GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

JUNE EXAMINATION GRADE 12

2026

MATHEMATICS

(PAPER 2)

SURNAME:										
NAME:										
NAME OF SCHOOL:										
DATE:	**2**	**0**	**2**	**6**		M	M		D	D

ANSWER ALL THE QUESTIONS IN THE QUESTION PAPER.

	MARKER				MODERATOR			
QUESTION	**MARKS**			**MARKER'S INITIALS**	**MARKS**			**MODERATOR'S 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			
				TOTAL				

TIME: 3 hours

MARKS: 150

26 pages + an information sheet

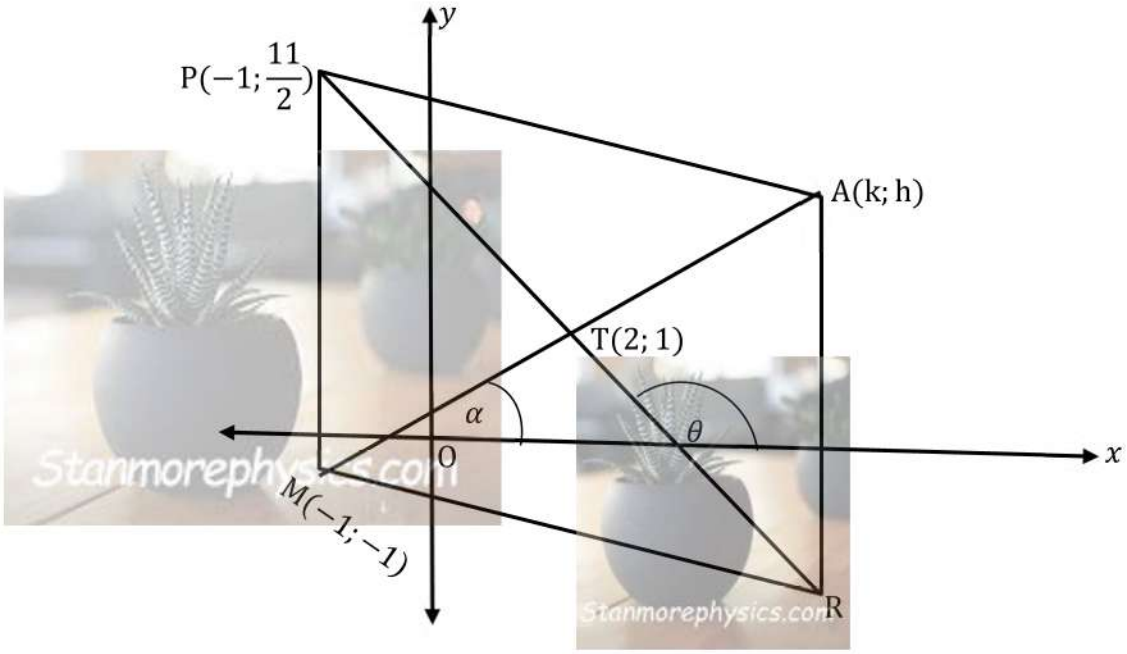
INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

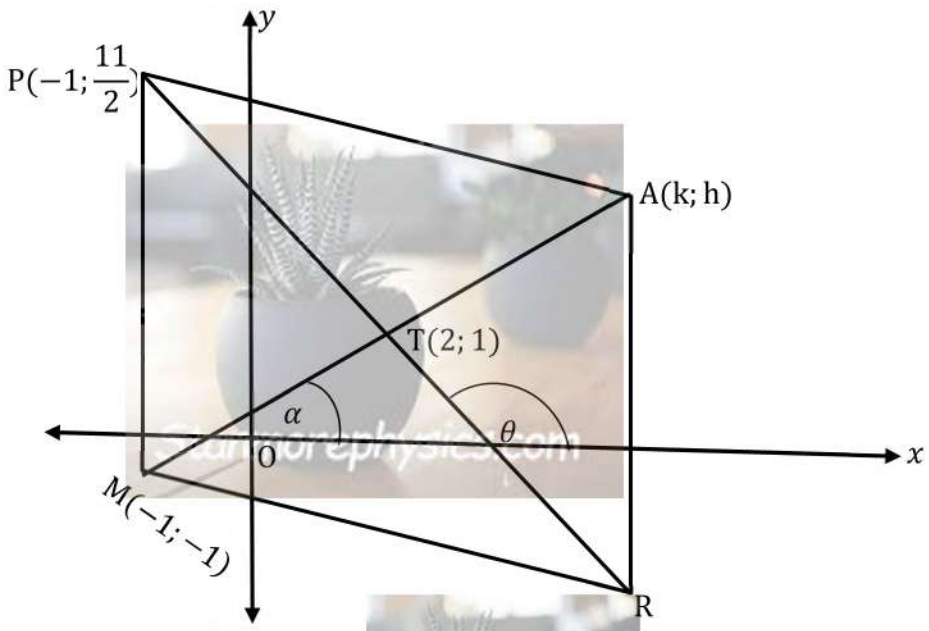
1. This question paper consists of 9 questions. Answer ALL questions in the spaces provided.
2. Clearly show ALL calculations, diagrams, graphs, etc. that you have used in determining your answers.
3. Answers only will NOT necessarily be awarded full marks.
4. You may use an approved scientific calculator (non-programmable and non-graphical), unless stated otherwise.
5. If necessary, round-off answers correct 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. Draw a neat line through any work/rough work that must NOT be marked.
12. In the event that you use the additional space provided:
    - 12.1 Write down the number of the question.
    - 12.2 Leave a line and rule off after your answer.
13. Write neatly and legibly.

QUESTION 1

In the diagram below, ARMP is a quadrilateral with vertices P $\left(-1;\frac{11}{2}\right)$, A(k; h), R and M(−1; −1). The diagonals of ARMP intersect at T (2; 1).
α and θ are angles of inclination of AM and PR, respectively.



1.1	Calculate the gradient of MT.	(2)
1.2	Determine the equation of the line that is parallel to AM and passes through P, in the form $y = mx + c$.	(3)



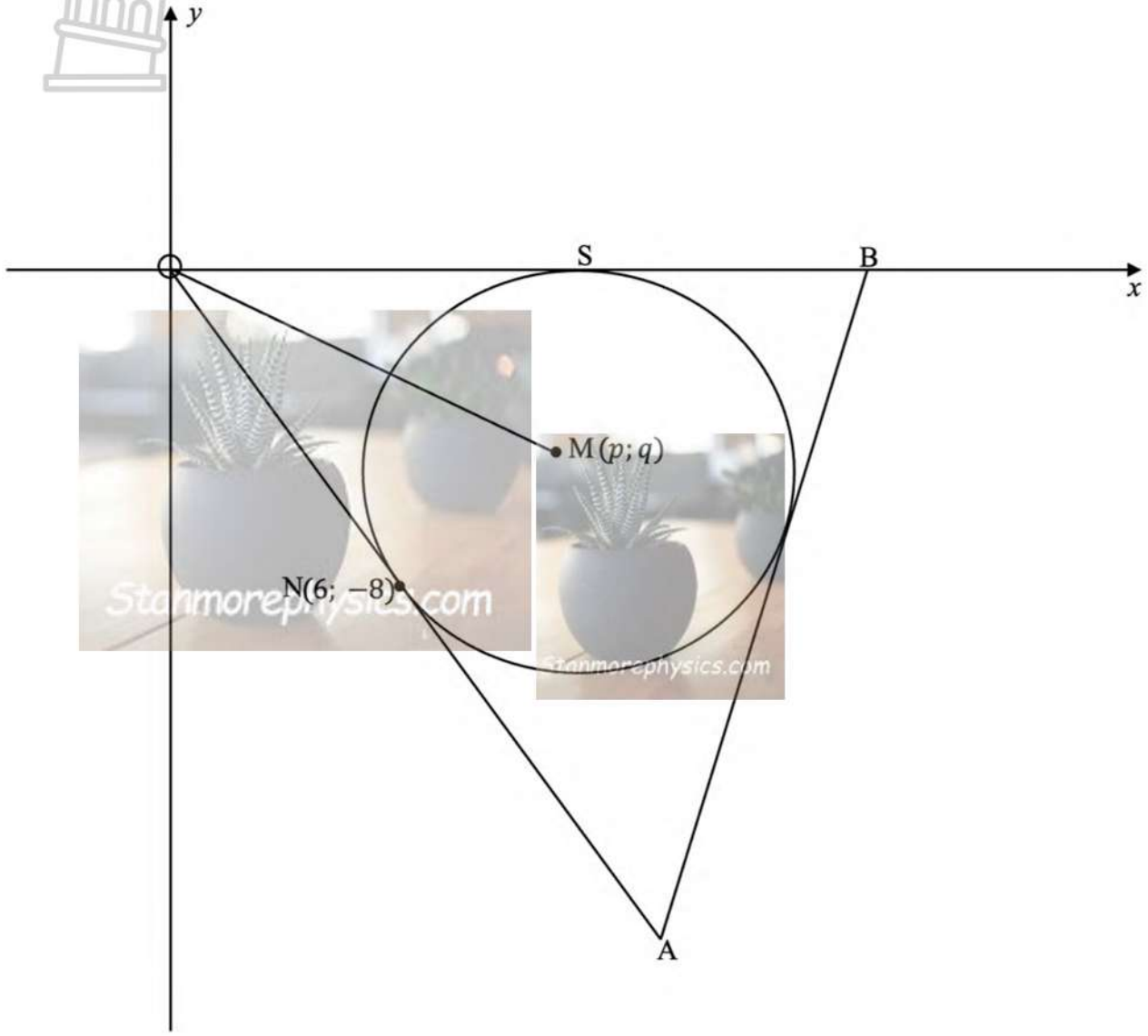
1.3	If T is the midpoint of AM, calculate the values of k and h.	(3)
1.4	Calculate the length of AM, leaving your answer **in surd form.**	(2)
1.5	If it is given that AP||RM and AR||PM, determine the coordinates of R.	(3)

1.6	Calculate the size of $P\widehat{T}A$.	(5)
1.7	Show that $P\widehat{A}M \neq 90°$.	(3)
1.8	Calculate the area of ΔMPT.	(4)

[25]

QUESTION 2

In the diagram below, a circle, centred at M$(p; q)$, touches the x-axis at S and line OA is a tangent to the circle at N$(6; -8)$.

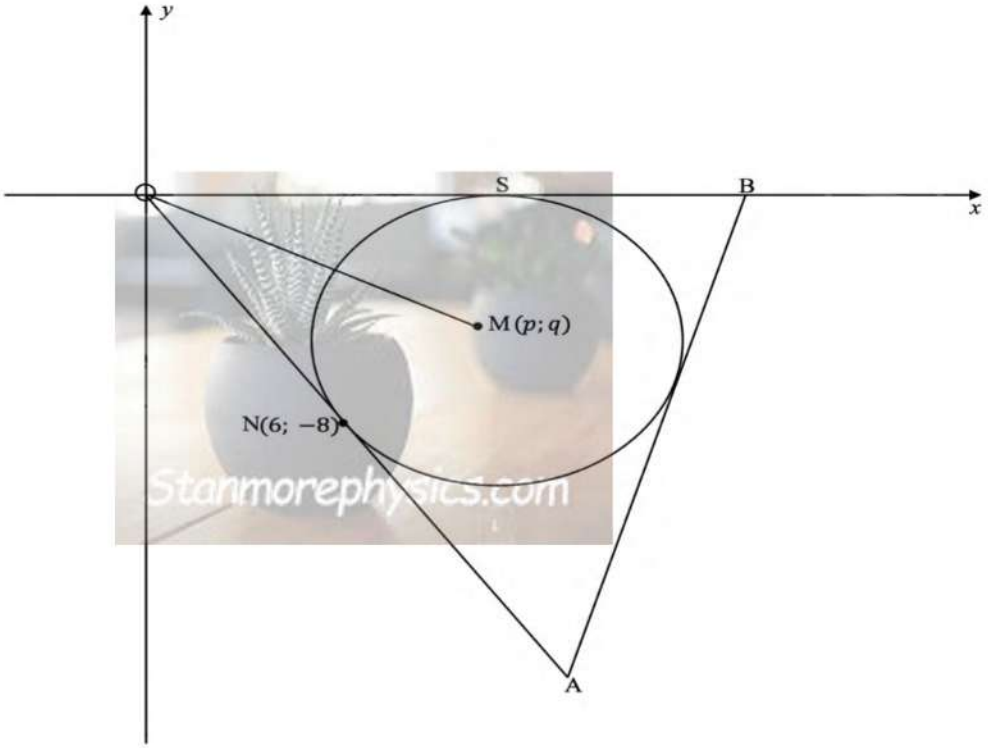


2.1	Calculate:		
	2.1.1	The length of ON	(2)

	2.1.2	The value of p	(2)
	2.1.3	The gradient of MN	(2)
	2.1.4	The value of q	(2)
2.2		Determine the equation of the circle in the form of $(x-a)^2+(y-b)^2=r^2$.	(3)
2.3		$x=k$ is a tangent to the circle. Write down the value(s) of k.	(2)

2.4	The line $y = -\frac{4}{3}x + t$ is perpendicular to OA, passes through M and cuts the circle at two different points. Determine the values of t.	(5)
2.5	Another circle with equation $(x-10)^2 + (y-6)^2 = 25$ is given. Will the two circles touch, cut or not? Give a reason for the answer.	(2)

[20]



QUESTION 3

3.1	Given: $\sin A = 2q$ and $\cos A = q$, and $0° < A < 90°$. With the aid of a diagram and **without the use of a calculator**, calculate:		
	3.1.1	The value of $\tan A$	(2)
	3.1.2	The value of q	(3)
3.2	Given that $\sin 54° = p$, express each of the following in terms of p, **without the use of a calculator:**		
	3.2.1	$\sin 594°$	(2)

	3.2.2	$\cos 36°$	(2)
	3.2.3	$\cos 18°$	(4)
3.3		Simplify the following **without the use of a calculator**: $\dfrac{\cos 140° - \sin(90° - \theta)}{\sin 410° + \cos(-\theta)}$	(6)

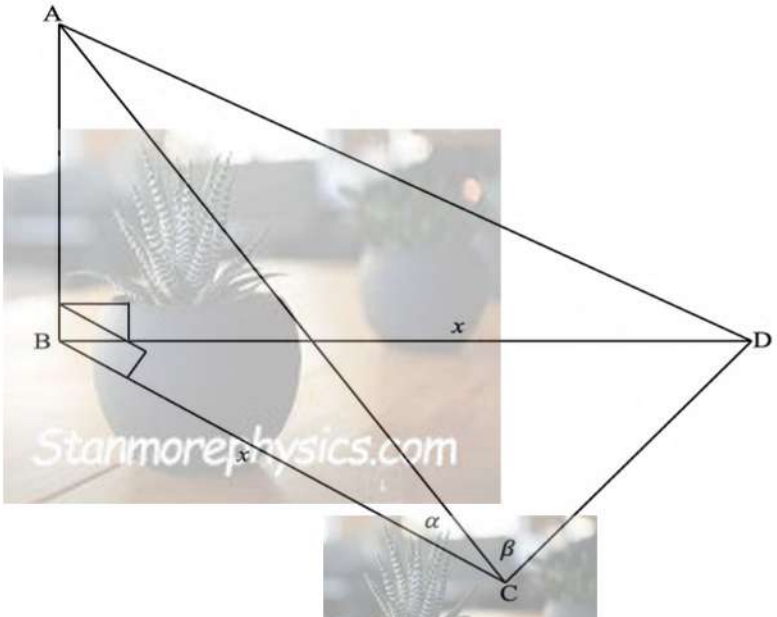
3.4	Determine, **without the use of a calculator**, the value of the following trigonometric expression: $\cos(x+65°).\cos(x+20°)-\sin(x+245°).\sin(x+20°)$	(4)
3.5	Determine the general solution of: $\cos^2 x-\sin^2 x=\frac{1}{2}$	(4)

3.6	Given the identity: $\frac{\sin 2\theta \,.\, \tan\theta}{\cos 2\theta + 1} = \tan^2\theta$		
	3.6.1	Prove the identity.	(4)
	3.6.2	Determine the value of θ for which the identity is undefined if $0° \leq \theta \leq 180°$.	(4)

[35]

QUESTION 4

In the diagram below, B, C and D are points on the same horizontal plane. AB is a vertical tower with the angle of elevation from C to A equal to α and $A\hat{C}D = \beta$. BD = BC = x.

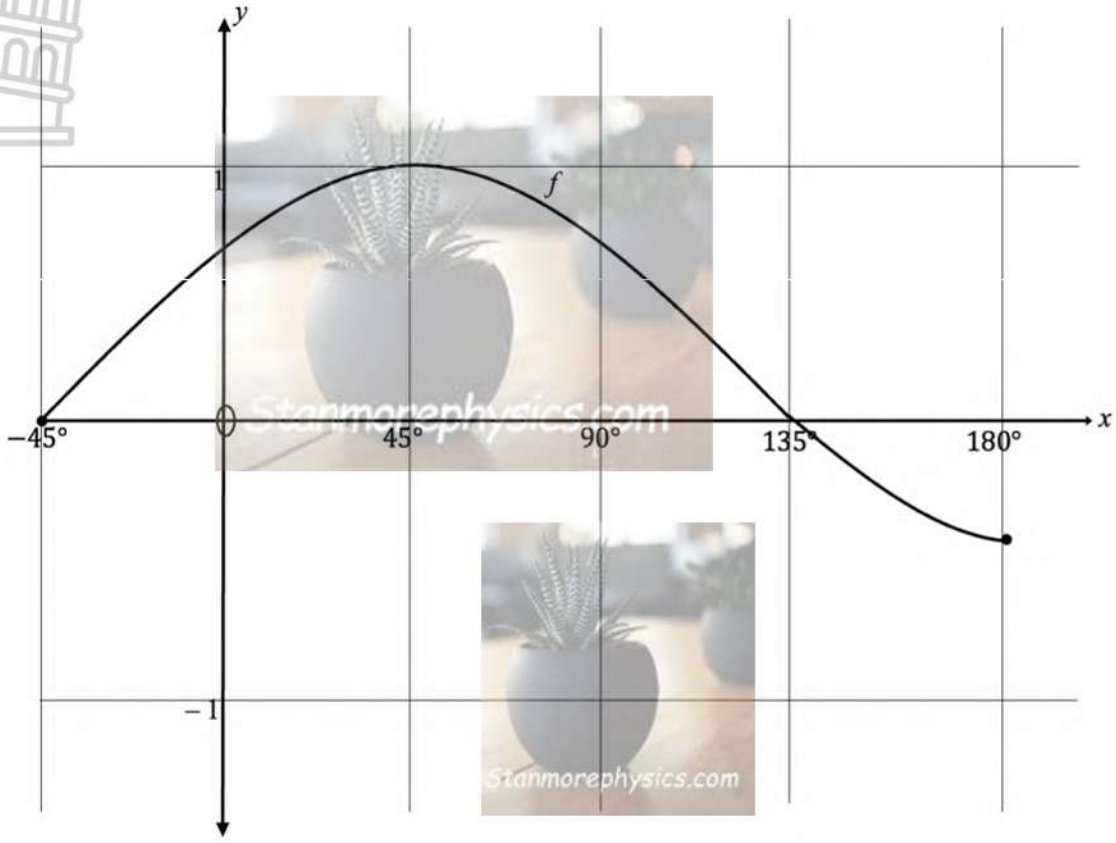


4.1	Give a reason why AC = AD.	(1)
4.2	Write AC in terms of x and α.	(2)
4.3	Show that CD = $\dfrac{2x\cos\beta}{\cos\alpha}$.	(4)
4.4	Hence, or otherwise, determine the length of CD if $x = 25\ cm$, $\alpha = 30°$ and $\beta = 65{,}62°$.	(2)

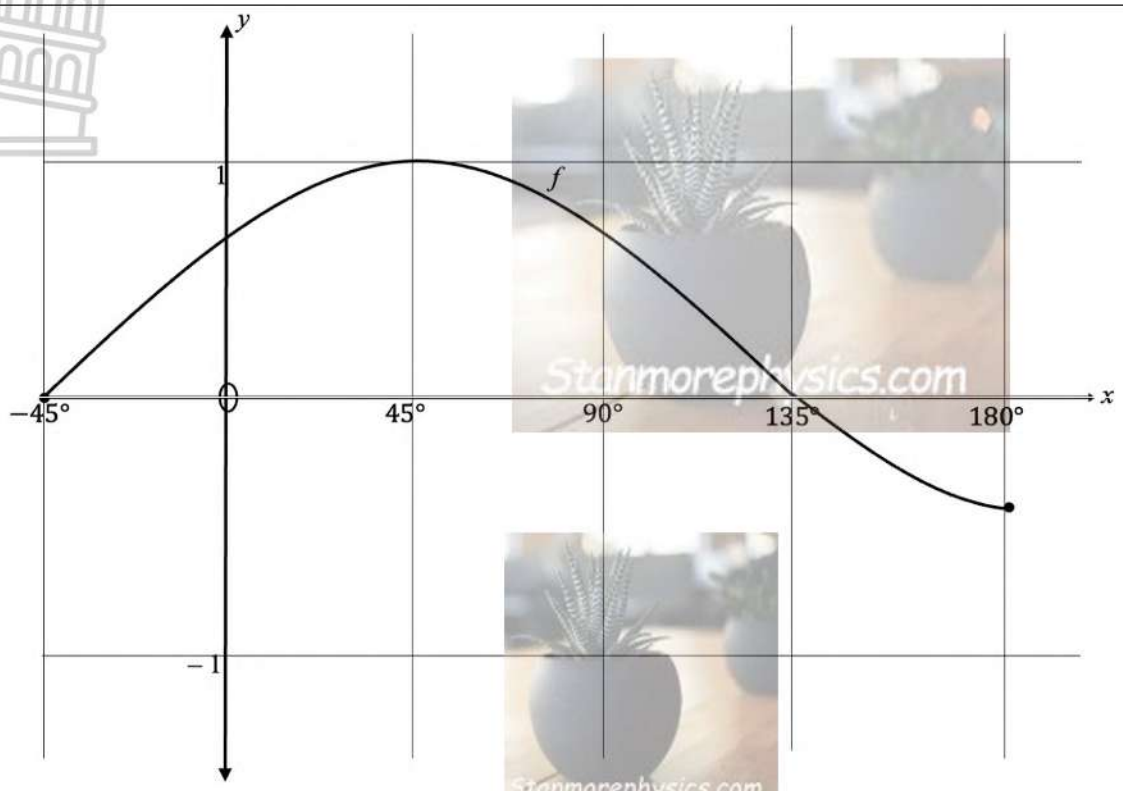
[9]

QUESTION 5

Sketched below is the graph of $f(x) = \cos(x - 45°)$ for $-45° \leq x \leq 180°$.



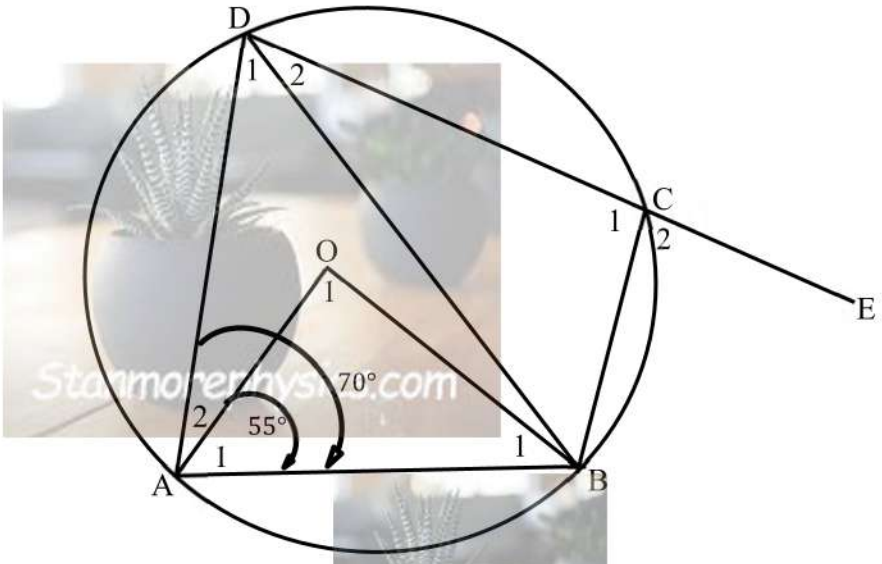
Use the graph above to answer the questions that follow.		
5.1	Write down the range of f for the given interval.	
		(2)

5.2	Draw the graph of $h(x) = \sin 2x$, for $x \in [-45°; 180°]$ on the same set of axes as the sketch of f below. Indicate all the intercepts with the axes as well as the turning points.	
		(3)
5.3	State the period of h.	
		(1)
5.4	Use your graph to determine the values of x for which f and h are both increasing.	
		(2)
5.5	Determine the values of x for which $f(x) - h(x) = 1$.	
		(2)
5.6	The graph of f is translated 60° to the left to form the graph of g. Write down the equation of g in the form $g(x) = \ldots$	
		(1)

[11]

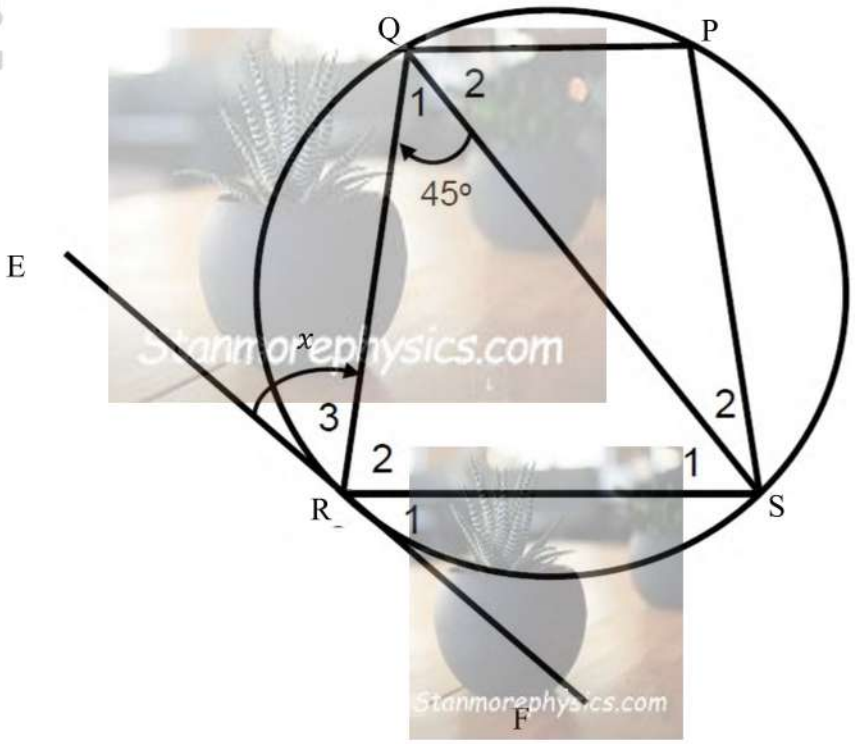
QUESTION 6

6.1 A, B, C and D are points on a circle with centre O. DE is a straight line, $B\hat{A}D = 70°$ and $O\hat{A}B = 55°$.



Determine, giving reasons, the sizes of the following angles:		
6.1.1	$\hat{B}_1$	(2)
6.1.2	$\hat{O}_1$	(2)
6.1.3	$\hat{D}_1$	(2)
6.1.4	$\hat{C}_2$	(2)

6.2 In the diagram below, P, Q, R and S are points on the circumference of a circle. ERF is a tangent to the circle at R. $\widehat{Q}_1 = 45°$ and $\widehat{R}_3 = x$.

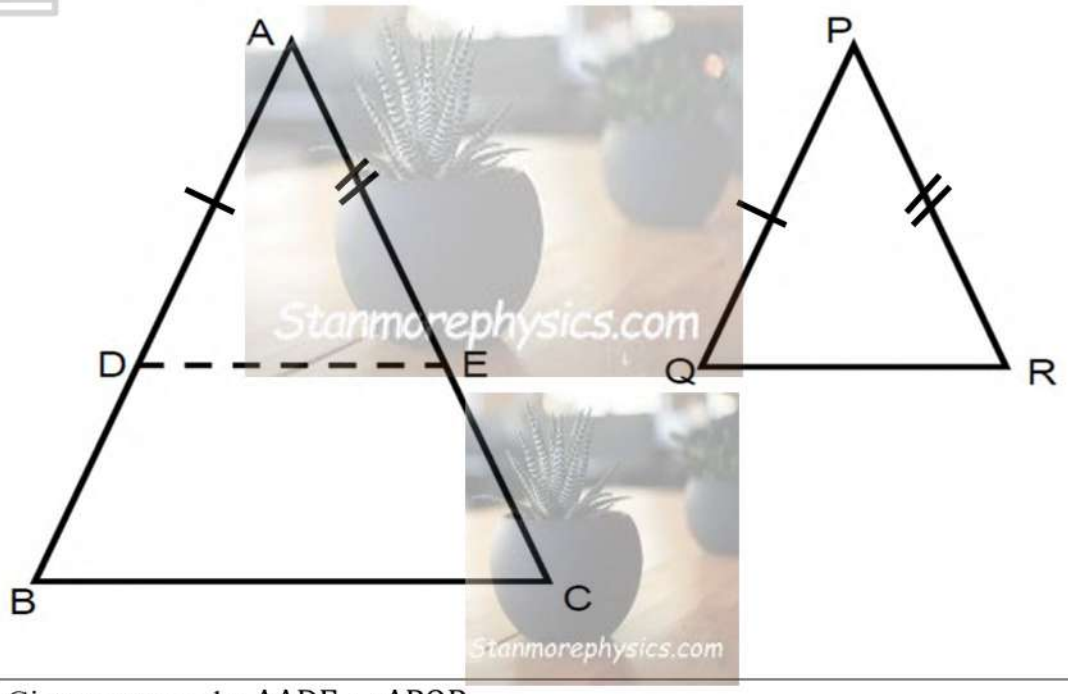


Answer the following questions, giving reasons for your answers.		
6.2.1	Determine the size of $\hat{S}_1$ in terms of x.	(2)
6.2.2	Prove that $\widehat{P} = x + 45°$.	(4)

[14]

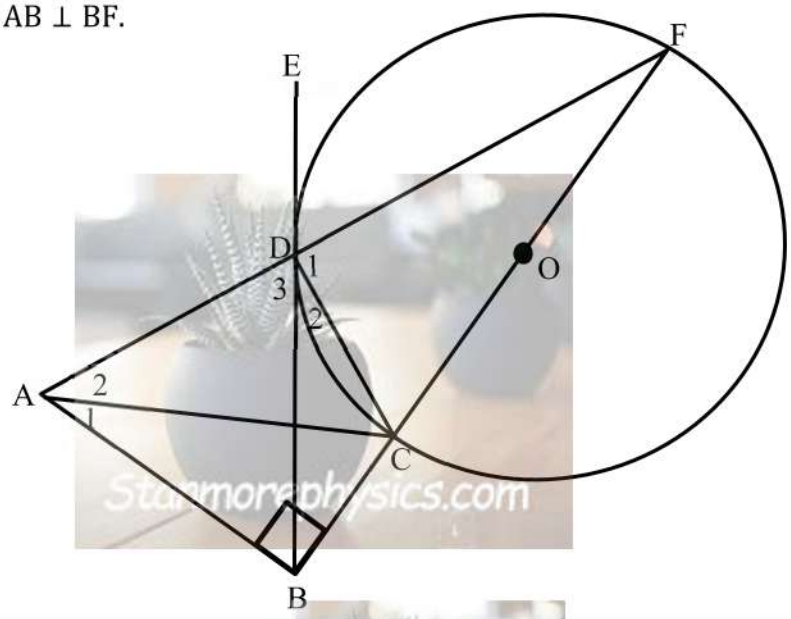
QUESTION 7

7.1 In the diagram below, ΔABC and ΔPQR are drawn such that $\hat{A} = \hat{P}$, $\hat{B} = \hat{Q}$, and $\hat{C} = \hat{R}$. DE is drawn such that $AD = PQ$ and $AE = PR$.



7.1.1	Give a reason why $\Delta ADE \equiv \Delta PQR$.	(1)
7.1.2	Hence, prove that $\frac{AB}{PQ} = \frac{AC}{PR}$.	(5)

7.2 C, D and F are points on a circle with centre O. ADF is a straight line and BE is a tangent to the circle at point D. AB ⊥ BF.

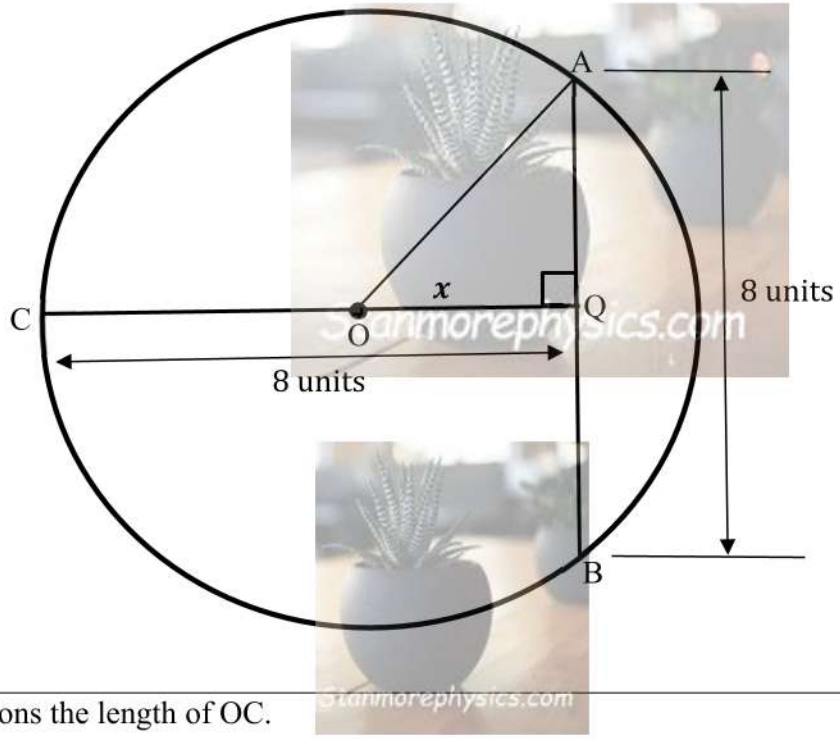


7.2.1	Prove that ABCD is a cyclic quadrilateral.	(3)
7.2.2	Prove that AB is a tangent to the circle passing through A, C and F.	(4)

[13]

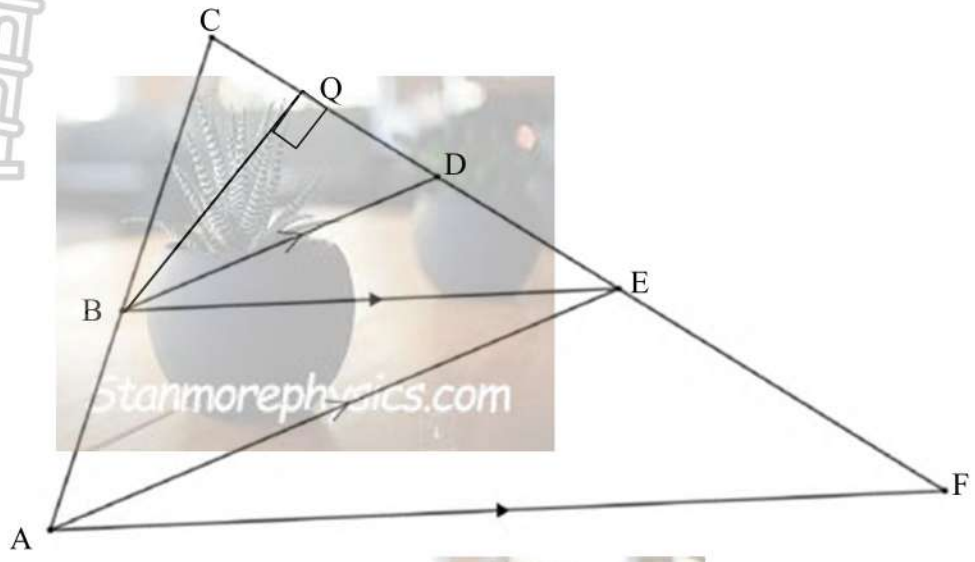
QUESTION 8

8.1 In the diagram below, O is the centre of the circle and C is a point on the circumference of the circle. Chord AB = 8 units. CQ = 8 units and passes through the centre of the circle. OQ = x units and CQ ⊥ AB.



Calculate, with reasons the length of OC.	
	(5)

8.2 In ΔCAF below, B is a point on AC while Q, D and E are points on FC. BD||AE and BE||AF. AC : BC = 9 : 5. BQ ⊥ CD.

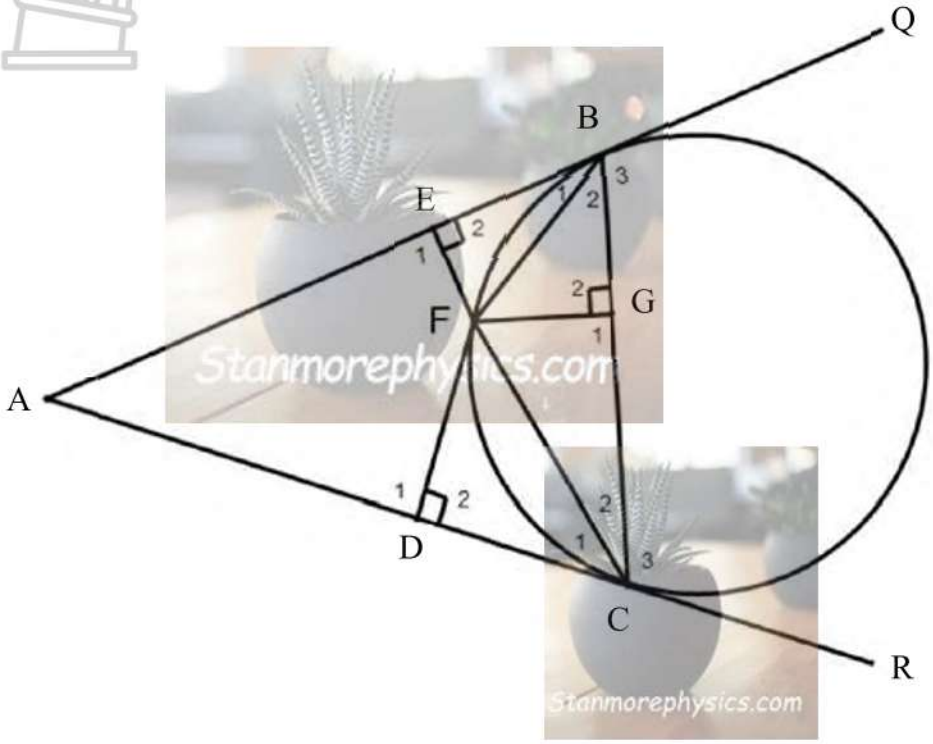


8.2.1	Determine the ratio AB : BC.	(1)
8.2.2	Calculate the length of AC if it is given that AB = 6 units.	(2)
8.2.3	Determine, with reason(s), the value of $\frac{\text{Area of } \Delta BDC}{\text{Area of } \Delta BED}$.	(2)
8.2.4	If it is given that FC = 15 units calculate, giving reasons, the length of DE.	(4)

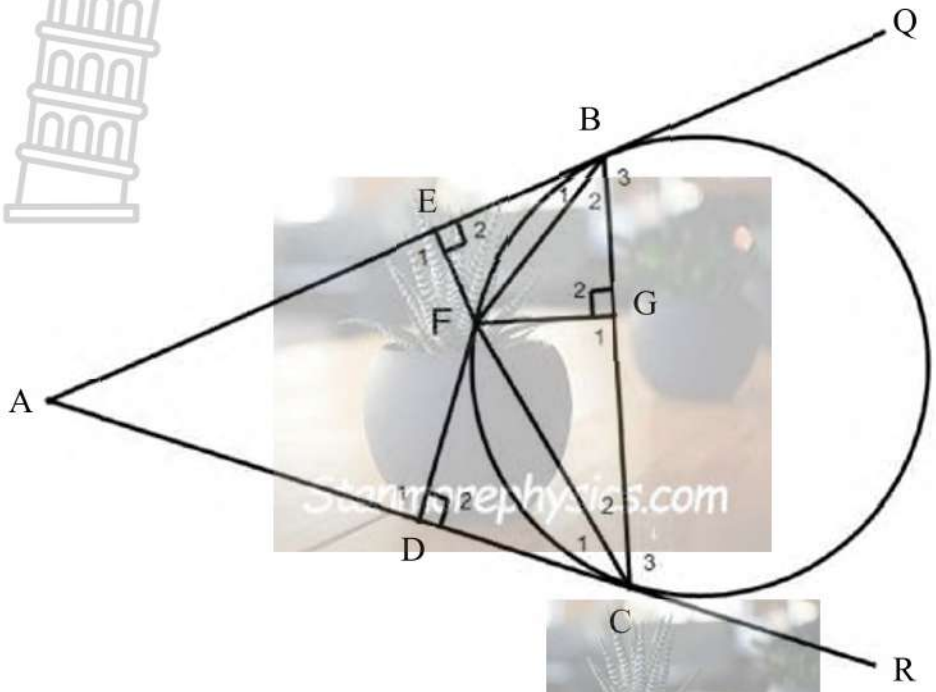
[14]

QUESTION 9

In the diagram below, BCF is a triangle with points B, F and C on the circumference of the given circle. AQ and AR are tangents to the circle at B and C respectively. FE ⊥ AB, FG ⊥ BC and FD ⊥ AC.



9.1	Prove that ΔBEF ||| ΔCGF.	(3)



9.2	Prove that $FG^2 = FE \times FD$.	(6)

[9]

ADDITIONAL SPACE	

ADDITIONAL SPACE		

ADDITIONAL SPACE

TOTAL: 150

END

INFORMATION SHEET

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

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

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

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

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

$$\sum_{i=1}^{n} 1 = n$$

$$\sum_{i=1}^{n} i = \frac{n(n+1)}{2}$$

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

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

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

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

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

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

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

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

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

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

$$y = mx + c$$

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

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

$$m = \tan\theta$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

JUNE EXAMINATION/ *JUNIE EKSAMEN* GRADE/*GRAAD* 12

2026

MARKING GUIDELINES/ *NASIENRIGLYNE*

MATHEMATICS/ *WISKUNDE*

(PAPER/*VRAESTEL* 2)

27 pages/*bladsye*

NOTE:

- If a candidate answers a question TWICE, only mark 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 guidelines. Stop marking at the second calculation error.
- Assuming answers/values to solve a problem is NOT acceptable.

LET WEL:

- *As 'n kandidaat 'n vraag TWEE KEER beantwoord het, sien slegs die EERSTE poging na.*
- *As 'n kandidaat 'n antwoord van 'n vraag doodtrek en dit nie oordoen nie, sien die doodgetrekte poging na.*
- *Volgehoue akkuraatheid word in ALLE aspekte van die nasienriglyne toegepas. Hou op nasien by die tweede berekeningsfout.*
- *Aannames van antwoorde/waardes om 'n probleem op te los, word NIE toegelaat NIE.*

GEOMETRY/*MEETKUNDE*	
S	A mark for a correct statement (A statement mark is independent of a reason.)
	'n Punt vir 'n korrekte bewering *('n Punt vir 'n bewering is onafhanklik van 'n rede.)*
R	A mark for a correct reason (A reason mark may only be awarded if the statement is correct.)
	'n Punt vir 'n korrekte rede *('n Punt word slegs vir die rede toegeken as die bewering korrek is.)*
S/R	Award a mark if the statement AND reason are both correct.
	Ken 'n punt toe indien beide die bewering EN rede korrek is.

AMENDMENT TO MARKING GUIDELINES

JUNE 2026 PROVINCIAL COMMON EXAMINATION

FOR ATTENTION: THE CHIEF INVIGILATOR

SUBJECT / *VAK*	**MATHEMATICS/*WISKUNDE***
PAPER / *VRAESTEL*	**2**
DATE OF EXAMINATION	**8 JUNE/*JUNIE* 2026**

The errata for the Marking Guidelines of **MATHEMATICS P2/*WISKUNDE* V2** has reference.

There was an error in **QUESTION 2.4** which affected the possible candidate responses on BOTH the English AND Afrikaans versions of the question paper. This matter was addressed at the Marking Standardisation Meeting.

To ensure that candidates are not disadvantaged nor prejudiced in any way, you are advised to ask your Mathematics Educator to please **ignore QUESTION 2.4** when marking. This question carries 5 marks.

In other words, the paper must be marked out of a total of 145 instead of 150 and then the learners' marks must be converted to a mark out of 150. E.g. Should a learner attain $\frac{29}{145}$ then that mark is recalculated as $\frac{30}{150}$.

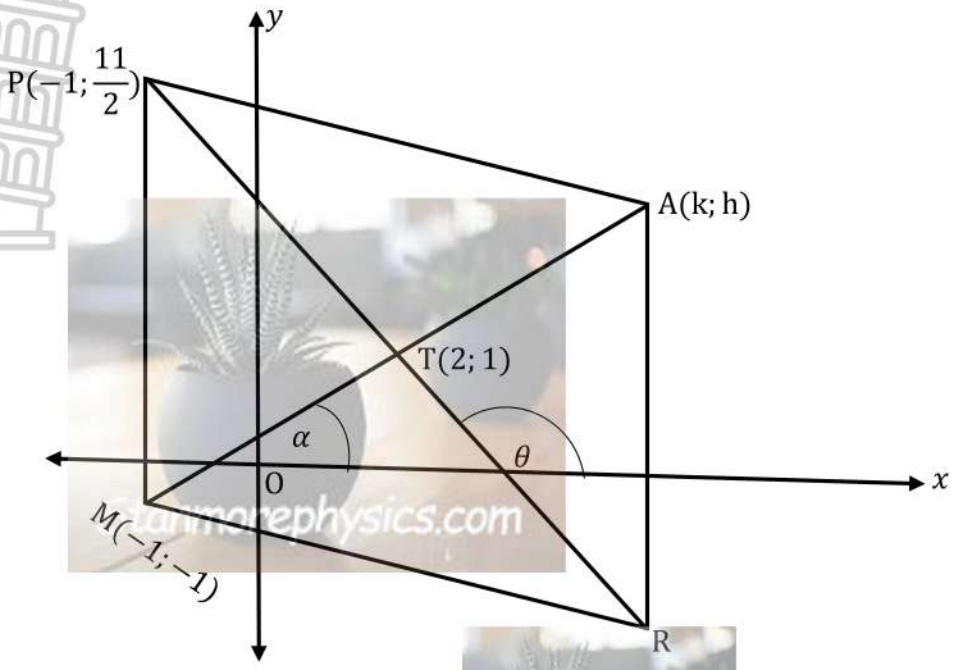
Use the formula: $\frac{a}{145} \times 100 = b$. *Then,* $\frac{b}{100} \times 150 = c$

C is the mark that is entered into SASAMS ***out of 150****.*

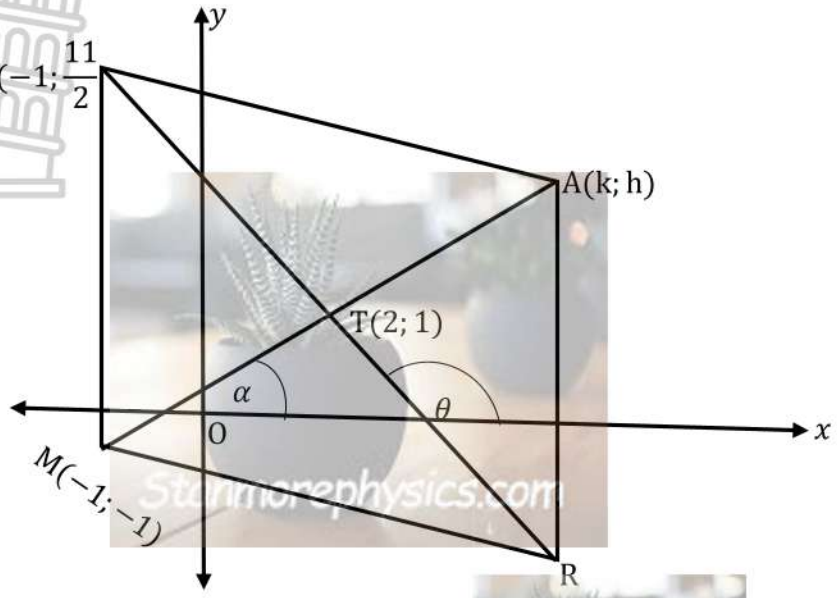
MR JONATHAN WILLIAMS

DIRECTOR: EXAMINATIONS MANAGEMENT
9 JUNE 2026

QUESTION/*VRAAG* 1



1.1	$m_{MT} = \frac{-1-1}{-1-2}$ $= \frac{2}{3}$	✓substitution into gradient formula/ *substitusie in die gradiënt formule* ✓answer/*antwoord* (2)
1.2	$y = \frac{2}{3}x + c$ $\frac{11}{2} = \frac{2}{3}(-1) + c$ $c = \frac{37}{6}$ $\therefore y = \frac{2}{3}x + \frac{37}{6}$ **OR/*OF*** $y - \frac{11}{2} = \frac{2}{3}(x - (1))$ $\therefore y = \frac{2}{3}x + \frac{37}{6}$	✓ $m_{line/lyn} = \frac{2}{3}$ ✓ substitution into equation formula/ *substitusie in die vergelykings-formule* ✓ answer/*antwoord* (3) **OR/*OF*** ✓ $m_{line/lyn} = \frac{2}{3}$ ✓ substitution into equation formula/ *substitusie in die vergelykings-formule* ✓ answer/*antwoord* (3)
1.3	$\frac{-1+k}{2} = 2$ $\therefore k = 5$ $\frac{-1+h}{2} = 1$ $\therefore h = 3$ Answer only: Full marks *Slegs antwoord: Volpunte*	✓substitution into midpoint formula/ *substitusie in die middelpuntsformule* ✓ $k = 5$ ✓ $h = 3$ (3)



1.4	AM=$\sqrt{(-1-5)^2+(-1-3)^2}$ $= 2\sqrt{13}$ units/*eenhede* (*Accept* $\sqrt{52}$) **OR/*OF*** MT=$\sqrt{(-1-2)^2+(-1-1)^2}=\sqrt{13}$ $\therefore$ AM $= 2$MT $= 2\sqrt{13}$ units/*eenhede*	✓ substitution into distance formula/ *substitusie in afstandsformule* ✓ answer **in surd form**/ *antwoord in* ***wortelvorm*** (2) ✓ substitution into distance formula/ *substitusie in afstandsformule* ✓ answer **in surd form**/ *antwoord in* ***wortelvorm*** (2)
1.5	ARMP is a parallelogram/*is 'n parallelogram* (2 pairs of opp sides $\parallel$ /*2 pare oorst sye* $\parallel$) $\frac{x_R+(-1)}{2}=2$ $x_R = 5$ $\frac{y_R+\frac{11}{2}}{2}=1$ $y_R=-\frac{7}{2}$ $\quad\therefore R(5;-\frac{7}{2})$ Answer only: Full marks *Slegs antwoord: Volpunte* *Translation implied* *Translasie* geïmpliseer	✓ method/*metode* ✓ $x_R = 5$ ✓ $y_R=-\frac{7}{2}$ (3)

1.6

$m_{AM} = \frac{2}{3}$

$\alpha = \tan^{-1}(\frac{2}{3})$

$\propto = 33{,}69°$

$m_{PR} = \frac{\frac{11}{2} - 1}{-1 - 2} = -\frac{3}{2}$

$\theta = \tan^{-1}\left(-\frac{3}{2}\right) + 180$

$\theta = 123{,}69°$

$M\hat{T}R = 123{,}69° - 33{,}69° = 90°$

$\therefore P\hat{T}A = 90°$ (vert opp <s)/(*regoorst* <e)

If one < is rounded off and the other one not, then penalize 1 mark/ *as een < afgerond is, penalieer een punt*

✓$m_{AM} = \frac{2}{3}$

✓$\alpha = 33{,}69°$

✓$m_{PR} = -\frac{3}{2}$

✓$\theta = 123{,}69°$

✓answer/*antwoord* (5)

OR/*OF*

$m_{AM} = \frac{2}{3}$

$m_{PR} = \frac{\frac{11}{2} - 1}{-1 - 2} = -\frac{3}{2}$

$m_{AM} \times m_{PR} = \frac{2}{3} \times -\frac{3}{2} = -1$

$\therefore AM \perp PR$

$\therefore P\hat{T}A = 90°$

OR/*OF*

✓$m_{AM} = \frac{2}{3}$

✓$m_{PR} = -\frac{3}{2}$

✓$m_{AM} \times m_{PR} = -1$

✓ $AM \perp PR$

✓answer/*antwoord* (5)

OR/*OF*

$PT = \sqrt{(1-2)^2 + (\frac{11}{2} - 1)^2} = \frac{3\sqrt{13}}{2} = 5{,}41$

$AT = \sqrt{(5-2)^2 + (3-1)^2} = \sqrt{13} = 3{,}61$

$AP = \sqrt{(5-(-1))^2 + (3 - \frac{11}{2})^2} = 6{,}5$

$P\hat{T}A = \cos^{-1}\left(\frac{(\frac{3\sqrt{13}}{2})^2 + (\sqrt{13})^2 - (\frac{13}{2})^2}{2\left(\frac{3\sqrt{13}}{2}\right)(\sqrt{13})}\right)$

$\therefore P\hat{T}A = 90°$

OR/*OF*

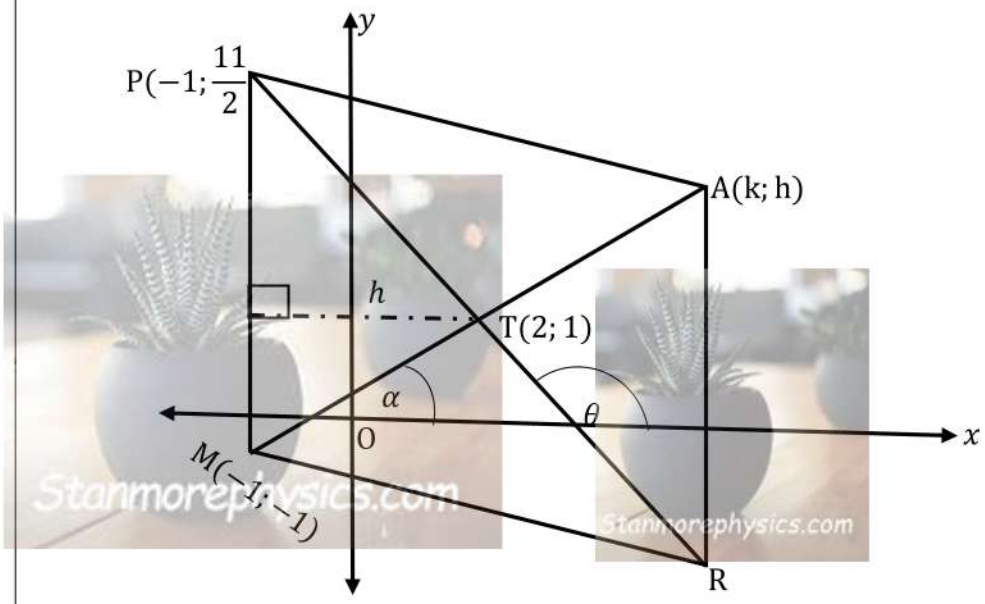
✓ $PT = \frac{3\sqrt{13}}{2}$

✓ $AT = \sqrt{13}$

✓$AP = \frac{13}{2}$

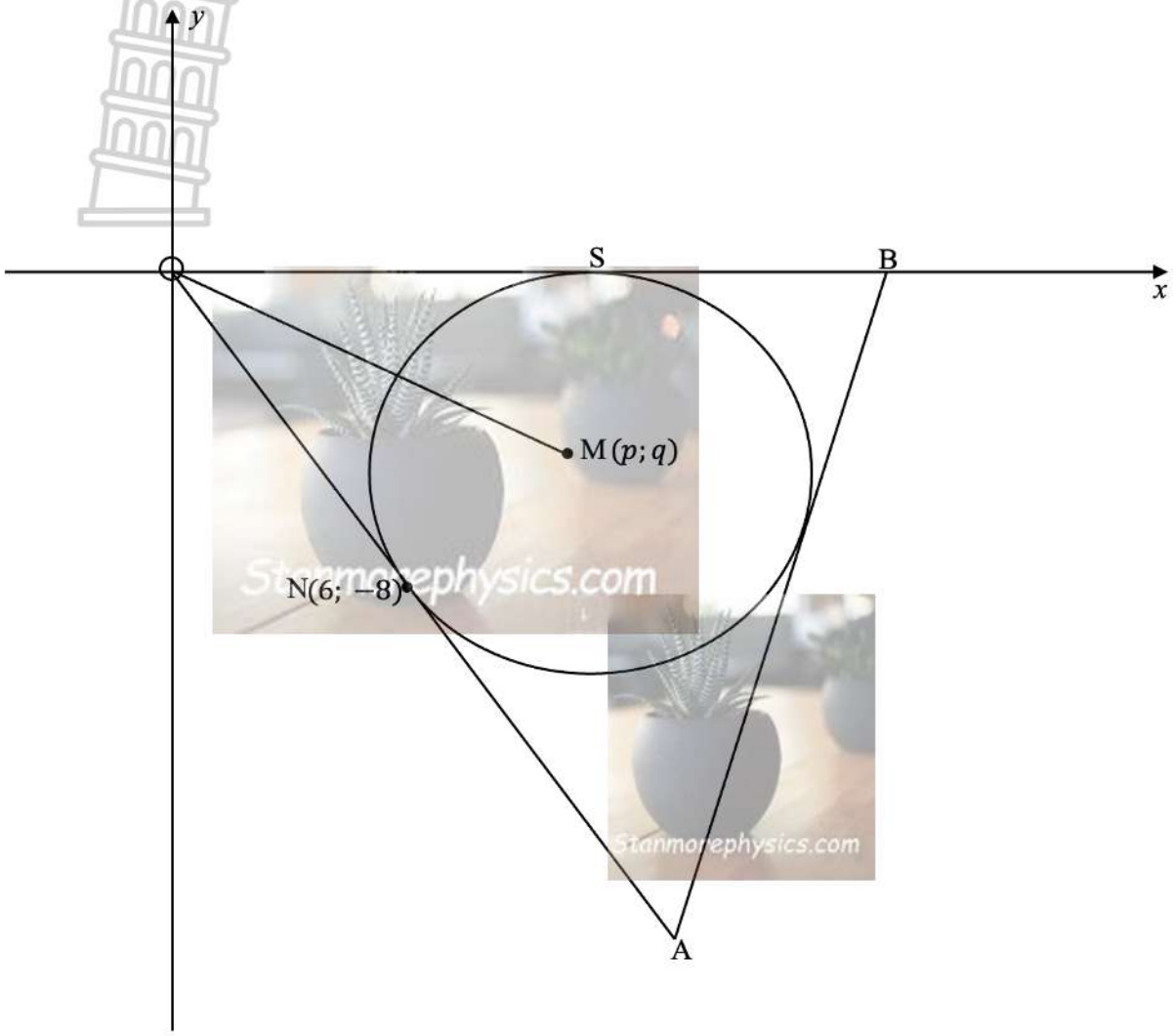
✓substitution into cosine formula/ *substitution in cos-formule*

✓answer/*antwoord* (5)

1.7	$m_{AP} = \frac{\frac{11}{2}-3}{-1-5} = -\frac{5}{12}$ $m_{AM} = \frac{2}{3}$ $m_{AP} \times m_{AM} = -\frac{5}{12} \times \frac{2}{3} \neq -1$ $\therefore P\hat{A}M \neq 90°$	✓ $m_{AP} = -\frac{5}{12}$ ✓ $m_{AM} = \frac{2}{3}$ ✓ $m_{AP} \times m_{AM} \neq -1$ (3)
1.8		
	$h = 3$ units/*eenhede* $MP = \frac{11}{2} - (-1) = \frac{13}{2}$ $= 6{,}5$ units/*eenhede* Area of /*opp* $\Delta MPT = \frac{1}{2} \times \frac{13}{2} \times 3$ units^2/*eenhede*^{2} $= \frac{39}{4}$ units^2/*eenhede*^{2} $= 9{,}75$ units^2/*eenhede*^{2}	✓ $h = 3$ units/$h = 3$ *eenhede* ✓ length of MP/ *lengte van MP* ✓ substitution into area formula /*substitusie in oppervlakformule* ✓ answer/*antwoord* (4)

	OR/*OF*	**OR/*OF***
	$P\hat{T}M = 90°$ (<s on a str line) /$(< e\ op\ 'n\ reguitlyn)$	
	$PT = \sqrt{(-1-2)^2 + (\frac{11}{2}-1)^2} = \frac{3\sqrt{13}}{2} = 5{,}41$	✓ $PT = \frac{3\sqrt{13}}{2}$
	$MT = \sqrt{(-1-2)^2 + (-1-1)^2} = \sqrt{13} = 3{,}61$	✓ $MT = \sqrt{13}$
	Area of / $(opp\ van)$ ΔMPT	
	$= \frac{1}{2} \times \frac{3\sqrt{13}}{2} \times \sqrt{13}$ units^2/*eenhede*^{2}	✓ substitution into area formula *substitusie in opp. formule*
	$= \frac{39}{4}$ units^2/*eenhede*^{2}	✓ answer/*antwoord* (4)
	$= 9{,}75$ units^2/*eenhede*^{2}	
	OR/*OF*	**OR/*OF***
	$P\hat{T}M = 90°$ (<s on a str line) /$(< e\ op\ 'n\ reguitlyn)$	
	$PT = \sqrt{(1-2)^2 + (\frac{11}{2}-1)^2} = \frac{3\sqrt{13}}{2} = 5{,}41$	✓ $PT = \frac{3\sqrt{13}}{2}$ ✓ $MT = \sqrt{13}$
	$MT = \sqrt{(-1-2)^2 + (-1-1)^2} = \sqrt{13} = 3{,}61$	
	Area of/Opp van ΔMPT	
	$= \frac{1}{2} \times \frac{3\sqrt{13}}{2} \times \sqrt{13} \sin(90°)$ units^2/*eenhede*^{2}	✓ substitution into area formula *substitusie in opp. formule*
	$= \frac{39}{4}$ units^2/*eenhede*^{2}	✓ answer/*antwoord* (4)
	$= 9{,}75$ units^2/*eenhede*^{2}	
		[25]

QUESTION/*VRAAG* 2

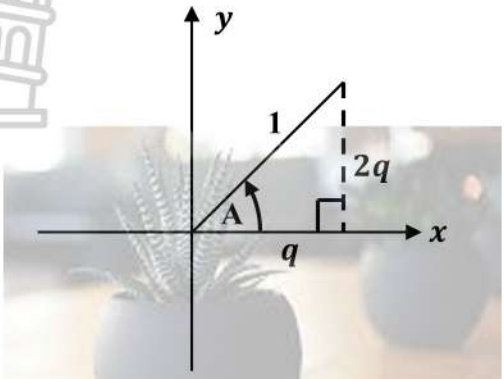


2.1.1	$ON = \sqrt{(6-0)^2 + (-8-0)^2}$ $ON = \sqrt{100}$ $\therefore ON = 10$ units/*eenhede*	✓ substitution/*substitusie* ✓ answer/*antwoord* (2)
2.1.2	ON = OS tangents from the same point/ *raaklyne vanuit dieselfde punt* $\therefore p = 10$ **ANSWER ONLY: FULL MARKS** ***SLEGS ANTWOORD: VOLPUNTE***	✓ S ✓ answer/*antwoord* (2)
2.1.3	ON ⊥ NM tangent ⊥ radius/*raaklyn* ⊥ *radius* $m_{ON} = \frac{-8-0}{6-0}$ $\therefore m_{ON} = -\frac{4}{3}$ $\therefore m_{NM} = \frac{3}{4}$	✓ $-\frac{4}{3}$ ✓ $\frac{3}{4}$ (2)

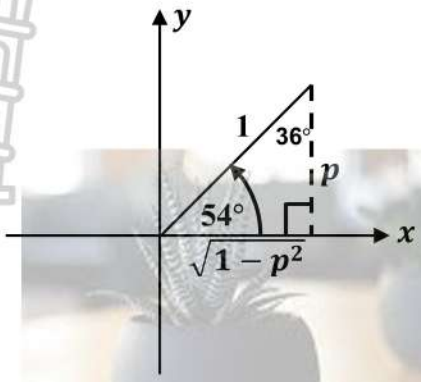
2.1.4	$m_{NM} = \frac{3}{4}$ $\frac{q-(-8)}{10-6} = \frac{3}{4}$ $\frac{q+8}{4} = \frac{3}{4}$ $q = -5$ **OR/*OF*** $y = \frac{3}{4}x + c$ $-8 = \frac{3}{4}(6) + c$ $c = -\frac{25}{2}$ $y = \frac{3}{4}x - \frac{25}{2}$ $q = \frac{3}{4}(10) - \frac{25}{2}$ $q = -5$	✓ equating and simplifying/ *gelykstelling en vereenvoudiging* ✓ answer/*antwoord* ***OR*/OF** ✓ substitution/*vervanging* ✓ answer/*antwoord* (2)
2.2	MS $= r = 5$ units/*eenhede* $(x-10)^2 + (y+5)^2 = 25$	✓ radius ✓ subs centre coordinates/ *subst middelpuntkoördinate* ✓ equation/*vergelyking* (3)
2.3	$(x-10)^2 + (-5+5)^2 = 25$ $(x-10)^2 = 25$ $\therefore k = 5$ or/*of* $k = 15$ $k = 5$ or/*of* $k = 15$	✓ substitution/*vervanging* ✓ both answer/*beide antwoord* (2)
2.4	Coordinates of the point directly opposite N is C. / *Koördinate van die punt direk teenoor N is C.* $\frac{x+6}{2} = 10$ $\quad$ $\frac{y-8}{2} = -5$ $x + 6 = 10 \times 2$ $\quad$ $y - 8 = -5 \times 2$ $\therefore x = 14$ $\quad$ $\therefore y = -2$ $\therefore$ C$(14; -2)$ equation of the tangent at C/ *vergelyking van raaklyn by C* $y + 2 = -\frac{4}{3}(x - 14)$ $\therefore y = -\frac{4}{3}x + \frac{50}{3}$ $\therefore 0 < t < \frac{50}{3}$	✓ substitution into correct midpoint formula/*subst in korrekte middelpuntsformule* ✓ x – value/*waarde* ✓ y – value/*waarde* ✓ equation of tangent at C/ *vergelyking van raaklyn by C* ✓ value of t/*waarde van t* (5)

2.5	They will not touch./*Hulle sal nie raak nie* The new circle is the old circle shifted up by 11 units/ *Die nuwe sirkel is die ou sirkel wat met 11 eenhede opwaarts gekuif het.* **OR/*OF*** sum of radii/*som van radiusse = 10* distance between centres/*afstand tussen middelpunte* $= \sqrt{(10-10)^2+(6+5)^2}$ *= 11* ∴ the circles do not touch or cut/*die sirkels raak of sny nie*	✓ answer/*antwoord* ✓ any valid reason/ *enige geldige rede* ✓distance between centres> sum of radii /*afstand tussen middelpunte > som van radiusse* ✓the circles do not touch or cut/*die sirkels raak of sny nie.*	(2) (2)
			[15]

QUESTION/*VRAAG* 3

3.1			
	3.1.1	$\tan A = \frac{2q}{q}$ $\therefore \tan A = 2$ **OR/*OF*** $\frac{\sin A}{\cos A} = \frac{2q}{q} = 2 = \tan A$	✓ correct diagram/ *korrekte diagram* ✓ answer/*antwoord* (2) **OR/*OF*** ✓ quotient identity/ *kwosiënt identiteit* ✓ answer/*antwoord* (2)
	3.1.2	$(2q)^2 + q^2 = 1$ $5q^2 = 1$ $q^2 = \frac{1}{5}$ $q = \frac{1}{\sqrt{5}}$ $q = \frac{\sqrt{5}}{5}$	✓ Pythagoras ✓ simplification/ *vereenvoudiging* ✓ answer in any form/ *antwoord in enige vorm* (3)

3.2



$x^2 + y^2 = r^2$
$\therefore x = \sqrt{1-(p)^2}$

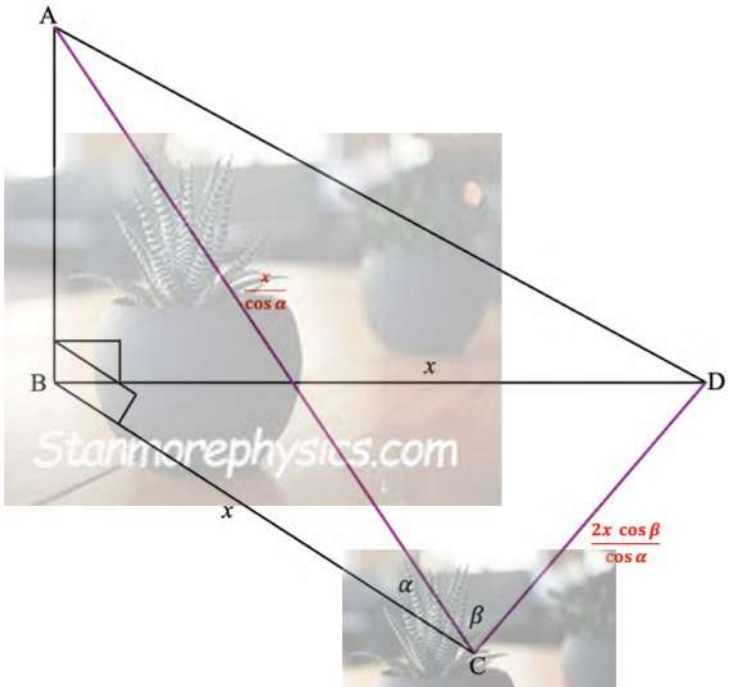
	3.2.1	$\sin 594°$ $= \sin 234°$ $= -\sin 54°$ $= -p$	✓ $-\sin 54°$ ✓ $-p$	(2)
	3.2.2	$\cos 36° = p$ **or/*of*** $\cos 36°$ $= \cos(90° - 54°)$ $= \sin 54$ $= p$	✓✓ answer/*antwoord*	(2)
	3.2.3	$\cos 18° \sin 2(36°)$ $= \sin 72°$ $= \sin 2(36°)$ $= 2\sin 36° . \cos 36°$ $= 2\left(\frac{\sqrt{1-(p)^2}}{1}\right)\left(\frac{p}{1}\right)$ $= 2p\sqrt{1-(p)^2}$ **OR/*OF*** $cos18° = \cos(54° - 36°)$ $= cos54°cos36° + sin54°sin36°$ $= \sqrt{1-p^2} \times p + p \times \sqrt{1-p^2}$ $= 2p\sqrt{1-(p)^2}$	✓ $\sin 72°$ ✓ $\sin 2(36°)$ ✓ $2\sin 36° . \cos 36°$ ✓ $2p\sqrt{1-(p)^2}$ **OR/*OF*** ✓$cos18° = \cos(54° - 36°)$ ✓ $cos54°cos36° + sin54°sin36°$ ✓ $\sqrt{1-p^2} \times p + p \times \sqrt{1-p^2}$ ✓$2p\sqrt{1-(p)^2}$	(4) (4)

3.3	$= \frac{\cos(90°+50°)-\cos\theta}{\sin 50°+\cos\theta}$ $= \frac{-\sin 50°-\cos\theta}{\sin 50°+\cos\theta}$ $= \frac{-(\sin 50°+\cos\theta)}{\sin 50°+\cos\theta}$ $= -1$	✓ $-\sin 50°$ ✓ $\cos\theta$ ✓ $\sin 50°$ ✓ $\cos\theta$ ✓ common factor/ *gemeenskaplike faktor* ✓ answer/*antwoord*	(6)

3.4	$\cos(x+65°).\cos(x+20°) - \sin(x+245°).\sin(x+20°)$ $= \cos(x+65°).\cos(x+20°) + \sin(x+65°).\sin(x+20°)$ $= \cos[(x+65°) - (x+20°)]$ $= \cos 45°$ $= \frac{1}{\sqrt{2}}$ or/*of* $\frac{\sqrt{2}}{2}$	✓ reduction/*reduksie of herleiding* ✓ compound angles/ *saamgestelde hoeke* ✓ $\cos 45°$ ✓ answer/*antwoord* (4)
3.5	$\cos^2 x - \sin^2 x = \frac{1}{2}$ $\cos 2x = \frac{1}{2}$ ref angle/*verwysingshoek*: $2x = \cos^{-1}\left(\frac{1}{2}\right)$ $\therefore 2x = 60° + k.360°$ 1st Quad/*1ste Kwad*: $2x = 60° + k.360°$ $\therefore x = 30° + k.180°, k \in \mathbb{Z}$ 4th Quad/*4de Kwad*: $2x = 360° - 60° + k.360°$ $2x = 300° + k.360°$ $\therefore \quad x = 150° + k.180°\ , k \in \mathbb{Z}$ **OR/*OF*** $\cos^2 x - \sin^2 x = \frac{1}{2}$ $2\cos^2 x - 2\sin^2 x = 1$ $2\cos^2 x - 2\sin^2 x = \sin^2 x + \cos^2 x$ $2\sin^2 x + \sin^2 x = 2\cos^2 x - \cos^2 x$ $3\sin^2 x = \cos^2 x$ $\therefore \tan^2 x = \frac{1}{3}$ $\therefore \tan x = \frac{1}{\sqrt{3}}$ $\therefore x = 30°$ #ref angle/ *#verw hoek* $\therefore x = 30° + k.180°\ ;\ k \in \mathbb{Z}$ $x = 180° + 30° + k.180°\ k \in \mathbb{Z}$ $x = 210° + k.180°\ k \in \mathbb{Z}$	✓ $\cos 2x = \frac{1}{2}$ ✓ $2x = 60° + k.360°$ ✓ $x = 30° + k.180°, k \in \mathbb{Z}$ (4) ✓ $x = 150° + k.180°\ ,$ $k \in \mathbb{Z}$ **OR/*OF*** ✓ multiplying by 2 and using identity/ *vermenigvuldig met 2 en gebruik identiteit* ✓ $3\sin^2 x = \cos^2 x$ ✓ $\tan x = \frac{1}{\sqrt{3}}$ ✓ answer/*antwoord* (4)

3.6		$\frac{\sin 2\theta \,.\tan\theta}{\cos 2\theta + 1} = \tan^2\theta$	
	3.6.1	LHS $= \frac{\sin 2\theta.\tan\theta}{\cos 2\theta+1}$ $= \frac{2\sin\theta\cos\theta.\frac{\sin\theta}{\cos\theta}}{2\cos^2\theta-1+1}$ $= \frac{2\sin^2\theta}{2\cos^2\theta}$ $= \tan^2\theta$ $\therefore$ LHS = RHS/*LK=RK*	✓ $2\sin\theta\cos\theta$ ✓ $\frac{\sin\theta}{\cos\theta}$ ✓ $2\cos^2\theta - 1$ ✓ $\frac{2\sin^2\theta}{2\cos^2\theta}$ (4)
	3.6.2	$\cos 2\theta + 1 = 0$ $\cos 2\theta = -1$ $2\theta = 180°$ $\theta = 90°$	If only $\theta = 90°$ for tanθ undefined $(\frac{1}{4})$ */as slegs* $\theta = 90°$ *vir* tanθ *ongedefinieërd* tanθ $(\frac{1}{4})$ ✓ denominator/*noemer* = 0 ✓ $\cos 2\theta = -1$ ✓ $2\theta = 180°$ ✓ $\theta = 90°$ (4)
			[35]

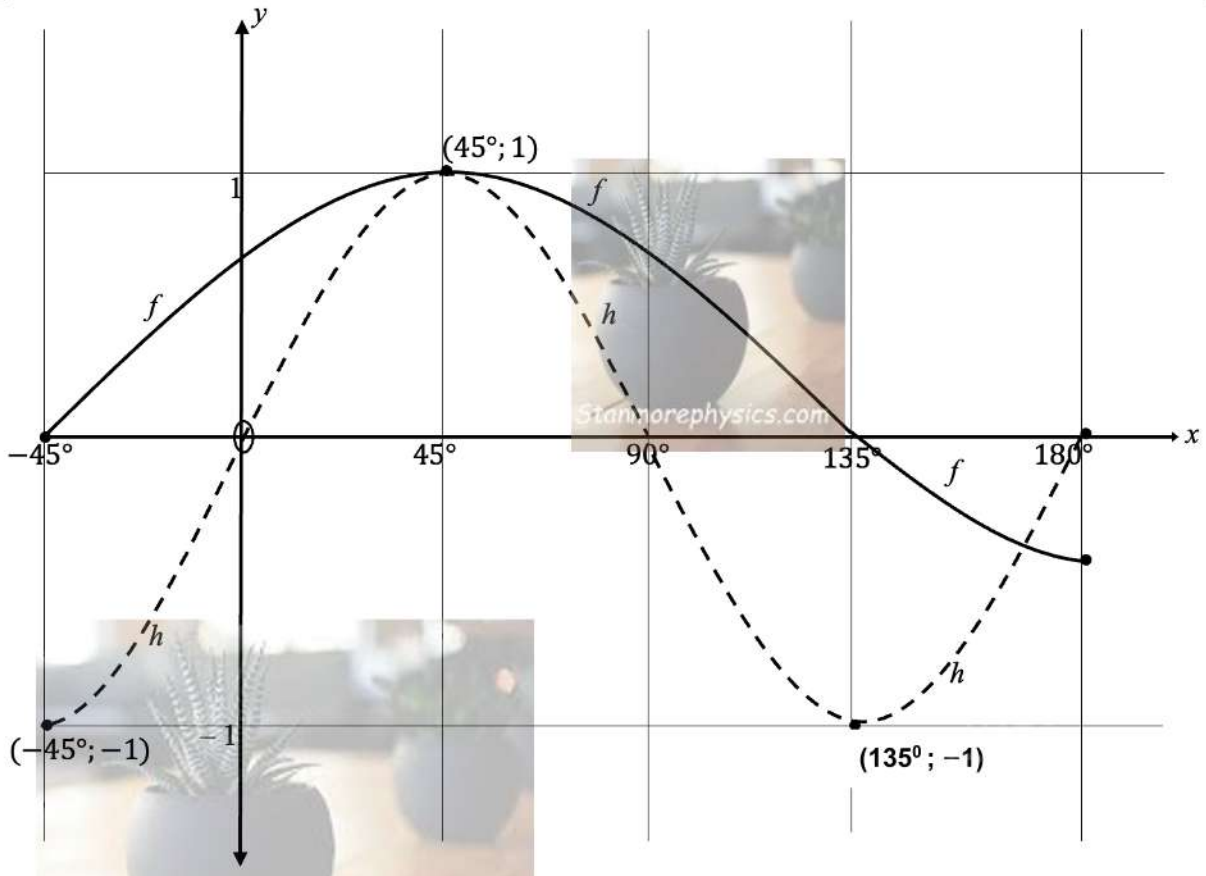
QUESTION/*VRAAG* 4



4.1	$\Delta ABC \equiv \Delta ABD$ (S.A.S)/($S\angle S$)	✓ **R** (1)
4.2	$\cos\alpha = \frac{x}{AC}$ $\therefore AC = \frac{x}{\cos\alpha}$	✓ correct ratio/*korrekte verhouding* ✓ AC simplified as subject/ *AC vereenvoudig as onderwerp* (2)
4.3	$CD^2 = \left(\frac{x}{\cos\alpha}\right)^2 + \left(\frac{x}{\cos\alpha}\right)^2 - 2\left(\frac{x}{\cos\alpha}\right)\left(\frac{x}{\cos\alpha}\right)\cos(180° - 2\beta)$ $CD^2 = \frac{2x^2}{\cos^2\alpha} - 2\left(\frac{x^2}{\cos^2\alpha}\right)\cos 2\beta$ $CD^2 = \frac{2x^2}{\cos^2\alpha}(1 + \cos 2\beta)$ $CD^2 = \frac{2x^2}{\cos^2\alpha}(1 + (1 - 2\sin^2\beta))$ $CD^2 = \frac{2x^2}{\cos^2\alpha}(1 + (1 - 2(1 - \cos^2\beta)))$ $CD^2 = \frac{2x^2}{\cos^2\alpha}(2\cos^2\beta)$ $CD^2 = \frac{4x^2\cos^2\beta}{\cos^2\alpha}$ $\therefore CD = \frac{2x\cos\beta}{\cos\alpha}$	✓ correct use of cos rule/ *korrekte gebruik van cos-reël* ✓ simplification/ *vereenvoudig* ✓ applying double angles/ *gebruik dubbelhoeke* ✓ identity/*identiteit* (4)

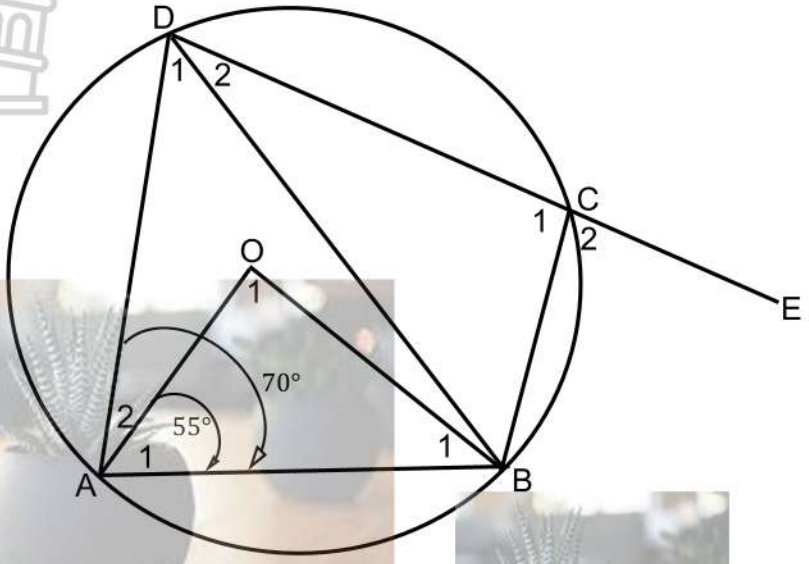
	OR/*OF*	**OR/*OF***
	$A\hat{D}C = \beta$	
	$C\hat{A}D = 180° - 2\beta$	✓ $A\hat{D}C = \beta$ and/*en*
	$\frac{CD}{\sin(180°-2\beta)} = \frac{AC}{\sin\beta}$	$C\hat{A}D = 180° - 2\beta$
	$CD = \frac{AC.\sin 2\beta}{\sin\beta}$	✓ correct use of sin rule/ *korrekte gebruik van sin-reël*
	but $AC = \frac{x}{\cos\alpha}$	
	$CD = \frac{\left(\frac{x}{\cos\alpha}\right).\sin 2\beta}{\sin\beta}$	✓ substituting AC/ *substitusie van AC*
	$CD = \frac{x.2\sin\beta.\cos\beta}{\cos\alpha.\sin\beta}$	✓ double angle/*dubbelhoek*
	$\therefore CD = \frac{2x.\cos\beta}{\cos\alpha}$	(4)
4.4	$CD = \frac{2(25)\cos 65{,}62°}{\cos 30°}$ penalize 1 mark for incorrect rounding /*penaliseer 1 punt vir foutiewe afronding*	✓ substitution/*substitusie*
	$CD = 23{,}83$ cm	✓ answer/*antwoord* (2)
		[9]

QUESTION/*VRAAG* 5

5.1	$f(180°) = \cos(180° - 45°)$ $= -0{,}71$ **ANSWER ONLY: FULL MARKS** ***SLEGS ANTWOORD: VOLPUNTE*** $\therefore -0{,}71 \leq y \leq 1$ **OR/*OF*** $\therefore y \in [-0{,}71; 1]$ **OR/*OF*** $-\frac{\sqrt{2}}{2} \leq y \leq 1$	✓ $f(180°)$ ✓ answer/*antwoord*	(2)
5.2	**SEE THE GRAPH BELOW AND ALLOCATE MARKS ACCORDINGLY:** ***SIEN DIE GRAFIEK HIERONDER EN KEN PUNTE TOE DAARVOLGENS:*** ✓ intercepts/*afsnitte* ✓ shape/*vorm* ✓turning points/*draaipunte*		(3)
			
5.3	Period/*periode* = 180°	✓ answer/*antwoord*	(1)
5.4	$-45° < x < 45°$ **OR/*OF*** $x \in (-45°; 45°)$ **ACCEPT/ *AANVAAR*:** $-45° \leq x \leq 45°$	✓✓ answer/*antwoord*	(2)
5.5	$x = -45°$ or/*of* $x = 135°$	✓ $-45°$ ✓ $135°$	(2)
5.6	$g(x) = \cos(x + 15°)$	✓ answer/*antwoord*	(1)
			[11]

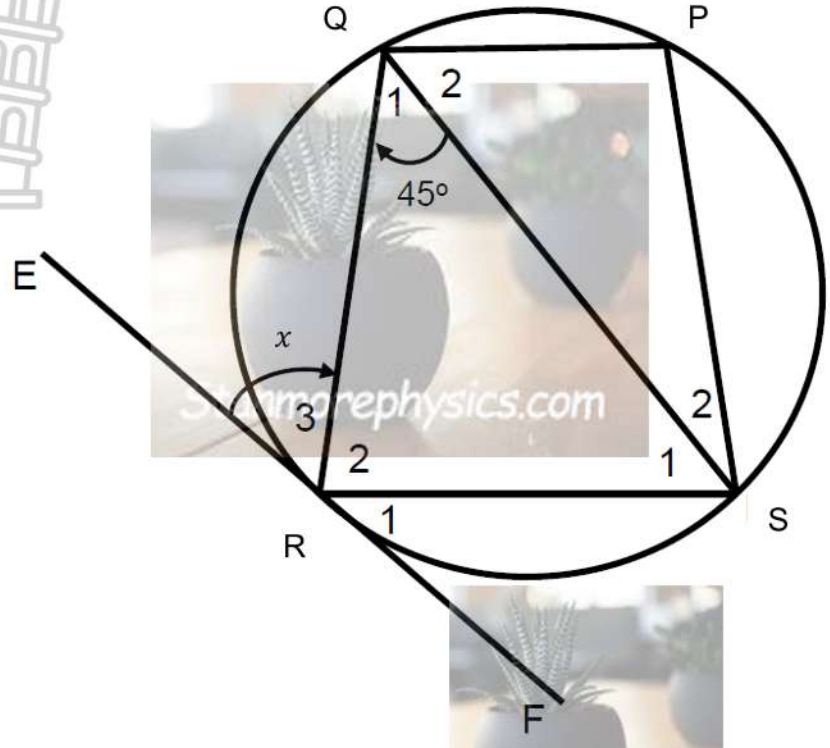
QUESTION/*VRAAG 6*

6.1



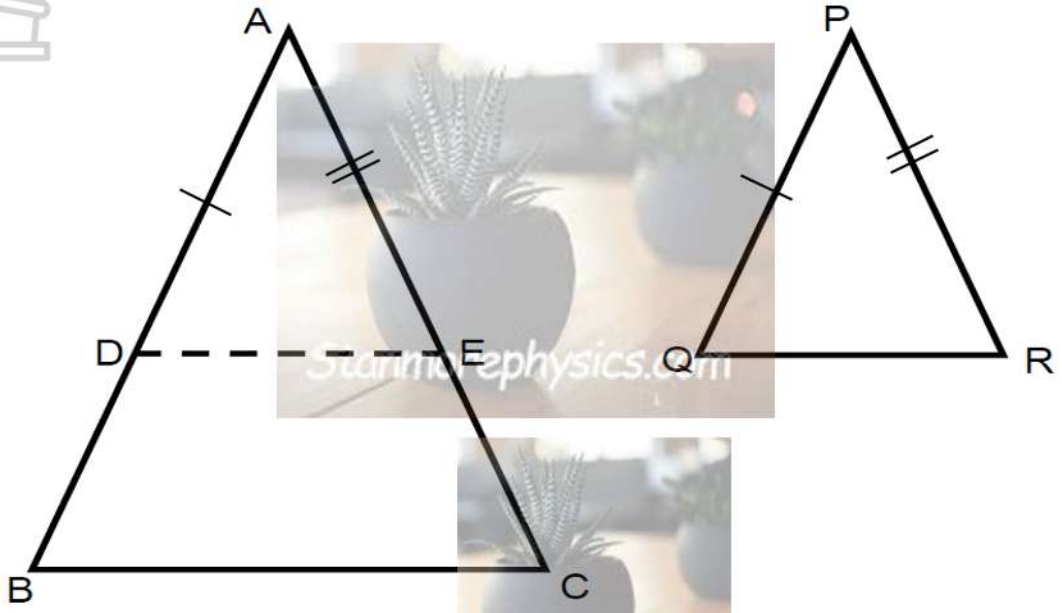
	6.1.1	$\hat{B}_1 = 55°$ (<s opp equal radii)/*(<e teenoor gelyke radiusse)* **OR/*OF*** OA = OB (radii)(*radiusse)* $\hat{B}_1 = 55°$ (<s opp equal sides)/*(<e teenoor gelyke radiusse)*	✓S ✓R ✓ OA = OB (radii) *(radiusse}* ✓ S	(2) (2)
	6.1.2	$\hat{O}_1 = 70°$ (sum of/*som van* < s in Δ)/*(<e van Δ)*	✓ S ✓R	(2)
	6.1.3	$\hat{D}_1 = 35°$ (< at centre = 2 ×< at circumference) *(midpts <= 2 × omtreks<)*	✓S ✓R	(2)
	6.1.4	$\hat{C}_2 = 70°$ (ext < of a cyclic quad)/*(buite< van kvh)* **OR** $\hat{C}_1 = 110°$ (opp <s of a cyclic quad)/ *(teenooorst<e kvh)* $\hat{C}_2 = 70°$ (<s on a st line)/*(<e op reguitlyn)*	✓S ✓R ✓S/R ✓ S	(2) (2)

6.2

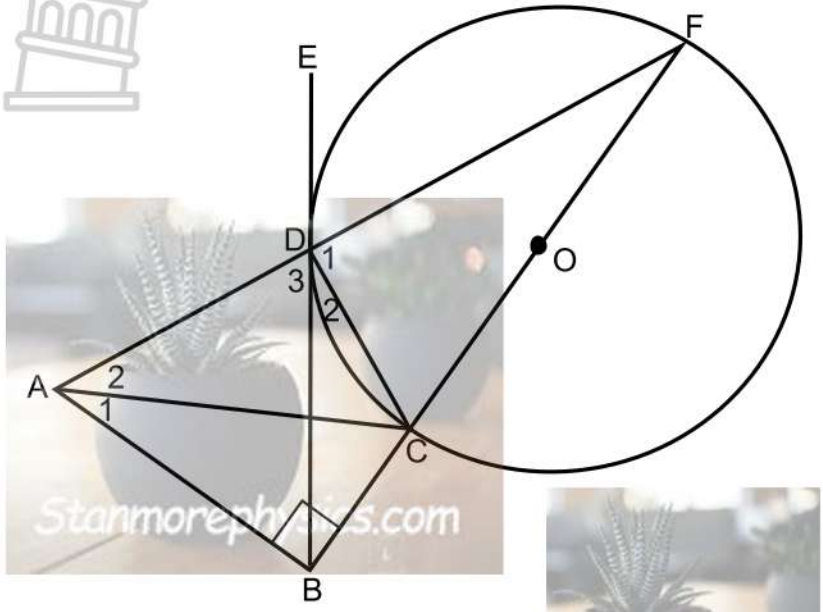


	6.2.1	$\hat{S}_1 = x$ (tan chord theorem)/(∠*tussen raaklyn en koord)*	✓ S ✓ R	(2)
	6.2.2	$\hat{R}_2 = 180° - (\hat{S}_1 + 45°)$ (sum of <s in Δ)/(<*e van Δ)* $= 180° - (x + 45°)$	✓S ✓R	
		$\hat{R}_2 + \hat{P} = 180°$ (opp <s of cyclic quad)/*(teenooorst<e kvh)* $\therefore 180° - (x + 45°) + \hat{P} = 180°$ $\hat{P} = x + 45°$	✓S ✓R	(4)
		OR/*OF*	**OR/*OF***	
		$\hat{R}_1 = 45°$ (tan chord theorem)*(∠ tussen rlyn en koord)* $\hat{R}_2 = 180° - (x + 45°)$ (<s on st line)/*(<e op reguitlyn)* $\hat{R}_2 + \hat{P} = 180°$ (opp <s of cyclic quad)/*teenooorst<e kvh* $\therefore 180° - (x + 45°) + \hat{P} = 180°$ $\hat{P} = x + 45°$	✓S ✓ R ✓S ✓R	(4)
				[14]

QUESTION/*VRAAG* 7

7.1.1	SAS/*(S<S)*	✓ R	(1)
7.1.2			
	$A\hat{D}E = \hat{Q}$ (≡ Δs)/*(≡ Δe)*	✓ S	
	$A\hat{D}E = \hat{B}$ (both $= \hat{Q}$)/*(beide $= \hat{Q}$)*		
	∴ DE||BC (corresp <s =)/*(ooreenk <e =)*	✓ S ✓ R	
	$\frac{AB}{AD} = \frac{AC}{AE}$ (prop theorem; DE||BC)/*(lyn || een sy van Δ; DE||BC)*	✓ S ✓ R	
	But/*Maar* AD = PQ and/*en* AE = PR (given)/*(gegee)*		
	∴ $\frac{AB}{PQ} = \frac{AC}{PR}$		(5)
	OR/OF		
	In ΔABC and ΔPQR:	✓ S	
	$\hat{A} = \hat{P}$ *(given/gegee)*		
	$\hat{B} = \hat{Q}$ *(given/gegee)*	✓ S ✓ R	
	$\hat{C} = \hat{R}$ *(given/gegee)*		
	$\Delta ABC \,\|\|\|\, \Delta PQR$ (<<<)		
	$\frac{AB}{PQ} = \frac{AC}{PR}$	✓ S ✓ R	(5)

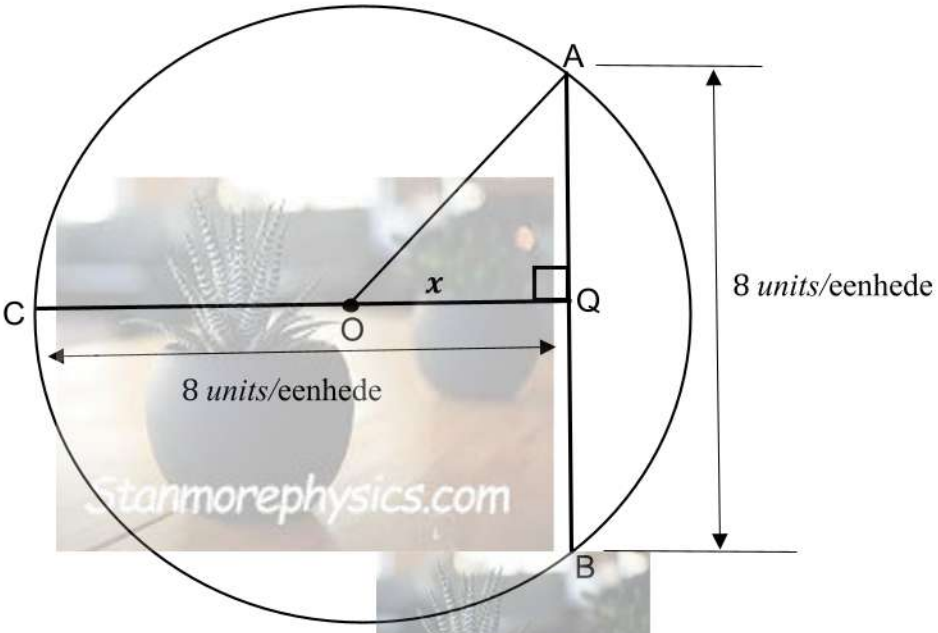
7.2



7.2.1	$\hat{B} = 90°$ (given)/*(gegee)* $\hat{D}_1 = 90°$ (< in a semi − circle)/*(< in halwe sirkel)* ∴ ABCD is a cyclic quadrilateral (converse: ext < of a cyclic quad) / *ABCD is 'n kvh (buite < van vierhoek = teenoorst binne <)* **OR/*OF*** $\hat{B} = 90°$ (given) /*(gegee)* $\hat{D}_1 = 90°$ (< in a semicircle)/*(< in 'n halwe sirkel)* $\hat{D}_2 + \hat{D}_3 = 90°$ (< s on a st line)/*(<e op reguitlyn)* ∴ ABCD is a cyclic quadrilateral (converse: opp < s of a cyclic quad)/ *ABCD is 'n kvh (buite < van vierhoek =teenoorst binne <)*	✓S ✓R ✓R (3) **OR/*OF*** ✓S ✓R ✓R (3)
7.2.2	$\hat{A}_1 = \hat{D}_2$ (< s in the same seg)/(< *e in dies sirkel segm*) $\hat{D}_2 = \hat{F}$ (tan chord theorem)/*(< tussen raaklyn en koord)* ∴ $\hat{A}_1 = \hat{F}$ (both $= \hat{D}_2$) /*(beide* $= \hat{D}_2$*)* ∴ AB is a tangent/*is 'n raaklyn* (converse: tan − chord thrm **OR** < between line and chord) *(omg < e in dies sirkel segm **OF** < tussen lyn en koord = < in teenoorst sirkel segm)*	✓S ✓R ✓ S/R ✓ R (4)
		[13]

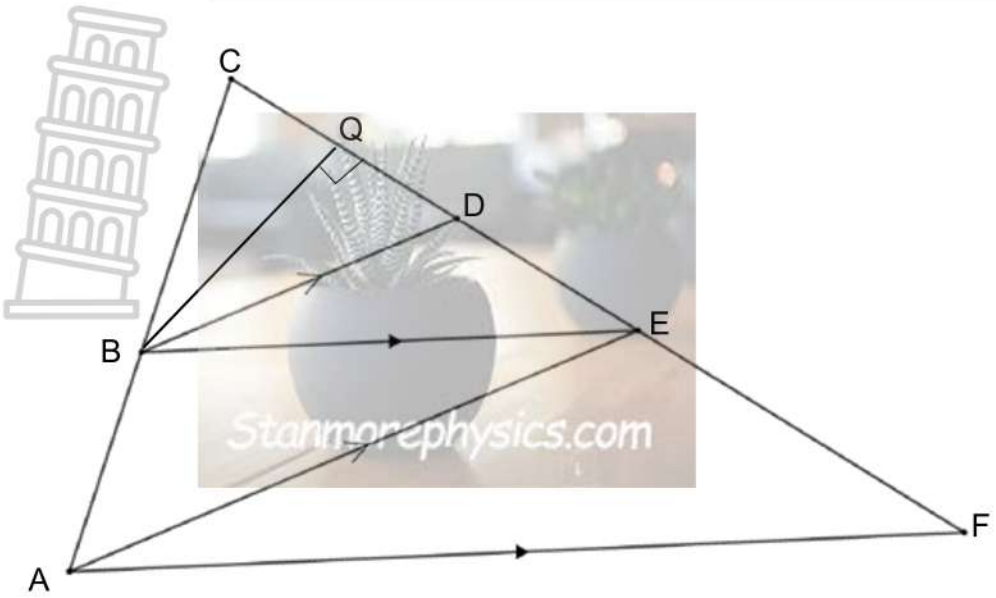
QUESTION/*VRAAG* 8

8.1



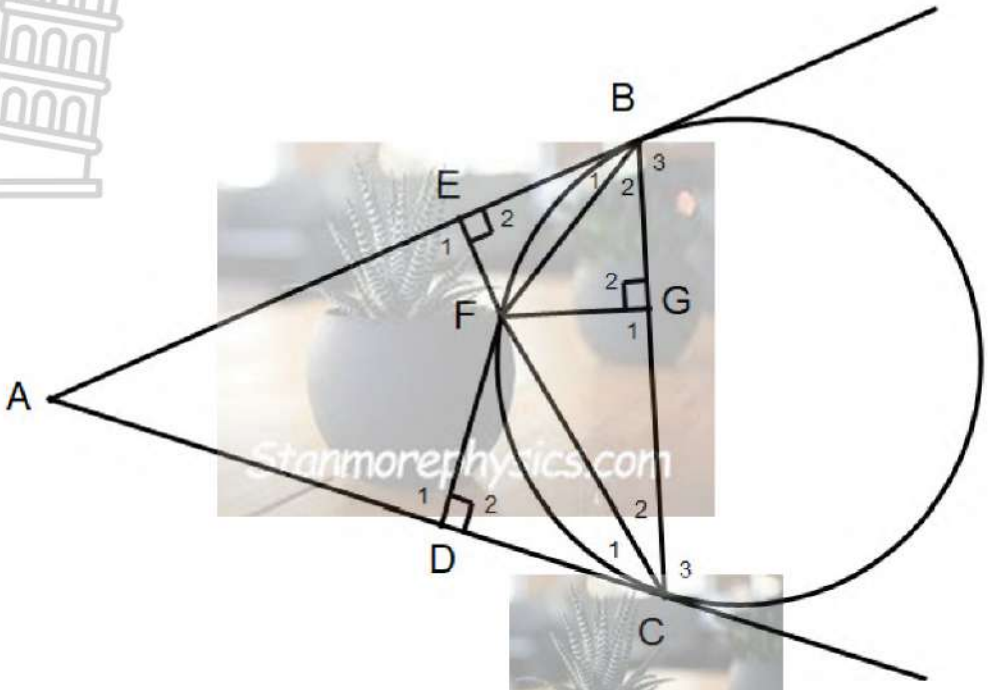
	$AQ = 4$ units/*eenhede* (line from centre $\perp$ chord) / *(loodlyn uit midpt O na koord)*	✓ S ✓ R
	$OC = OA = 8 - x$ (radii)/*(radiusse)*	✓ $OA = 8 - x$
	$OA^2 = x^2 + AQ^2$ (Pythagoras)	
	$(8 - x)^2 = x^2 + 4^2$	✓ S
	$64 - 16x + x^2 = x^2 + 16$	
	$16x = 48$	
	$\therefore x = 3$	(5)
	$\therefore OC = 5$ units/*eenhede*	✓ $OC = 5$ units/ *eenhede*
	OR/*OF*	**OR/*OF***
	$OC = OA$ (radii)/*(radiusse)*	✓ $OQ = 8 - OC$
	$OQ = 8 - OC$	
	$AQ = 4$ units/*eenhede* (line from centre $\perp$ chord) / *(loodlyn uit midpt O na koord)*	✓ S ✓ R
	$OA^2 = OQ^2 + 4^2$ (Pythagoras)	
	$OC^2 = (8 - OC)^2 + 4^2$	✓ S
	$OC^2 = 64 - 16OC + OC^2 + 16$	
	$16OC = 80$	
	$\therefore OC = 5$ units/*eenhede*	✓ S (5)

8.2

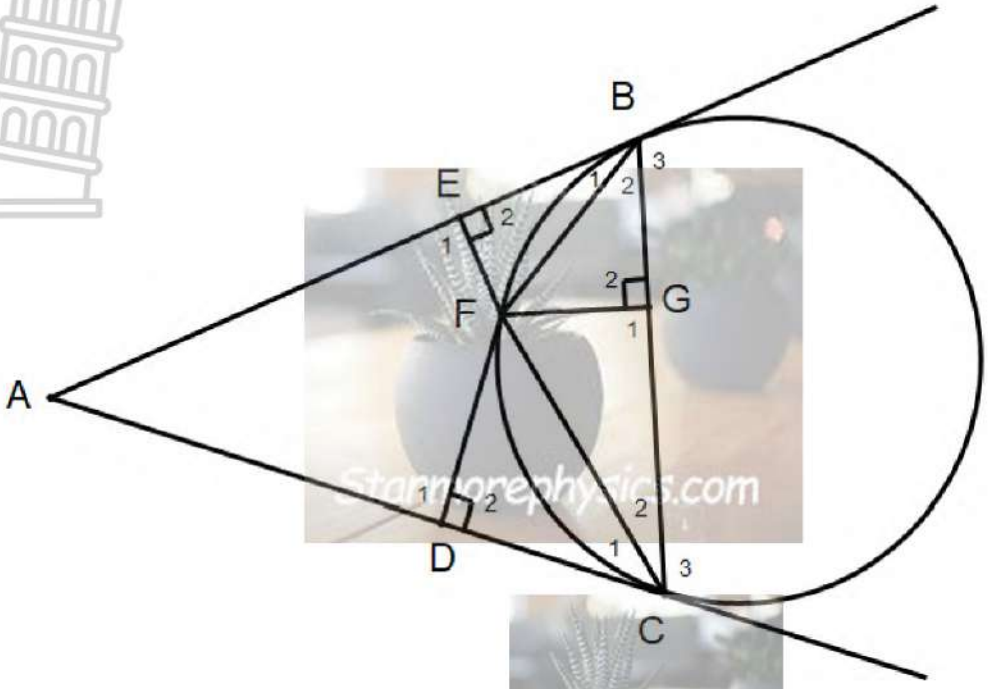


8.2.1	4 : 5	✓ S (1)
8.2.2	$\frac{AC}{AB} = \frac{9}{4}$ (given/*gegee*) $AC = \frac{9}{4} \times 6$ units/*eenhede* $AC = \frac{27}{2}$ units/*eenhede* $= 13{,}5$ units/*eenhede*	✓ substitution /*substitusie* ✓ answer/*antwoord* (2)
8.2.3	$\frac{\text{Area of } \Delta BDC}{\text{Area of } \Delta BED} = \frac{\frac{1}{2} \times CD \times BQ}{\frac{1}{2} \times DE \times BQ}$ $= \frac{CD}{DE}$ $= \frac{5}{4}$ (prop theorem; BD||AE)/ line|| one side of Δ *(lyn || een sy van Δ)*	✓ $\frac{\text{Area of } \Delta BDC}{\text{Area of } \Delta BED} = \frac{CD}{DE}$ $\frac{Opp\ \Delta BDC}{Opp\ \Delta BED} = \frac{CD}{DE}$ ✓ S/R (2)
8.2.4	$\frac{EC}{FC} = \frac{BC}{AC} = \frac{5}{9}$ (prop theorem; BE||AF) / line|| one side of Δ *(lyn||een sy van Δ)* $\frac{EC}{15} = \frac{5}{9}$ $EC = \frac{25}{3} = 8{,}33$ $\frac{DE}{EC} = \frac{4}{9}$ (prop theorem; BD||AE)/ line|| one side of Δ *(lyn||een sy van Δ)* $DE = \frac{4}{9} \times EC$ $= \frac{4}{9} \times \frac{25}{3}$ $\therefore DE = \frac{100}{27}$ units/*eenhede* = 3,70 units/*eenhede*	✓ $\frac{EC}{FC} = \frac{5}{9}$ ✓ $EC = \frac{25}{3} = 8{,}33$ ✓ $\frac{DE}{EC} = \frac{4}{9}$ ✓ answer/*antwoord* (4)
		[14]

QUESTION/*VRAAG 9*



9.1	In ΔBEF and/*en* ΔCGF, $\hat{E}_2 = \hat{G}_1$ (both = 90°, given)/(*beide* = 90°, *gegee*) $\hat{B}_1 = \hat{C}_2$ (tan chord theorem)/(< *tussen raaklyn en koord*) $E\hat{F}B = C\hat{F}G$ (sum of/*som van* < s in Δ)/(< *e van* Δ) ∴ ΔBEF|||ΔCGF (<<<)	✓ $\hat{E}_2 = \hat{G}_1$ ✓ S/R ✓ <<< **OR/*OF*** Sum of/*som van* <s in Δ/ (< *e van* Δ) (3)



9.2	In ΔCDF and/*en* ΔBGF, $\hat{D}_2 = \hat{G}_2$ (both = 90°, given)/(*beide* = 90°, *gegee*) $\hat{C}_1 = \hat{B}_2$ (tan chord theorem)/(< *tussen raaklyn en koord*) $C\hat{F}D = B\hat{F}G$ (sum of < s in Δ)/(< *e van* Δ) ∴ ΔCDF|||ΔBGF (<<<) ΔBEF|||ΔCGF (proven) $\frac{FD}{FG} = \frac{FC}{FB}$ (ΔCDF|||ΔBGF) $\frac{FG}{FE} = \frac{FC}{FB}$ (ΔBEF|||ΔCGF) $\frac{FD}{FG} = \frac{FG}{FE}$ $(both\ /beide = \frac{FC}{FB})$ ∴ $FG^2 = FE \times FD$	✓ S ✓ R ✓ ΔCDF|||ΔBGF ✓ S/R ✓ S ✓ $\frac{FD}{FG} = \frac{FG}{FE}$ (6)
		[9]

TOTAL/*TOTAAL:* 145