle$) $\therefore \Delta APT \parallel \Delta BPA$ [$\angle \angle \angle$]		(4)
11.2.2	$\frac{BT}{PT} = \frac{CB}{AC}$ [prop theorem; $PA \parallel TC$ / line $\parallel$ one side of Δ] $\frac{3AC}{PT} = \frac{CB}{AC}$ $3AC^2 = PT.CB$ $AC^2 = \frac{PT.CB}{3}$ $\therefore AC = \sqrt{\frac{PT.CB}{3}}$	✓ S ✓ R ✓ substitute $BT = 3AC$	(3)



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TOTAL: 150