higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE (VOCATIONAL)

MATHEMATICS
(Second paper)
NQF LEVEL 4

6 November 2024

This marking guideline consists of 12 pages.

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QUESTION 1

1.1	**Working**	**Explanation**	**Mark**
1.1.1	$\hat{Y}_1 = 26°$ (Tan – chord theorem) ✓✓	1S, 1R	(2)
1.1.2	$\hat{D}_1 = 26°$ (Alternate angles) ✓✓	1S, 1R	(2)
1.1.3	$\hat{B} = 180° - 26° = 154°$ (Opp. Angles of Cyclic Quad.)✓✓	1S, 1R	(2)
1.1.4	$\hat{C}_2 = \hat{A}_3$ (Opp. Angles of isosceles Δ) $\therefore\ \hat{C}_2 = \frac{180° - 154°}{2} = 13°$(Sum of interior angles in a Δ)✓✓	1S, 1R	(2)

1.2			
	$\hat{M}_2 = 90°$(Line from centre to midpoint of chord)✓✓ $\hat{T}_1 + \hat{T}_2 = \hat{T} = 90°$ (Radius ⊥ Tangent) ✓✓ $\Rightarrow \hat{T} + \hat{M}_2 = 180°$ $\therefore$ OTGM is a cyclic quad (opp. angles are suppl.)✓ **OR** $\hat{M}_1 = 90°$(Line from centre to midpoint of chord)✓✓ $\hat{T}_1 + \hat{T}_2 = \hat{T} = 90°$ (Radius ⊥ Tangent) ✓✓ $\Rightarrow \hat{T} = \hat{M}_1$ $\therefore$ OTGM is a cyclic quad (Ext. angles = Int. Opp. angle)✓	1S, 1R 1S, 1R 1R	(5)

1.3	**Working**	**Explanation**	**Mark**
1.3.1	$x_M = \frac{0-6}{2} = -3$✓ and $y_M = \frac{0+4}{2} = 2$✓ $\therefore$ M$(-3;2)$	1CA, 1CA	(2)
1.3.2	NM $= \sqrt{(-6--3)^2 + (4-2)^2}$✓✓ $= \sqrt{13}$✓ **OR** MO $= \sqrt{(-3-0)^2 + (2-0)^2}$ ✓✓ $= \sqrt{13}$ ✓	1SF, 1SF 1CA	(3)
1.3.3	$(x+3)^2 + (y-2)^2 = 13$✓✓	1CA, 1CA	(2)
1.3.4	$m_r = \frac{0-4}{0+6} = -\frac{2}{3}$ **OR** $m_r = \frac{0-2}{0+3} = -\frac{2}{3}$ **OR** $m_r = \frac{2-4}{-3+6} = -\frac{2}{3}$ ✓ and $\therefore m_T = \frac{3}{2}$ ✓ $\Rightarrow y - 4 = \frac{3}{2}(x+6)$ $\quad 4 = \frac{3}{2}(-6) + C \Rightarrow C = 13$ $\therefore y = \frac{3}{2}x + 13$ ✓ $\quad \therefore y = \frac{3}{2}x + 13$	1 mark for m_r 1 mark for m_T 1 mark for equation	(3)
1.3.5	$0 = \frac{3}{2}x + 13 \Rightarrow x = -\frac{26}{3} = -8.667$ ✓ $\therefore$ S$\left(-\frac{26}{3};0\right)$✓	1CA 1CA	(2)

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QUESTION 2

2.1	**Working**	**Explanation**	**Mark**
2.1.1	$1-2\sin^2 15°$ $=\cos(30°)$✓ $=\frac{\sqrt{3}}{2}$ ✓	1 B/D 1 CA	(2)
2.1.2	$\sin 96°\cos 24°-\sin 24°\cos 276°$ $=\sin(180°-96°)\cos 24°-\sin 24°\cos(360°-276°)$✓ $=\sin 84°\cos 24°-\sin 24°\cos 84°$√ $=\sin(84°-24°)$√ $=\sin 60°$ √ $=\frac{\sqrt{3}}{2}$ √	1 B/D ½ mark for $84°$ ½ mark $\sin(84°-24°)$ ½ mark for $\sin 60°$ ½ mark for $\frac{\sqrt{3}}{2}$ (CA)	(3)
2.1.3	$\cos 75°$ $=\cos(45°+30°)$✓ $=\cos 45°\cos 30°-\sin 45°\sin 30°$ ✓ $=\left(\frac{\sqrt{2}}{2}\times\frac{\sqrt{3}}{2}\right)-\left(\frac{\sqrt{2}}{2}\times\frac{1}{2}\right)$ OR $\frac{1}{\sqrt{2}}\times\frac{\sqrt{3}}{2}-\frac{1}{\sqrt{2}}\times\frac{1}{2}$✓ $=\frac{\sqrt{6}-\sqrt{2}}{4}$ **OR** $\frac{\sqrt{3}-1}{2\sqrt{2}}$✓	1 reduction (A) 1 expanding 1 each for special angle ratios (CA) 1 for conclusion	(4)

2.2			
	$\sin 2x+\sin x=6\cos x+3$ $\Rightarrow 2\sin x\cos x+\sin x-6\cos x-3=0$ √ $\Rightarrow \sin x(2\cos x+1)-3(2\cos x+1)=0$ $\Rightarrow(\sin x-3)(2\cos x+1)=0$ √√ $\Rightarrow \sin x=3$ (no solution)√ *or* $\cos x=-\frac{1}{2}$ √ $\Rightarrow x_{ref}=\cos^{-1}\left(\frac{1}{2}\right)=60°$√ $\therefore x=\{120°;240°\}$ √√	½ mark for double angle ½ mark for common factor ½ mark for each factor ½ mark for $\sin x=3$ ½ mark for $\cos x=-\frac{1}{2}$ ½ mark for x_{ref} ½ mark for each x value	(4)

2.3	**Working**	**Explanation**	**Mark**
2.3.1	LHS $= \frac{1+\sin 2x}{\sin^2 x}$ $= \frac{\sin^2 x+\cos^2 x+2\cos x\sin x}{\sin^2 x}$ ✓ $= \frac{(\sin x+\cos x)^2}{\sin^2 x}$ ✓ $= \left(\frac{\sin x+\cos x}{\sin x}\right)^2$ √ $= \left(\frac{\sin x}{\sin x}+\frac{\cos x}{\sin x}\right)^2$ √ $=$ RHS Alternative RHS $= \left(1+\frac{\cos x}{\sin x}\right)^2$ $= 1+\frac{2\cos x}{\sin x}+\frac{\cos^2 x}{\sin^2 x}$ ✓ $= \frac{\sin^2 x+\cos^2 x+2\cos x\sin x}{\sin^2 x}$ ✓ ✓ $=$ LHS	½ mark for each identity 1 mark for $(\sin x+\cos x)^2$ ½ mark for $\left(\frac{\sin x+\cos x}{\sin x}\right)^2$ ½ mark for $\left(\frac{\sin x}{\sin x}+\frac{\cos x}{\sin x}\right)^2$ 1 mark for expansion 1 mark for numerator 1 mark for denominator	(3)
2.3.2	LHS $= \frac{2\sin x\cos x}{\cos^4 x-\sin^4 x}$ $= \frac{\sin 2x}{(\cos^2 x-\sin^2 x)(\cos^2 x+\sin^2 x)}$ ✓ ✓ $= \frac{\sin 2x}{\cos 2x}$ ✓ $=$ RHS	1 mark for numerator 1 mark for denominator 1 mark for $\frac{\sin 2x}{\cos 2x}$	(3)

2.4	**Working**	**Explanation**	**Mark**
2.4.1	$\sin 60° = \frac{15}{\text{PS}}$ ✓ $\Rightarrow \text{PS} = \frac{15}{\sin 60°} = 17{,}3m = 10\sqrt{3}m$ ✓ **OR** $\frac{\sin 60°}{15} = \frac{\sin 90°}{\text{PS}}$ ✓ $\Rightarrow \text{PS} = \frac{15 \sin 90°}{\sin 60°} = 17{,}3m = 10\sqrt{3}m$ ✓ **OR** $\text{P}\hat{\text{S}}\text{Q} = 180° - 90° - 60° = 30°$ $\cos 30° = \frac{15}{\text{PS}}$ ✓ $\Rightarrow \text{PS} = \frac{15}{\cos 30°} = 17{,}3m = 10\sqrt{3}m$ ✓	1 SF 1 CA	(2)
2.4.2	$\cos 30° = \frac{18}{\text{SW}}$ ✓ $\Rightarrow \text{SW} = \frac{18}{\cos 30°} = 20{,}8m = 12\sqrt{3}m$ ✓ **OR** $\text{V}\widehat{\text{W}}\text{S} = 180° - 90° - 30° = 60°$ $\therefore \sin 60° = \frac{18}{\text{SW}}$ ✓ $\Rightarrow \text{SW} = \frac{18}{\sin 60°} = 20{,}8m = 12\sqrt{3}m$ ✓ **OR** $\frac{\sin 60°}{18} = \frac{\sin 90°}{\text{SW}}$ ✓ $\Rightarrow \text{SW} = \frac{18 \sin 90°}{\sin 60°} = 20{,}8m = 12\sqrt{3}m$ ✓	1 SF 1 CA	(2)
2.4.3	$\text{PW}^2 = (17{,}3)^2 + (20{,}8)^2 - 2(17{,}3)(20{,}8)\cos 120°$ ✓ $\Rightarrow \text{PW}^2 = 1091{,}77$ $\therefore \text{PW} = 33\text{m}$✓	1 SF 1 CA	(2)

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QUESTION 3

	Working	Explanation	Mark
3.1	See ADDENDUM A below✓✓✓		(3)
3.2	OPTION 1 See ADDENDUM B below √√√√√ $b = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - \left(\sum x\right)^2}$ $= \frac{(6 \times 694) - (93 \times 34)}{(6 \times 1967) - (93)^2}\sqrt{}$ $= 0{,}318\sqrt{}$ $a = \overline{y} - b\overline{x}$ $= 5{,}67 - (0{,}318 \times 15{,}5)$ $= 0{,}741\sqrt{}$ $\therefore y = 0{,}741 + 0{,}318x\sqrt{}$	½ mark for each sum/mean in table ½ mark for subst. into formula of b (SF) ½ mark for b value (CA) ½ mark for a value (CA) ½ mark for reg. eqn.	
	OPTION 2 See ADDENDUM B below √√√√√ $b = \frac{\sum (x_i - \overline{x})(y_i - \overline{y})}{\sum (x_i - \overline{x})^2}$ $= \frac{167}{525{,}5}\sqrt{}$ $= 0{,}318\sqrt{}$ $a = \overline{y} - b\overline{x}$ $= 5{,}67 - (0{,}318 \times 15{,}5)$ $= 0{,}741\sqrt{}$ $\therefore y = 0{,}741 + 0{,}318x\sqrt{}$	½ mark for each sum/mean in table ½ mark for subst. into formula of b (SF) ½ mark for b value (CA) ½ mark for a value (CA) ½ mark for reg. eqn.	(5)
3.3	See ADDENDUM A below ✓✓		(2)

3.4	$y = 0{,}741 + 0{,}318(16)$✓ $\Rightarrow y = 5{,}83$✓	1SF 1CA	(2)
3.5	$\bar{x} = 15{,}5$ (See ADDENDUM B below) $s^2 = \frac{(3-15{,}5)^2 + (8-15{,}5)^2 + \cdots + (12-15{,}5)^2}{6}$ ✓ $= 87{,}583$ ✓ $= \frac{1051}{12}$ $s = \sqrt{\frac{1051}{12}} = 9{,}359$✓ ALTERNATIVE FOR 3.5 $s^2 = \frac{525{,}5}{6} = \frac{1051}{12} = 87{,}583$ ✓ $s = \sqrt{\frac{1051}{12}} = 9{,}359$✓	1SF 1CA 1CA	(3)

x	$x - \bar{x}$	$(x - \bar{x})^2$
3	$-12{,}5$	156,25
8	$-7{,}5$	56,25
30	14,5	210,25
25	9,5	90,25
15	$-0{,}5$	0,25
12	$-3{,}5$	12,25
TOTAL	0	525,5✓

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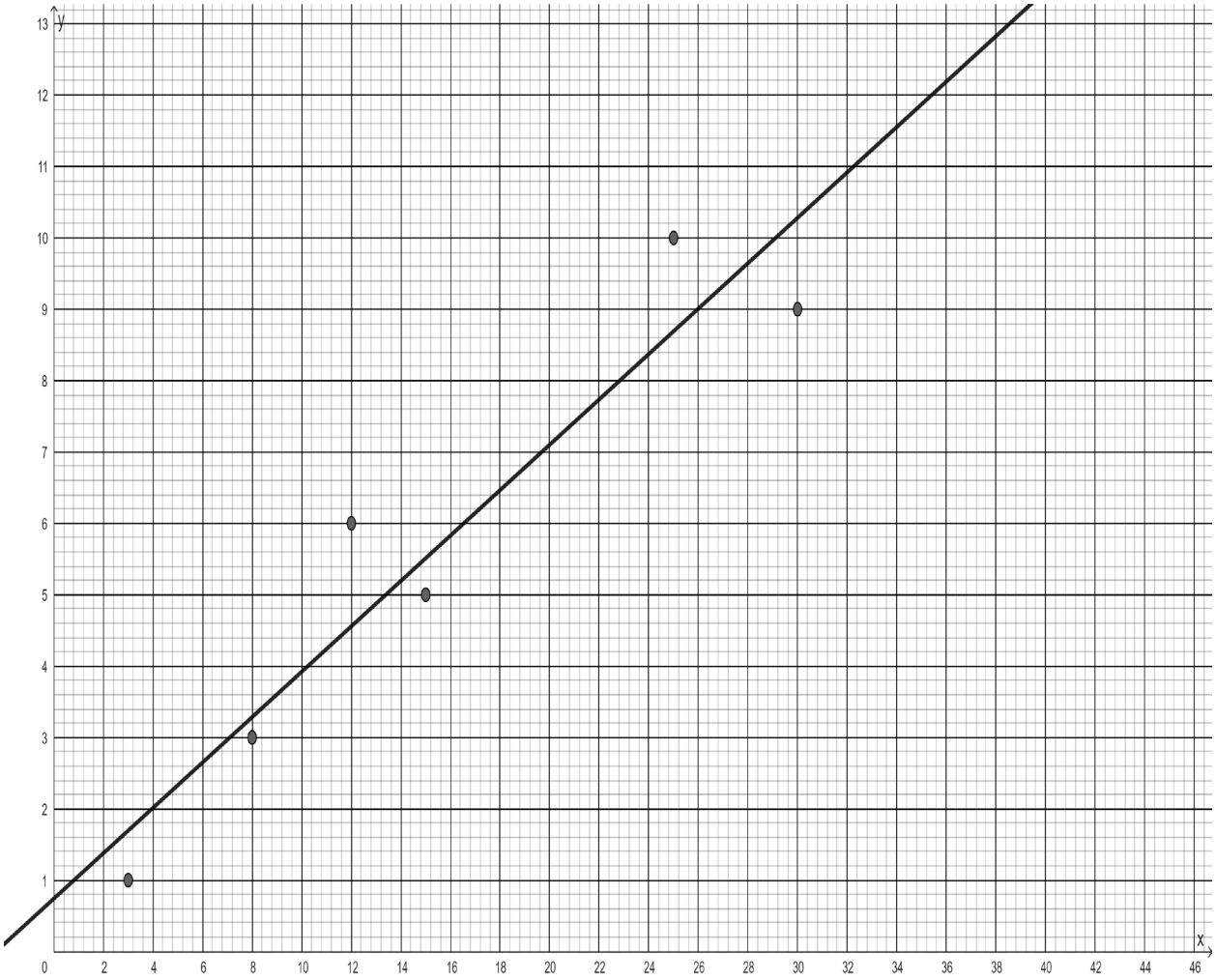
ADDENDUM A

EXAMINATION NUMBER: | | | | | | | | | | | | |

CENTRUM NUMBER: | | | | | | | | | | | |

3.1
3.3



Regression line✓✓

Note: Regression line must pass through the points (0; 0,741); (26; 9) and $(\bar{x}\,;\bar{y})$

Scatterplot✓✓✓

Note: Subtract 1 mark for any 2 points plotted incorrectly.

ADDENDUM B

EXAMINATION NUMBER:

CENTRUM NUMBER:

3.2

OPTION 1

Pollutant levels (x)	**Thinning (y)**	xy	x^2
3	1	3	9
8	3	24	64
30	9	270	900
25	10	250	625
15	5	75	225
12	6	72	144
$\sum x = 93\surd$	$\sum y = 34\surd$	$\sum xy = 694\surd$	$\sum x^2 = 1967\surd$
$\bar{x} = 15,5 = \frac{31}{2}\surd$	$\bar{y} = 5,67 = \frac{17}{3}\surd$		

OPTION 2

Pollutant levels (x)	**Thinning (y)**	$(x-\bar{x})(y-\bar{y})$	$(x-\bar{x})^2$
3	1	58,375	156,25
8	3	20,025	56,25
30	9	48,285	210,25
25	10	41,135	90,25
15	5	0,335	0,25
12	6	-1.155	12,25
$\sum x = 93\surd$	$\sum y = 34\surd$	$\sum (x-\bar{x})(y-\bar{y}) = 167\surd$	$\sum (x-\bar{x})^2 = 525,5\surd$
$\bar{x} = 15,5 = \frac{31}{2}\surd$	$\bar{y} = 5,67 = \frac{17}{3}\surd$		

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QUESTION 4

4.1	**Working**	**Explanation**	**Mark**
4.1.1	Two events A and B are mutually inclusive if they can happen at the same time.(Accept any correct definition) ✓ $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$ ✓	1 mark for Definition 1F	(2)
4.1.2	Two events A and B are (statistically) independent if there is no influence of one event on the other .(Accept any correct definition) ✓ $P(A \text{ and } B) = P(A) \times P(B)$ ✓	1 mark for Definition 1F	(2)

4.2	**Working**	**Explanation**	**Mark**
4.2.1	$X = 46;\ Y = 8$ ✓✓	1 CA; 1 CA	(2)
4.2.2 (a)	$P(A) = \frac{31}{91} = 0{,}341$ ✓	1 CA	(1)
(b)	$P(C \text{ from females only}) = \frac{23}{46} = 0{,}5$ ✓	1 CA	(1)
(c)	$P(F \text{ or } B) = \frac{46}{91} + \frac{28}{91} - \frac{8}{91}$ ✓ $= \frac{66}{91}$ ✓ $= 0{,}725$	1SF 1 A	(2)
(d)	$P(\overline{B}) = 1 - P(B)$ $= 1 - \frac{28}{91}$ ✓ $= \frac{9}{13}$ $= 0{,}692$ ✓ **OR** $P(\overline{B}) = P(A) + P(C) = \frac{31}{91} + \frac{32}{91} = \frac{9}{13}$ ✓✓ $= 0{,}692$	1 mark for complementary probability 1 mark for answer **OR** 1 mark for numerator 1 mark for denominator	(2)
4.2.3	$P(M \text{ and } A) = \frac{16}{91} = 0{,}2$ ✓ $P(M) \times P(A) = \frac{45}{91} \times \frac{31}{91} = 0{,}2$ ✓ ∴ The event "Male" and Grade "A" are independent ✓	1 CA 1 CA 1 R	(3)

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QUESTION 5

	Working	Explanation	Mark
5.1	Compound Interest	1S	(1)

5.2	$A = P(1 + in)$ $\Rightarrow 22464 = P\left(1 + \frac{5.5}{100} \times 8\right)$ ✓ $\Rightarrow 22464 = 1.44P$ ✓ $\Rightarrow P = \frac{22464}{1.44} = R15600$ ✓	 1 SF 1S 1 A	 (3)

5.3	Working	Explanation	Mark
5.3.1	$A_t = A_0\left(1 + \frac{r}{100m}\right)^{t \times m}$ $A_t = 17\,500\left(1 + \frac{7.5}{100 \times 4}\right)^{12 \times 4}$ ✓ $= R42\,685{,}85$ ✓	 1 SF 1 CA	 (2)
5.3.2	$\text{Interest} = A_t - A_0$ $= R42\,685{,}85 - R17\,500$ $= R25\,185{,}85$✓	1 CA	 (1)

5.4	<u>OLD CAR</u> $A = P(1 - i)^n$ $= 350\,000\left(1 - \frac{20}{100}\right)^7$ ✓ $= R73\,400.32$ ✓ <u>NEW CAR</u> $A = P(1 + in)$ $\Rightarrow A = 350\,000\left(1 + \frac{5}{100} \times 7\right)$ ✓ $= R472\,500$ ✓ $\text{Trade} - \text{in Amount} = R472\,500 - R73\,400.32$ $= R399\,099.68$ ✓	 1 SF 1 CA 1 SF 1 CA 1 CA	 (5)

5.5	**Working**	**Explanation**	**Mark**
5.5.1	Taxable income = Gross Income − Deductions Note: Accept any other valid definition.	1S	(1)
5.5.2	Tax rebate is a refund offered to tax payers depending on their age. Note: Accept any other valid definition.	1S	(1)

5.6	**Working**	**Explanation**	**Mark**
5.6.1	Gross annual income = $(12 \times 150000) + 100000 + 75000$ = R 1 975 000 ✓ Tax payable = R644 489 + 45%(1 975 000 − 1 817 000) = R715 589 ✓ Rebates = 17 235 + 9444 = R26 679 ✓ Annual Tax = R715 589 − R26 679 = R688 910 ✓ Amount due to SARS = R688 910 − R650 000 = R38 910 ✓	1 for gross annual income 1 mark for tax payable 1 mark for rebates 1 mark for annual tax 1A	(5)
5.6.2	She needs to start contributing to a pension fund, medical aid scheme, UIF (unemployment insurance fund) and also open an investment account with any financial institution. Note: Award full marks if at least one deduction is mentioned.	1S	(1)

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TOTAL: 100

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