KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

MATHEMATICS P2

COMMON TEST

JUNE 2022

MARKING GUIDELINE

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MARKS: 150

TIME: 3 hours

NOTE:

- 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/answer to solve a problem is unacceptable.

This marking guideline consists of 12 pages.

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NSC - Memorandum

QUESTION 1

1.1	$m_{AB} = \frac{3-9}{9-7} = -3$	A✓ Subst. into correct formula A✓Answer	(2)
1.2	M(8 ; 6)	A✓ x – value A✓ y – value	(2)
1.3	$m_{MQ} = \frac{1}{3}$ $6 = \frac{1}{3}(8) + c$ $c = \frac{10}{3}$ $y = \frac{1}{3}x + \frac{10}{3}$	CA✓gradient of MQ CA✓Substitution of M and gradient CA✓Equation of line	(3)
1.4	$m_{AQ} = \frac{3}{3} = 1$ $6 = 1(4) + c$ $c = 2$ $y = x + 2$ $x + 2 = \frac{1}{3}x + \frac{10}{3}$ $3x + 6 = x + 10$ $2x = 4$ $x = 2$ $y = 4$ Q(2 ; 4)	A✓gradient of AQ CA✓equation of AQ CA✓Equating CA✓x – value CA✓y – value	(5)
1.5	AQ $= \sqrt{(7-2)^2 + (9-4)^2} = \sqrt{50} = 5\sqrt{2}$ units QB $= \sqrt{(9-2)^2 + (3-4)^2} = \sqrt{50} = 5\sqrt{2}$ units $\therefore$ AQ = QB	A ✓Use of distance formula A✓AQ length A✓QB length	(3)
1.6	Midpoint of AC: $\left(\frac{11}{2}; \frac{15}{2}\right)$ Let D$(x\ ;\ y)$ $\left(\frac{x+9}{2}; \frac{y+3}{2}\right) = \left(\frac{11}{2}; \frac{15}{2}\right)$ D(2 ; 12)	A✓Midpoint of AC CA✓$\left(\frac{x+9}{2}; \frac{y+3}{2}\right)$ CA✓Equating to Midpoint of AC CA✓Answer	(4)

1.7	Inclination of AC: $m = \tan\alpha$ $1 = \tan\alpha$ $\alpha = 45^\circ$ Inclination of AB: $m = \tan\beta$ $-3 = \tan\beta$ $\beta = 108{,}4^\circ$ $\theta = 108{,}4^\circ - 45^\circ = 63{,}4^\circ$	 CA✓ $\tan\alpha = 1$ CA✓Inclination of AC CA✓$\tan\beta = -3$ CA✓Inclination of AB CA✓Answer	 (5)
			[24]

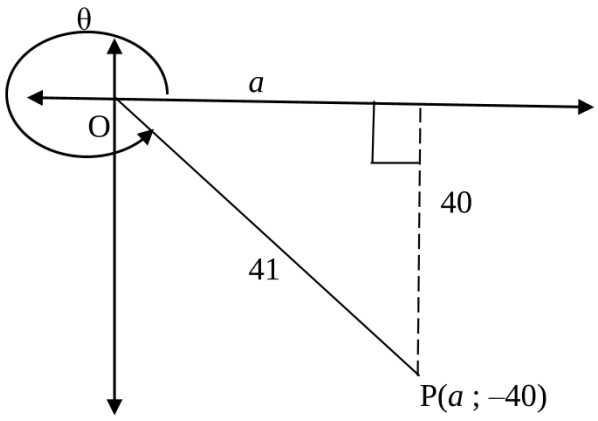
QUESTION 2

2.1	$x^2 + y^2 - 2x + 6y = 15$ $x^2 - 2x + 1 + y^2 + 6y + 9 = 15 + 1 + 9 = 25$ $(x-1)^2 + (y+3)^2 = 25$ Centre $(1\,;-3)$ and Radius : 5 units	A✓Completing the square CA✓Equation in Centre – radius form CA✓Centre CA✓radius	(4)
2.2	Let $y = 0$: $x^2 - 2x - 15 = 0$ $(x+3)(x-5) = 0$ $x = -3 \;\; or \;\; x = 5$ $B(-3;0)$ $C(5;0)$	A✓Letting $y = 0$ CA✓ factors CA✓ CA✓answers	(4)
2.3	$m_{AD} = \frac{-6+3}{5-1} = -\frac{3}{4}$ $m_{tangent} = \frac{4}{3}$ ……..(Radius ⊥ tangent) $-6 = \frac{4}{3}(5) + c$ $c = -\frac{38}{3}$ $y = \frac{4}{3}x - \frac{38}{3}$	CA✓gradient of radius CA✓gradient of tangent CA✓substitution of point D and gradient of tangent CA✓y – intercept value CA✓equation of tangent	(5)

2.4	Height of ΔABC = 3 units Area of $\Delta ABC = \frac{1}{2}(8)(3)$ $= 12$ square units	CA ✓ height value CA✓base value CA✓Answer	(3)
2.5	**Do not mark this sub – question.** The distance between the centres must equal the sum of the radii. $A(1;-3)$ *and* $E(1;b)$ $AE = \sqrt{(1-1)^2+(b+3)^2} = 5+1$ $\therefore (b+3)^2 = 36$ $\therefore b+3 = \pm 6$ $\therefore b = 3$ *or* $b = -9$	A ✓ Condition CA ✓Subst. into distance formula CA ✓ Simplifying CA ✓ Answer	(4)
2.6	$PB = \sqrt{(-1+3)^2+(-7-0)^2}$ $PB = \sqrt{53} >$ radius Therefore, P lies outside the circle.	CA ✓Use of distance formula CA ✓ $PB = \sqrt{53} >$ radius CA ✓Justification	(3)
	Excluding 2.5 , question 2 will have a maximum of 19 marks.		**[19]**

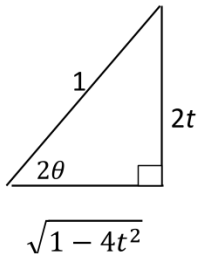
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QUESTION 3

3.1	 $82\cos\theta + \sin(\theta - 180^\circ)$ $= 82\cos\theta - \sin\theta$ $= 82\left(\frac{9}{41}\right) - \left(\frac{-40}{41}\right)$ $= 18\frac{40}{41}$ **If Answer is given in terms of *a*, Max 4/6 marks.**	A ✓diagram in correct quadrant A ✓ *a* – value = 9 A ✓reduction CACA ✓✓substitution CA ✓Answer	(6)

3.2	$27\tan\theta - \cos(90^\circ - \theta)$ $= 27\tan\theta - \sin\theta$ $= 27\left(\frac{-40}{9}\right) - \left(\frac{-40}{41}\right)$ $= \frac{-4880}{41}$ 	A ✓reduction CACA ✓✓substitution CA ✓Answer	(4)
3.3	$\cos 2\theta + 1$ $= 2\cos^2\theta - 1 + 1$ $= 2\left(\frac{9}{41}\right)^2$ $= \frac{162}{1681}$	A ✓double angle substitution CA✓substitution CA ✓Answer	(3)
			[13]

QUESTION 4

4.1	$\sin\theta\cos\theta = t$ $2\sin\theta\cos\theta = 2t$ $\sin 2\theta = 2t$ $\sin^2 2\theta + \cos^2 2\theta = 1$ $\cos 2\theta = \sqrt{1-4t^2}$ $\therefore \tan 2\theta = \frac{2t}{\sqrt{1-4t^2}}$ 	A ✓$\sin 2\theta = 2t$ A ✓$\sin^2 2\theta + \cos^2 2\theta = 1$ A ✓$\cos 2\theta = \sqrt{1-4t^2}$ A ✓Answer	(4)
4.2	$\cos 2\theta = 1 - 2\sin^2\theta$ $\sin^2\theta = \frac{1-\cos 2\theta}{2}$ $\sin\theta = \sqrt{\frac{1-\cos 2\theta}{2}}$ $\sin\theta = \sqrt{\frac{1-\sqrt{1-4t^2}}{2}}$	A ✓Identity or $\sin^2\theta = \frac{1-\cos 2\theta}{2}$ A ✓Making sin θ the subject A ✓quadrant CA ✓Answer	(4)
			[8]

QUESTION 5

5.1.1	$\frac{\tan 480^\circ . \sin 300^\circ . \cos 14^\circ . \sin(-135^\circ)}{\sin 104^\circ . \cos 225^\circ}$ $= \frac{(-\tan 60^\circ)(-\sin 60^\circ)(\cos 14^\circ)(-\sin 45^\circ)}{(\sin 76^\circ)(-\cos 45^\circ)}$ $= \frac{\left(\frac{\sqrt{3}}{1}\right)\left(\frac{\sqrt{3}}{2}\right)(\cos 14^\circ)\left(\frac{\sqrt{2}}{2}\right)}{(\cos 14^\circ)\left(\frac{\sqrt{2}}{2}\right)}$ $= \frac{3}{2}$	A ✓Reduction in numerator A ✓Reduction in denominator CACA ✓✓ Numerator CA✓Denominator CA ✓Answer	(6)
5.1.2	$\cos(90^\circ - 2x).\tan(180^\circ + x) + \sin^2(360^\circ - x)$ $= \sin 2x . \tan x + \sin^2 x$ $= 2\cos x \sin x . \frac{\sin x}{\cos x} + \sin^2 x$ $= 2\sin^2 x + \sin^2 x$ $= 3\sin^2 x$	A A A ✓✓✓Reduction A ✓double angle expansion A ✓$\frac{\sin x}{\cos x}$ CA ✓Answer	(6)
5.2.1	$-\cos^{2022}\theta$	AA ✓✓Answer	(2)
5.2.2	$1 - \tan^2\theta = 0$ $\tan\theta = \pm 1$ $\theta = 45^\circ \ or \ 135^\circ \ or \ 90^\circ$	A ✓$1 - \tan^2\theta = 0$ A ✓$\tan\theta = \pm 1$ A ✓ 45° A ✓ 135° A ✓ 90°	(5)
5.2.3	$\frac{\sin^n\theta - \cos^n\theta}{1 - \tan^n\theta} = -\cos^n\theta$	AA✓✓Answer	(2)
5.2.4	$LHS = \frac{\sin^n\theta - \cos^n\theta}{1 - \tan^n\theta}$ $= \frac{\sin^n\theta - \cos^n\theta}{1 - \frac{\sin^n\theta}{\cos^n\theta}}$ $= \frac{\sin^n\theta - \cos^n\theta}{\frac{\cos^n\theta - \sin^n\theta}{\cos^n\theta}}$ $= \frac{-(\cos^n\theta - \sin^n\theta)}{1} \times \frac{\cos^n\theta}{\cos^n\theta - \sin^n\theta}$ $= -\cos^n\theta = RHS$	A ✓$\frac{\sin\theta}{\cos\theta}$ A✓$\sin^n\theta - \cos^n\theta$ A ✓$\cos^n\theta$ A ✓changing sign of numerator A ✓Inverting and multiplying	(5)
			[26]

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QUESTION 6

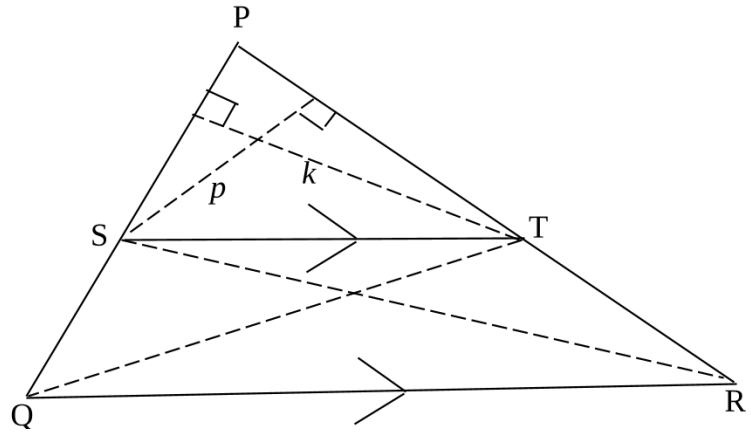
6.1	$\frac{x}{\text{AH}} = \tan\theta$ $\text{AH} = \frac{x}{\tan\theta}$	A✓trig ratio CA✓AH in terms of *x* and θ	(2)
6.2	$\text{H}\widehat{\text{B}}\text{A} = \beta$ ... ... (AH = HB) $\text{A}\widehat{\text{H}}\text{B} = 180^\circ - 2\beta$ ... ... (A's of Δ) $\frac{12x}{\sin(180^\circ - 2\beta)} = \frac{\frac{x}{\tan\theta}}{\sin\beta}$ $\frac{12}{\sin 2\beta} = \frac{\frac{1}{\tan\theta}}{\sin\beta}$ $12\tan\theta.\sin\beta = 2\sin\beta\cos\beta$ $\tan\theta = \frac{\cos\beta}{6}$	A✓ $\text{A}\widehat{\text{H}}\text{B} = 180^\circ - 2\beta$ A✓ sine rule for ΔAHB A✓Simplification A✓ Simplification LHS A✓ expansion of $\sin 2\beta$	(5)
6.3	$\tan\theta = \frac{\cos\beta}{6}$ $\tan\theta = \frac{\cos 40^\circ}{6}$ $x = AH\tan\theta$ $x = (60)\left(\frac{\cos 40^\circ}{6}\right)$ $x = 10\cos 40^\circ = 7.66\,m$ - Height of lighthouse	A✓ substitution of β A✓Making *x* subject A✓ substitution of AH CA✓ Answer	(4)
			[11]

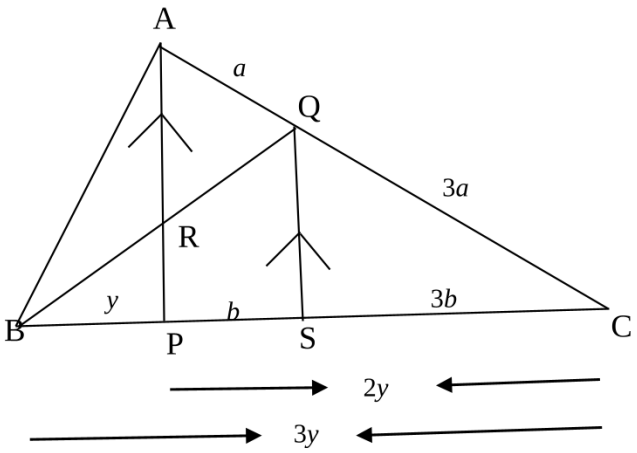
GEOMETRY	
S	**A mark for a correct statement** **(A statement mark is independent of a reason.)**
R	**A mark for a correct reason** **(A reason mark may only be awarded if the statement is correct.)**
S/R	**Award a mark if the statement AND reason are both correct.**

QUESTION 7

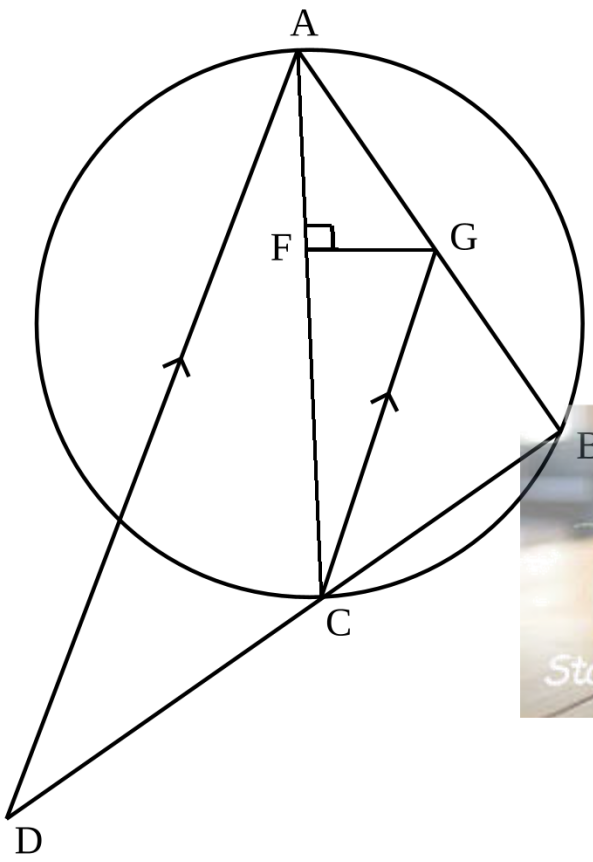
7.1	$\widehat{O}_2 = 116^\circ$……(A at centre = 2A at circumference)	A✓ S A✓ R	(2)
7.2	$D\widehat{E}B = 32^\circ$……(A in a semi circle)	A✓ S A✓ R	(2)
7.3	$\widehat{A}_1 = \frac{180^\circ - 116^\circ}{2} = 32^\circ$……(A of isosceles Δ…radii)	CA✓ S A✓ R	(2)
7.4	OC ⊥ DE ……(Line from Centre bisecting chord) $A\widehat{B}E = 58^\circ$……(A's of Δ)	A✓ S A✓ R CA✓S	(3)
7.5	Let CB = x , then AC = $\frac{3}{2}x$ AB = $\frac{5}{2}x$ Now $\frac{5}{2}x = 2r$ $x = \frac{4}{5}r$ OC = $\frac{1}{5}r$ $DC^2 = r^2 - \left(\frac{1}{5}r\right)^2$…….(Pythagoras) $DC^2 = \frac{24}{25}r^2$ DC = $\frac{\sqrt{24}}{5}r = \frac{2\sqrt{6}}{5}r$ units	A✓ $\frac{5}{2}x = 2r$ A✓ $x = \frac{4}{5}r$ A✓ OC = $\frac{1}{5}r$ CA✓S CA✓ Answer	(5)
			[14]

QUESTION 8

8.1		**N.B.** **No Construction – Award 0 marks**	
	Construction: Draw SR, QT and heights p and k.	A✓S Construction	
	$\frac{\text{Area of } \Delta \text{ PST}}{\text{Area of } \Delta \text{ QTS}} = \frac{\frac{1}{2}.\text{PS}.k}{\frac{1}{2}.\text{SQ}.k} = \frac{\text{PS}}{\text{SQ}}$	A✓S	
	$\frac{\text{Area of } \Delta \text{ PST}}{\text{Area of } \Delta \text{ RST}} = \frac{\frac{1}{2}.\text{PT}.p}{\frac{1}{2}.\text{TR}.p} = \frac{\text{PT}}{\text{TR}}$	A✓S	
	$\text{Area of } \Delta \text{ QTS} = \text{Area of } \Delta \text{ RST}$ ...(Same base and // lines)	A✓S A✓ R	
	$\frac{\text{Area of } \Delta \text{ PST}}{\text{Area of } \Delta \text{ QTS}} = \frac{\text{Area of } \Delta \text{ PST}}{\text{Area of } \Delta \text{ RST}}$	A✓S	
	$\frac{\text{PS}}{\text{SQ}} = \frac{\text{PT}}{\text{TR}}$		(6)

8.2	 		
8.2.1	Let AQ = a and QC = $3a$ $\frac{PS}{SC} = \frac{AQ}{QC} = \frac{a}{3a} = \frac{1}{3}$ …..(Prop. Thm.;AP // QS) Let PS = b and SC = $3b$ and Let BP = y and BC = $3y$ Therefore PC = $2y$ Now $2y = 4b$ Therefore $y = 2b$ $\frac{BP}{PS} = \frac{2b}{b} = \frac{2}{1}$	A✓S A✓R A✓S PC = $2y$ A✓S $2y = 4b$ A✓S Answer	(5)
8.2.2	$\frac{BR}{RQ} = \frac{BP}{PS} = 2$ …..(Prop. Thm.; AP // QS)	A✓S A✓R	(2)
			[13]

QUESTION 9

9.1.1	Let $A\hat{C}G = G\hat{C}B = x$
	$D\hat{A}C = A\hat{C}G = x$ ….(Alt. A's ; AD // GC)
	$A\hat{D}C = G\hat{C}B = x$ ….(Corresp. A's ; AD // GC)
	DC = AC …(Sides opposite equal angles)
	ΔCAD is isosceles …..(Base angles are equal)
		A✓ S/ R
		A✓ S A✓ R
		A✓ R
			(4)

9.1.2	$\frac{BC}{CD} = \frac{BG}{GA}$ ……(Prop. Thm. ; AD // GC) But AC = CD …… (Proved in 9.1.1) $\frac{BC}{AC} = \frac{BG}{GA}$	A✓ S A✓ R A✓ S	(3)
9.1.3	In ΔAFG and ΔABC 1] $C\hat{A}B$ is common 2] $A\hat{F}G = A\hat{B}C = 90^{\circ}$ …(Angle in semi circle) 3] $A\hat{G}F = A\hat{C}B$ …(Remaining Angles) ΔAFG /// ΔABC ….(AAA)	A✓ S A✓ S/R A✓ R	(3)

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9.2.1	$AB^2 = 20^2 - 12^2$ ……..(Pythagoras) $AB^2 = 256$ AB = 16 units	A✓ S A✓ S Simplifying CA✓ S Answer	(3)
9.2.2	$\frac{BC}{AC} = \frac{BG}{GA}$ ……(From 9.1.2) $\frac{12}{20} = \frac{6}{GA}$ AG = 10 units $\frac{GF}{BC} = \frac{AG}{AC}$ ……(from 9.1.3) $\frac{GF}{12} = \frac{10}{20}$ GF = 6 units	A✓ S/ R CA✓ S AG = 10 units CA✓ S GF = 6 units	(3)
9.2.3	$\frac{AF}{16} = \frac{10}{20}$ ……(from 9.1.3) AF = 8 units	CA✓ S CA✓ S	(2)
			[18]
		TOTAL	**150**

