KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 11



MATHEMATICS

COMMON TEST

MARCH 2022

MARKS: 75

TIME: 1½ hours

This question paper consists of 6 pages and 2 DIAGRAM SHEETS.

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INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of 5 questions.

2. Answer ALL the questions.

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

4. Clearly show ALL calculations, diagrams, graphs, etc. which you have used in determining your answers.

5. Answers only will NOT necessarily be awarded full marks.

6. You may use an approved scientific calculator (non-programmable and non-graphical), unless stated otherwise.

7. If necessary, round off answers correct to TWO decimal places, unless stated otherwise.

8. Diagrams are NOT necessarily drawn to scale.

9. TWO DIAGRAM SHEETS for QUESTION 4.1, QUESTION 4.2, QUESTION 4.3, QUESTION 5.1 AND QUESTION 5.2 are attached at the end of this question paper. Detach the DIAGRAM SHEETS and hand in together with your ANSWER BOOK.

10. Write neatly and legibly.

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QUESTION 1



1.1 Solve for x:

1.1.1 $(x-2)(3x+4)=0$ (2)

1.1.2 $(x-2)(3x+4)<0$ (2)

1.1.3 $5x^2-11x+4=0$ (answer correct to two decimals) (3)

1.1.4 $\frac{4}{x+3}+\frac{x}{x-1}=\frac{12x+20}{x^2+2x-3}$ (5)

1.2 Solve simultaneously for x and y:

$3y+x=2$ and $y^2+x=xy+y$ (6)

1.3 For which values of k will the equation $x^2+6x-2k=0$ have non-real roots? (3)

[21]

QUESTION 2

2.1 Solve for x:

2.1.1 $16^x=1$ (1)

2.1.2 $\sqrt{2x+7}=4-x$ (4)

2.2 Simplify:

2.2.1 $\left(\frac{1}{\sqrt[3]{p^2}}\right)^{-3}$ (3)

2.2.2 $\left(\frac{\sqrt{5^{2023}}-\sqrt{5^{2021}}}{\sqrt{5^{2020}}}-\sqrt{45}\right)^2$ (4)

[12]

QUESTION 3

DO NOT USE A CALCULATOR WHEN ANSWERING QUESTION 3.

3.1 If $\cos 34^\circ = t$, express each of the following in terms of t:

3.1.1 $\sin 34^\circ$ (3)

3.1.2 $\tan 146^\circ$ (2)

3.2 Simplify to a single trigonometric ratio:

3.2.1 $$\frac{\sin 550^\circ}{\cos(-170^\circ)}$$ (3)

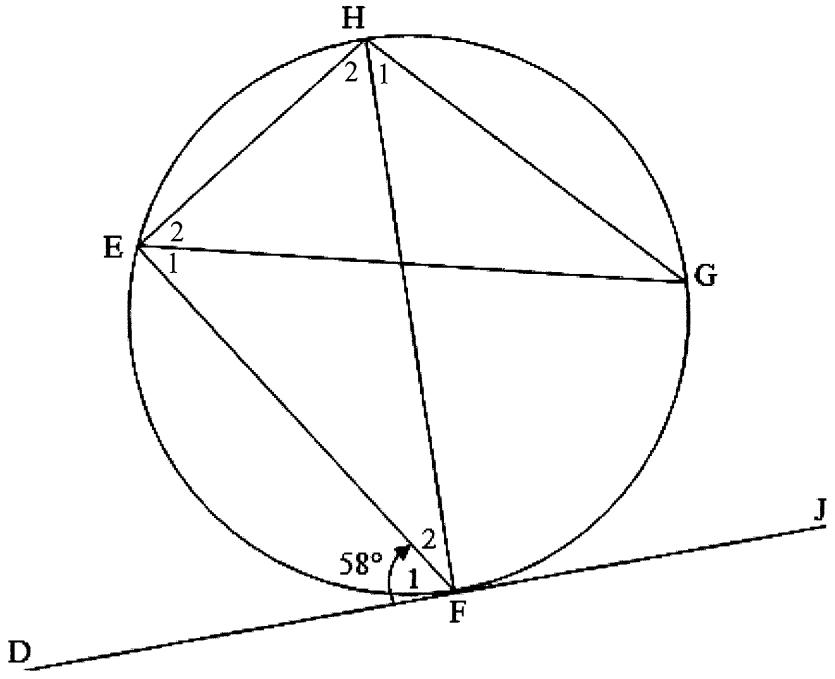
3.2.2 $$\sqrt{1+\cos(90^\circ+\theta)\sin(180^\circ-\theta)}$$ (4)

[12]

PROVIDE REASONS FOR YOUR STATEMENTS AND CALCULATIONS IN QUESTIONS 4 and 5.

QUESTION 4

4.1 In the diagram below, points E, F, G and H lie on the circle. FH is a diameter. DJ is a tangent to the circle at F. Chords EF, EG, EH and HG are drawn. $\hat{F}_1 = 58^\circ$.



4.1.1 Write down the size of each of the following angles:

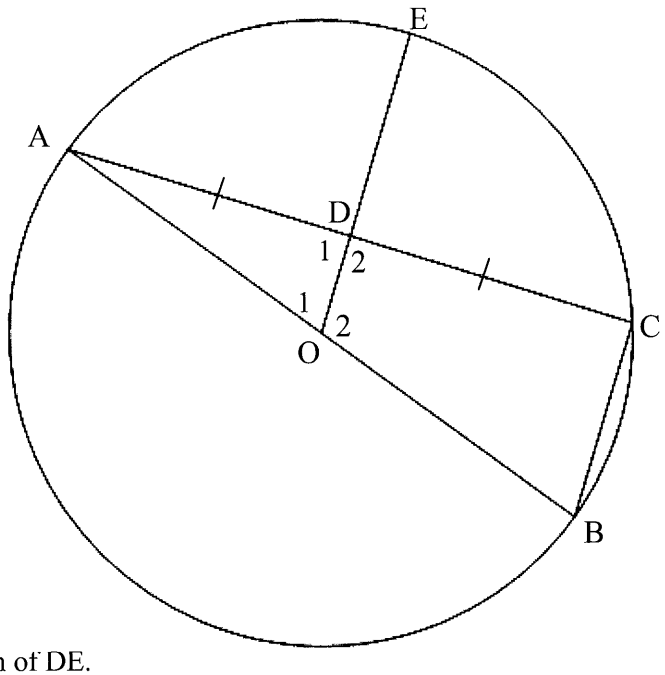
(a) $F\hat{E}H$ (1)

(b) $D\hat{F}H$ (1)

4.1.2 Calculate the size of $\hat{G}$. (3)

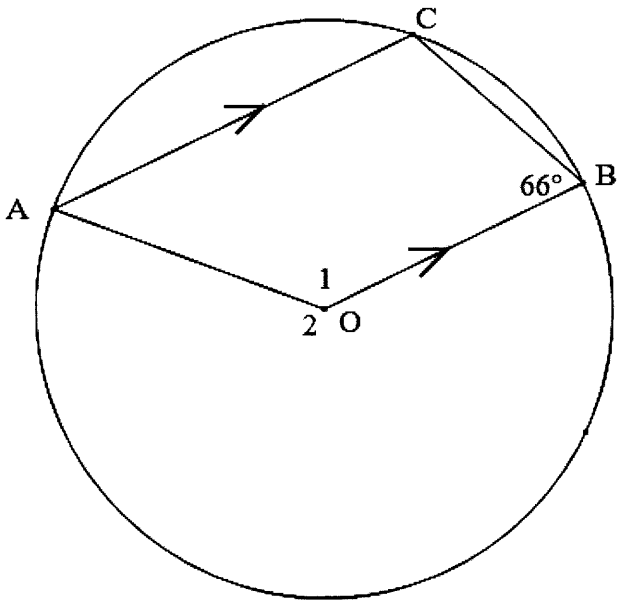
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4.2 In the diagram, AB is a diameter of the circle with centre O. C is a point on the circle. AC and BC are drawn.
D is a point on AC such that AD = CD = 48 cm. OD is drawn and produced to E, where E is a point on the circle. OD = 14 cm.



Calculate the length of DE. (5)

4.3 O is the centre of the circle passing through points A, B and C. AC || OB and $\hat{B} = 66^\circ$.

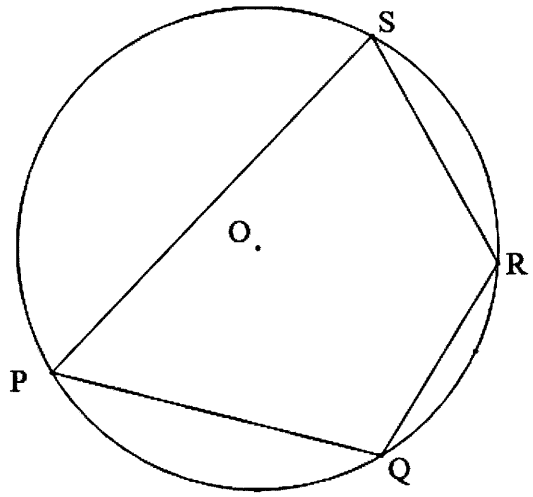


Calculate the size of $\hat{A}$. (5)

[15]

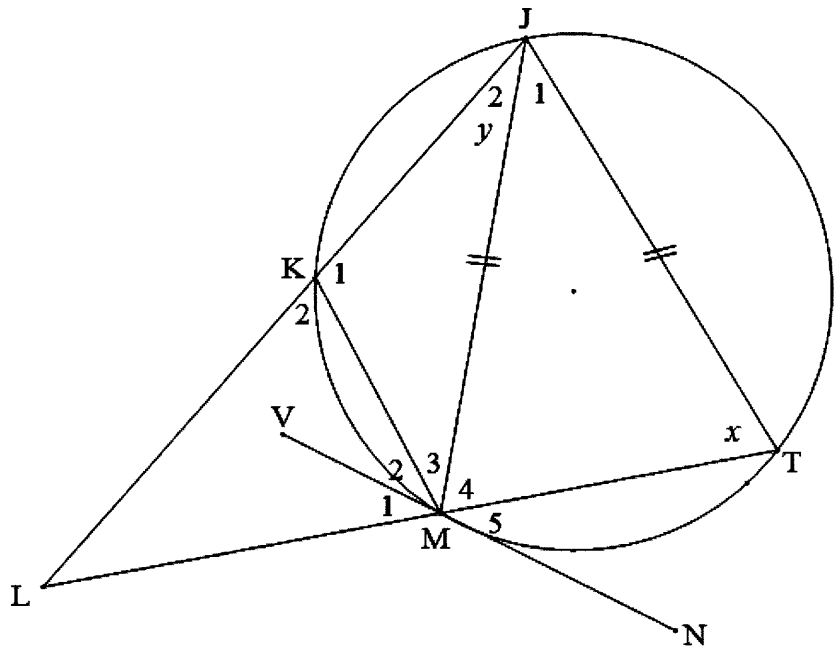
QUESTION 5

5.1 In the diagram below, O is the centre of the circle and PQRS is a cyclic quadrilateral.



Prove the theorem which states that $\hat{P}+\hat{R}=180^{\circ}$. (5)

5.2 JKMT is a cyclic quadrilateral with JM = JT. NV is a tangent to the circle at M. TM produced meets JK produced at L. $\hat{T}=x$ and $\hat{J}_2=y$.



5.2.1 Write down, with reasons, three other angles each equal to x. (5)

5.2.2 Determine $\hat{M}_3$ in terms of x and y. (2)

5.2.3 Prove that JM is a tangent to the circle passing through the points K, L and M. (3)

[15]

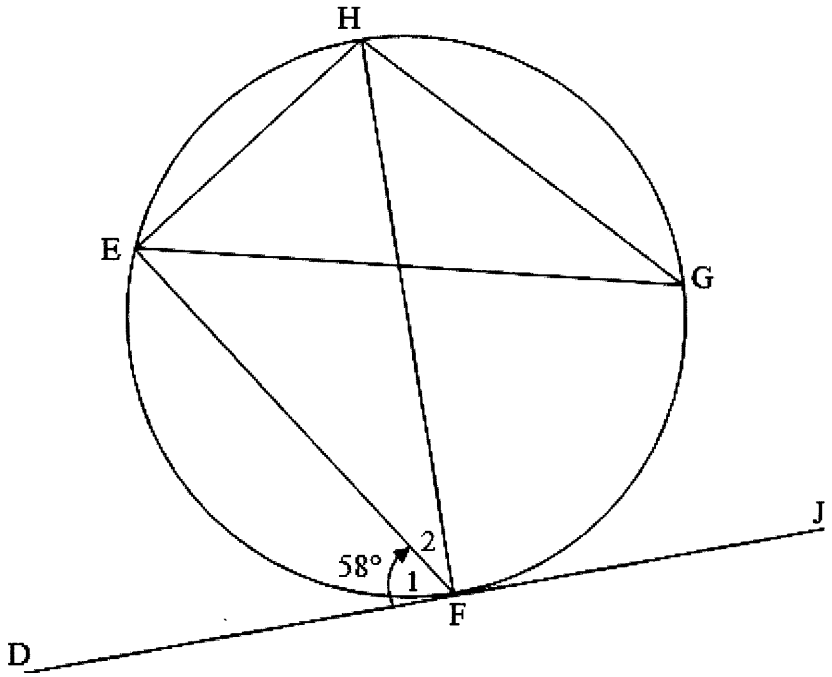
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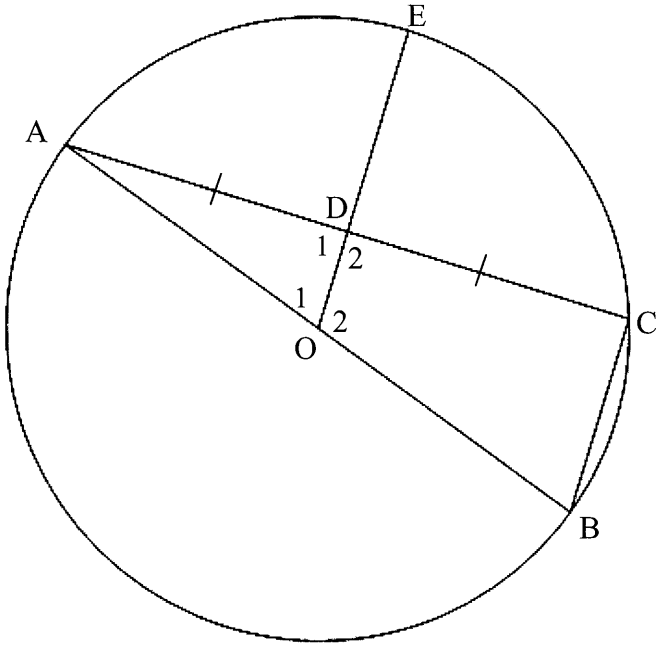
NAME & SURNAME:

DIAGRAM SHEET 1

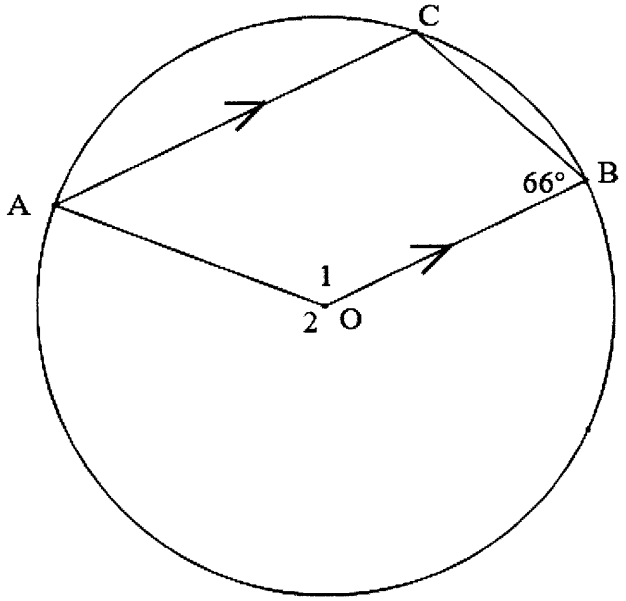
QUESTION 4.1



QUESTION 4.2



QUESTION 4.3



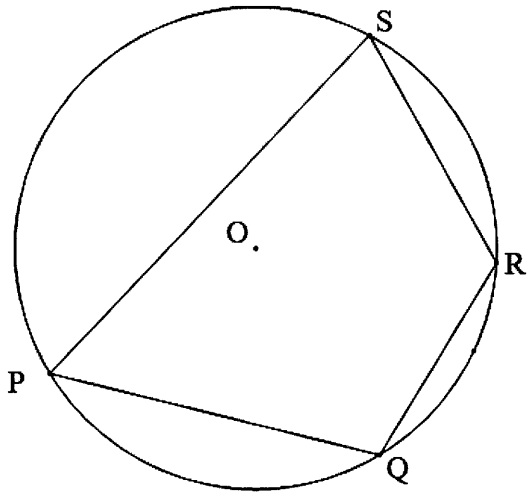
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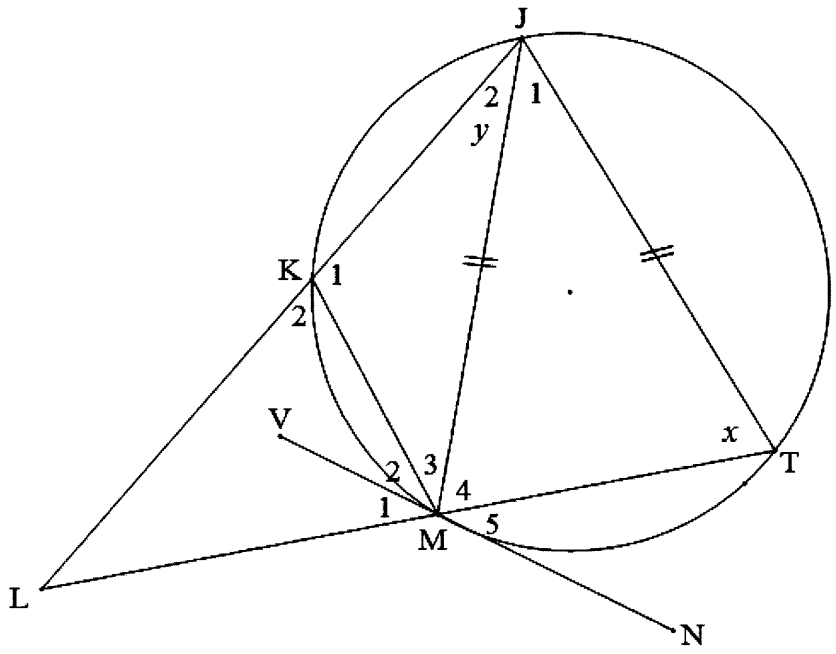
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DIAGRAM SHEET 2

QUESTION 5.1



QUESTION 5.2



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NATIONAL SENIOR CERTIFICATE

GRADE 11

MATHEMATICS

MARKING GUIDELINES

COMMON TEST

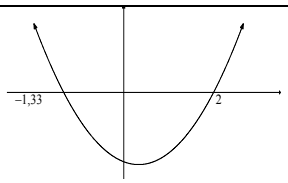
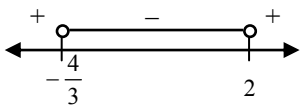
MARCH 2022

MARKS: 75

This memorandum consists of 6 pages.

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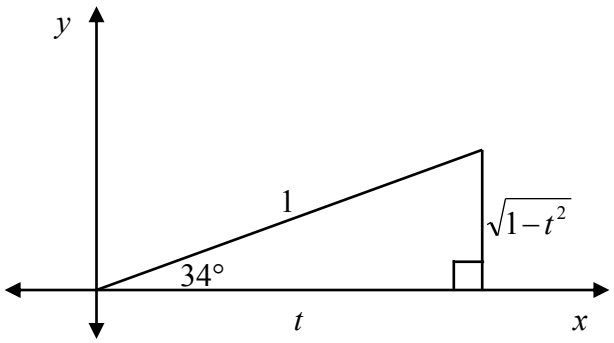
QUESTION 1

1.1.1	$x=2$ or $x=-\frac{4}{3}$	✓✓ answer (2)
1.1.2	 **OR**  $-\frac{4}{3}<x<2$	✓ ✓ answer (2)
1.1.3	$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$ $=\frac{-(-11)\pm\sqrt{(-11)^2-4(5)(4)}}{2(5)}$ $=1{,}74$ or $0{,}46$	✓ substitution ✓ ✓ answer (3)
1.1.4	$\frac{4}{x+3}+\frac{x}{x-1}=\frac{12x+20}{x^2+2x-3}$ $\frac{4}{x+3}+\frac{x}{x-1}=\frac{12x+20}{(x+3)(x-1)}$ $4(x-1)+x(x+3)=12x+20$ $4x-4+x^2+3x=12x+20$ $x^2-5x-24=0$ $(x-8)(x+3)=0$ $x=8$ or $x\neq-3$	✓ factorisation ✓ multiply through by LCD ✓ standard form ✓ factors ✓ answers with selection (5)
1.2	$x=2-3y$ Substitute in $y^2+x=xy+y$: $y^2+2-3y=y(2-3y)+y$ $y^2+2-3y=2y-3y^2+y$ $4y^2-6y+2=0$ $2y^2-3y+1=0$ $(2y-1)(y-1)=0$ $y=\frac{1}{2}$ or $y=1$ $x=\frac{1}{2}$ or $x=-1$	✓ making x the subject of the formula ✓ substitution ✓ standard form ✓ factors ✓ values of y ✓values of x (6)
1.3	For non-real roots, D = $b^2-4ac<0$ $6^2-4(1)(-2k)<0$ $8k<-36$ $k<-\frac{9}{2}$	✓ condition for non-real roots ✓ substitution ✓ answer (3)
		[21]

QUESTION 2

2.1.1	$16^x = 1$ $16^x = 16^0$ $x = 0$	✓ answer (1)
2.1.2	$\sqrt{2x+7} = 4-x$ $2x+7 = (4-x)^2$ $2x+7 = 16-8x+x^2$ $x^2-10x+9 = 0$ $(x-1)(x-9) = 0$ $x = 1$ or $x \neq 9$	✓ squaring both sides ✓ standard form ✓ factorisation ✓ answer with selection (4)
2.1.2	$\left(\frac{1}{\sqrt[3]{p^2}}\right)^{-3}$ $= \left(\frac{1}{p^{\frac{2}{3}}}\right)^{-3}$ $= \left(p^{-\frac{2}{3}}\right)^{-3}$ $= p^2$ **OR** $\left(\frac{1}{\sqrt[3]{p^2}}\right)^{-3}$ $= \left(\sqrt[3]{p^2}\right)^3$ $= \left(p^{\frac{2}{3}}\right)^3$ $= p^2$	✓ $\sqrt[3]{p^2} = p^{\frac{2}{3}}$ ✓ $\frac{1}{p^{\frac{2}{3}}} = p^{-\frac{2}{3}}$ ✓ answer (3) **OR** ✓ $\left(\frac{1}{\sqrt[3]{p^2}}\right)^{-3} = \left(\sqrt[3]{p^2}\right)^3$ ✓ $\sqrt[3]{p^2} = p^{\frac{2}{3}}$ ✓ answer (3)
2.2.2	$\left(\frac{\sqrt{5^{2023}}-\sqrt{5^{2021}}}{\sqrt{5^{2020}}}-\sqrt{45}\right)^2$ $= \left(\frac{\sqrt{5}.5^{1011}-\sqrt{5}.5^{1010}}{5^{1010}}-3\sqrt{5}\right)^2$ $= \left(\frac{\sqrt{5}.5^{1010}(5^1-1)}{5^{1010}}-3\sqrt{5}\right)^2$ $= \left(\sqrt{5}(4)-3\sqrt{5}\right)^2$ $= 5$	✓ $\frac{\sqrt{5}.5^{1011}-\sqrt{5}.5^{1010}}{5^{1010}}$ ✓ $3\sqrt{5}$ ✓ factorisation ✓ answer (4)
		[12]

QUESTION 3

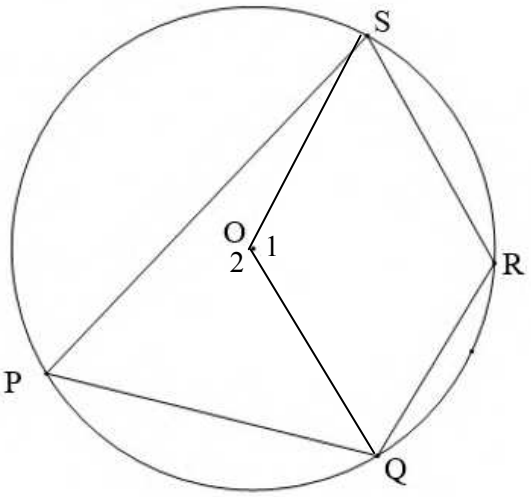
3.1.1	 $\sin 34^\circ$ $= \sqrt{1-t^2}$ **OR** $\sin^2 34^\circ + \cos^2 34^\circ = 1$ $\sin^2 34^\circ + t^2 = 1$ $\sin^2 34^\circ = 1 - t^2$ $\sin 34^\circ = \sqrt{1-t^2}$	✓ correct sketch with labels for t and 1 correctly indicated ✓ label of $\sqrt{1-t^2}$ correctly indicated ✓ answer (3) **OR** ✓ square identity ✓ substitution ✓ answer (3)
3.1.2	$\tan 146^\circ$ $= -\tan 34^\circ$ $= -\dfrac{\sqrt{1-t^2}}{t}$	✓ $-\tan 34^\circ$ ✓ answer (2)
3.2.1	$\dfrac{\sin 550^\circ}{\cos(-170^\circ)}$ $= \dfrac{\sin 190^\circ}{\cos 170^\circ}$ or $\dfrac{\sin 190^\circ}{\cos 190^\circ}$ $= \dfrac{-\sin 10^\circ}{-\cos 10^\circ}$ $= \tan 10^\circ$	✓ $-\sin 10^\circ$ ✓ $-\cos 10^\circ$ ✓ answer (3)
3.2.2	$\sqrt{1+\cos(90^\circ+\theta).\sin(180^\circ-\theta)}$ $= \sqrt{1-\sin\theta.\sin\theta}$ $= \sqrt{1-\sin^2\theta}$ $= \sqrt{\cos^2\theta}$ $= \cos\theta$	✓ $-\sin\theta$ ✓ $\sin\theta$ ✓ $\sqrt{\cos^2\theta}$ ✓ answer (4)
		[12]

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 die rede)***
R	**A mark for the 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 statement AND reason are both correct**
	Ken 'n punt toe as die bewering EN rede beide korrek is

QUESTION 4

4.1.1 (a)	$F\hat{E}H = 90^\circ$ [$\angle$ in a semi-circle]	✓ S/R (1)
4.1.1 (b)	$D\hat{F}H = 90^\circ$ [tangent $\perp$ diameter]	✓ S/R (1)
4.1.2	$\hat{F}_2 = 90^\circ - 58^\circ = 32^\circ$ $\hat{G} = 32^\circ$ [$\angle$s in the same segment]	✓ $\hat{F}_2 = 32^\circ$ ✓ S ✓ R (3)
4.2	$\hat{D}_1 = 90°$ [line from centre to midpoint of chord] In ΔADO: $AO^2 = AD^2 + OD^2$ [Pythagoras] $= 48^2 + 14^2$ $AO = 50\,\text{cm} = \text{radius} = OE$ $\therefore DE = 50 - 14 = 36\,\text{cm}$	✓ S ✓ R ✓ S/R ✓ length of radius ✓ answer (5)
4.3	$\hat{C} = 180^\circ - 66^\circ$ [co-interior $\angle$s; AC || OB] $= 114^\circ$ $\hat{O}_2 = 2 \times \hat{C}$ [$\angle$ at centre = 2 × $\angle$ at circumference] $= 228^\circ$ $\hat{O}_1 = 360^\circ - 228^\circ$ [$\angle$s around a point] $= 132^\circ$ $\hat{A} = 180^\circ - 132^\circ$ [co-interior $\angle$s; AC || OB] $= 48^\circ$	✓ S/R ✓ S ✓ R ✓ S/R ✓ S (5)
		[15]

QUESTION 5

5.1	 Construction: Join QO and SO. Let obtuse $S\hat{O}Q = \hat{O}_1$, and reflex $S\hat{O}Q = \hat{O}_2$. Proof: $\hat{O}_1 = 2\hat{P}$ [$\angle$ at centre = 2 $\times$ $\angle$ at circumference] $\hat{O}_2 = 2\hat{R}$ [$\angle$ at centre = 2 $\times$ $\angle$ at circumference] $\hat{O}_1 + \hat{O}_2 = 360^\circ$ [$\angle$s around a point] $\therefore 2\hat{P} + 2\hat{R} = 360^\circ$ $\therefore 2(\hat{P} + \hat{R}) = 360^\circ$ $\therefore \hat{P} + \hat{R} = 180^\circ$	✓ construction ✓ S/R ✓ S ✓ S/R ✓ S (5)
5.2.1	$\hat{M}_4 = x$ [$\angle$s opposite = sides] $V\hat{M}J = \hat{T} = x$ [tan-chord theorem] $\hat{K}_2 = \hat{T} = x$ [ext. $\angle$ of cyclic quad.]	✓ S/R ✓ S ✓ R ✓ S ✓ R (5)
5.2.2	$\hat{M}_3 = \hat{K}_2 - \hat{J}_2$ [ext. $\angle$ of ΔKMJ] $= x - y$ **OR** $\hat{M}_2 = \hat{J}_2 = y$ [tan-chord theorem] $\therefore \hat{M}_3 = x - y$ **OR** $\hat{K}_1 = 180^\circ - x$ [opposite $\angle$s of cyclic quad] $\hat{M}_3 = 180^\circ - (\hat{K}_1 + \hat{J}_2)$ [sum of $\angle$s of ΔKMJ] $= 180^\circ - (180^\circ - x + y)$ $= x - y$	✓ S/R ✓ answer **OR** ✓ S/R ✓ answer (2) **OR** ✓ S/R ✓ answer (2)
5.2.3	$\hat{L} = \hat{M}_4 - \hat{J}_2$ [ext. $\angle$ of ΔMLJ] $= x - y$ $\therefore \hat{M}_3 = \hat{L}$ [both = $x - y$] $\therefore$ JM is a tangent to the circle through K, L & M [converse: tan-chord theorem]	✓ S/R ✓ $\hat{M}_3 = \hat{L}$ ✓ R (3)
		[15]

TOTAL: 75

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