



education

MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

MATHEMATICS P2

SEPTEMBER 2026

MARKS: 150

TIME: 3 HOURS

This question paper consists of 12 pages, 1 information sheet and an ANSWER BOOK of 19 pages.

INSTRUCTIONS AND INFORMATION

Read the following instructions and information carefully before answering the questions.

1. This question paper consists of 10 questions.
2. Answer ALL the questions in the SPECIAL ANSWER BOOK provided.
3. Clearly show ALL calculations, diagrams, graphs, etc. which 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 off 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.



QUESTION 1

Mr Mabitsela is retired and he supplements his pension by mowing lawns for customers who live in his neighbourhood. As part of a review of his charges for this work, he measures the approximate areas (x) in m^2 of a random sample of 12 lawns and notes the time (y) in minutes, that it takes him to mow these lawns. His results are shown in the table below.

Area (x) in m^2	360	120	845	602	1190	530	245	486	350	1005	320	250
Time (y) in minutes	50	28	130	75	120	95	55	70	48	110	55	60

- 1.1 Calculate the equation of the least squares regression line. ✓ (3)
 - 1.2 Calculate the correlation coefficient for the data. ✓ (1)
 - 1.3 Comment on the correlation of the data. ✓ (1)
 - 1.4 Given that Mr Mabitsela charges a flat call out fee of R150, as well as R50 per half hour, or part thereof, estimate the charge for mowing a customer's lawn that has an area of $560 m^2$. (Note: any part of a half hour is charged as a full half-hour. For example: 100 minutes is charged as 2 hours). (4)
- [9]

QUESTION 2

A group of learners from Mr Malaza's class wrote a Mathematics test which was scored out of 75 marks. The results were represented in the table below.

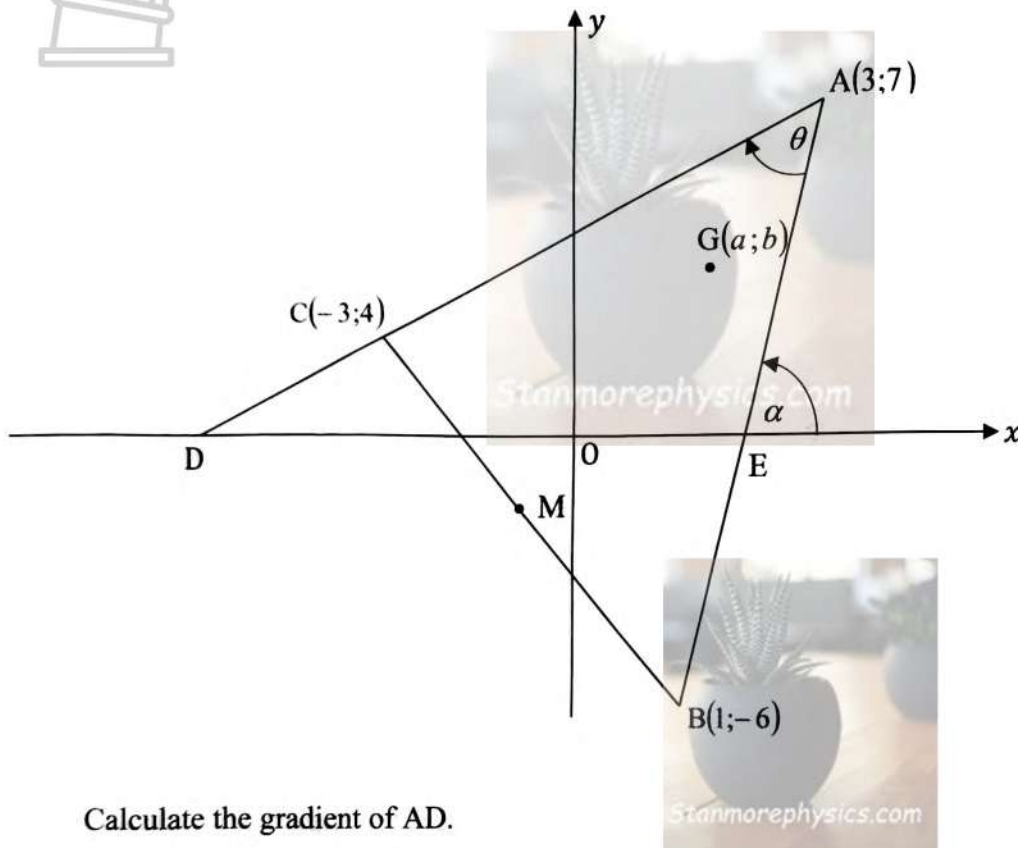
Marks	Frequency	Cumulative frequency
$5 < x \leq 15$	4	
$15 < x \leq 25$	7	
$25 < x \leq 35$	m	21
$35 < x \leq 45$	11	
$45 < x \leq 55$	11	
$55 < x \leq 65$	8	
$65 < x \leq 75$	n	
Total	54	

- 2.1 Determine the values of m and n . ✓ (2)
 - 2.2 Complete the above table. ✓ (2)
 - 2.3 Draw a cumulative frequency curve (Ogive) to represent above data on the diagram provided on the answer book. ✓ (3)
 - 2.4 Use the graph to estimate the 25th percentile of the data. ✓ (1)
 - 2.5 Determine the estimated average and the standard deviation of the data. ✓ (3)
- [11]

QUESTION 3

In the diagram below, $A(3;7)$, $B(1;-6)$ and $C(-3;4)$ are the vertices of $\triangle ABC$.

M is the midpoint of BC , AC is extended to cut the x -axis at D , and AB cuts the x -axis at E . The angles θ and α are shown on the diagram. G is the point $(a;b)$.

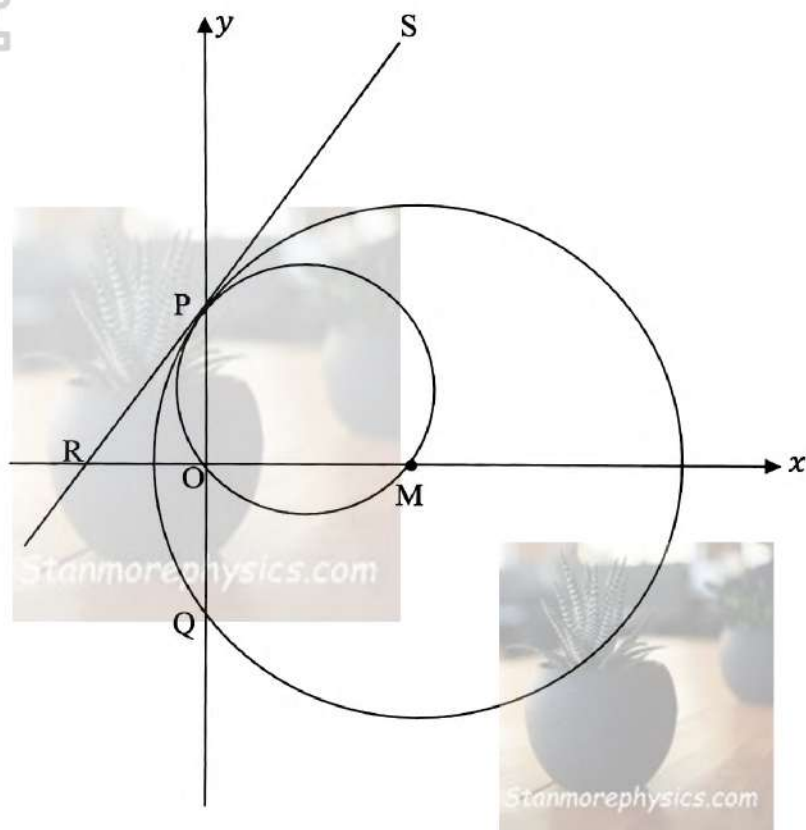


- 3.1 Calculate the gradient of AD . (2)
- 3.2 Determine the equation of AC . (2)
- 3.3 Determine the length of AD . Leave your answer in simplest surd form (4)
- 3.4 Determine the coordinates of M . (2)
- 3.5 Calculate the size of θ rounded off to the nearest degree. (5)
- 3.6 If the points A , G and M are collinear and $CG = \sqrt{17}$, calculate the possible values of a and b . (6)

[21]

QUESTION 4

A larger circle with equation $x^2 - 8x + y^2 = 9$ cuts the y -axis at P and Q, and has its centre on the x -axis at M. A smaller circle with equation $(x - k)^2 + (y - t)^2 = r^2$ touches the larger circle internally at P and passes through point M, the centre of the larger circle. RPS is a common tangent to both circles at P and cuts the x -axis at R.

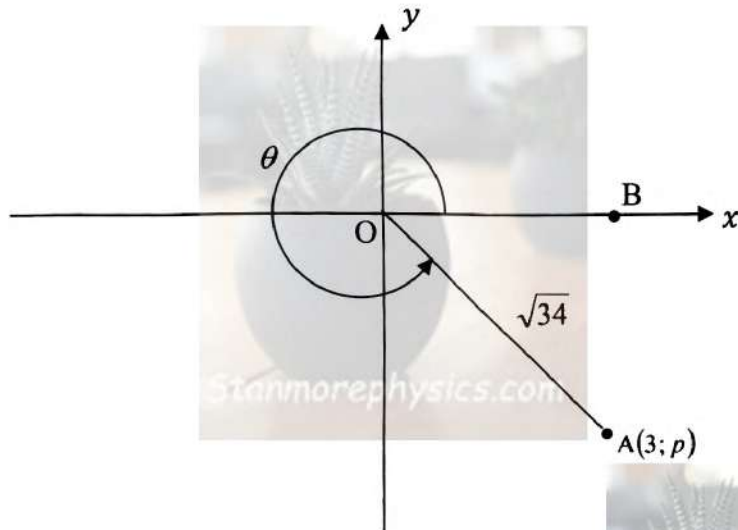


- 4.1 Determine the coordinates of M. (2)
- 4.2 Determine the length of PQ. (2)
- 4.3 Determine the equation of the tangent to the circle at P. (5)
- 4.4 Calculate the area of $\triangle PRM$ rounded off to two decimal places. (4)
- 4.5 Determine the equation of the smaller circle in the form $(x - k)^2 + (y - t)^2 = r^2$. (3)
- 4.6 Determine the maximum distance between P' and T if P' is the reflection of P along the centre of the smaller circle and T is a point on the larger circle. (3)

[19]

QUESTION 5

- 5.1 Given: $\sin(P - Q) = \sin P \cos Q - \cos P \sin Q$. Use the formula given to derive a formula for $\cos(P + Q)$. (3)
- 5.2 In the diagram below, $A(3; p)$ is a point in the Cartesian plane. $OA = \sqrt{34}$ and $\hat{BOA} = \theta$, which is a reflex angle.



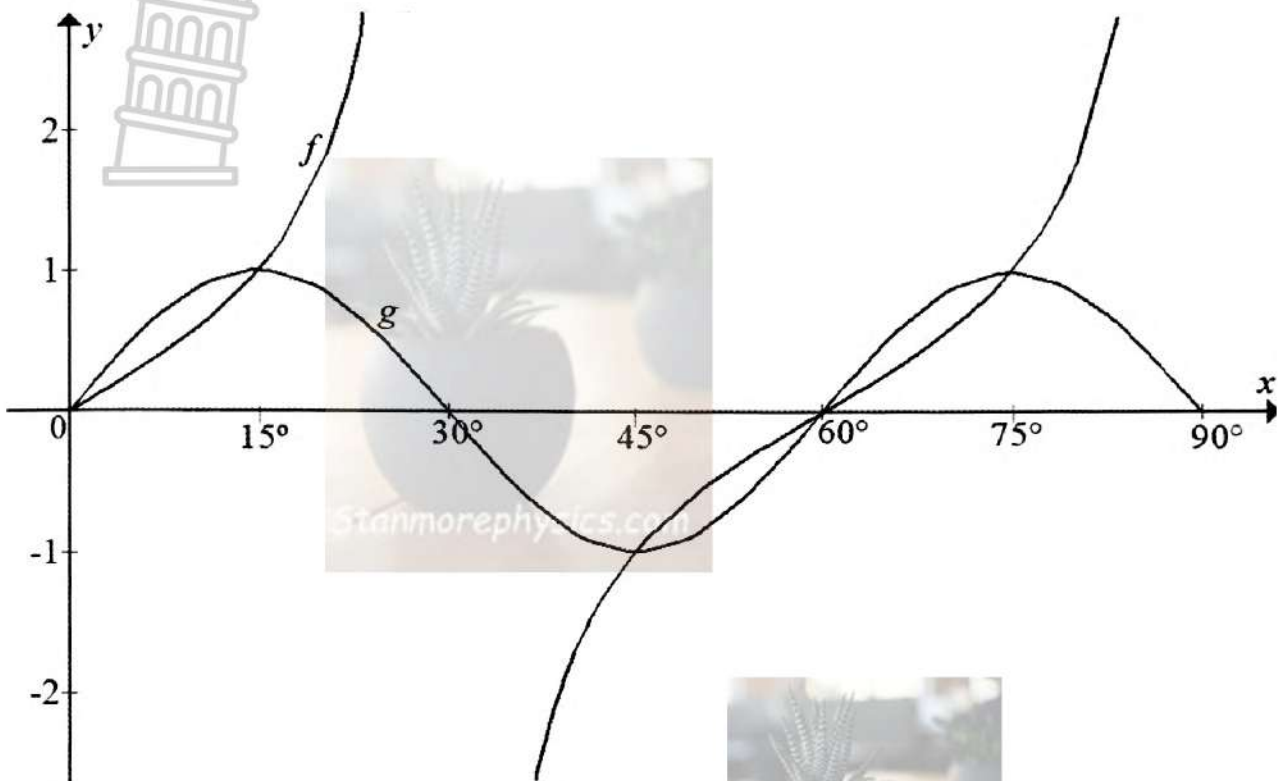
Determine **without using a calculator** the value of:

- 5.2.1 P (2)
- 5.2.2 $\cos(60^\circ + \theta)$ (4)
- 5.3 Determine the value of k :
 $\sin 50^\circ = \sin 145^\circ \cos(360^\circ - k) - \cos(k + 90^\circ) \cos(-35^\circ)$ if $0^\circ \leq k \leq 90^\circ$. (5)
- 5.4 Prove that: $4 \cos \theta - \frac{1 + \cos 2\theta}{\cos \theta} = \frac{\sin 2\theta}{\sin \theta}$ (4)
- 5.5 Determine the general solution of $2 \cos x = 3 \tan x$ (6)
- 5.6 Determine the value of $3 - 4 \sin^2 22,5^\circ$ **without using a calculator**. (4)

[28]

QUESTION 6

- 6.1 On the set of axes, the graphs of $f(x) = \tan 3x$ and $g(x) = \sin 6x$ are shown for the interval $x \in [0^\circ; 90^\circ]$.



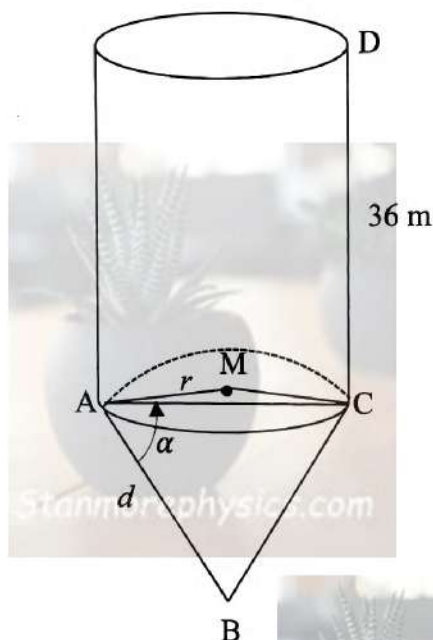
- 6.1.1 Write down the period of f . (1)
- 6.1.2 Write down the equations of the asymptotes of f , in the interval $x \in [0^\circ; 90^\circ]$. (2)
- 6.1.3 Determine using the graphs the values of x for which $f(x) \leq g(x)$ in the interval $x \in [0^\circ; 60^\circ]$. (2)
- 6.2 Given: $h(x) = \sin(6x - 60^\circ)$
- 6.2.1 Describe how the graph of h is obtained by translating the graph of $y = \sin 6x$. (2)
- 6.2.2 Write down the range of $p(x) = -2h(x) + 1$ (3)

[10]

QUESTION 7

The diagram represents a right cylindrical silo. M is the centre of the circular base with BA and BC tangents to the base at A and C . MA , the radius of the circular base is r . A , M and C lie on the same horizontal plane. DC represents the vertical height of the cylindrical part of the silo.

$\hat{BAC} = \alpha$, $DC = 36$ metres and $AB = d$.



7.1 Express $\hat{B}$ in terms of α (2)

7.2 Show that $AC = 2d \cos \alpha$ (4)

7.3 If $AMCB$ is a cyclic quadrilateral, $AC = 12,22$ m and $\hat{ABC} = 72^\circ$. Show that $r = 7,55$ metres. (3)

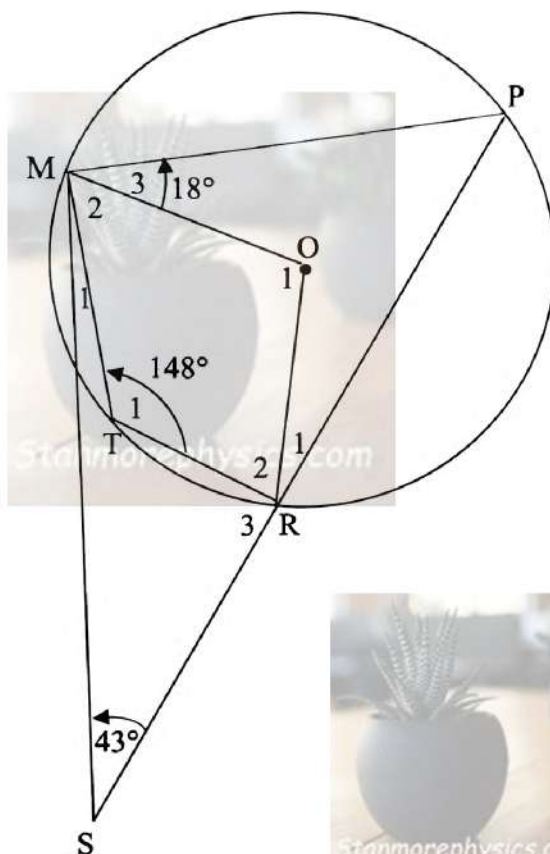
7.4 Calculate the volume of the cylindrical part of the silo correct to the nearest cubic metre. (2)

[11]

QUESTION 8

In the diagram below, P, M, T and R are points on a circle with centre O.

PR produced meets MS at S. Radii OM and OR and the chords MT and TR are drawn. $\hat{T}_1 = 148^\circ$, $\hat{P}MO = 18^\circ$ and $\hat{S} = 43^\circ$.



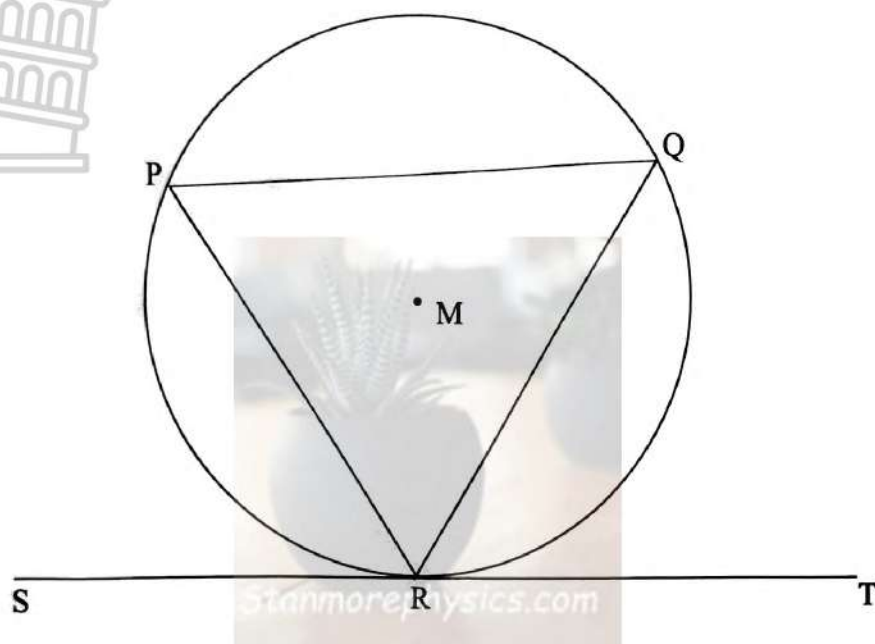
Calculate with reasons, the size of:

- 8.1 $\hat{P}$ (2)
- 8.2 $\hat{O}_1$ (2)
- 8.3 $\hat{OMS}$ (2)
- 8.4 $\hat{R}_3$ if it is given that $\hat{TMS} = 6^\circ$. (2)

[8]

QUESTION 9

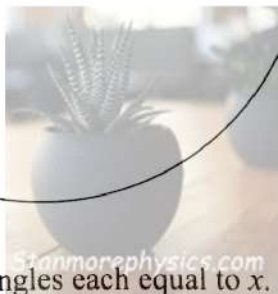
- 9.1 In the diagram below, M is the centre of a circle and SRT is a tangent to the circle at R. PQ, PR and QR are chords.



Prove the theorem which states that $\hat{PRS} = \hat{PQR}$.

(5)

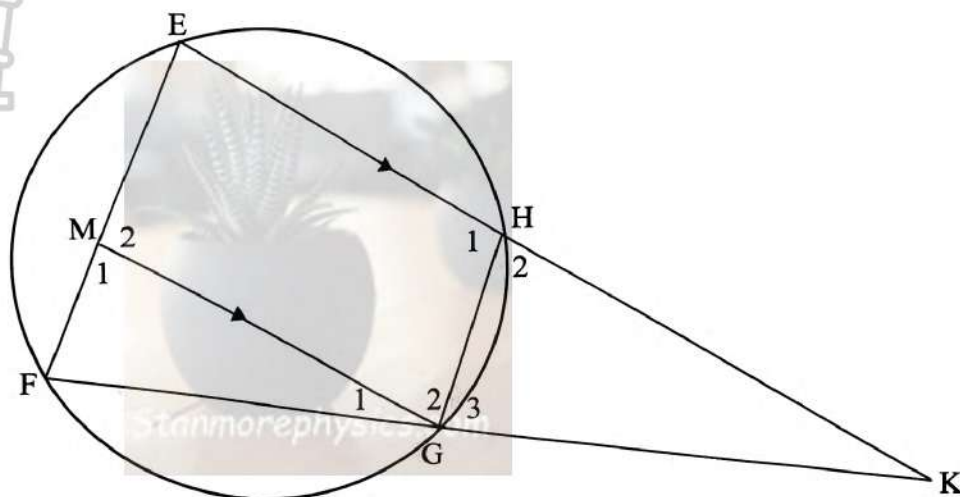
- 



- [22]

QUESTION 10

In the diagram, E, F, G and H lie on the circle. EH and FG are produced to K. M is a point on EF such that $MG \parallel EK$ and $KG = EF$.



10.1 Prove that:

10.1.1 $\triangle KGH \parallel \triangle KEF$

(3)

10.1.2 $EF^2 = KE \cdot GH$

(3)

10.1.3 $KG^2 = EM \cdot KF$

(2)

10.2 If it is given that $EK = 20$ units, $FK = 16$ units and $GH = 4$ units, calculate the length of EM.

(3)

TOTAL: [11]
150

INFORMATION SHEET

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

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

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

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

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

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

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

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

$$S_\infty = \frac{a}{1 - r}; -1 < r < 1 \quad F = \frac{x[(1 + i)^n - 1]}{i}$$

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

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

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

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

$$y = mx + c$$

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

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

$$m = \tan \theta$$

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

$$\text{In } \triangle ABC: \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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

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

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

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

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

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

$$\bar{x} = \frac{\sum x}{n}$$

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

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

$$\sin 2A = 2 \sin A \cos A$$

$$P(A \text{ of } B) = P(A) + P(B) - P(A \text{ en } B)$$

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

NAME OF LEARNER:
NAAM VAN LEERDER:
CLASS / KLAS:



**NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT**

MATHEMATICS P2 / WISKUNDE V2

GRADE 12 / GRAAD 12

SEPTEMBER 2026

**SPECIAL ANSWER BOOK
SPESIALE ANTWOORDEBOEK**

QUESTION/ VRAAG	MAX MARK MAKS PUNT	MARK PUNT			INITIAL VOORLETTER	MODERATION MODERERING			INITIAL VOORLETTER
1	9								
2	11								
3	21								
4	19								
5	28								
6	10								
7	11								
8	8								
9	22								
10	11								
TOTAL TOTAAL	150								

This answer book consists of 19 pages.
Hierdie antwoordeboek bestaan uit 19 bladsye.

QUESTION/VRAAG 1

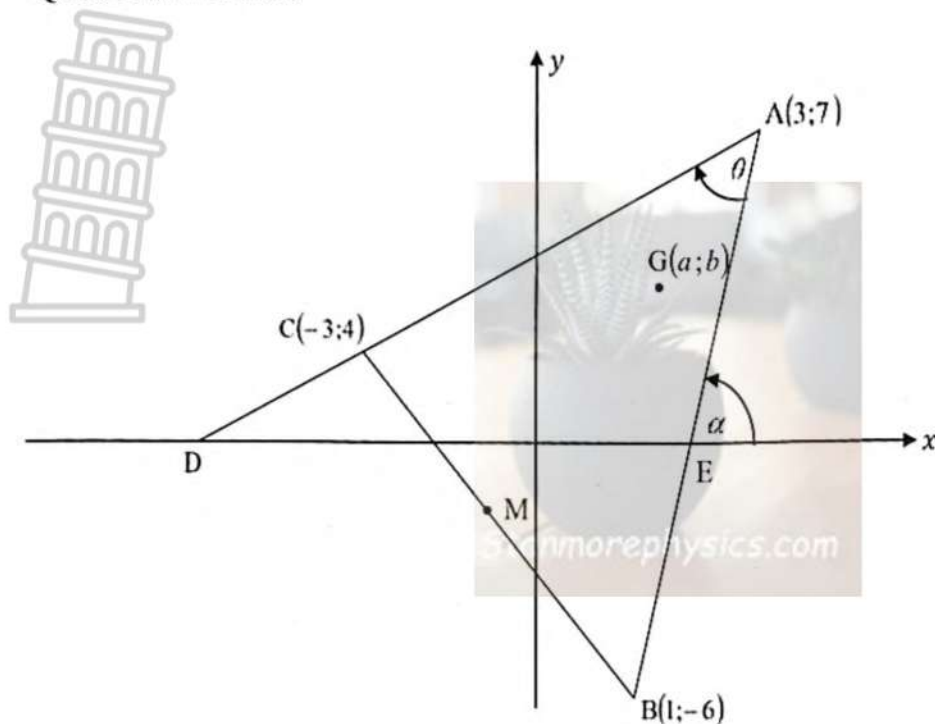
Area (x) (m ²)	360	120	845	602	1190	530	245	486	350	1005	320	250
Time/Tyd (t)(minutes)	50	28	130	75	120	95	55	70	48	110	55	60

	Solution/Oplissing	Marks Punte
1.1		(3)
1.2		(1)
1.3		(1)
1.4		(4)
		[9]

QUESTION/VRAAG 2

2.1				(2)																											
2.2	<table border="1"> <thead> <tr> <th>Marks/Punte</th> <th>Frequency Frekwensie</th> <th>Cumulative frequency Kumulatiewe frekwensie</th> </tr> </thead> <tbody> <tr> <td>$5 < x \leq 15$</td> <td>4</td> <td></td> </tr> <tr> <td>$15 < x \leq 25$</td> <td>7</td> <td></td> </tr> <tr> <td>$25 < x \leq 35$</td> <td>m</td> <td>21</td> </tr> <tr> <td>$35 < x \leq 45$</td> <td>11</td> <td></td> </tr> <tr> <td>$45 < x \leq 55$</td> <td>11</td> <td></td> </tr> <tr> <td>$55 < x \leq 65$</td> <td>8</td> <td></td> </tr> <tr> <td>$65 < x \leq 75$</td> <td>n</td> <td></td> </tr> <tr> <td>Total/Totaal</td> <td>54</td> <td></td> </tr> </tbody> </table>				Marks/Punte	Frequency Frekwensie	Cumulative frequency Kumulatiewe frekwensie	$5 < x \leq 15$	4		$15 < x \leq 25$	7		$25 < x \leq 35$	m	21	$35 < x \leq 45$	11		$45 < x \leq 55$	11		$55 < x \leq 65$	8		$65 < x \leq 75$	n		Total/Totaal	54	
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Total/Totaal	54																														
2.3	MATHEMATICS TEST MARKS/WISKUNDE TOETSPUNT			(3)																											
2.4	Stanmorephysics.com			(1)																											
2.5	<table border="1"> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> </table>							(3)																							
				[11]																											

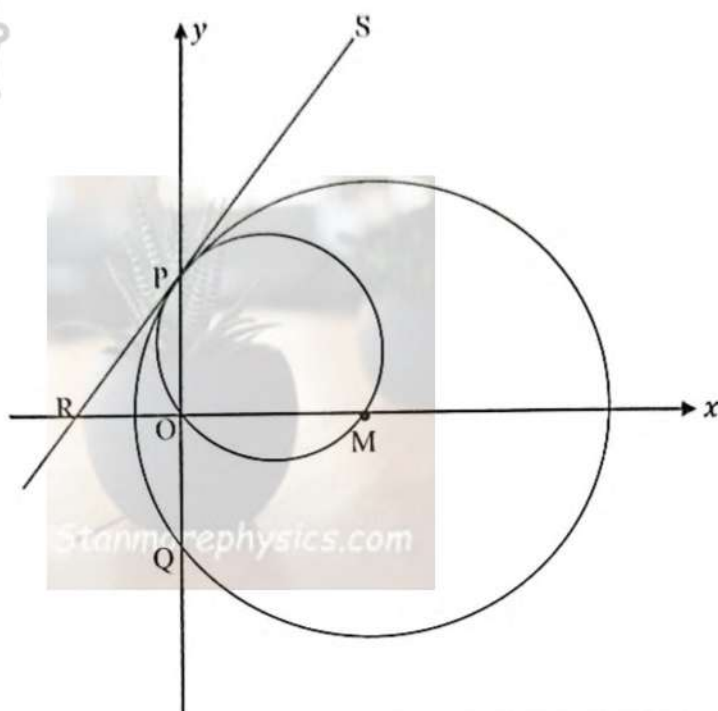
QUESTION/VRAAG 3



3.1		(2)
3.2		(2)
3.3		(4)

3.4		
3.5		(2)
3.6		(5)
		(6)
		[21]

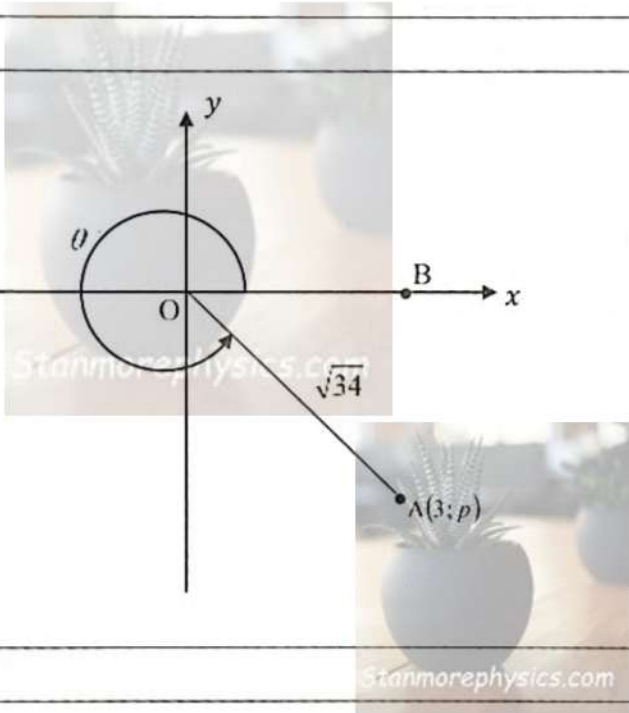
QUESTION/VRAAG 4



4.1		(2)
4.2		(2)
4.3		(5)

4.4		(4)
4.5	 Stanmorephysics.com	(3)
4.6		(3)
		[19]

QUESTION/FRAG 5

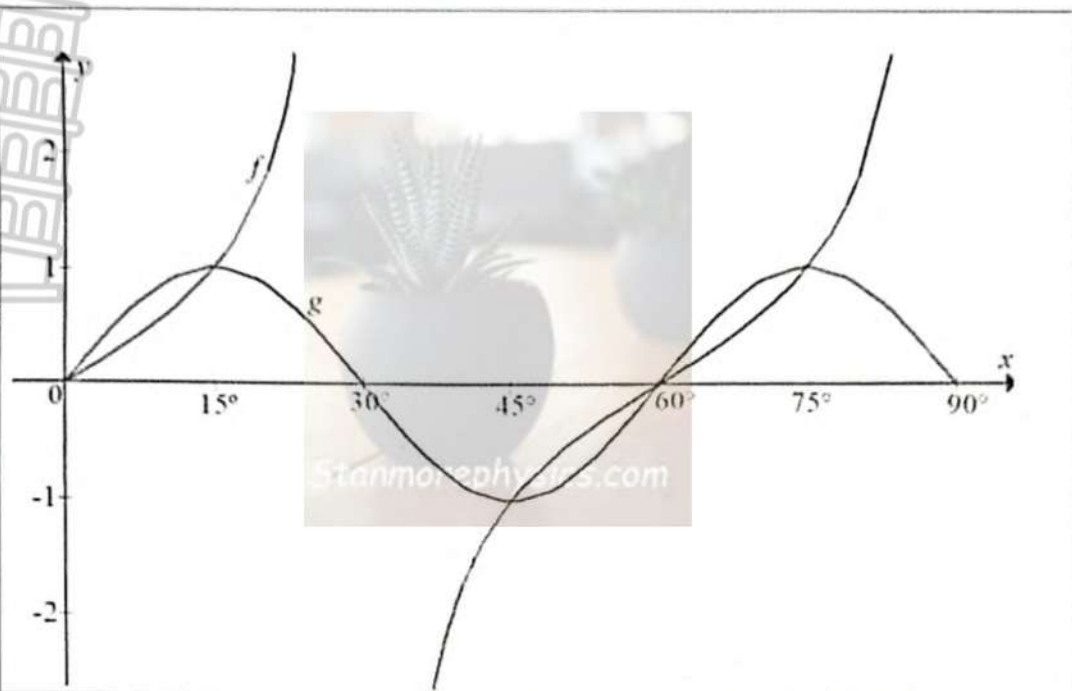
5.1		
5.2		(3)
5.2.1		(2)
5.2.2		(4)

5.3		(5)
5.4	 Stanmorephysics.com	(4)
5.5		(6)

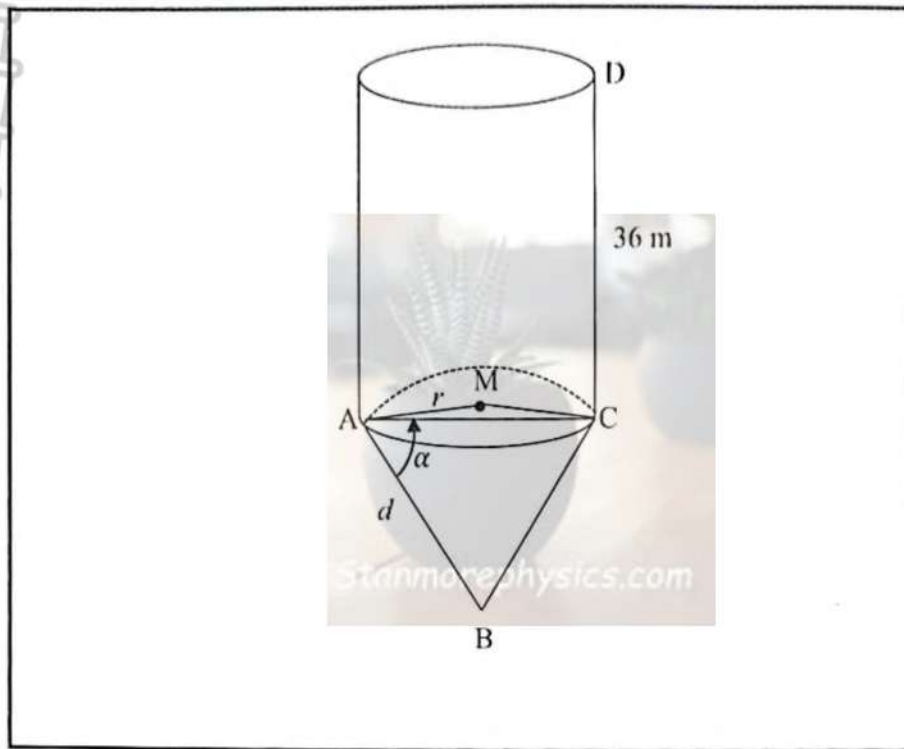
5.6		
		[28]

Additional space/Bykomende ruimte

QUESTION/VRAAG 6

6.1		
6.1.1		(1)
6.1.2		(2)
6.1.3		(2)
6.2.1		(2)
6.2.2		(3)
		[10]

QUESTION/VRAAG 7



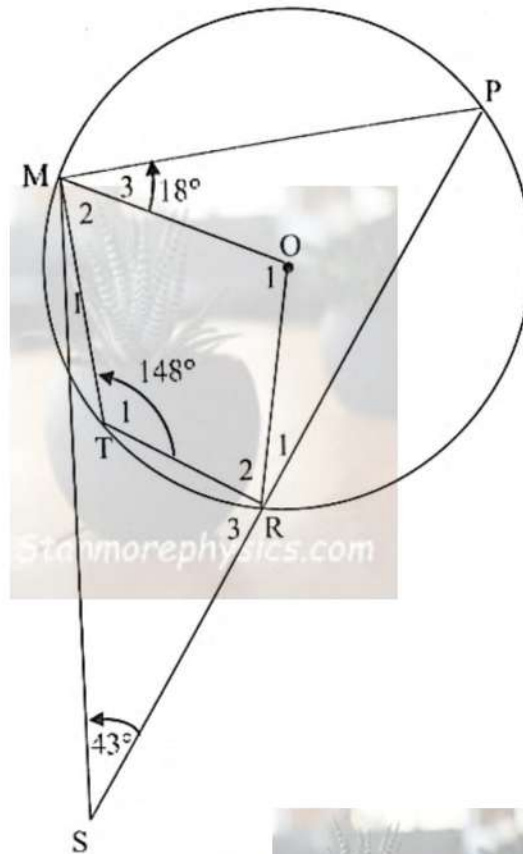
7.1		(2)
7.2		(4)
7.3		(3)

7.4		
		(2)
		[11]

Additional space/Bykomende ruimte

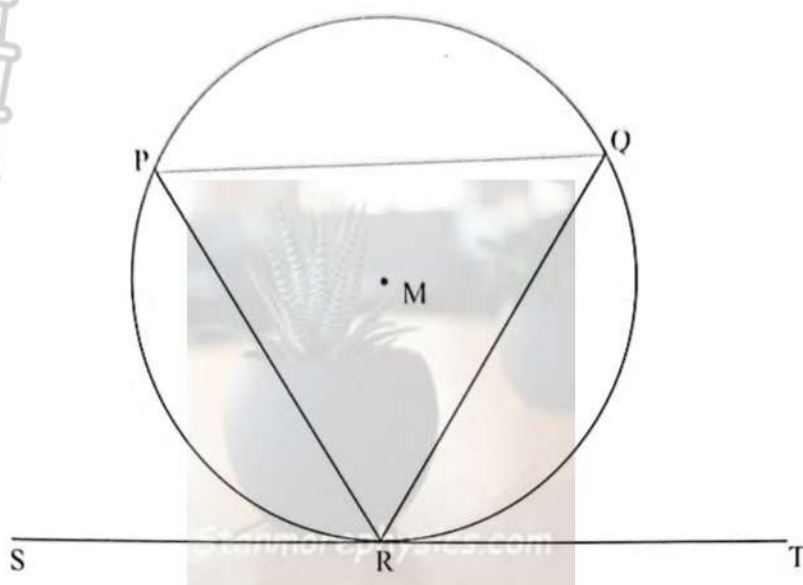


QUESTION/VRAAG 8



8.1		(2)
8.2		(2)
8.3		(2)
8.4		(2)
		[8]

QUESTION/VRAAG 9

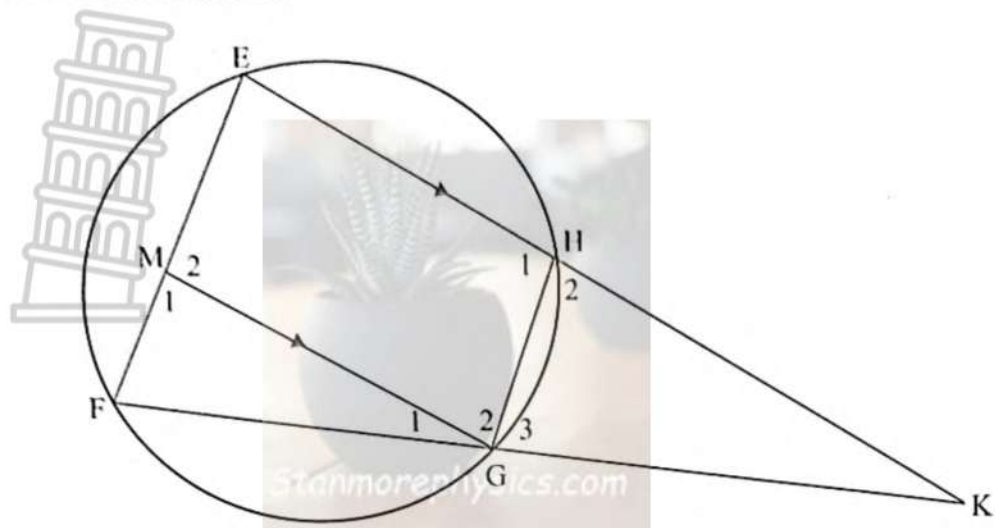


9.1	

9.2		
9.2.1		(6)
9.2.2		(2)

9.2.3		(2)
9.2.4		(3)
9.3		(4)
		[22]

QUESTION/VRAAG 10



10.1.1		(3)
10.1.2		(3)
10.1.3		(2)
10.2		(3)
		[11]
TOTAL/TOTAAL: 150		



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GRADE 12/GRAAD 12

MATHEMATICS P2 / WISKUNDE V2

SEPTEMBER 2026

MARKING GUIDELINE/NASIENRIGLYNE

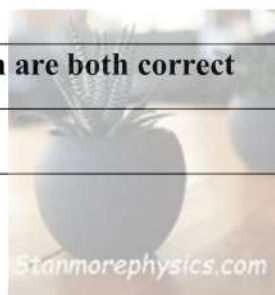
MARKS/PUNTE: 150

**These marking guidelines consist of 20 pages.
Hierdie nasienriglyne bestaan uit 20 bladsye.**

NOTE:

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

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



QUESTION 1 / VRAAG 1

Area/Oppervlakte (x) in m ²	360	120	845	602	1190	530	245	486	350	1005	320	250
Time/Tyd (y) in minutes/minute	50	28	130	75	120	95	55	70	48	110	55	60

1.1	$\hat{y} = 0,09x + 28,14$	✓ 0,09 ✓ 28,14 ✓ Answer/Antwoord (3)
1.2	$r = 0,91$	✓ Answer/Antwoord (1)
1.3	Very strong positive / Baie sterk positief	✓ Answer/Antwoord (1)
1.4	$\hat{y} = 0,09(560) + 28,14$ $= 78,54$ Cost/Koste = $150 + 3(50)$ $= R300$	✓ Substitution/Substitusie ✓ 78,54 ✓ 3 ✓ R300 (4)

[9]



QUESTION 2 / VRAAG 2

Marks Punte	Frequency Frekwensie	Cumulative frequency Kumulatiewe frekwensie
$5 < x \leq 15$	4	
$15 < x \leq 25$	7	
$25 < x \leq 35$	m	21
$35 < x \leq 45$	11	
$45 < x \leq 55$	11	
$55 < x \leq 65$	8	
$65 < x \leq 75$	n	
Total	54	

2.1 $m = 10$
 $n = 3$ ✓ $m = 10$
 ✓ $n = 3$ (2)

2.2

Marks Punte	Frequency Frekwensie	Cumulative frequency Kumulatiewe frekwensie
$5 < x \leq 15$	4	4
$15 < x \leq 25$	7	11
$25 < x \leq 35$	10	21
$35 < x \leq 45$	11	32
$45 < x \leq 55$	11	43
$55 < x \leq 65$	8	51
$65 < x \leq 75$	3	54
Total/Totaal	54	

✓ 1st/e 4 CF/KF
 ✓ Last/laaste 3 CF/KF (2)

2.3

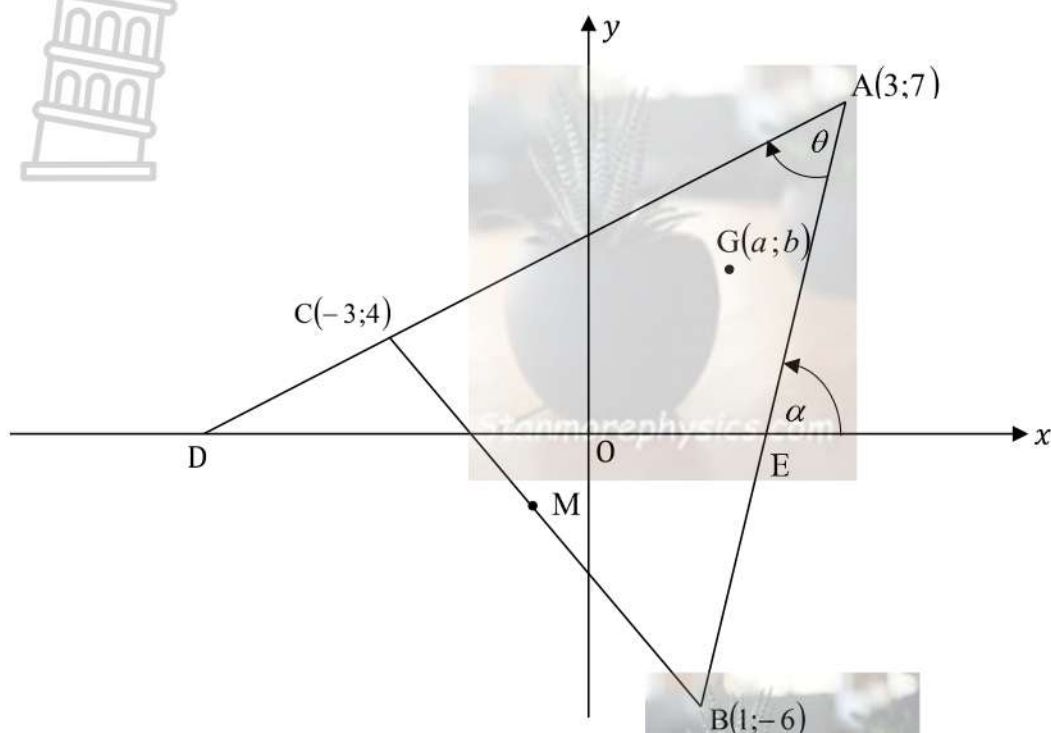
✓
 Grounded/Gegronde
 ✓ Plot upper boundaries / Plot boonste grense
 ✓ Smooth Curve/ Gladde kurwe (3)

2.4 $P_{25} = 27,5$ marks / punte ✓
 Answer/Antwoord

		(1)
2.5	$\bar{x} = \frac{(10)(4) + (20)(7) + (30)(10) + (40)(11) + (50)(11) + (60)(8) + (70)(3)}{54}$ = 40marks/ punte $\sigma = 16,33$marks/ punte	✓ Method/ Metode ✓ 40 marks/ punte ✓ 16,33 marks/ punte (3)
		[11]



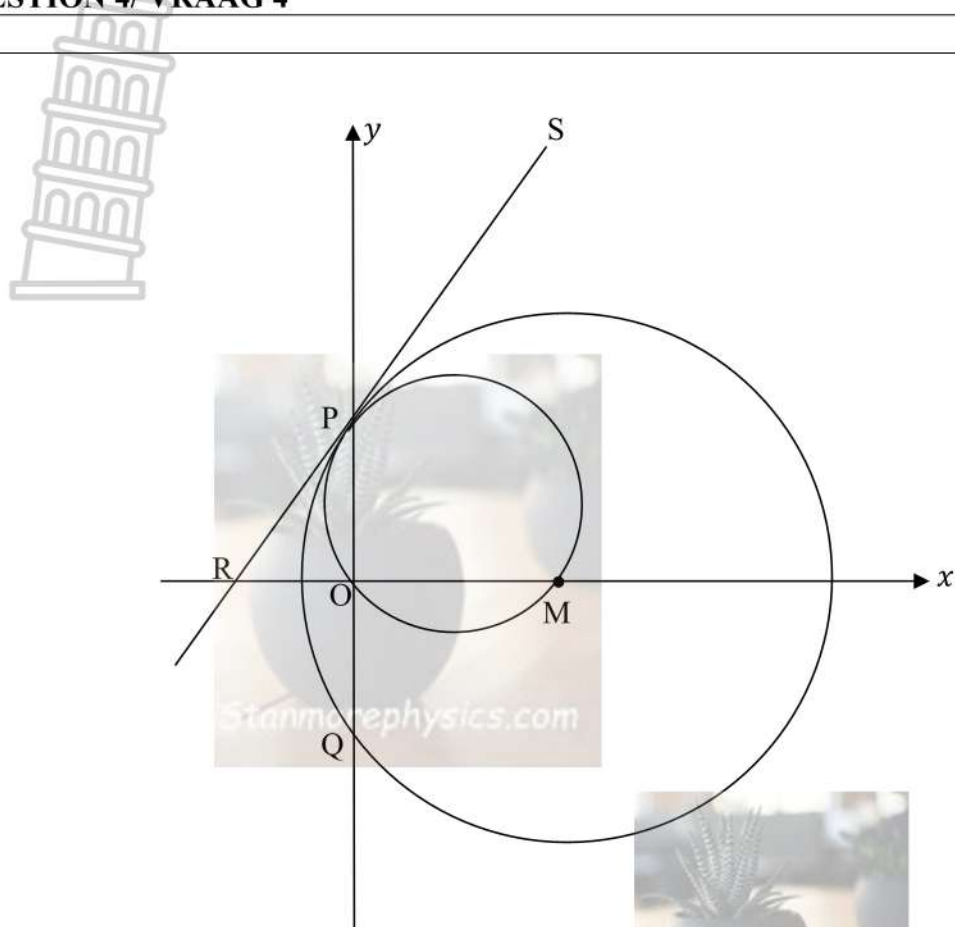
QUESTION 3 / VRAAG 3



3.1	$m_{AD} = \frac{7-4}{3-(-3)}$ $= \frac{1}{2}$	✓ Substitution/Substitusie ✓ Answer/Antwoord (2)
3.2	$y-7 = \frac{1}{2}(x-3)$ $\therefore y = \frac{1}{2}x + \frac{11}{2}$	✓ Substitution/Substitusie ✓ Answer /Antwoord (2)
3.3	$y = \frac{1}{2}x + \frac{11}{2}$ $0 = \frac{1}{2}x + \frac{11}{2}$ $x = -11$ $D(-11;0)$ $AD = \sqrt{(3 - (-11))^2 + (7 - 0)^2}$ $= 7\sqrt{5} = 15,65$	✓ Substitution/Substitusie ✓ $x = -11$ ✓ Substitution/Substitusie ✓ Answer /Antwoord (4)
3.4	$M\left(\frac{-3+1}{2}; \frac{4-6}{2}\right)$ $M(-1;-1)$	✓ Substitution/Substitusie ✓ Answer/Antwoord (2)

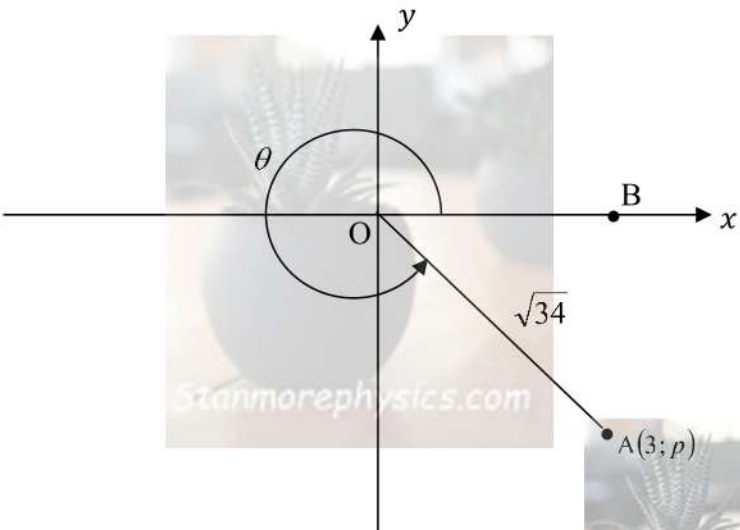
3.5	 $\tan \hat{ADE} = m_{AD} = \frac{1}{2}$ $\hat{ADE} = 26,56^\circ$ $m_{AB} = \frac{7 - (-6)}{3 - 1}$ $= \frac{13}{2}$ $\tan \alpha = \frac{13}{2}$ $\alpha = 81,25^\circ$ $\theta + 26,56^\circ = 81,25^\circ$ $\theta = 54,69^\circ \approx 55^\circ$	$\checkmark \hat{ADE} = 26,56^\circ$ $\checkmark$ Substitution/Substitusie $\checkmark m_{AB} = \frac{13}{2}$ $\checkmark \alpha = 81,25^\circ$ $\checkmark \theta = 55^\circ$ (5)
3.6	$m_{AM} = m_{AG}$ $\frac{7 - (-1)}{3 - (-1)} = \frac{7 - b}{3 - a}$ $2 = \frac{7 - b}{3 - a}$ $b = 2a + 1$ $GC^2 = (a - (-3))^2 + (b - 4)^2$ $(\sqrt{17})^2 = (a + 3)^2 + (2a + 1 - 4)^2$ $17 = a^2 + 6a + 9 + 4a^2 - 12a + 9$ $5a^2 - 6a + 1 = 0$ $(5a - 1)(a - 1) = 0$ $a = \frac{1}{5} \text{ or/of } a = 1$ $b = \frac{7}{5} \text{ or/of } b = 3$	$\checkmark b = 2a + 1$ $\checkmark$ Substitution/Substitusie $\checkmark$ Standard form/Standaardvorm $\checkmark$ Factors/Faktore $\checkmark$ Values/Waardes of/van a $\checkmark$ Values/Waardes van b (6)
		[21]

QUESTION 4/ VRAAG 4



4.1	$x^2 - 8x + y^2 = 9$ $x^2 - 8x + 16 + y^2 = 25$ $(x - 4)^2 + (y - 0)^2 = 25$ $M(4; 0)$	✓ $(x - 4)^2 + y^2 = 25$ ✓ $M(4; 0)$ (2)
4.2	$x^2 - 8x + y^2 = 9$ $(0)^2 - 8(0) + y^2 = 9$ $y = \pm 3$ $PQ = 6 \text{ units / eenhede}$ OR/OF $0 = \frac{0+x_Q}{2}; 0 = \frac{3+y_Q}{2}$ $Q(0; -3)$ $PQ = 6 \text{ units / eenhede}$	✓ Substitution/Substitusie ✓ Answer/Antwoord (2) OR/OF ✓ Substitution/Substitusie ✓ Answer/Antwoord (2)
4.3	$(0 - 4)^2 + y^2 = 25$ $y^2 = 9$ $y = 3$ $P(0; 3)$ $m_{PM} = \frac{0 - 3}{4 - 0} = -\frac{3}{4}$	✓ $y = 3$ ✓ Substitution/Substitusie ✓ $m_{PM} = -\frac{3}{4}$

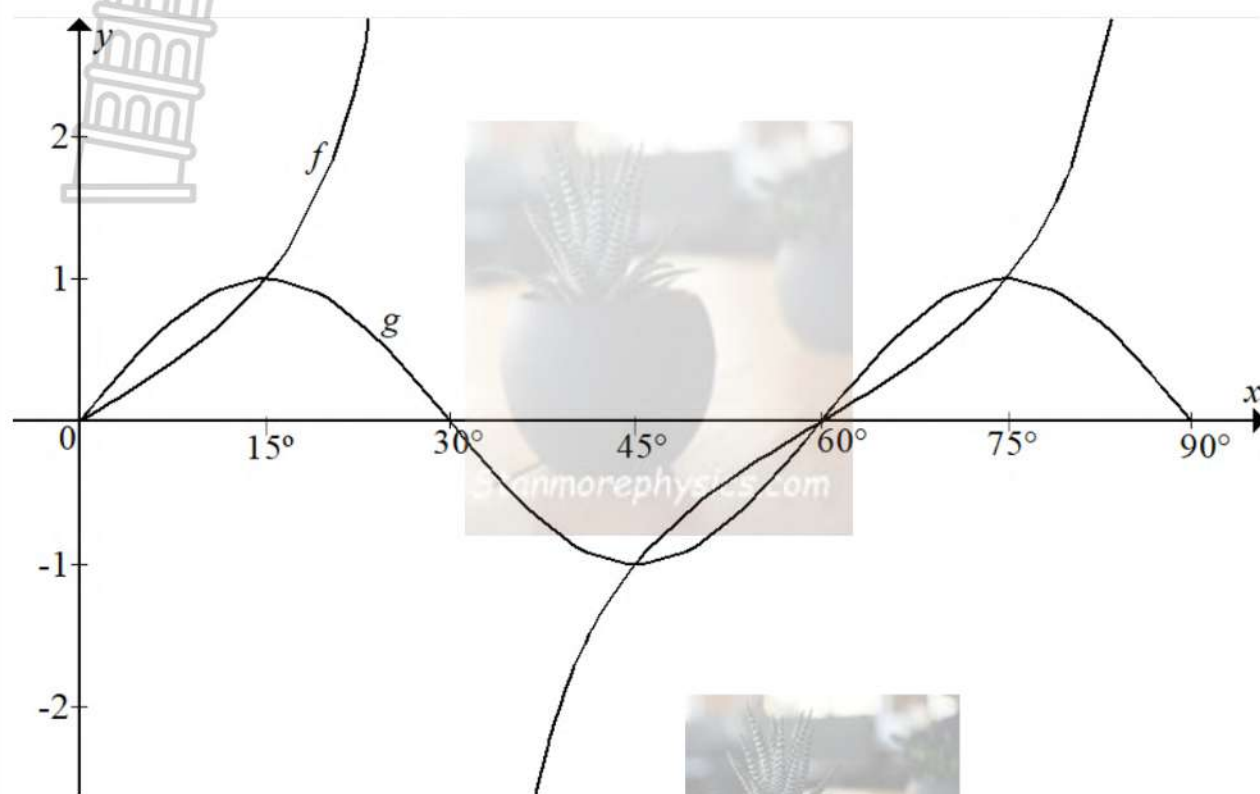
	$m_{\text{tangent/raaklyn}} = \frac{4}{3}$ $y = \frac{4}{3}x + 3$	$\checkmark m_{\text{tangent/raaklyn}} = \frac{4}{3}$ $\checkmark \text{Answer/Antwoord}$ (5)
4.4	$y = \frac{4}{3}x + 3$ $0 = \frac{4}{3}x + 3$ $x = -\frac{9}{4}$ $R\left(-\frac{9}{4}; 0\right)$ $RP^2 = \left(0 - \left(-\frac{9}{4}\right)\right)^2 + (3 - 0)^2$ $RP^2 = \frac{81}{16} + 9$ $RP^2 = \frac{225}{16}$ $RP = \frac{15}{4}$ $\text{Area/Opp of/van } \triangle PRM = \frac{1}{2}(RP)(PM)$ $= \frac{1}{2}\left(\frac{15}{4}\right)(5)$ $= \frac{75}{8} = 9,34$	$\checkmark x = -\frac{9}{4}$ $\checkmark \text{Substitution/Substitusie}$ $\checkmark RP = \frac{15}{4}$ $\checkmark \text{Answer/Antwoord}$ (4)
4.5	$M_{PM}\left(\frac{4+0}{2}; \frac{3+0}{2}\right)$ $M_{PM}\left(2; \frac{3}{2}\right)$ $(0-2)^2 + \left(3-\frac{3}{2}\right)^2 = r^2$ $r^2 = \frac{25}{4}$ $(x-2)^2 + \left(y-\frac{3}{2}\right)^2 = \frac{25}{4}$	$\checkmark M_{PM}\left(2; \frac{3}{2}\right)$ $\checkmark (x-2)^2 + \left(y-\frac{3}{2}\right)^2$ $\checkmark r^2 = \frac{25}{4}$ (3)
4.6	P, M and P' are collinear/is koliniër $P'(4; 0)$ $r = 5$ Maximum distance/Maksimum afstand $= 5 \text{ units /eenhede}$	$\checkmark \text{P, M and P' are collinear/}$ /is koliniër $\checkmark P'(4; 0)$ $\checkmark \text{Answer/Antwoord}$ (3)
		[19]

QUESTION 5 / VRAAG 5		
5.1	$\begin{aligned}\cos(P + Q) &= \sin[90^\circ - (P + Q)] \\ &= \sin[(90^\circ - P) - Q] \\ &= \sin(90^\circ - P)\cos Q - \cos(90^\circ - P)\sin Q \\ &= \cos P \cos Q - \sin P \sin Q\end{aligned}$	✓ $\sin(90^\circ - (P + Q))$ ✓ $\sin((90^\circ - P) - Q)$ ✓ Expansion (3)
		
5.2.1	$\begin{aligned}(3)^2 + (p)^2 &= (\sqrt{34})^2 \\ p &= -5\end{aligned}$	✓ Subst. Pyth. ✓ Answer/Antwoord (2)
5.2.2	$\begin{aligned}\cos(60^\circ + \theta) &= \cos 60^\circ \cos \theta - \sin 60^\circ \sin \theta \\ &= \left(\frac{1}{2}\right)\left(\frac{3}{\sqrt{34}}\right) - \left(\frac{\sqrt{3}}{2}\right)\left(\frac{-5}{\sqrt{34}}\right) \\ &= \frac{3+5\sqrt{3}}{2\sqrt{34}}\end{aligned}$	✓ Expansion/Brei uit ✓ Special Angles/Spesiale hoeke ✓ Substitution/Substitusie ✓ Answer/Antwoord (4)
5.3	$\begin{aligned}\sin 50^\circ &= \sin 145^\circ \cos(360^\circ - k) - \sin(-375^\circ) \cos(-35^\circ) \\ \sin 50^\circ &= \sin 35^\circ \cos k - [-\sin 375^\circ \cos 35^\circ] \\ \sin 50^\circ &= \sin 35^\circ \cos k + \sin 15^\circ \cos 35^\circ \\ \therefore k &= 15^\circ\end{aligned}$	✓ $\sin 35^\circ$ ✓ $\cos k$ ✓ $\sin 15^\circ$ ✓ $\cos 35^\circ$ ✓ Answer/Antwoord (5)
5.4	$\begin{aligned}\text{LHS} &= 4\cos\theta - \frac{1+\cos 2\theta}{\cos\theta} \\ &= \frac{4\cos^2\theta - (1+\cos 2\theta)}{\cos\theta} \\ &= \frac{4\cos^2\theta - 1 - (2\cos^2\theta - 1)}{\cos\theta}\end{aligned}$	✓ Single Fraction/Enkel breuk ✓ $2\cos^2\theta - 1$

	$\begin{aligned} &= \frac{2\cos^2\theta}{\cos\theta} \\ &= 2\cos\theta \\ \text{RHS} &= \frac{\sin 2\theta}{\sin\theta} \\ &= \frac{2\sin\theta\cos\theta}{\sin\theta} \\ &= 2\cos\theta \end{aligned}$	✓ Simplification/Vereenvoudig ✓ $2\sin\theta\sin$ (4)
5.5	$\begin{aligned} 2\cos x &= 3\tan x \\ 2\cos x &= \frac{3\sin x}{\cos x} \\ 2\cos^2 x &= 3\sin x \\ 2(1 - \sin^2 x) &= 3\sin x \\ 2 - 2\sin^2 x &= 3\sin x \\ 2\sin^2 x + 3\sin x - 2 &= 0 \\ (2\sin x - 1)(\sin x + 2) &= 0 \\ \sin x &= \frac{1}{2} \text{ or /of } \sin x = -2 \text{ Invalid/Ongeldig} \\ x &= 30^\circ + k.360^\circ; k \in \mathbb{Z} \text{ or/of} \\ x &= 150^\circ + k.360^\circ; k \in \mathbb{Z} \end{aligned}$	✓ $\frac{3\sin x}{\cos x}$ ✓ $1 - \sin^2 x$ ✓ Standard form/Standaard vorm ✓ Equation/Vergelyking ✓ $x = 30^\circ$ or/of $x = 150^\circ$ ✓ $k.360^\circ; k \in \mathbb{Z}$ (6)
5.6	$\begin{aligned} \cos 45^\circ &= 1 - 2\sin^2 22,5^\circ \\ \frac{\sqrt{2}}{2} &= 1 - 2\sin^2 22,5^\circ \\ \sin^2 22,5^\circ &= \frac{1 - \frac{\sqrt{2}}{2}}{2} \\ &= \frac{2 - \sqrt{2}}{4} \\ 3 - 4\sin^2 22,5^\circ &= 3 - 4\left(\frac{2 - \sqrt{2}}{4}\right) \\ &= 3 - 2 + \sqrt{2} \\ &= 1 + \sqrt{2} \end{aligned}$ OR/OF $\begin{aligned} \sin^2 22,5^\circ &= \frac{1 - \cos 45^\circ}{2} \\ \sin^2 22,5^\circ &= \frac{1 - \frac{\sqrt{2}}{2}}{2} \\ &= \frac{2 - \sqrt{2}}{4} \\ 3 - 4\sin^2 22,5^\circ &= 3 - 4\left(\frac{2 - \sqrt{2}}{4}\right) \\ &= 1 + \sqrt{2} \end{aligned}$	✓ $\cos 45^\circ = 1 - 2\sin^2 22,5^\circ$ ✓ Special Angle/Spesiale hoek ✓ Substitution/Substitusie ✓ Answer/Antwoord (4) OR ✓ $\sin^2 22,5^\circ = \frac{1 - \cos 45^\circ}{2}$ ✓ Special Angle ✓ Substitution/Substitusie ✓ Answer/Antwoord (4)
		[28]

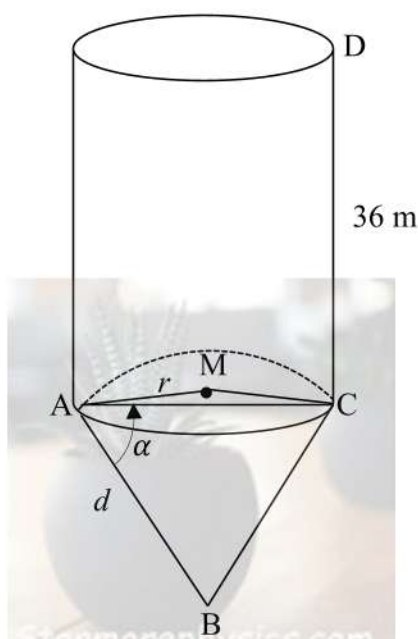
QUESTION 6 / VRAAG 6

6.1



6.1.1	60°	✓ Answer /Antwoord (1)
6.1.2	$x = 30^\circ$ $x = 90^\circ$	✓ $x = 30^\circ$ ✓ $x = 90^\circ$ (2)
6.1.3	$0^\circ \leq x \leq 15^\circ$ or/of $30^\circ < x \leq 45^\circ$	✓ $0^\circ \leq x \leq 15^\circ$ ✓ $30^\circ < x \leq 45^\circ$ (2)
6.2.1	The graph of $y = \sin 6x$ has been translated 10° to the right. Die grafiek van $y = \sin 6x$ het 10° regs geskuif.	✓ 10° ✓ to the right / regs (2)
6.2.2	$p(x) = -2 \sin(6x - 60^\circ) + 1$ $y \in [-2, 2]$ OR/OF $-2 \leq y \leq 2$ Range/Waardeversameling: $y \in [-2 + 1; 2 + 1]$ $y \in [-1; 3]$ OR/OF Range/Waardeversameling: $-1 \leq y \leq 3$	✓ $y \in [-2; 2]$ ✓✓ $y \in [-1; 3]$ (3)
		[10]

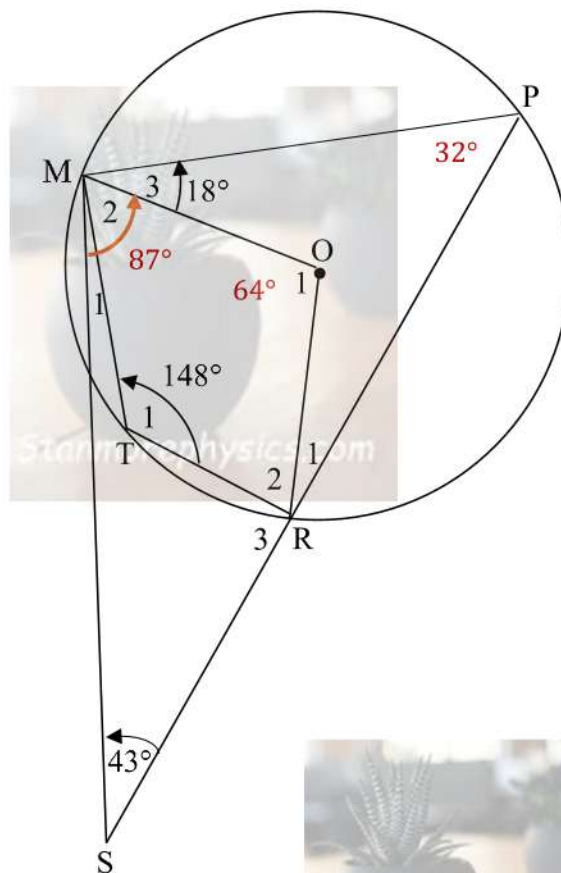
QUESTION 7 / VRAAG 7



7.1	$AB = BC = d$ tans from common pt / raaklyne uit dieselfde punt $\hat{A}CB = \alpha$ $\angle$ s opp = sides / $\angle$ e teenoor = e sye $\hat{B} = 180^\circ - 2\alpha$ sum of $\angle$ s in Δ / binne $\angle$ e van Δ	$\checkmark \hat{A}CB = \alpha$ $\checkmark \hat{B} = 180^\circ - 2\alpha$ (2)
7.2	$AC^2 = AB^2 + BC^2 - 2AB \cdot BC \cos B$ $AC^2 = d^2 + d^2 - 2d \cdot d \cos(180^\circ - 2\alpha)$ $AC^2 = 2d^2 - 2d^2(-\cos 2\alpha)$ $AC^2 = 2d^2 + 2d^2 \cos 2\alpha$ $AC^2 = 2d^2 + 2d^2(2\cos^2 \alpha - 1)$ $AC^2 = 4d^2 \cos^2 \alpha$ $\therefore AC = 2d \cos \alpha$	$\checkmark$ Cosine rule / cosreël $\checkmark -\cos 2\alpha$ $\checkmark 2\cos^2 \alpha - 1$ $\checkmark AC^2 = 4d^2 \cos^2 \alpha$ (4)
7.3	In ΔACM : $\hat{AMC} = 108^\circ$ opp $\angle$ s of cyclic quad / teenoorst $\angle$ e van koordevierhoek $AM = MC = r$ radii / radiusse $\hat{MAC} = 36^\circ$ sum of $\angle$ s in Δ / binne $\angle$ e van Δ $AC = 2r \cos(\hat{MAC})$ $12,22 = 2r \cos 36^\circ$ $r = \frac{12,22}{2 \cos 36^\circ} = 7,55 \text{ m}$ OR/OF	$\checkmark \hat{AMC} = 108^\circ$ $\checkmark \hat{MAC} = 36^\circ$ $\checkmark 12,22 = 2r \cos 36^\circ$ (3) OR/OF

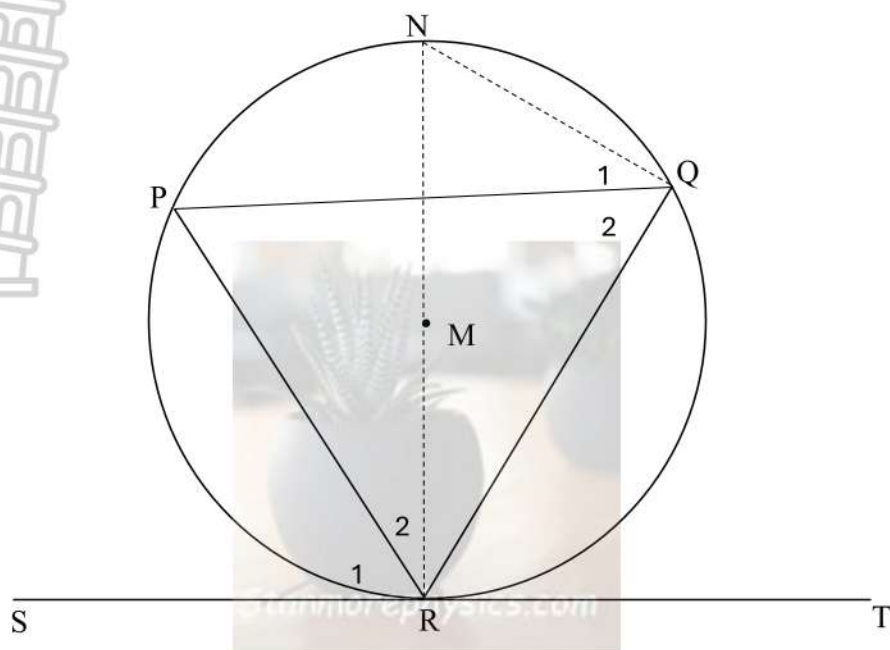
	$\hat{AMC} = 108^\circ$ opp $\angle$s of cyclic quad/ teenoorst $\angle$e van koordevierhoek $AM = MC = r$ radii/radiusse $\hat{MAC} = 36^\circ$ sum of $\angle$s in Δ/ binne $\angle$e van Δ $\frac{r}{\sin 36^\circ} = \frac{12,22}{\sin 108^\circ}$ $r = \frac{12,22 \sin 36^\circ}{\sin 108^\circ} = 7,5523753425 \dots$ $\therefore r = 5,55m$ as required/soos gevra. OR/OF $\hat{AMC} = 108^\circ$ opp $\angle$s of cyclic quad/ teenoorst $\angle$e van koordevierhoek $AM = MC = r$ radii/radiusse $AC^2 = r^2 + r^2 - 2r \cdot r \cos 108^\circ$ $(12,22)^2 = r^2 + r^2 - 2r^2 \cos 108^\circ$ $149,3284 = 2r^2 - 2r^2 \cos 108^\circ$ $r^2(2 - 2 \cos 108^\circ) = 149,3284$ $r = \sqrt{\frac{149,3284}{2 - 2 \cos 108^\circ}}$ $\therefore r = 7,55m$ as required/soos gevra.	✓ $\hat{AMC} = 108^\circ$ ✓ $\hat{MAC} = 36^\circ$ ✓ $\frac{r}{\sin 36^\circ} = \frac{12,22}{\sin 108^\circ}$ (3) OR/OF ✓ $\hat{AMC} = 108^\circ$ ✓ Substitution into Cosine Rule /Substitusie in Cos-reël ✓ simplification/vernoudig (3)
7.4	$V = \pi r^2 h$ $= \pi (7,55)^2 (36)$ $= 6446,83m^3$ $= 6\,447\,m^3$	✓ Substitution into correct formula /Substitusie in korrekte formule ✓ Answer/Antwoord (2)
		[11]

QUESTION 8 / VRAAG 8



8.1	$\hat{P} = 32^\circ$ opp $\angle$ s of cyclic quad / teenoorst $\angle$ e van koordevierhoek	✓S ✓R	(2)
8.2	$\hat{O}_1 = 2\hat{P}$ $= 64^\circ$ $\angle$ at centre = $2\angle$ at circumference /middelpunts $\angle$ = $2 \times$ omtreks $\angle$	✓S ✓R	(2)
8.3	$\hat{PMS} + 43^\circ + 32^\circ = 180^\circ$ sum $\angle$ s of ΔMPS /binne $\angle$ e van ΔMPS $\hat{PMS} = 105^\circ$ $\therefore \hat{OMS} = 87^\circ$	✓ $\hat{PMS} = 105^\circ$ ✓ $\hat{OMS} = 87^\circ$	(2)
8.4	$\hat{PMT} = 105^\circ - 6^\circ = 99^\circ$ $\hat{R}_3 = \hat{PMT} = 99^\circ$ ext $\angle$ of cyclic quad / buite $\angle$ van koordevierhoek	✓ $\hat{PMT} = 99^\circ$ ✓S/R	(2)
			[8]

QUESTION 9 / VRAAG 9



9.1

Construction: Draw diameter RMN and join NQ.
 Konstruksie: Teken middellyn RMN en verbind NQ.

$$\hat{R}_1 + \hat{R}_2 = 90^\circ \mid \tan \perp \text{radius/ raaklyn} \perp \text{radius}$$

$$\hat{Q}_1 + \hat{Q}_2 = 90^\circ \mid \angle s \text{ in the semi-circle / } \angle e \text{ in halfsirkel}$$

$$\hat{R}_2 = \hat{Q}_1 \mid \angle s \text{ in the same seg / } \angle e \text{ in dieselfde sirkelsegment}$$

$$\hat{R}_1 + \hat{R}_2 = \hat{Q}_1 + \hat{Q}_2 \mid = 90^\circ$$

$$\therefore \hat{R}_2 = \hat{Q}_2$$

Hence/Vervolgens $\hat{P}RS = \hat{P}QR$ as required. /soos gevra

✓Construction/Konstruksie

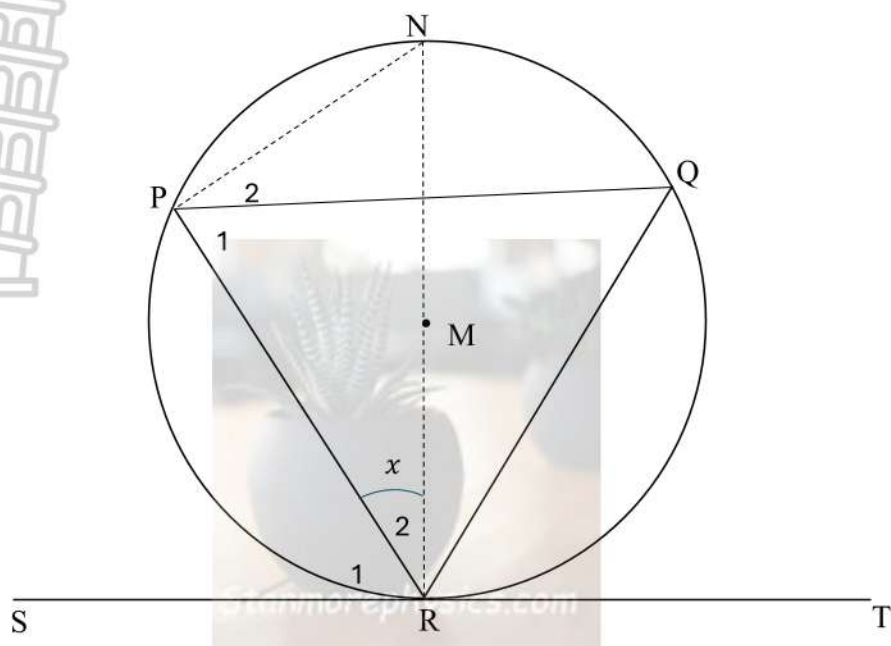
✓S ✓R

✓S/R

✓S/R

(5)

QUESTION 9 / VRAAG 9



9.1

Construction: Draw diameter RMN and join NP.
 Konstruksie: Teken middellyn RMN en verbind NP.

✓ Construction/Konstruksie

Let/Laat $\hat{R}_2 = x$

$\hat{R}_1 = 90^\circ - x$ | $\tan \perp$ radius / raaklyn $\perp$ radius

✓ S ✓ R

$\hat{N} + \hat{NPR} + \hat{R}_2 = 180^\circ$ | sum of $\angle$ s in Δ / binne $\angle$ e van Δ

✓ S/R

$\hat{N} = 90^\circ - x$

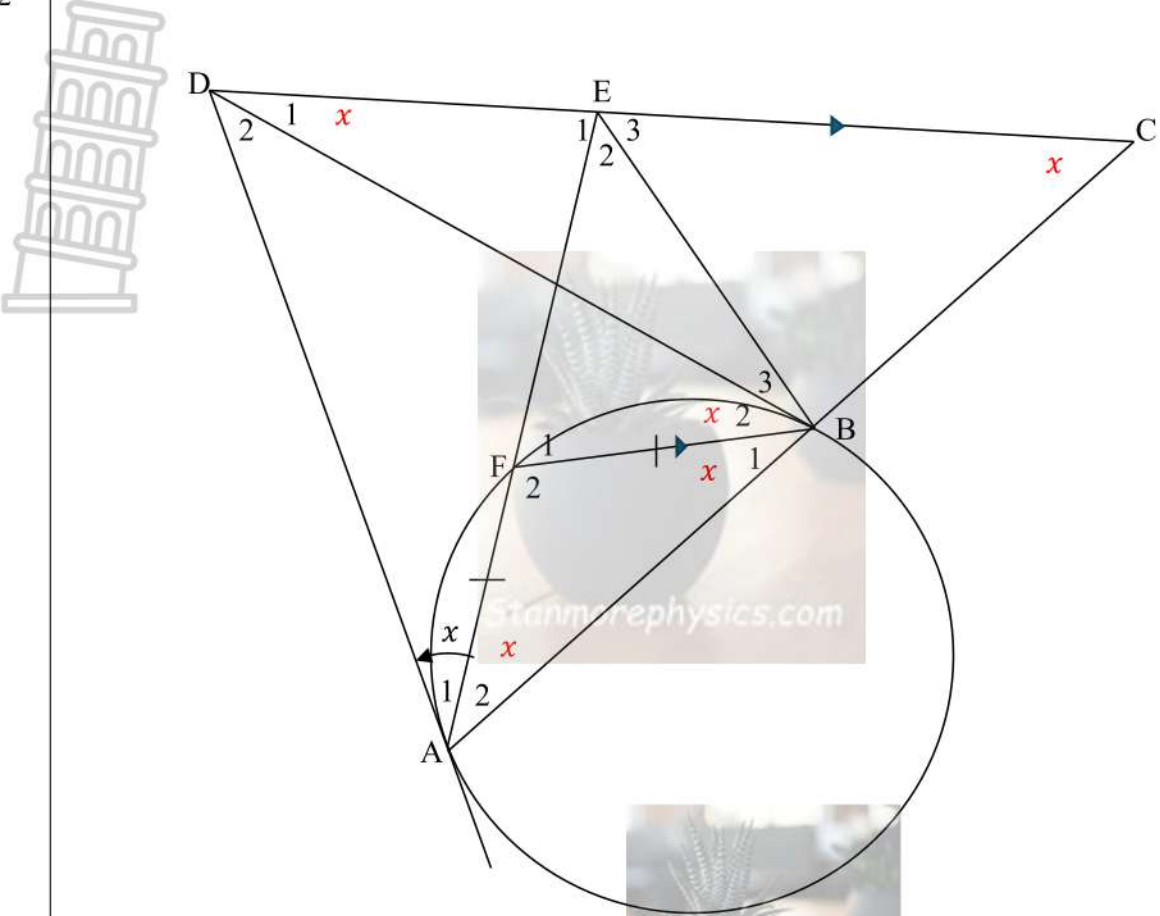
$\hat{Q} = \hat{N}$ | $\angle$ s in the same seg / $\angle$ e in dieselfde sirkelsegment

✓ S/R

$\hat{R}_2 = \hat{N}$ | $= 90^\circ - x$

Hence/Vervolgens $\hat{PRS} = \hat{PQR}$ as required. /soos gevra

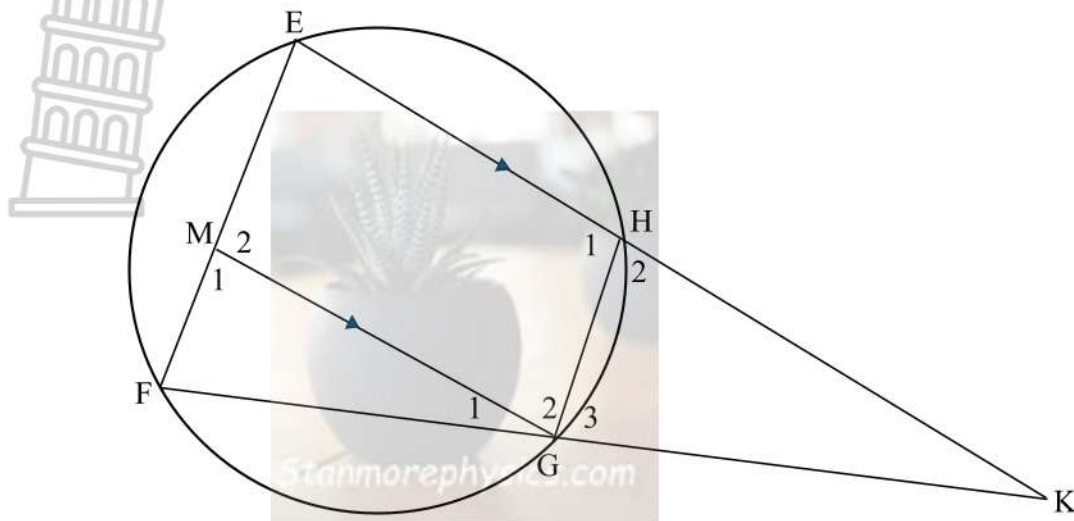
(5)

9.2		
9.2.1	$\hat{A}_1 = \hat{B}_1 = x$ tan-chord theorem/raaklyn koord stelling $\hat{A}_2 = \hat{B}_1 = x$ $\angle$ s opp = sides / $\angle$ e teenoor = e sye $\hat{B}_2 = \hat{A}_2 = x$ tan-chord theorem/ raaklyn koord stelling $\hat{B}_1 = \hat{C} = x$ corresp $\angle$ s / ooreenkomstige $\angle$ e, $DC \parallel FB$ $\hat{B}_2 = \hat{D}_1 = x$ alt $\angle$ s / verwisselende $\angle$ e, $DC \parallel FB$	✓S/R ✓S/R ✓S ✓S ✓R ✓S/R (6)
9.2.2	$\hat{D}_1 = \hat{A}_2$ proven/ bewys ABED is a cyclic quadrilateral converse $\angle$ s in the same seg ABED is 'n koordevierhoek omgekeerde $\angle$ e in dieselfde sirkelsegment.	✓ $\hat{D}_1 = \hat{A}_2$ ✓R (2)
9.2.3	$\hat{A}_1 = \hat{B}_3 = x$ $\angle$ s in the same seg / $\angle$ e in dieselfde sirkelsegment $\widehat{ABE} = \hat{B}_1 + \hat{B}_2 + \hat{B}_3$ maar/but $\widehat{B}_1 = \hat{B}_2 = \hat{B}_3 = \hat{A}_1 = x$ $\therefore \widehat{ABE} = 3\hat{A}_1$	✓S/R ✓S (2)
9.2.4	$\hat{D}_1 = \hat{C} = x$ $BC = BD$ sides opp = $\angle$ /sye teenoor = e $\angle$ e $AD = BD$ tans from common pt / raaklyne uit dieselfde punt	✓ $\hat{D}_1 = \hat{C}$ ✓S/R ✓S/R (3)

	$\therefore AD = BC \quad \quad = BD$	
9.3	$\frac{AF}{FE} = \frac{AB}{BC} = \frac{2}{3} \quad \quad \text{prop theorem/eweredigheidstelling, FB EC}$ $\frac{\text{Area of/van } \triangle FAB}{\text{Area of/van } \triangle EAC} = \frac{\frac{1}{2}AF \cdot AB \sin A_2}{\frac{1}{2}AE \cdot AC \sin A_2}$ $= \frac{\frac{1}{2}(2)(2) \sin A_2}{\frac{1}{2}(5)(5) \sin A_2}$ $= \frac{4}{25}$	✓S ✓R ✓ $\frac{\frac{1}{2}AF \cdot AB \sin A_2}{\frac{1}{2}AE \cdot AC \sin A_2}$ ✓ Answer/Antwoord (4)
		[22]



QUESTION 10 / VRAAG 10



10.1.1	In $\triangle KGH$ and/en $\triangle KEF$: $\hat{K} = \hat{K}$ common/gemeenskaplik $\hat{G}_3 = \hat{E}$ ext $\angle$ of cyclic quad/buite$\angle$ van koordevierhoek $\hat{H}_2 = \hat{F}$ ext $\angle$ of cyclic quad/buite$\angle$ van koordevierhoek $\therefore KGH \parallel \triangle KEF$ equiangular/AAA//gelykhoekig/HHH	✓S ✓S/R ✓R (3)
10.1.2	$\frac{EF}{GH} = \frac{KE}{KG}$ $\parallel \Delta s$ /e $EF \cdot KG = KE \cdot GH$ But $KG = EF$ given/gegee $\therefore EF^2 = KE \cdot GH$	✓ $\frac{EF}{GH} = \frac{KE}{KG}$ ✓R ✓ $EF \cdot KG = KE \cdot GH$ or/of Substituting/Vervang $KG = EF$ (3)
10.1.3	$\frac{EF}{EM} = \frac{KF}{KG}$ prop theorem/eweredigheidstelling, $MG \parallel EK$ $EF \cdot KG = EM \cdot KF$ $\therefore KG^2 = EM \cdot KF$	✓ $\frac{EF}{EM} = \frac{KF}{KG}$ ✓ $EF \cdot KG = EM \cdot KF$ or/of Substituting/Vervang $KG = EF$ (2)
10.2	$KE \cdot GH = EM \cdot KF$ $20 \times 4 = EM \times 16$ $\therefore EM = 5 \text{ units / eenhede}$	✓ $KE \cdot GH = EM \cdot KF$ ✓ Substitution/Vervanging ✓ Answer/Antwoord (3)
		[11]
TOTAL: 150		