education
MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

MATHEMATICS PAPER 2

SEPTEMBER 2024

MARKING GUIDELINE

MARKS: 150

This marking guideline consist of 18 pages

NSC Marking Guideline

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 guiselines.
- Assuming values/answers in order to solve a problem is unacceptable.

QUESTION 1

Preparatory exam(x)	55	35	67	85	91	48	78	72	15	75	69	37
Final exam(y)	57	50	74	80	92	50	80	81	23	80	75	42

1.1	$a = 12{,}01$ $b = 0{,}88$ $y = 12{,}01 + 0{,}88x$	✓ value of a ✓ value of b ✓ Equation. (3)
1.2		✓ any correct two points ✓ straight line joining the points ✓ passing through $\left(\bar{x}\,;\,\bar{y}\right)$ (3)
1.3	$y = 12{,}01 + 0{,}88(46)$ $y = 52\%$ **OR** calculator $y = 52{,}50\%$	✓ Substitution ✓ Answer. (2)
1.4	$r = 0{,}98$	✓ Answer. (1)
1.5	There's a very strong positive correlation between preparatory marks and final marks.	✓ Answer. (1)
1.6	No, the preparatory exam mark is the independent variable. Hence we cannot determine the preparatory mark using the final mark.	✓ Answer. ✓ Reason. (2)
		[12]

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QUESTION 2

2.1	Expenditure(in rand)	Frequency	Cumulative frequency		
	$50 \leq x < 100$	24	24	✓76 ; 90	
	$100 \leq x < 150$	52	76		
	$150 \leq x < 200$	14	90	✓ 96 ; 100	
	$200 \leq x < 250$	**6**	96		
	$250 \leq x < 300$	4	100		
					(2)

2.2		✓ Correct points ✓ Grounding ✓ Shape (3)

Cellphone expenditure for 100 learners.

2.3	$\bar{x} = \dfrac{(50\times 24) + (125\times 52) + (175\times 14) + (225\times 6) + (275\times 4)}{100}$ $= \dfrac{12600}{100}$ $=126$	✓ Method ✓ ÷100 ✓ Answer (3)
		[8]

SA EXAM PAPERS

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QUESTION 3

3.1.1	$m_{AB} = \dfrac{3-0}{1-(-2)} = 1$	✓ substitution ✓ answer (2)
3.1.2	$AC^2 = (p-1)^2 + (-4-3)^2$ $\therefore (\sqrt{50})^2 = p^2 - 2p + 1 + 49$ $\therefore 50 = p^2 - 2p + 50$ $\therefore 0 = p^2 - 2p$ $\therefore 0 = p(p-2)$ $p = 0$ or $p = 2$ $\therefore p = 2$	✓ dist formula used ✓ correct substitution ✓ standard form ✓ working to $p = 2$ (4)
3.1.3	Midpoint of AB: $M = \left(\dfrac{-2+1}{2} ; \dfrac{0+3}{2}\right) = \left(-\dfrac{1}{2} ; \dfrac{3}{2}\right)$ Gradient of $\perp$ line through M: $m = -1$ Equation of perp bisector:	✓ midpoint M ✓ grad of $\perp$ line

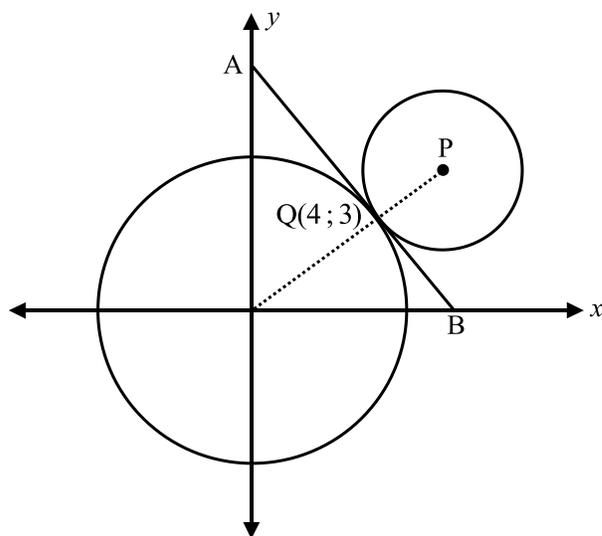|		
	$y - \dfrac{3}{2} = -1\left(x + \dfrac{1}{2}\right)$ $\therefore y - \dfrac{3}{2} = -x - \dfrac{1}{2}$ $\therefore y = -x + 1$	✓ sub into formula ✓ $y = -x + 1$ (4)
3.1.4	D$(5\,;\,-1)$	✓ $x_D = 5$ ✓ $y_D = -1$ (2)
3.1.5	$\hat{B}_1 + \hat{B}_2 = 90°$ ABCD is a rectangle $\therefore$ AC is a diameter Centre is the midpoint of AC: $\left(\dfrac{1+2}{2}\,;\,\dfrac{-4+3}{2}\right) = \left(\dfrac{3}{2}\,;\,-\dfrac{1}{2}\right)$ Radius is half of the length of AC: $r = \dfrac{\sqrt{50}}{2}$ Equation of circle: $\left(x - \dfrac{3}{2}\right)^2 + \left(y + \dfrac{1}{2}\right)^2 = \left(\dfrac{\sqrt{50}}{2}\right)^2$ $\therefore \left(x - \dfrac{3}{2}\right)^2 + \left(y + \dfrac{1}{2}\right)^2 = \dfrac{25}{2}$	✓ $\hat{B}_1 + \hat{B}_2 = 90°$ ✓ $\left(\dfrac{3}{2}\,;\,-\dfrac{1}{2}\right)$ ✓ $r = \dfrac{\sqrt{50}}{2}$ ✓ equation of circle (4)
3.1.6	$\hat{A}_1 = \theta$ alt $\angle$s = ; AB $\parallel$ CD $\tan \hat{B}_1 = m_{AB}$ $\therefore \tan \hat{B}_1 = 1$ $\therefore \hat{B}_1 = 45°$ $\tan \hat{E}_1 = m_{AC} = \dfrac{-4-3}{2-1} = -7$ $\therefore \tan \hat{E}_1 = -7$ $\therefore \hat{E}_1 = 98{,}13010235°$ $\theta = 98{,}13010235° - 45°$ $\therefore \theta = 53°$	✓ $\hat{A}_1 = \theta$ ✓ $\hat{B}_1 = 45°$ ✓ $m_{AC} = -7$ ✓ $\hat{E}_1 = 98{,}13010235°$ ✓ $\theta = 53°$ (5)

3.2	$3x + by = -2$	✓ $y = -\dfrac{3}{b}x - \dfrac{2}{b}$
	$\therefore by = -3x - 2$	
	$\therefore y = -\dfrac{3}{b}x - \dfrac{2}{b}$	✓ equating equations
	$-\dfrac{3}{b}x - \dfrac{2}{b} = -\dfrac{2}{3}x + 2$	✓ substituting $x = -3$
	$\therefore -9x - 6 = 2bx + 6b$	
	Substitute $x = -3$:	
	$\therefore -9(-3) - 6 = -2b(-3) + 6b$	
	$\therefore 27 - 6 = 6b + 6b$	✓ $b = \dfrac{7}{4}$
	$\therefore 21 = 12b$	
	$\therefore b = \dfrac{21}{12} = \dfrac{7}{4}$	(4)
		[24]

QUESTION 4

4.1	$x^2 - 12x + y^2 - 9y + 50 = 0$	✓ $(x-6)^2$
	$\therefore x^2 - 12x + 36 + y^2 - 9y + \dfrac{81}{4} = -50 + 36 + \dfrac{81}{4}$	✓ $\left(y - \dfrac{9}{2}\right)^2$
	$\therefore (x-6)^2 + \left(y - \dfrac{9}{2}\right)^2 = \dfrac{25}{4}$	✓ $\dfrac{25}{4}$
		(3)
4.2	$m_{OB} = \dfrac{3}{4}$	✓ $m_{OB} = \dfrac{3}{4}$
	$\therefore m_{AB} = -\dfrac{4}{3}$	✓ $m_{AB} = -\dfrac{4}{3}$
	$y - 3 = -\dfrac{4}{3}(x - 4)$	✓ substitution of point
	$\therefore y - 3 = -\dfrac{4}{3}x + \dfrac{16}{3}$	✓ equation
	$y = -\dfrac{4}{3}x + \dfrac{25}{3}$	(4)
4.3	Circumference of small $= 2\pi\left(\dfrac{5}{2}\right) = 5\pi$	✓ $r = \dfrac{5}{2}$
	Circumference of large $= 2\pi(5) = 10\pi$	✓ $r = 5$
		✓ $5\pi; \; 10\pi$

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	Two revolutions.	✓ two revolutions (4)
4.4	$A\left(0;\dfrac{25}{3}\right)$ $B\left(\dfrac{25}{4};0\right)$ $\therefore OA = \dfrac{25}{3}$ and $OB = \dfrac{25}{4}$ $Area\ \Delta AOB = \dfrac{1}{2}\times\dfrac{25}{4}\times\dfrac{25}{3} = \dfrac{625}{24}\ units^2$	✓ $OA = \dfrac{25}{3}$ ✓ $OB = \dfrac{25}{4}$ ✓ calculating area (3)
4.5	$Q(4;3)$ $C(-4;3)$ $\therefore CQ = 8\ units$	✓ $C(-4;3)$ ✓ $CQ = 8$ (2)
		[16]

QUESTION 5

5.1.1	$p^2 + y^2 = 1^2$ $y = \sqrt{1-p^2}$ $\tan 201° = \tan(180° + 21°)$ $\quad\quad = \tan 21°$ $\quad\quad = \dfrac{\sqrt{1-p^2}}{p}$	✓ $y = \sqrt{1-p^2}$ ✓ $\tan 21°$ ✓ $\dfrac{\sqrt{1-p^2}}{p}$ (3)
5.1.2	$\sin 42° = \sin 2(21°)$ $\quad\quad = 2\sin 21°\cos 21°$ $\quad\quad = 2\left(\sqrt{1-p^2}\right)(p)$ $\quad\quad = 2p\sqrt{1-p^2}$	✓ $\sin 2(21°)$ ✓ Identity ✓ Answer. (3)
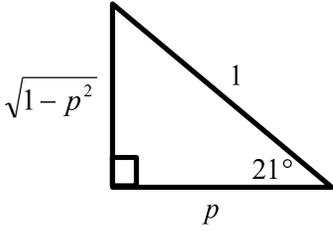
5.1.3	$\cos(30° + 21°) = \cos 30° \cos 21° - \sin 30° \sin 21°$ $= \dfrac{\sqrt{3}}{2}(p) - \dfrac{1}{2}\left(\sqrt{1-p^2}\right)$ $= \dfrac{p\sqrt{3} - \sqrt{1-p^2}}{2}$	✓ $\cos(30° + 21°)$ ✓ Compound angle. ✓ Substitution. ✓ Answer.　　　　　(3)
5.2	$\dfrac{\sin 210° \cos 510°}{\cos 315° \sin(-135°)}$ $= \dfrac{(-\sin 30°)(\cos 150°)}{(\cos 45°)(-\sin 135°)}$ $= \dfrac{(-\sin 30°)(-\cos 30°)}{(\cos 45°)(-\sin 45°)}$ $= \dfrac{\left(-\dfrac{1}{2}\right)\left(-\dfrac{\sqrt{3}}{2}\right)}{\left(\dfrac{\sqrt{2}}{2}\right)\left(-\dfrac{\sqrt{2}}{2}\right)}$ $= -\dfrac{\sqrt{3}}{2}$	✓ $-\sin 30°$ ✓ $-\cos 30°$ ✓ $\cos 45°$ ✓ $-\sin 45°$ ✓ $-\dfrac{1}{2}$ ✓ $-\dfrac{\sqrt{2}}{2}$ ✓ $-\dfrac{\sqrt{3}}{2}$ 　　　　　　　(7)
5.3	$\dfrac{\cos\theta - \cos 2\theta + 2}{3\sin\theta - \sin 2\theta}$ $= \dfrac{\cos\theta - (2\cos^2\theta - 1) + 2}{3\sin\theta - 2\sin\theta\cos\theta}$ $= \dfrac{\cos\theta - 2\cos^2\theta + 1 + 2}{\sin\theta(3 - 2\cos\theta)}$ $= \dfrac{3 + \cos\theta - 2\cos^2\theta}{\sin\theta(3 - 2\cos\theta)}$ $= \dfrac{(3 - 2\cos\theta)(1 + \cos\theta)}{\sin\theta(3 - 2\cos\theta)}$ $= \dfrac{1 + \cos\theta}{\sin\theta}$ $= RHS$	✓ $2\cos^2\theta - 1$ ✓ $2\sin\theta\cos\theta$ ✓ $3 + \cos\theta - 2\cos^2\theta$ ✓ $(3 - 2\cos\theta)(1 + \cos\theta)$ ✓ $\sin\theta(3 - 2\cos\theta)$ 　　　　　　　(5)

5.4	$\sin\theta\sin\dfrac{3\theta}{2}+\cos\dfrac{3\theta}{2}\cos\theta=-\dfrac{\sqrt{3}}{2}$ $\cos\dfrac{3\theta}{2}\cos\theta+\sin\theta\sin\dfrac{3\theta}{2}=-\dfrac{\sqrt{3}}{2}$ $\cos\left(\dfrac{3\theta}{2}-\theta\right)=-\dfrac{\sqrt{3}}{2}$ $\cos\left(\dfrac{\theta}{2}\right)=-\dfrac{\sqrt{3}}{2}$ $\dfrac{\theta}{2}=150°+k.360°\ k\in\mathbb{Z}$ OR $\dfrac{\theta}{2}=-150°+k.360k\in\mathbb{Z}$ $\theta=300°+k.720°k\in\mathbb{Z}$ $\theta=-300°+k.720°k\in\mathbb{Z}$ **OR** $ref\angle=30°$ $\dfrac{\theta}{2}=180°-30°+k.360°$ or $\dfrac{\theta}{2}=180°+30°+k.360°k\in\mathbb{Z}$ $\theta=300°+k.720°\ k\in\mathbb{Z}$ **or** $\theta=420°+k.720°\ k\in\mathbb{Z}$	✓ $\cos\left(\dfrac{3\theta}{2}-\theta\right)$ ✓ $\dfrac{\theta}{2}=\pm150°+k.360°$ ✓ $\theta=300°+k.720°$ ✓ $-300°+k.720°$ (4) **OR** ✓ $\cos\left(\dfrac{3\theta}{2}-\theta\right)$ ✓ $\dfrac{\theta}{2}=180°\pm+k.360°$ ✓ $300°+k.720°$ ✓ $420°+k.720°$ (4)
5.5.1	Maximum value is 1 and minimum value is -1	✓ Answer. (1)
5.5.2	Range of both graphs is $-1\le y\le1$ $\sin\theta.\cos\beta=-1$ $\sin\theta=1\ and\ \cos\beta=-1\ or\ \sin\theta=-1\ and\ \cos\beta=-1$ $\theta=90°\ \ and\ \ \beta=-180°\ or\ \theta=270°\ and\ \beta=0°$	✓ $\theta=90°$ ✓ $\beta=-180°$ ✓ $\theta=270°$ ✓ $\beta=0°$ (4)
		[30]

QUESTION 6

6.1		$f(x)$ ✓ $x - intercepts$ ✓ $y - intercept$ ✓ Shape. $g(x)$ ✓ $x - intercepts$ ✓ $y - intercept$ ✓ Shape. (6)
6.2.1	360°	✓ Answer (1)
6.2.2	0°	✓ Answer (1)
6.3.3	$90° < x < 150°$ OR $x \in (90°; 150°)$	✓ Notation ✓ Endpoints. (2)
		[10]

QUESTION 7

7.1	$\widehat{TUG} = 2\theta$	$\checkmark$ Answer. (1)
7.2	$\dfrac{TG}{\sin 2\theta} = \dfrac{k}{\sin 90^\circ}$ **OR** $\cos(90^\circ - 2\theta) = \dfrac{TG}{k}$ $k \sin 2\theta = TG \times 1$ $\therefore TG = k \sin 2\theta$ $\quad\quad\quad \sin 2\theta = \dfrac{TG}{k}$ $\therefore TG = k \sin 2\theta$	$\checkmark$ Sine rule. $\checkmark$ $\sin 90^\circ = 1$ **OR** $\checkmark$ Trig ratio. $\checkmark$ $\sin 2\theta$ (2)
7.3	$\dfrac{TV}{\sin 150^\circ} = \dfrac{TG}{\sin \theta}$ $\dfrac{TV}{\frac{1}{2}} = \dfrac{TG}{\sin \theta}$ $TV = \dfrac{\frac{1}{2} TG}{\sin \theta}$ $TV = \dfrac{\frac{1}{2}(k \sin 2\theta)}{\sin \theta}$ $TV = \dfrac{\frac{1}{2}(2k \sin \theta \cos \theta)}{\sin \theta}$ $\therefore TV = k \cos \theta$	$\checkmark$ $\dfrac{TV}{\sin 150^\circ} = \dfrac{TG}{\sin \theta}$ $\checkmark$ $\dfrac{1}{2}$ $\checkmark$ $TV = \dfrac{\frac{1}{2} TG}{\sin \theta}$ $\checkmark$ $2 \sin \theta \cos \theta$ (4)
7.4	$\triangle TGV = \frac{1}{2} TG \cdot GV \sin 150^\circ$ $= \frac{1}{2} k \sin 2\theta \cdot 8 \cdot \frac{1}{2}$ $= 2k \sin 2\theta$	$\checkmark$ Substitution. $\checkmark$ Method. (2)

	OR	OR
	$\triangle \text{TGV} = \dfrac{1}{2}\text{TV}.\text{GV}.\sin\theta$ $= \dfrac{1}{2}k\cos\theta.8.\sin\theta$ $= 4\cos\theta.\sin\theta$ $= 2k(2\cos\theta\sin\theta)$ $= 2k\sin 2\theta$	✓ Substitution. ✓ Method. (2)
		[09]

QUESTION 8

8.1		✓ construction ✓ $\hat{O}_1 = 2\hat{C}$ ✓ $\hat{O}_2 = 2\hat{A}$ ✓ Writing the statement $360° = 2\hat{C} + 2\hat{A}$ and hence $\hat{A} + \hat{C} = 180°$ ✓ two correct reasons (5)

$\hat{O}_1 = 2\hat{C}$ $\angle$ at centre $= 2\times\angle$ at circ

$\hat{O}_2 = 2\hat{A}$ $\angle$ at centre $= 2\times\angle$ at circ

$\hat{O}_1 + \hat{O}_2 = 2\hat{C} + 2\hat{A}$

$360° = 2\hat{C} + 2\hat{A}$ $\angle$s round a point

$\therefore 180° = \hat{C} + \hat{A}$

$\therefore \hat{A} + \hat{C} = 180°$

8.2			
8.2.1	$\hat{R}_1 = 65°$ tan chord theorem	✓ S /R	(1)
8.2.2	$\hat{R}_3 + \hat{R}_4 = 90°$ tan $\perp$ radius $\therefore \hat{R}_4 = 55°$	✓ S ✓ R	(2)
8.2.3	$\hat{S}_1 + \hat{S}_2 = 90°$ $\angle$ in semi-circle $\hat{T} = 35°$ ext $\angle$ of Δ	✓ S ✓ R ✓ S (3)	
			[11]

QUESTION 9

9.1	$\hat{O}_1 = \hat{A}$ [∠ at the centre is = 2x ∠ at the circumference]	✓ S ✓ R	
	$2x = \hat{A}$		
	$\hat{A} = x$	✓ S ✓R	
	But $\hat{A} = \hat{D} = x$ [∠'s in the same segment]		
	$\hat{D} = \hat{C}_2 = x$ [∠'s opp = sides]	✓S ✓ R	(6)
9.2	$\hat{M}_2 = 90°$ [∠ from centre to midpoint of a chord]	✓ S ✓ R	
	∴ $\hat{O}_2 = 90° - x$ [sum of ∠'s in a △]	✓ R	(3)
9.3	$\hat{O}_2 = 90° - x$ [proved in 9.2]		
	∴ $\hat{C}_3 = 90° - x$ [tan ⊥ rad]	✓S ✓ R	
	∴ $\hat{O}_2 = \hat{C}_3$ [both = 90° − x]	✓ S	
	∴ EC is a tangent to circle passing through M, C & O. Converse tan-chord theorem.	✓ R	(4)
9.4	$\hat{C}_3 = 90° - x$ [proven in 9.3]		
	$\hat{O}_3 = 180° - (90° - x) - 2x$ [∠'s on a straight line]	✓S ✓ R	
	∴ $\hat{O}_3 = 90° - x$		
	∴ $\hat{O}_3 = \hat{C}_3$ [both = 90° − x] ∴ DOCE is a cyclic quadrilateral. Converse ∠'s in the same segment.	✓ R	(3)
			[16]

QUESTION 10

10.1.1	Tan-chord theorem	✓ Answer (1)
10.1.2	Corresp. $\angle s$; BF $\parallel$ AC	✓ Answer (1)
10.2.1	$\hat{C}_2 = \hat{B}_3$ $\qquad$ [alt. $\angle$s ; AC $\parallel$ BF] $\hat{B}_3 = \hat{G}_3$ $\qquad$ [$\angle s$ in the same segment] $\hat{G}_3 = \hat{F}_2$ $\qquad$ [Alt. $\angle$s; AC $\parallel$ BF] $\therefore \hat{B}_3 = \hat{F}_2$ $\qquad$ [both $= \hat{G}_3$] $\therefore$ BH = FH $\qquad$ [sides opp.$= \angle$s]	✓ S/R ✓ S/R ✓ S ✓ R (4)

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10.2.2	In ΔBEF and ΔDGF		
	$\hat{E} = \hat{G}_4$	[ext. $\angle$ of cyclic quad.]	✓ S/R
	$\hat{B}_4 = \hat{A}$	[alt. $\angle s$; AC $\parallel$ BF]	✓ S/R
	$\hat{A} = \hat{D}$	[$\angle$s in the same segment]	
	$\therefore \hat{B}_4 = \hat{A}$		
	$\hat{F}_1 = \hat{F}_3$	[sum of $\angle s$ in a Δ]	✓ R
	$\Delta BEF \parallel\parallel\parallel \Delta DGF$	[$\angle\angle\angle$]	(3)
10.2.3	$\hat{B}_2 = \hat{F}_3$	[$\angle$s in the same segment]	✓ S/R
	$\hat{H}_2 = \hat{H}_4$	[vert. opp $\angle s$]	✓ S/R
	$\therefore \hat{G}_2 = \hat{C}_3$	[sum of $\angle s$ in a Δ]	✓ R
	$\Delta BGH \parallel\parallel\parallel \Delta FCH$	[$\angle\angle\angle$]	
	$\dfrac{BG}{FC} = \dfrac{BH}{FH}$		✓ S
	$\therefore FH.BG = BH.FC$		(4)
			[13]

		TOTAL:		150