higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

MATHEMATICS N3

24 November 2023

This marking guideline consists of 11 pages.

MARKING LEGEND	
SYMBOL	**EXPLANATION OF SYMBOL**
A	Accuracy
M	Method
CA	Consistent accuracy (follow up)
B/D	Breakdown
S	Statement
R	Reason
S/R	Statement and reason
F	Choosing correct formula
SF	Substitution into correct formula

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QUESTION 1

	SOLUTION	EXPLANATION	
1.1	$(p+qn)(p-qn)+2qn-1$ $=p^2-q^2n^2+2qn-1$ ✓ $=p^2-(q^2n^2-2qn+1)$ ✓ $=p^2-[(qn-1)(qn-1)]$ $=[p-(qn-1)][p+(qn-1)]$ ✓ ✓	1 Simplification 1Grouping 1 mark for each factor	(4)
1.2	$f(x)=2x^3+4ax^2-3a^2x-2$ $R=f(a)=2(a)^3+4a(a)^2-3a^2(a)-2$ ✓ $=2a^3+4a^3-3a^3-2$ ✓ $\therefore \quad 22=3a^3-2$ $\therefore \quad 3a^3=24$ $a^3=8$ $\therefore a=2$ ✓	1 for R=f(a) 1 SF 1 S 1 A	(4)
1.3	$\frac{a^2-a-6}{a^2+a-20}\times\frac{2a-8}{2a-6}\div\frac{a^2-3a-10}{a^2-25}$ $=\frac{a^2-a-6}{a^2+a-20}\times\frac{2a-8}{2a-6}\times\frac{a^2-25}{a^2-3a-10}$ ✓ $=\frac{(a-3)(a+2)}{(a-4)(a+5)}\times\frac{2(a-4)}{2(a-3)}\times\frac{(a-5)(a+5)}{(a+2)(a-5)}$ √ √ √ $=1$ √ √ √ ✓	2 M ½ for correct numerator; ½ for correct denominator 1 A	(6)

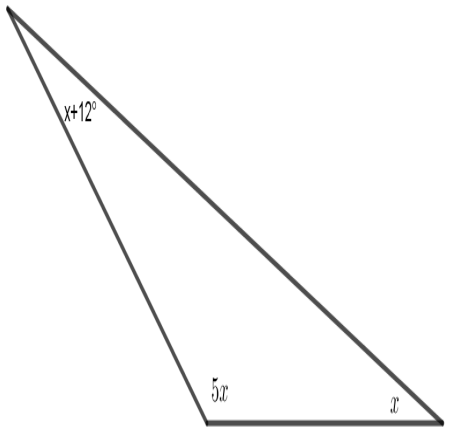
	SOLUTION		EXPLANATION	
1.4	$4x^2 - x - 1 = 0$ $\therefore \quad 4x^2 - x = 1$ $\therefore \quad x^2 - \frac{1}{4}x = \frac{1}{4}$ ✓ $\therefore x^2 - \frac{1}{4}x + \left(-\frac{1}{4\times 2}\right)^2 = \frac{1}{4} + \left(-\frac{1}{4\times 2}\right)^2$ $\therefore x^2 - \frac{1}{4}x + \left(-\frac{1}{8}\right)^2 = \frac{1}{4} + \frac{1}{64}$ ✓ $\therefore \quad \left(x - \frac{1}{8}\right)^2 = \frac{16+1}{64}$ $\therefore \quad \left(x - \frac{1}{8}\right)^2 = \frac{17}{64}$ $\therefore \quad x - \frac{1}{8} = \pm\frac{\sqrt{17}}{8}$ $\therefore \quad x = \frac{1}{8} \pm \frac{\sqrt{17}}{8}$ ✓ $\therefore \quad x = \frac{1+\sqrt{17}}{8}$ or $x = \frac{1-\sqrt{17}}{8}$ $\therefore \quad x = 0,640$ ✓ $x = -0,390$ ✓		1 Simplifying 1 completing the square 1 Simplifying 1 mark for each value of x	(5)
				[19]

QUESTION 2

	SOLUTION		EXPLANATION	
2.1	$\frac{20^{2n+1}\times 100^{2-n}}{64^{\frac{n}{3}}}$ $= \frac{(5\times 2^2)^{2n+1}\times(5^2\times 2^2)^{2-n}}{(2^6)^{\frac{n}{3}}}$ ✓ $= \frac{5^{2n+1}\times 2^{4n+2}\times 5^{4-2n}\times 2^{4-2n}}{2^{2n}}$ $= 5^{2n+1+4-2n}\times 2^{4n+2+4-2n-2n}$ √ √ $= 5^3 \times 2^6$ √ $= 3125\times 64$ $= 200\ 000$ ✓	ALTERNATIVE SOLUTION $\frac{20^{2n+1}\times 100^{2-n}}{64^{\frac{n}{3}}}$ $= \frac{(2\times 10)^{2n+1}\times(10^2)^{2-n}}{(2^6)^{\frac{n}{3}}}$ ✓ $= \frac{2^{2n+1}.10^{2n+1}.10^{4-2n}}{2^{2n}}$ √ √ $= 2^{2n+1-2n}.10^{2n+1+4-2n}$ $= 2\times 10^5$ √ √ $= 200\,000$ ✓	1 splitting the powers 2 Simplifying powers 1 A	(4)

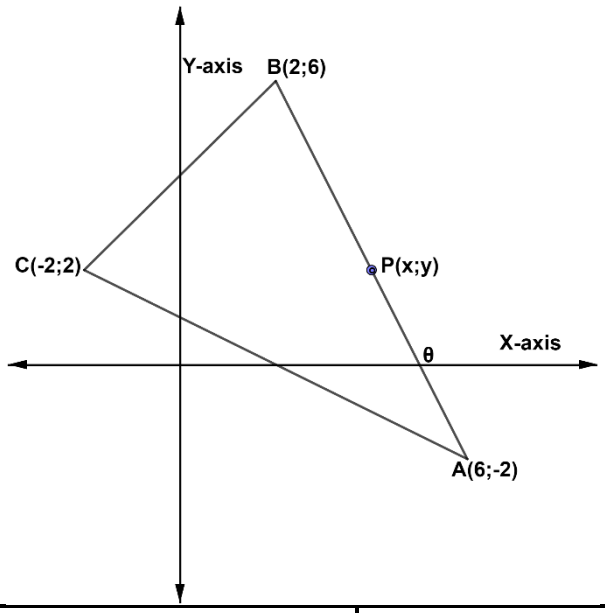
		SOLUTION		**EXPLANATION**	
2.2	2.2.1	$(\log x)^2 - 5 = \log(10x)$ $\therefore (\log x)^2 - 5 = \log 10 + \log x$ ✓ $\therefore (\log x)^2 - \log x - 1 - 5 = 0$ $\therefore (\log x)^2 - \log x - 6 = 0$ ✓ $\therefore (\log x - 3)(\log x + 2) = 0$ ✓ $\therefore \log x = 3$ or $\log x = -2$ $\therefore x = 10^3$ $x = 10^{-2}$ $\therefore x = 1000$ ✓ or $x = \frac{1}{100}$ ✓		1 Applying log law 1 Simplifying 1 Factorising 1 for each value of x	(5)
	2.2.2	$3(x^{\frac{1}{2}} + x^{-\frac{1}{2}}) = 10$ $3x^{\frac{1}{2}} + \frac{3}{x^{\frac{1}{2}}} = 10$ ✓ $3x + 3 = 10x^{\frac{1}{2}}$ $3x - 10x^{\frac{1}{2}} + 3 = 0$ ✓ $(3x^{\frac{1}{2}} - 1)(x^{\frac{1}{2}} - 3) = 0$ ✓ $(3x^{\frac{1}{2}} - 1) = 0$ or $(x^{\frac{1}{2}} - 3) = 0$ $x^{\frac{1}{2}} = \frac{1}{3}$ or $x^{\frac{1}{2}} = 3$ $\therefore x = \frac{1}{9}$ ✓ or $x = 9$ ✓		1 S 1 S 1 Factorisation 1 for x: 1 for x	(5)
					[14]

QUESTION 3

	SOLUTION		EXPLANATION	
3.1	$BA^2 + DA = V$ $BA^2 + DA - V = 0$ ✓ $A = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $A = \frac{-D \pm \sqrt{D^2 - 4(B)(-V)}}{2B}$ ✓ $A = \frac{-D \pm \sqrt{D^2 + 4BV}}{2B}$ ✓	ALTERNATIVE ANSWER $BA^2 + DA = V$ $\therefore A^2 + \frac{D}{B}A = \frac{V}{B}$ $\therefore A^2 + \frac{D}{B}A + \frac{D^2}{4B^2} = \frac{D^2}{4B^2} + \frac{V}{B}$ ✓ $\therefore \left(A + \frac{D}{2B}\right)^2 = \frac{D^2 + 4BV}{4B^2}$ $\therefore A + \frac{D}{2B} = \pm\sqrt{\frac{D^2 + 4BV}{4B^2}}$ ✓ $= \pm\frac{\sqrt{D^2 + 4BV}}{2B}$ $\therefore A = -\frac{D}{2B} \pm \frac{\sqrt{D^2 + 4BV}}{2B}$ $= \frac{-D \pm \sqrt{D^2 + 4BV}}{2B}$ ✓	1 S 1 SF 1 A	(3)
3.2	Let the first angle be x $\therefore$ the second angle will be $5x$ And the third angle will be $x + 12^\circ$ $x + 5x + x + 12^\circ = 180^\circ$ ✓ $\therefore 7x = 180^\circ - 12^\circ$ ✓ $\therefore 7x = 168^\circ$ $\therefore x = 24^\circ$ ✓ $\therefore 5x = 120^\circ$ ✓ $\therefore x + 12^\circ = 36^\circ$ ✓ The angles are: 24°; 120° *and* 36°		1 S 1 simplification 1 for each answer	(5)

	SOLUTION		EXPLANATION	
3.3	$\frac{x+1}{x-1}=\frac{-2}{x+2}\checkmark-\frac{x+2}{1-x}\quad\checkmark$ $\therefore \frac{x+1}{x-1}=\frac{-2}{x+2}+\frac{x+2}{x-1}$ $\therefore (x+1)(x+2)=-2(x-1)+(x+2)(x+2)$ $\therefore x^2+3x+2=-2x+2+x^2+4x+4$ $\therefore \quad 3x \quad =-2x+4x+4$ $\therefore \quad x=4\quad\checkmark$		1 M taking out -1 as common factor 1 M for multiplying each fraction by the LCD 1 for answer	(5)
				[13]

QUESTION 4

	SOLUTION		EXPLANATION	
				
4.1	$M_{AB}=\frac{y_2-y_1}{x_2-x_1}$ $=\frac{6+2}{2-6}\quad\checkmark$ $=\frac{8}{-4}$ $=-2\quad\checkmark$		1 SF 1 A	(2)

	SOLUTION		EXPLANATION	
4.2	$\theta = \tan^{-1}(-2)$ ✓ $\therefore \theta = 180^\circ - 63,435^\circ$ ✓ $\therefore \theta = 116,565^\circ$ ✓	ALTERNATIVE ANSWER $\theta = \tan^{-1}(-2)$ ✓ $\therefore \theta = -63,435^\circ + 180^\circ$ ✓ $\therefore \theta = 116,565^\circ$ ✓	1 CA 1 SF 1 A	(3)
4.3	Midpoint P: $= \left(\frac{x_1+x_2}{2}; \frac{y_1+y_2}{2}\right)$ $= \left(\frac{6+2}{2}; \frac{-2+6}{2}\right)$ ✓ $= \left(\frac{8}{2}; \frac{4}{2}\right)$ $= (4;2)$ ✓		1 SF 1 A	(2)
4.4	Distance $AC = \sqrt{(x_2-x_1)^2 + (y_2-y_1)^2}$ $= \sqrt{(-2-6)^2 + (2+2)^2}$ ✓ $= \sqrt{64+16}$ $= \sqrt{80}$ $= \sqrt{16 \times 5}$ √ $= 4\sqrt{5}$ √		1 SF ½ M for answer ½M for simplest surd form	(2)
4.5	$y - y_1 = m(x - x_1)$ $y - (-2) = 0(x - 6)$ $\therefore y = 2$ ✓ ✓		If the student wrote y=2, award full marks to answer. It was not necessary to indicate that the gradient is zero.	(2)
4.6	$\therefore x = 2$ ✓		If the student wrote x=2, award full marks to answer. It was not necessary to indicate that the gradient is not defined. All x-coordinates are equal .	(1)
4.7	Point of intersection $= (-4;7)$ ✓		1 M	(1)
4.8	$y - y_1 = \frac{y_2 - y_1}{x_2 - x_1}(x - x_1)$ $\therefore y - 0 = \frac{6-0}{2-0}(x-0)$ ✓ $\therefore y = 3x$ ✓		1 SF 1 A	(2)

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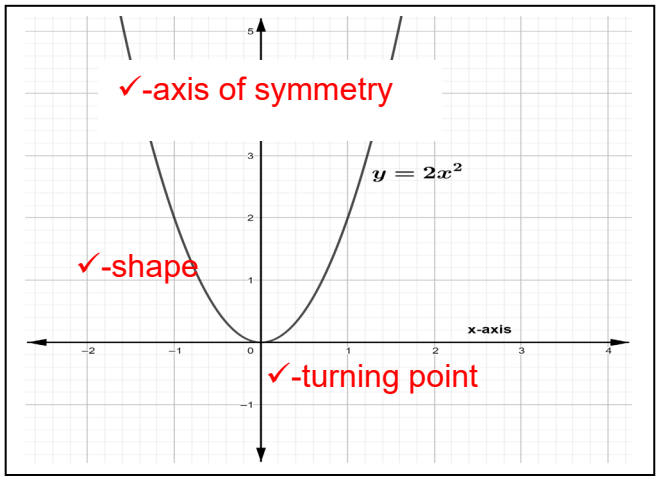
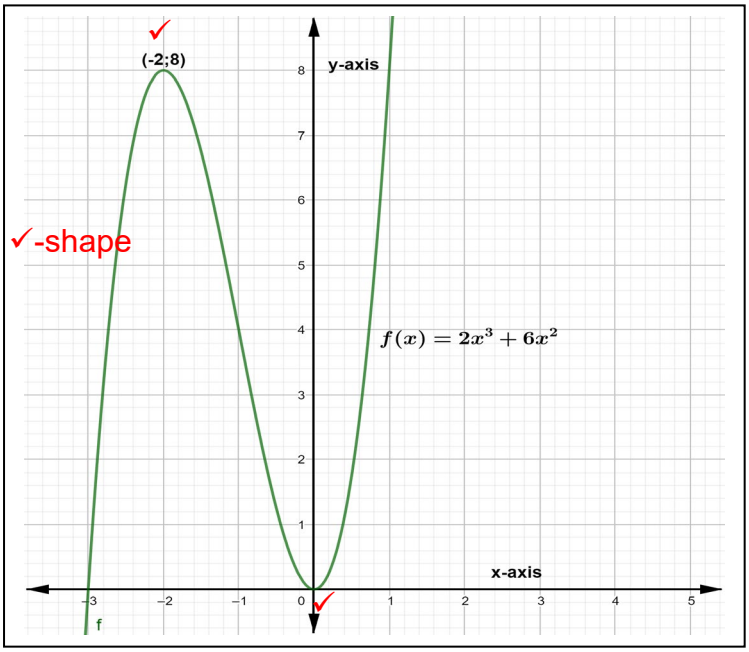
4.9	$M_{BC} = 1$ ✓ $M_{BC} \times M = -1$ $1 \times M = -1$ $M = -1$ ✓ $y - y_1 = m(x - x_1)$ $y - 6 = -1(x - 2)$ ✓ $y = -x + 2 + 6$ $y = -x + 8$ ✓	1 M for gradient (m) = -1 1 SF 1 answer	(4)
			[19]

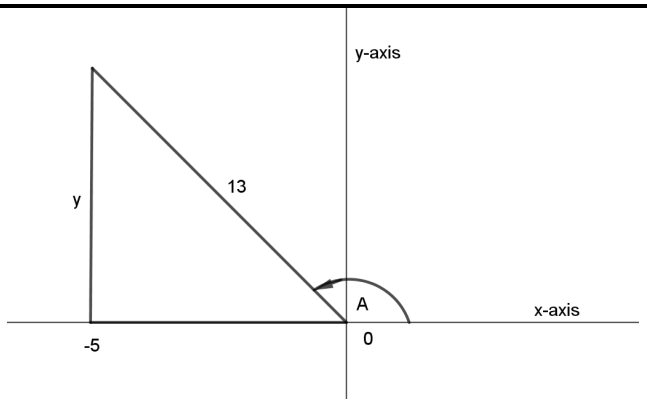
QUESTION 5

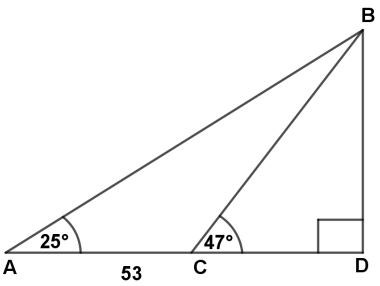
	SOLUTION		EXPLANATION	
5.1	$y = 2x^2$  		1 Turning point(0;0) 1 axis of symmetry 1 shape The mark for the shape can only be awarded if the graph have a min TP, was drawn in the first and second quadrant and have a turning point of (0;0)	(3)
5.2	$y = \frac{2}{x} - 2\sqrt{x} + \frac{1}{3}x^3$ $= 2x^{-1} - 2x^{\frac{1}{2}} + \frac{1}{3}x^3$ √ √ $\frac{dy}{dx} = -1 \times 2x^{-1-1} - \frac{1}{2} \times 2x^{\frac{1}{2}-1} + \frac{3x^{3-1}}{3}$ $= -2x^{-2} - x^{-\frac{1}{2}} + x^2$ ✓ ✓ ✓ $= \frac{-2}{x^2} - \frac{1}{\sqrt{x}} + x^2$ √ √		½ M each for applying the exponent laws in step 2 1 mark for each derivatives ½ for writing the powers in the correct form	(5)

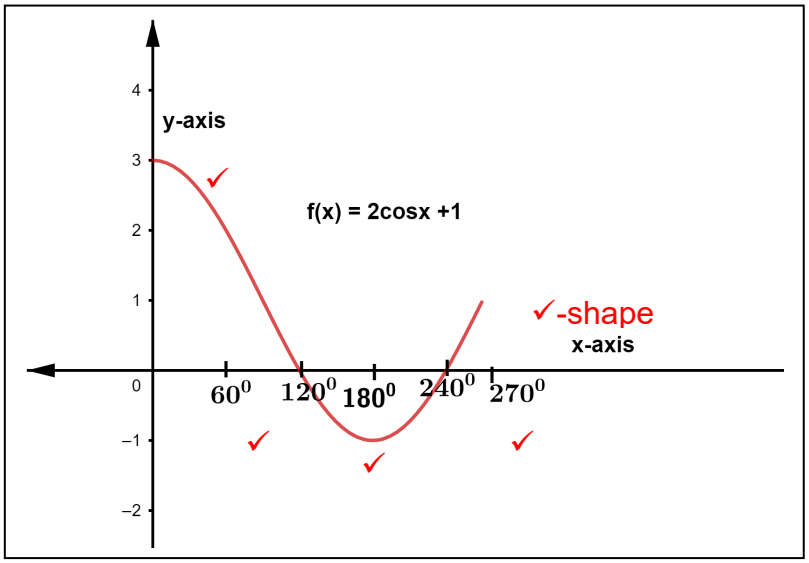
		SOLUTION		EXPLANATION	
5.3	5.3.1	$f(x) = 2x^3 + 6x^2$ $f(x) = 2x^3 + 6x^2$ $\therefore f'(x) = 6x^2 + 12x$ √ For TP's : $f'(x) = 0$ √ $\therefore\ 6x^2 + 12x = 0$ $\therefore 6x(x+2) = 0$ $\therefore x = 0$ ✓ *or* $x = -2$ ✓ If $x = 0$: $\therefore f(0) = 2(0)^3 + 6(0)^2 = 0$ ✓ If $x = -2$: $\therefore f(-2) = 2(-2)^3 + 6(-2)^2$ $= -16 + 24$ $= 8$ ✓ The coordinates of the turning points are $(0;0)$ and $(-2;8)$.		½ M for derivative ½ S(for letting it be equal to zero-for applying knowledge on max and min turning points) 1 M each for determining x 1 M each for determining y	(5)
	5.3.2	$2x^3 + 6x^2 = 0$ $2x^2(x+3) = 0$ $x = 0$ *and* $x = -3$  		1 M to each turning point 1 M for shape 1 for shape if all the other information was correct .The max TP is (-2;8) and min TP is (0;0)	(3)
					[16]

QUESTION 6

	SOLUTION	EXPLANATION	
6.1	$\frac{\tan A}{1+\tan^2 A} = \sin A \cos A$ $LHS = \frac{\tan A}{1+\tan^2 A}$ $= \frac{\tan A}{\sec^2 A}$ ✓ $= \frac{\sin A}{\cos A} \times \frac{1}{\sec^2 A}$ ✓ $= \frac{\sin A}{\cos A} \times \cos^2 A$ ✓ $= \sin A \cos A$ ✓ $\therefore LHS = RHS$	1 M square identity 1 M quotient identities 1 M 1 R	(4)

	SOLUTION		EXPLANATION	
6.2	$y^2 + 25 = 169$ $\therefore y^2 = 144$ $\therefore y = 12$			
	6.2.1	$\therefore \tan A = \frac{12}{-5}$ ✓ ✓	1 for finding y and replacing it with 12 1 for denominator	(2)
	6.2.2	$\sec A = -\frac{13}{5}$ ✓	1 for numerator 1 for denominator	(2)

6.3	*In* Δ ABC: $A\hat{C}B=133^o$ $A\hat{B}C= 22^o$ $\therefore \frac{BC}{\sin 25^o}=\frac{53}{\sin 22^o}$ ✓ $\therefore \quad BC=\frac{53\sin 25^o}{\sin 22^o}$ ✓ $\therefore \quad BC=59,793$ ✓ *In* Δ BCD: $\frac{BD}{BC}=\sin 47^o$ ✓ $\therefore BD = 59,793 \sin 47^o$ ✓ $=43,730$ m ✓	 **ALTERNATIVE ANSWER** *In* Δ ABC: $A\hat{C}B=133^o$ $A\hat{B}C= 22^o$ $\therefore \frac{AB}{\sin 133^o}=\frac{53}{\sin 22^o}$ ✓ $\therefore \quad AB=\frac{53\sin 133^o}{\sin 22^o}$ ✓ $\therefore \quad AB=103,473$ ✓ *In* Δ ABD: $\frac{BD}{AB}=\sin 25^o$ ✓ $\therefore BD = 103,473 \sin 25^o$ ✓ $=43,730$ m ✓	1 S 1 SF 1 answer 1 S 1 SF 1 answer	(6)

	SOLUTION		EXPLANATION	
6.4			1 for TP(180°;-1) 1 for TP (0° ;3)/or y-intercept x-intercepts(120° ;0) x-intercept(240° ;0) 1 M shape	(5)
				[19]

TOTAL : 100

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