GAUTENG PROVINCE

EDUCATION

REPUBLIC OF SOUTH AFRICA

PROVINCIAL EXAMINATION

NOVEMBER 2022

GRADE 11

MATHEMATICS

(PAPER 2)

TIME: 3 hours

MARKS: 150

14 pages and 4 answer sheets

P.T.O

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.

2. Clearly show ALL calculations, diagrams, graphs, et cetera 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. Where necessary, round off answers to TWO decimal places, unless stated otherwise.

6. Answer sheets for answering QUESTION 1.1, QUESTION 2.2, QUESTION 9.1 and QUESTION 11.1 are provided at the end of the question paper. Write your name in the spaces provided and submit them together with your ANSWER BOOK.

7. Diagrams are NOT necessarily drawn to scale.

8. Number the answers correctly according to the numbering system used in this question paper.

9. Write neatly and legibly.

QUESTION 1

The data below is the annual report from the local municipalities regarding the spending of money (in thousands of rands) on electricity.

250	266	277	287	287	259	306	315	294	329

1.1 Draw a box-and-whisker diagram of the data above on the attached ANSWER SHEET A. (3)

1.2 Comment on the skewness of the data. (1)

1.3 Calculate the standard deviation. (2)

1.4 How many municipalities are within one standard deviation of the mean? (3)

1.5 Determine the semi-interquartile range of the municipalities. (3)

[12]

QUESTION 2

32 learners wrote a Mathematics test and the results are shown below.

Marks	Frequency	Cumulative Frequency
$20 \le x < 30$	5	p
$30 \le x < 40$	5	10
$40 \le x < 50$	10	20
$50 \le x < 60$	7	q
$60 \le x < 70$	3	30
$70 \le x < 80$	1	31
$80 \le x < 90$	r	32

2.1 Find the values of $\boldsymbol{p}$, $\boldsymbol{q}$ and $\boldsymbol{r}$. (3)

2.2 Draw a cumulative frequency graph (OGIVE) of the data on the grid provided in the ANSWER SHEET B. (3)

2.3 Use the cumulative frequency graph to determine the value of the median. (2)

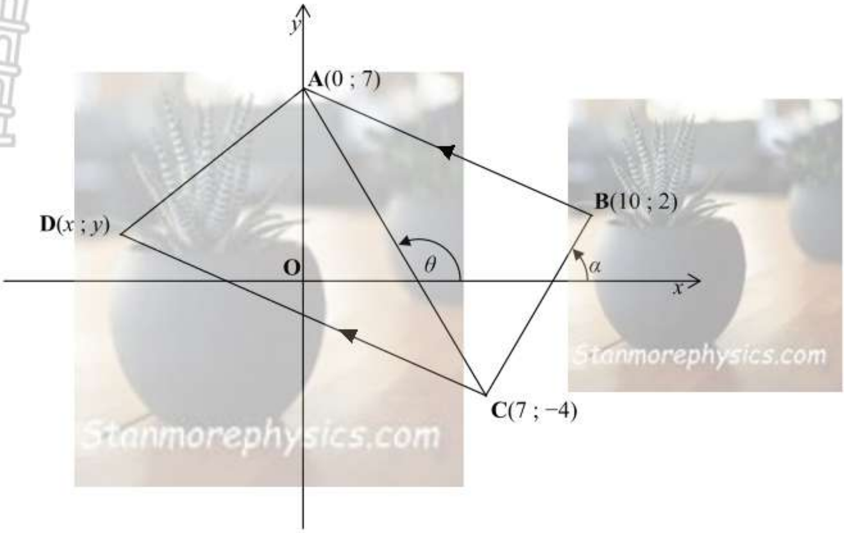
2.4 From the cumulative frequency graph, determine the number of learners who obtained a mark of more than 55. (2)

[10]

P.T.O.

QUESTION 3

In the diagram below, the points A(0 ; 7), B(10 ; 2), C(7 ; −4) and D $(x ; y)$ form quadrilateral ABCD. AB ∥ CD, with AC joined. The angles of inclination for AC and BC are θ and α respectively.



Determine:

3.1 The length of AB (Leave your answer in simplified surd form.) (3)

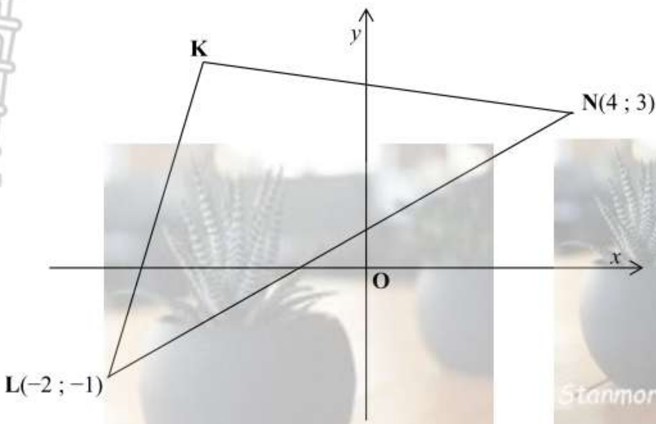
3.2 The gradient of AC (2)

3.3 The size of θ, the angle of inclination of AC (3)

3.4 The magnitude (size) of $B\hat{C}D$ (4)
[12]

QUESTION 4

Consider ΔKLN drawn below. KL has the equation $y = 5x + 9$, while KN has the equation $5y + x - 19 = 0$.



4.1 Show that the coordinates of K are $(-1 ; 4)$. (3)

4.2 Show that KL $\perp$ KN. (3)

4.3 Hence, or otherwise, determine the area of ΔKNL. (4)

4.4 Determine the equation of the perpendicular bisector of LN. (5)

4.5 If L, N and P $(7 ; y)$ are collinear, find y. (2)

4.6 Determine the coordinates of Q, if KLQN is a parallelogram. (2)

4.7 Explain, with geometric reasons, why KLQN is a square. (2)

[21]

QUESTION 5

5.1 Determine the value of the following without the use of a calculator:

$$\frac{\tan(180° - x)\cos(360° + x)}{2\cos(90° + x)}$$ (6)

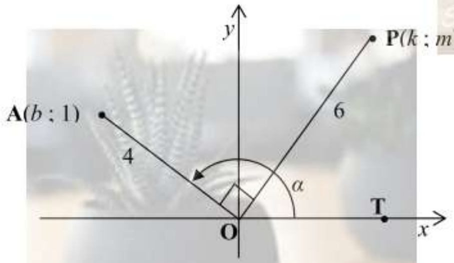
5.2 Given the identity:

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

5.2.1 Prove the above identity. (4)

5.2.2 For which values of θ will the identity be undefined? (5)

5.3 In the diagram below A is a point on the Cartesian plane such that $A\hat{O}T = \alpha$ with $OA = 4$. P $(k\,;\,m)$ is a point such that $OP = 6$ and $AO \perp OP$.



5.3.1 Determine the value of b. (2)

5.3.2 Determine, without the use of a calculator, the value of:

(a) $\tan\alpha$ (2)

(b) $\sin(-\alpha - 180° + \cos(-\alpha)$ (3)

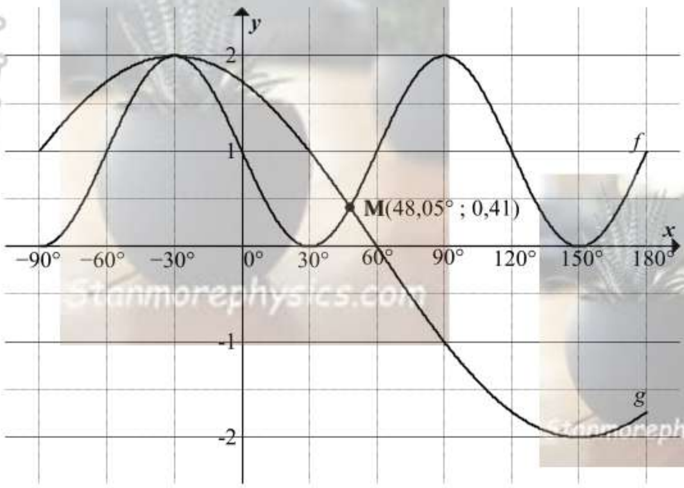
5.3.3 Without the use of a calculator, determine the values of k and m. (5)

[27]

P.T.O.

QUESTION 6

In the diagram below, the graphs of $f(x) = a \sin bx + 1$ and $g(x) = 2 \cos (x + p)$ are shown for the interval $-90° \leq x \leq 180°$.



6.1 Write down the amplitude of g. (1)

6.2 Determine the period of f. (1)

6.3 Determine the values of a, b and p. (3)

6.4 Determine the value(s) of x such that:

6.4.1 $g(x) > 0$ (1)

6.4.2 $f(x) \geq g(x)$ (2)

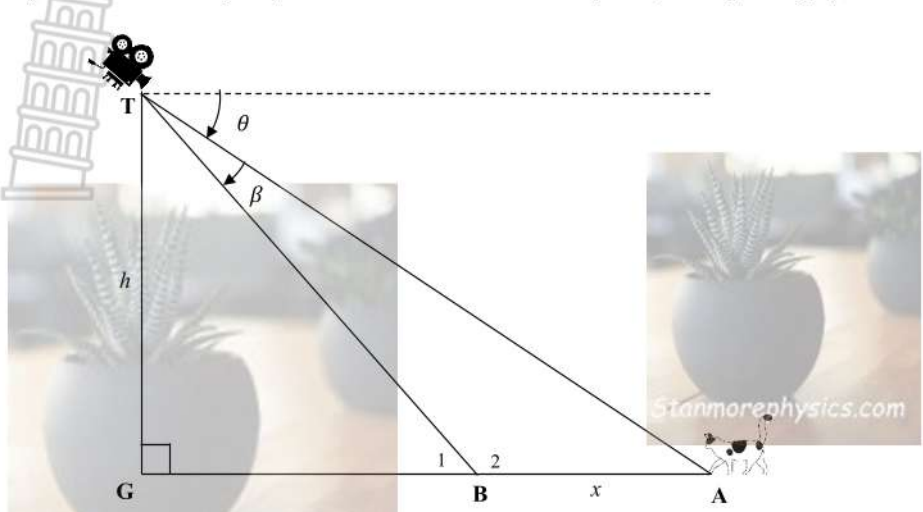
6.4.3 $f(x).g(x) < 0$ (2)

6.5 Given $h(x) = g(x + t)$, determine ALL values of t where $h(x) = h(-x)$. (3)

[13]

QUESTION 7

A camera person is stationed at the top of a vertical tower (TG) where TG = h. She films a cat starting at A, where the angle of depressionof T after A is θ. The camera follows the cat as it walks (in the same vertical plane) a distance of x metres horizontally to B, creating the angle β.



7.1 Determine $\hat{B}_1$ in terms of θ and β. (1)

7.2 Show that $x = \dfrac{h \sin \beta}{\sin(\theta + \beta) \sin \theta}$ (5)

7.3 Determine the distance (x) the cat walked from A to B if the tower was 20 m high, $\theta = 65°$ and $\beta = 37°$ (2)

[8]

QUESTION 8

Figure A below shows a rainwater gauge in the shape of a cone. The level of rainwater is indicated, with a diameter of 18 c*m*.
Figure B shows the same cone after a steel ball has been dropped into the cone. The angle of the cone is $\hat{P} = 28°$, with the steel ball having a radius of r cm. Q is the point where the ball touches the side of the cone.

FIGURE A

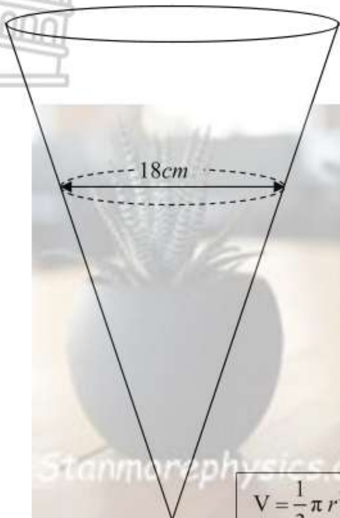
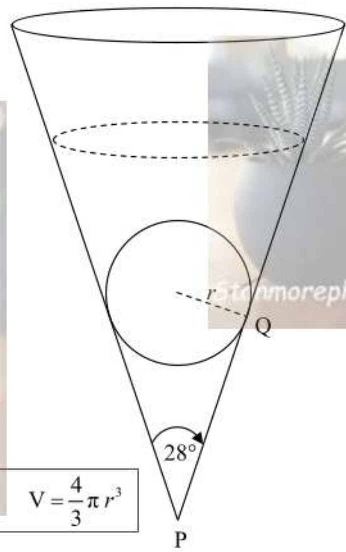


FIGURE B



$$V = \frac{1}{3}\pi r^3 \quad \text{or} \quad V = \frac{4}{3}\pi r^3$$

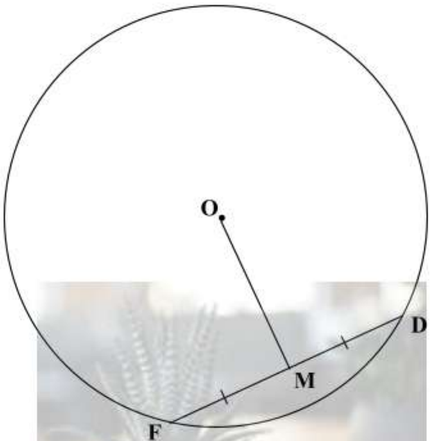
8.1 Determine the volume of rainwater in **FIGURE A**. (2)

8.2 The volume of rainwater in **FIGURE B** is increased by 268,08 cm^3 when the steel ball is placed inside the cone. Determine the length of PQ. (5)

[7]

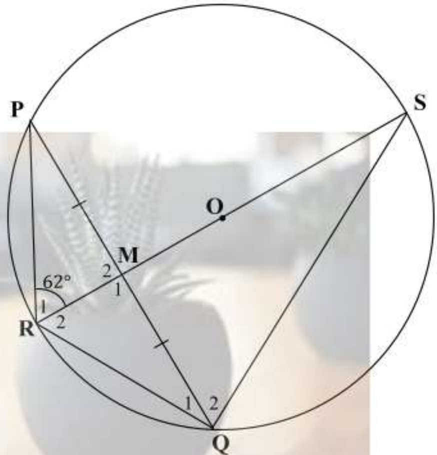
QUESTION 9

9.1 In the diagram, chord FD is drawn in a circle with centre O and FM = MD.



Use the diagram on the attached ANSWER SHEET C to complete the proof of the theorem which states that the line drawn from the centre of the circle to the midpoint of a chord will be perpendicular to that chord, that is, prove that OM $\perp$ FD. (4)

9.2 The points S, Q, R and P lie on the circumference of the circle with centre O. SR bisects chord PQ at M. PR and RQ are joined $\hat{R}_1 = 62°$



Calculate, with reasons, the values of the following angles:

9.2.1 $\hat{M}_2$ (2)

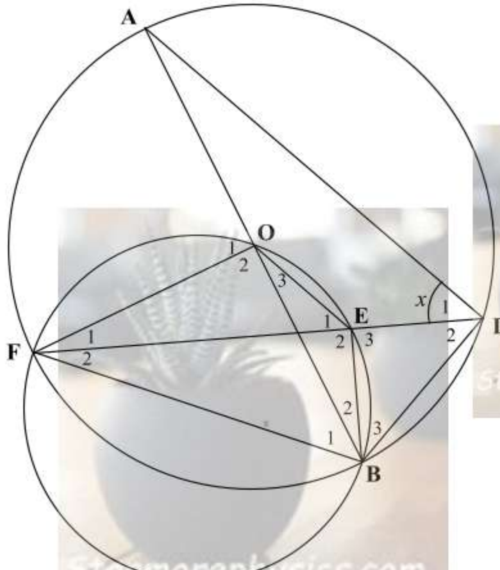
9.2.2 $\hat{Q}_1 + \hat{Q}_2$ (2)

9.2.3 $\hat{S}$ (2)

[10]

QUESTION 10

The larger circle ADBF with centre O, intersects the smaller circle at F and B respectively. Points O and E also lie on the smaller circle, with FED and AOB joined. $\hat{D}_1 = x$



10.1 Determine TWO other angles, each equal to x. (2)

10.2 Determine, with reasons, the following angles in terms of x:

10.2.1 $\hat{O}_1$ (2)

10.2.2 OFB (2)

10.2.3 $\hat{D}_2$ (2)

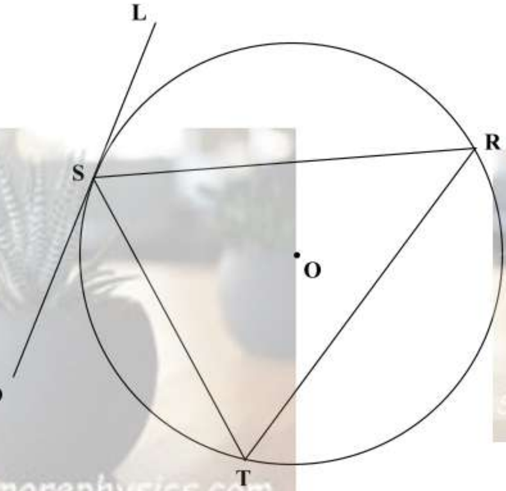
10.2.4 $\hat{E}_2$ (4)

10.3 Prove, with reasons, that EB = ED. (4)

[16]

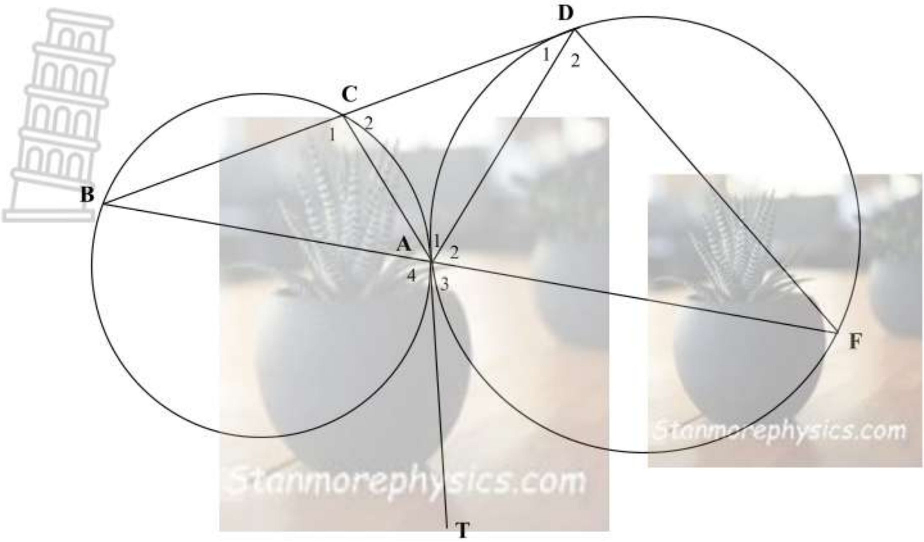
QUESTION 11

11.1 In the diagram, chords SR, RT and ST are drawn in a circle, with centre O.
DSL is a tangent to the circle at S.



Use the diagram on the attached ANSWER SHEET D to prove the theorem which states that the angle between the tangent DSL and chord SR is equal to the angle in the alternate segment, that is, prove that $L\hat{S}R = \hat{T}$. (6)

11.2 TA is a common tangent to circles CBA and FDA at A. Chords AC and AD are drawn, with BCD a tangent to the circle at D.



11.2.1 Provide the geometric reason that $\hat{D}_1 = \hat{F}$. (1)

11.2.2 Prove that $\hat{A}_1 = \hat{A}_2$. (7)
[14]

TOTAL: 150

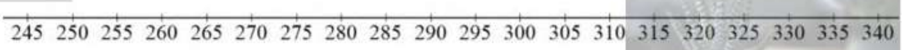
END

Name and Surname: ______________________________ **Grade:** ________

ANSWER SHEET A

QUESTION 1

1.1



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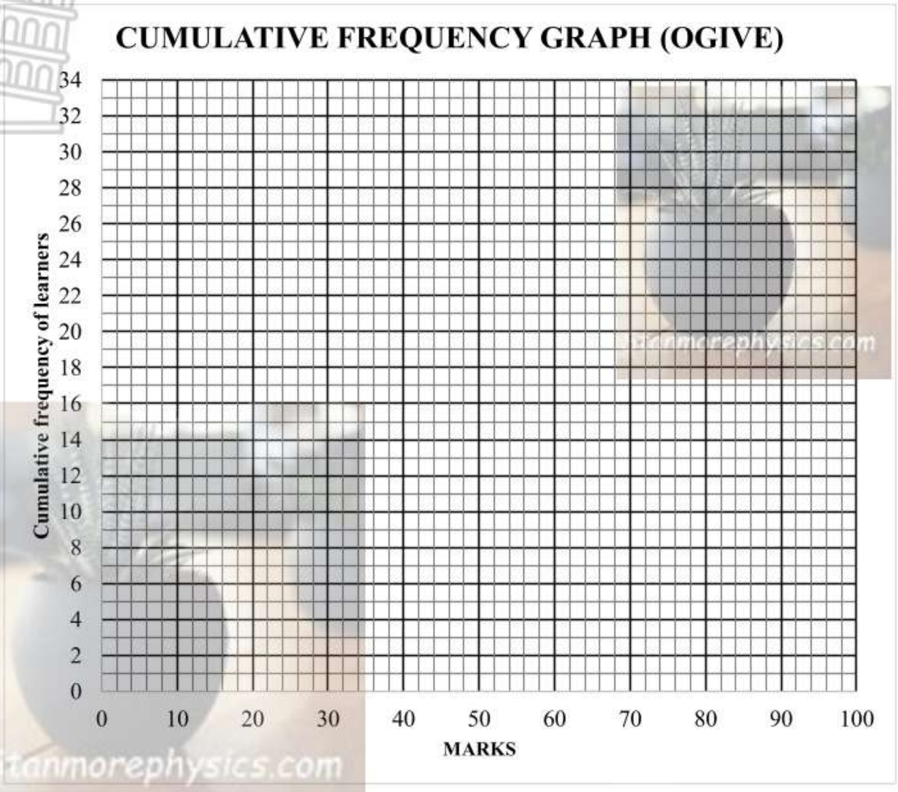
Name and Surname: ________________________________ Grade: ________

ANSWER SHEET B

QUESTION 2

2.2



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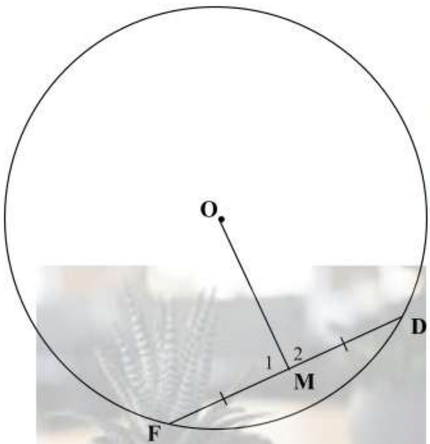
ANSWER SHEET C

QUESTION 9.1

9.1



Construction: ....

In ΔOFM and ΔODM

i. FM = MD **[GIVEN]**

ii. OM is a common side

iii. OF = OD [................................]

$\therefore$ [ΔOFM $\equiv$ ΔODM] [.....................]

.... [ΔOFM $\equiv$ ΔODM]

But $\hat{M}_1 = \hat{M}_2 = 180°$ [$\angle$'s on a straight line]

$\therefore\ \hat{M}_1 = \hat{M}_2 = 90°$

$\therefore$ OM $\perp$ FD

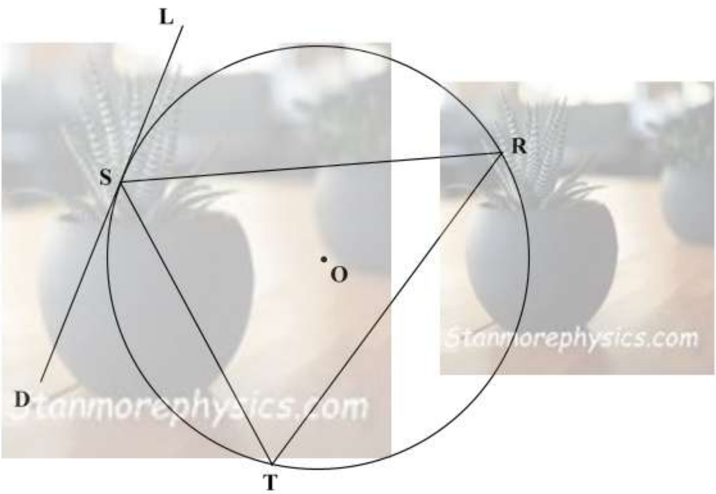
(4)

Name and Surname: ______________________________ **Grade:** ________

ANSWER SHEET D

QUESTION 11.1

11.1



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(6)

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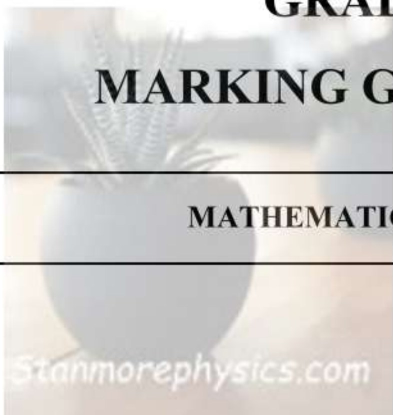
PROVINCIAL EXAMINATION

NOVEMBER 2022

GRADE 11

MARKING GUIDELINES



MATHEMATICS (PAPER 2)

22 pages

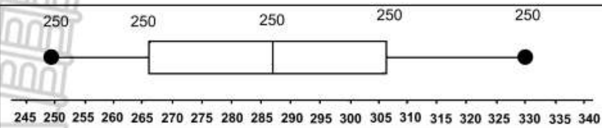
INSTRUCTIONS AND INFORMATION

- **A** – ACCURACY
- **CA** – CONSISTENT ACCURACY
- **S** – STATEMENT
- **R** – REASON
- **S/R** – STATEMENT with REASON

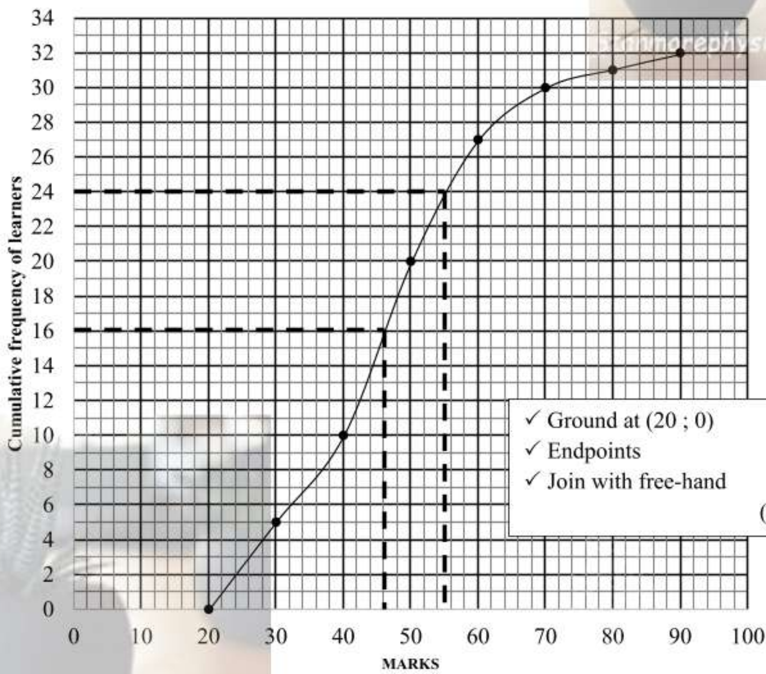
NOTES:

- If a candidate answered a question TWICE, mark only the first attempt.
- If a candidate crossed OUT an answer and did not redo it, mark the crossed-out answer.
- Consistent accuracy applies to ALL aspects of the marking guidelines.
- Assuming values/answers in order to solve a question is UNACCEPTABLE.

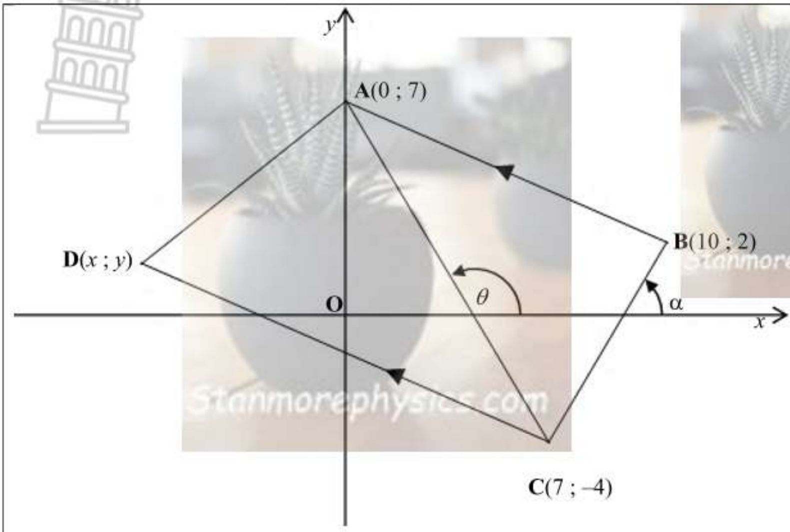
QUESTION 1

1.1		✓ Box (Q1 and Q3) ✓ Whiskers (Min. and Max.) ✓ Median	(3)
1.2	The data is distributed symmetrically, a normal distribution. **OR** The date is slightly skewed to the right.	✓ Explanation	(1)
1.3	$\sigma = 23{,}77$	✓✓ σ	(2)
1.4	$(\bar{x} - \sigma ; \bar{x} + \sigma)$ $= (287 - 23{,}77 ; 287 + 23{,}77)$ $= (263{,}23 ; 310{,}77)$ $\therefore$ 6 municipalities are within one standard deviation.	✓ $\bar{x} = 287$ ✓ Interval ✓ 6	(3)
1.5	S-IQR $= \frac{1}{2}(Q_3 - Q_1)$ $= \frac{1}{2}(306 - 266)$ $= 20$	✓ $Q_3 - Q_1$ ✓ $\frac{1}{2} \times$ ✓ Answer	(3)
			[12]

QUESTION 2

2.1	$p = 5$ $q = 27$ $r = 1$	✓ p ✓ q ✓ r	(3)
2.2	**CUMULATIVE FREQUENCY GRAPH (OGIVE)**  ✓ Ground at (20 ; 0) ✓ Endpoints ✓ Join with free-hand (3)		
2.3	M = 46	✓✓ M = 46(± 2)	(2)
2.4	32 – 24 = 8 ∴ 8 learners achieved a mark of greater than 55.	✓ $CF = 24(\pm 1)$ ✓ $32 - CF$	(2)
			[10]

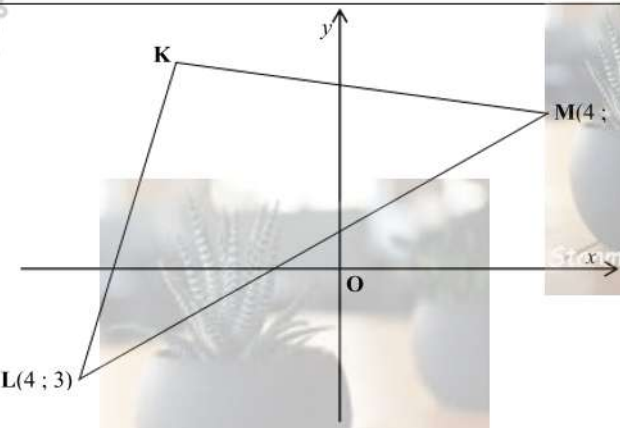
QUESTION 3



3.1	$AB = \sqrt{(0-10)^2+(7-2)^2}$ $AB = \sqrt{125}$ $AB = 5\sqrt{5}$	✓ Substitute into correct formula ✓ AB ✓ Simplified surd	(3)
3.2	$m_{AC} = \dfrac{7-(-4)}{0-7}$ $m_{AC} = -\dfrac{11}{7}$	✓ Gradient substitute ✓ m_{AC}	(2)
3.3	$\tan\theta = -\dfrac{11}{7}$ $RA = 57{,}528\ldots°$ $\theta = 180° - 57{,}528\ldots°$ $\theta = 122{,}47°$	✓ Angle of inclination substitute (CA 4.2) ✓ RA ✓ θ (subtract RA from 180°)	(3)

3.4	$\tan\alpha = 2$	α	
	$\alpha = 63{,}434\ldots^\circ$	$A\hat{C}B$	
	$A\hat{C}B = 122{,}47^\circ - 63{,}434\ldots^\circ$	$C\hat{A}B$	
	$A\hat{C}B = 59{,}04^\circ$	$B\hat{C}D$	
	$m_{AB} = \frac{1}{2}$		
	$C\hat{A}B = 180^\circ - \tan^{-1}\left(\frac{1}{2}\right) - 122{,}74^\circ$		
	$C\hat{A}B = 30{,}69^\circ$		
	$A\hat{C}D = 30{,}69^\circ$ [alt $\angle$'s, AB $\parallel$ CD]		
	$B\hat{C}D = 30{,}69^\circ + 59\ 04^\circ$		
	$B\hat{C}D = 89{,}73^\circ$		
	OR	**OR**	
	IF θ is not rounded		
	$\tan\alpha = 2$	✓ α	
	$\alpha = 63{,}434\ldots^\circ$	✓ $A\hat{C}B$	
	$A\hat{C}B = 122{,}4711\ldots^\circ - 63{,}434\ldots^\circ$	✓ $C\hat{A}B$	
	$A\hat{C}B = 59{,}036\ldots^\circ$	✓ $B\hat{C}D$	
	$m_{AB} = \frac{1}{2}$		
	$C\hat{A}B = 180^\circ - \tan^{-1}\left(\frac{1}{2}\right) - 122{,}74\ldots^\circ$		
	$C\hat{A}B = 30{,}963^\circ$		
	$A\hat{C}D = 30{,}963^\circ$ [alt $\angle$'s, AB $\parallel$ CD]		
	$B\hat{C}D = 30{,}963^\circ + 59\ 036\ldots^\circ$		
	$B\hat{C}D = 90^\circ$		(4)
			[12]

QUESTION 4



4.1	$y = 5x + 9$ and $5y + x - 19 = 0$ $5(5x + 9) + x = 19$ $26x = -26$ $x = -1$ $y = 5(-1) + 9$ $y = 5$ $\therefore$ K$(-1 ; 4)$	✓ Sub y ✓ Solve for x ✓ Sub x back NO MARK for coordinates (given)	(3)
4.2	$m_{KL} = 5$ and $m_{KM} = -\frac{1}{5}$ $\therefore\ m_{KL} \times m_{KM} = -1$ KL $\perp$ KM $\therefore\ L\hat{K}M = 90°$	✓ m_{KL} ✓ m_{KL} ✓ Definition of perpendicular gradients	(3)

4.3	$KL = \sqrt{((-1-(-2))^2 + (4-(-1))^2}$ $KL = \sqrt{26}$ $KN = \sqrt{(-1-4)^2 + (4-3)^2}$ $KN = \sqrt{26}$ Area $\Delta KML = \frac{1}{2}\left(\sqrt{26}\right)\left(\sqrt{26}\right)$ Area $\Delta KML = 13$ units^2	✓ KL length ✓ KN length ✓ Sub Area formula ✓ Area ΔKML	(4)
4.4	$M\left(\frac{-2+4}{2}; \frac{3+(-1)}{2}\right)$ $M(1\ ;\ 1)$ $m_{NL} = \frac{3-(-1)}{4-(-2)}$ $m_{NL} = \frac{2}{3}$ $y - y_1 = -\frac{2}{3}(x - x_1)$ $y - 1 = -\frac{2}{3}(x-1)$ $y = -\frac{2}{3}x + \frac{5}{2}$	✓ Midpoint of NL ✓ Gradient of NL ✓ Perpendicular gradient ✓ Substitute Midpoint ✓ Equation	(5)
4.5	$m_{NL} = m_{NP} = m_{LP}$ $\frac{2}{3} = \frac{y-3}{7-4}$ $y = 5$	✓ Definition of collinear ✓ Sub P(7 ; y)	(2)

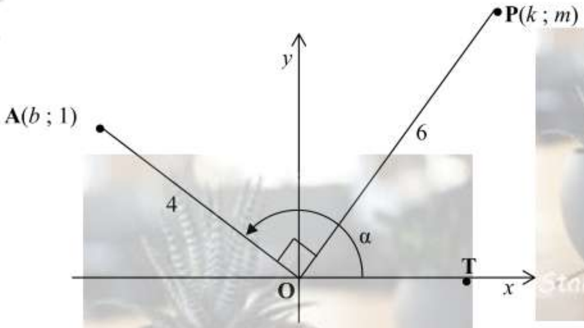
4.6	Q(3 ; –2)	✓ x_Q ✓ y_Q	(2)
4.7	$\hat{K} = 90°$ [proven in 4.1] $KL = KN = \sqrt{26}$ [proven in 4.2] ∴ KLQN is a square [a parallelogram with an interior ∠ of 90° and adjacent sides equal]	✓ Interior angle of 90° ✓ Adjacent sides equal	(2)
			[21]

QUESTION 5

5.1	$\dfrac{\tan(180° - x)\cos(360° + x)}{2\cos(90° + x)}$ $= \dfrac{-\tan x.\cos x}{-2\sin x}$ $= \dfrac{-\dfrac{\sin x}{\cos x}.\cos x}{-2\sin x}$ $= \dfrac{-\sin x}{-2\sin x}$ $= \dfrac{1}{2}$	✓ – tan x ✓ cos x ✓ –2 sin x ✓ – tan x identity ✓ simplify ✓ answer	(6)
5.2	5.2.1 LHS $= \dfrac{\sin\theta - 2\sin\theta\cos\theta}{2\cos^2\theta + \cos\theta - 1}$ $= \dfrac{\sin\theta(1 - 2\cos\theta)}{(2\cos\theta - 1)(\cos\theta + 1)}$ $= \dfrac{-\sin\theta(2\cos\theta - 1)}{(2\cos\theta - 1)(\cos\theta + 1)}$ $= \dfrac{-\sin\theta}{\cos\theta + 1}$ = RHS	✓ sin θ(1–2 cosθ) ✓ (2cosθ – 1)(cosθ + 1) ✓ Sign change/negative factor ✓ Simplify *with* conclusion	(4)

	5.2.2	Undefined when $2\cos\theta - 1 = 0$ $\cos\theta = \frac{1}{2}$ RA = 60° QI : $\theta = 60° + k.360°$; $k \in Z$ QIV : $\theta = 300° + k.360°$ **OR** when $\cos\ \theta = -1$ $\theta = 180° + k.360°$; $k \in Z$ **NOTE: Accept other equivalent general solutions.** $\cos\theta - 1$ $\theta = 180° + k.360°$; $k \in Z$	✓ $2\cos\theta - 1 = 0$ ✓ QI general solution ✓ QII general solution ✓ $k \in Z$ ✓ $\cos\ \theta = -1$ general solution	(5)

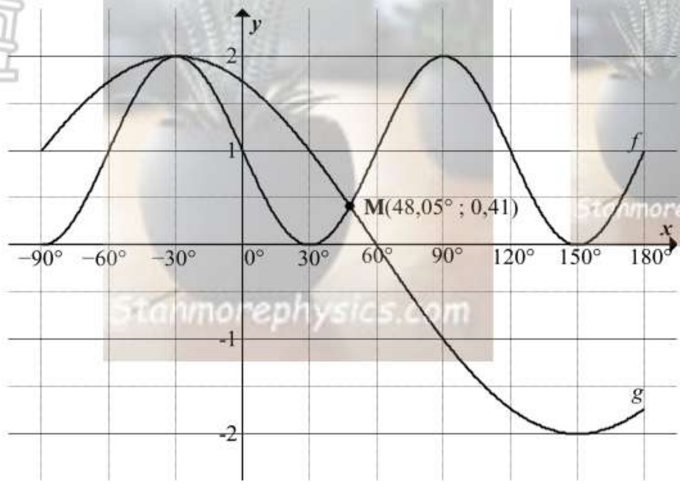
5.3



5.3.1	$b^2 + 1^2 = 4^2$ $b = \pm\sqrt{15}$ $b = -\sqrt{15}$ (QII)			✓ Pythagoras substitution ✓ $b = -\sqrt{15}$	(2)
5.3.2	(a)	$\tan\alpha = -\dfrac{1}{\sqrt{15}}$		✓ $\dfrac{y}{x}$ ✓ CA x	(2)
	(b)	$\sin(-\alpha - 180°) + \cos(-\alpha)$ $= \sin\alpha + \cos\alpha$ $= \left(\dfrac{1}{4}\right) + \left(\dfrac{-\sqrt{15}}{4}\right)$ $= \left(\dfrac{1-\sqrt{15}}{4}\right)$		✓ $\sin\alpha$ ✓ $\cos\alpha$ ✓ Substitute x ; y and r	(3)

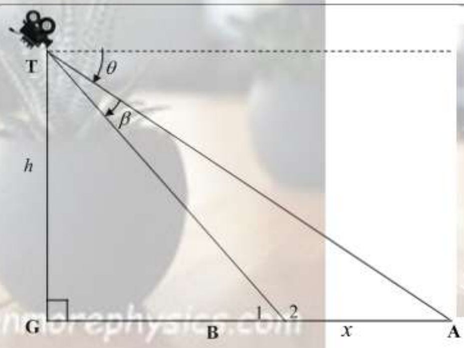
5.3.3	$\cos(\alpha - 90) = \frac{k}{6}$	$\sin(\alpha - 90) = \frac{m}{6}$	✓ $\cos(\alpha - 90) = \frac{k}{6}$	
	$\sin\alpha = \frac{k}{6}$	$-\cos\alpha = \frac{m}{6}$	✓ $\sin(\alpha - 90) = \frac{m}{6}$	
	$\therefore \frac{k}{6} = \frac{1}{4}$	$\cos\alpha = -\frac{m}{6}$	✓ Complementary reductions	
	$\therefore k = \frac{3}{2}$	$\therefore \frac{m}{6} = \left(\frac{-\sqrt{15}}{4}\right)$	✓ Equate ratios	
		$\therefore m = \frac{3\sqrt{15}}{2}$	✓ Values of k and m	
	OR		**OR**	
	P lies in QI, therefore both k and m are positive		✓ P in QI	
	A 90º rotation means $(x\,;y) \to (y\,;x)$		✓ $(x\,;y) \to (y\,;x)$ idea	
	$\frac{r_2}{r_1}$		✓ Ratio of radii	
	$\frac{6}{4}$		✓ Apply scale to x and y	
	$\frac{3}{2}$		✓ Values of k and m	
	$\therefore P\left(\frac{3}{2}.1;\frac{3}{2}.\sqrt{15}\right) = P(k\,;m)$		**Do NOT award full marks for answer only.**	
	$\therefore k = \frac{3}{2}$ and $m = \frac{3\sqrt{15}}{2}$			(5)
				[27]

QUESTION 6



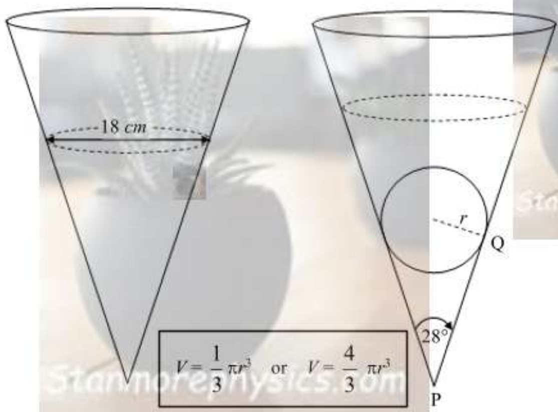
6.1	A = 2		✓ Answer	(1)
6.2	120º		✓ Answer	(1)
6.3	$a = -1$ $b = 3$ $p = 30°$		✓ a ✓ b ✓ p	(3)
6.4	6.4.1	$-90° \leq x < 60°$	✓ Interval	(1)
	6.4.2	$x = -30°$ or $48{,}05° \leq x \leq 180°$	✓ Interval ✓ $x = -30°$	(2)
	6.4.3	$60° < x < 150°$ or $150° < x \leq 180°$	✓ 60º and 180º ✓ Not incl. 150º but incl. 180º	(2)
6.5	$t = -30° + k.\ 360°$; $k \in$		✓✓ $t = -30°$ ✓ $k.\ 360°$	(3)
				[13]

QUESTION 7



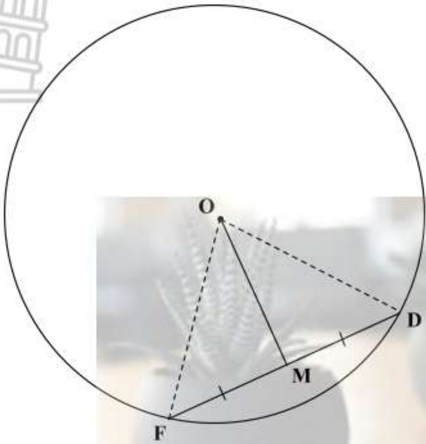
7.1	$\hat{B}_1 = \theta = \beta$	✓ Answer	(1)
7.2	In ΔTBG $\sin(\theta+\beta) = \dfrac{h}{BT}$ $BT = \dfrac{h}{\sin(\theta+\beta)}$ In ΔABT $\hat{A} = \theta$ $\dfrac{x}{\sin\beta} = \dfrac{BT}{\sin\theta}$ $\dfrac{x}{\sin\beta} = \dfrac{h}{\sin(\theta+\beta)\sin\theta}$ $x = \dfrac{h\sin\beta}{\sin(\theta+\beta)\sin\theta}$	✓ Correct ratio in ΔTBG ✓ BT ✓ Sine rule substitution ✓ BT substitution ✓ simplification	(5)
7.3	$x = \dfrac{h\sin\beta}{\sin(\theta+\beta)\sin\theta}$ $x = \dfrac{20\sin 37^\circ}{\sin(65^\circ+37^\circ)\sin 65^\circ}$ $x = 13{,}58\ m$ The cat travelled 13,58 m	✓ Substitution ✓ Answer	(2)
			[8]

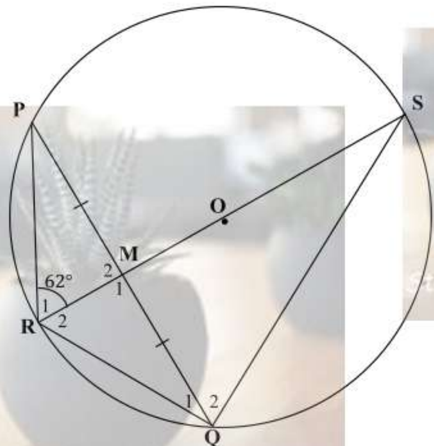
QUESTION 8



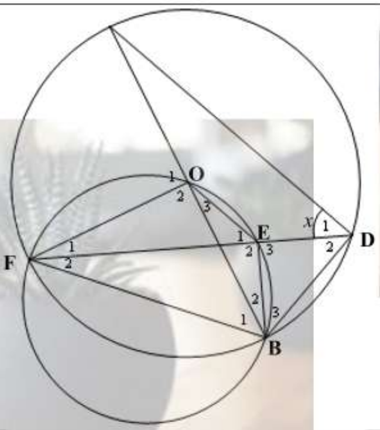
8.1	$V=\frac{1}{3}\pi(9)^3$ $V=763{,}41cm^3$	✓ Substitution ($r=9$) ✓ Answer	(2)
8.2	$V=\frac{4}{3}\pi r$ $268.08=\frac{4}{3}\pi r$ $\sqrt[3]{\frac{3\times 286{,}08}{4\pi}}=r$ $r=4$ $\tan 14°=\frac{4}{PQ}$ $PQ=\frac{4}{\tan 14°}$ $PQ=16{,}04\ cm$	✓ Substitute volume into correct formula ✓ Subject of the formula ✓ r ✓ tan 14° ✓ PQ	(5)
			[7]

QUESTION 9

9.1		✓ Construction	
	Construction: ***Join OF and OD***		
	In ΔOFM and ΔODM		
	i. FM = MD **[GIVEN]**		
	ii. OM is a common side		
	iii. OF = OD ***[Radii]***		
	$\therefore$ ΔOFM $\equiv$ ΔODM ***[SSS]***	✓ R	
	$\hat{\mathbf{M}}_1 = \hat{\mathbf{M}}_2$ [ΔOFM $\equiv$ ΔODM]	✓ R	
	But $\hat{M}_1 = \hat{M}_2 = 180°$ [$\angle$'*s* on a straight line]	✓ S	
	$\therefore$ $\hat{M}_1 = \hat{M}_2 = 90°$		
	$\therefore$ OM $\perp$ FD		(4)

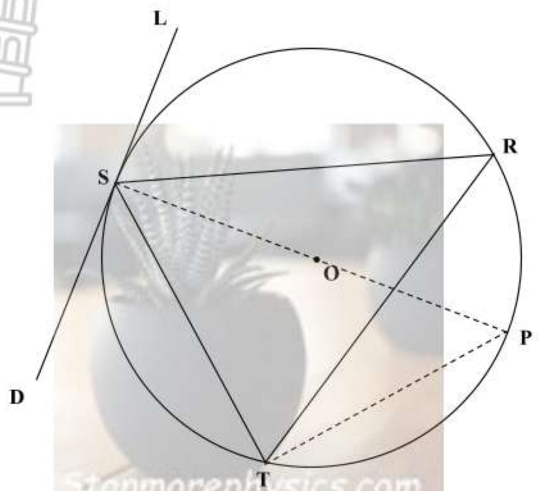
9.2				
	9.2.1	$\hat{M}_2 = 90°$ [line from centre to midpoint of chord]	✓ S ✓ R	(2)
	9.2.2	$\hat{Q}_1 + \hat{Q}_2 = 90°$ [$\angle$'s in a semi-circle]	✓ S ✓ R	(2)
	9.2.3	$\hat{P} = 28°$ [int $\angle$'s of a Δ] $\hat{S} = \hat{P} = 28°$ [$\angle$'s in the same segment]	✓ S/R ✓ R	(2)
				[10]

QUESTION 10



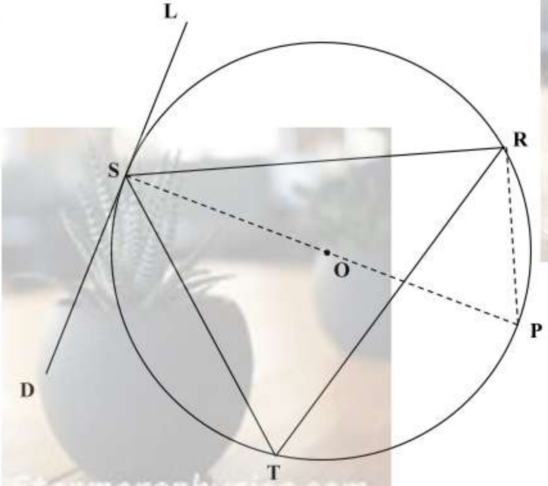
10.1	$\hat{B}_1 = \hat{D}_1 = x$	[$\angle$'s in the same segment]	✓ S	
	$\hat{B}_1 = \hat{E}_1 = x$	[$\angle$'s in the same segment]	✓ S	(2)
10.2	10.2.1 $\hat{O}_1 = 2x$	[$\angle$ at centre = 2 × $\angle$ at the circumf]	✓ S ✓ R	(2)
	10.2.2 $\hat{O}_1 = O\hat{F}B + \hat{B}_1$	[ext $\angle$ of Δ]	✓ R	
	$2x = O\hat{F}B + x$		✓ $O\hat{F}B = x$	
	$O\hat{F}B = x$			(2)
	10.2.3 $\hat{D}_2 = 90° - x$	[$\angle$'s in a semi circle]	✓ S ✓ R	(2)
	10.2.4 $\hat{O}_2 = 180° - 2x$	[$\angle$'s on a strt line]	✓ S ✓ R	
	$\hat{O}_2 = \hat{E}_2 = 180° - 2x$	[$\angle$'s in the same segment]	✓ S ✓ R	(4)
10.3	$\hat{E}_2 = \hat{B}_3 + \hat{D}_2$	[ext $\angle$ of Δ]	✓ R	
	$\therefore\ \hat{B}_3 = 90° - x$		✓ $\hat{B}_3 = 90° - x$	
	$\therefore\ \hat{B}_3 = \hat{D}_2$	[both $90° - x$]	✓ S	
	$\therefore$ EB = ED	[sides opp equal $\angle$s]	✓ R	(4)
				[16]

QUESTION 11



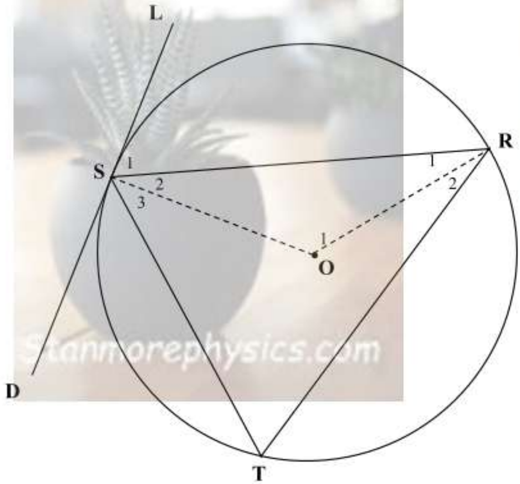
11.1	Construction: Draw diameter SP and join PT		✓ Construction
	$L\hat{S}R = 90° - R\hat{S}P$	[tan ⊥ rad]	✓ S ✓ R
	$S\hat{T}R = 90° - R\hat{T}P$	[∠'s in a semi circle]	✓ S ✓ R
	$R\hat{S}P = R\hat{T}P$	[∠'s in the same segment]	
	$\therefore\ L\hat{S}R = S\hat{T}R$		✓ S ✓ R

OR

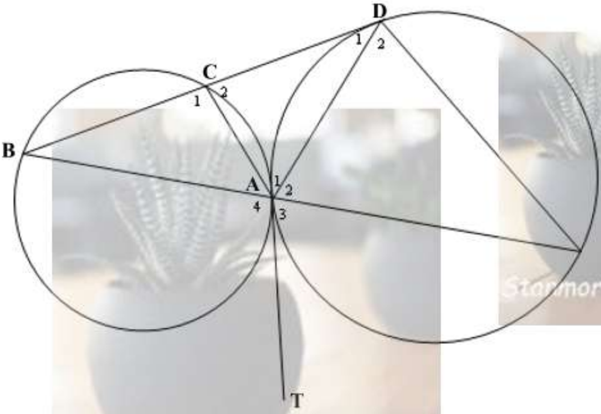


Construction: Draw diameter SP and join PR		✓ Construction	
$L\hat{S}R = 90° - R\hat{S}P$	[tan ⊥ rad]	✓ S/R	
$S\hat{R}P = 90°$	[∠'s in a semi circle]	✓ S ✓ R	
$S\hat{P}R = 90° - R\hat{S}P$	[int ∠'s of Δ]		
$L\hat{S}R = S\hat{P}R$	[both $90° - R\hat{S}P$]	✓ S	
$S\hat{P}R = S\hat{T}R$	[∠'s in the same segment]	✓ S/R	
$\therefore\ L\hat{S}R = S\hat{T}R$			

OR



	Construction: Join OS and OR		✓ Construction	
	$\hat{S}_1 + \hat{S}_2 = 90°$	[tan ⊥ radius]	✓ S ✓ R	
	$\hat{S}_2 = 90° - \hat{S}_1$			
	$\hat{R}_1 = \hat{S}_2 = 90° - \hat{S}_1$	[∠'s opp equal radii]	✓ S/R	
	$\hat{O}_1 = 180° - 2[90° - \hat{S}_1] = 2\hat{S}_1$	[int ∠'s of Δ]	✓ S	
	$\hat{O}_1 = \hat{S}_1$	[at centre = 2 × ∠ at circumf]	✓ S ✓ R	
	$\therefore\ L\hat{S}R = S\hat{T}R$			(6)

11.2	 x				
	11.2.1	tan chord theorem		✓ R	(1)
	11.2.2	$\hat{A}_4 = 180° - \hat{A}_3$	[$\angle$'s strt line]	✓ SR	
		$\hat{C}_1 = 180° - \hat{A}_3$	[tan chord theorem]	✓ S ✓ R	
		$\hat{C}_2 = \hat{A}_3$	[$\angle$'s strt line]	✓ SR	
		$\hat{D}_2 = \hat{A}_3$	[tan chord theorem]	✓ SR	
		$\therefore\ \hat{C}_2 = \hat{D}_2$	[both equal $\hat{A}_3$]	✓ S	
		$\hat{D}_1 = \hat{F}$	[tan chord theorem/proven in 11.2.1]	✓ R	
		$\hat{A}_1 = \hat{A}_2$	[int $\angle$'s in Δ/3rd $\angle$ in Δ]		(7)
					[14]
				TOTAL:	**150**