higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE (VOCATIONAL)

MATHEMATICS
(Second paper)
NQF LEVEL 4

25 February 2020

This marking guideline consists of 10 pages.

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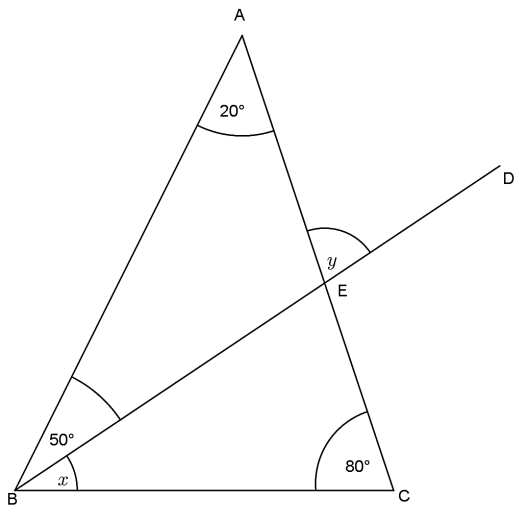
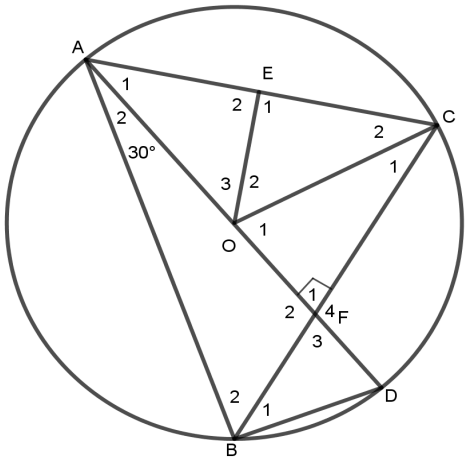
✓= 1 mark √= ½ mark

- Accept all mathematically valid solutions.
- Consistent accuracy will apply as a general rule.
- If a candidate does a question twice and does not delete either, mark the first attempt.
- If a candidate does a question, crosses it out and does not redo it, mark the deleted attempt.

MARKING LEGEND	
SYMBOL	**EXPLANATION OF SYMBOL**
A	Accuracy
M	Method
CA	Continuous accuracy (follow-up)
B/D	Breakdown
S	Statement
R	Reason
S/R	Statement and reason

QUESTION 1

1.1		**SOLUTION**	**EXPLANATION**	
				
	1.1.1	$A\hat{B}C = 180° - 80° - 20°$ $= 80°$ $x = 80° - 50°$ $= 30°$✓	1 for answer (A)	(1)
	1.1.2	$y = 50° + 20°$ ... ext. ∠ of ΔABE $y = 70°$✓	1 for answer (A)	(1)
	1.1.3	Isosceles triangle✓... $A\hat{B}C = 80° = \hat{B}$✓	1 for answer, 1 for reason (A)	(2)

1.2					
	1.2.1	(a)	$\widehat{B}_1 + \widehat{B}_2 = 90°$✓... subtended by dia. $\widehat{D} + 90° + 30° = 180°$ $\widehat{D} = 60°$✓	1 for 90° (CA) 1 for answer (CA)	
		(b)	$\widehat{D} = \widehat{C}_1 + \widehat{C}_2 = 60°$✓... same segment $\widehat{A}_1 + 60° + 90° = 180°$... angle sum ΔAFC $\widehat{A}_1 = 30°$✓	1 for S (A) 1 for answer (A)	
		(c)	$\widehat{O}_1 = 2\widehat{A}_1 = 60°$✓... angle at centre thm. $\widehat{C}_1 + 60° + 90° = 180°$ ... ΔCOF $\widehat{C}_1 = 30°$✓	1 for S (A) 1 for answer (A)	
				(3 × 2)	(6)
	1.2.2		$\widehat{B}_2 = 60°$... ΔABF $\widehat{B}_2 = \widehat{D}$✓... each = 60° AB is tangent ... conv. tan chord them✓	1 for S (A) 1 for reason (A)	(2)
	1.2.3		AE = CE ... given $\widehat{E}_1 = 90°$✓... mid pt of chord AC✓ $\widehat{F}_1 = 90°$ ... given $\widehat{F}_1 + \widehat{E}_1 = 180°$✓ ∴ CEOF is a cyclic quad because opp.∠'s of cyclic quad supplementry✓	1 for S, 1 for R (A) 1 for S (A) 1 for reason (A)	(4)

1.3	1.3.1	$r^2 = (-2)^2 + 3^2 = 13$√ $\therefore x^2 + y^2 = 13$ √	½ for S (A) ½ for answer (A)	(1)
	1.3.2	C(−3; −4) $r^2 = (-3-0)^2 + (0-4)^2 = 25$✓ C lies outside the ⊙ because 25 > 13✓	1 for S (A) 1 for R (A)	(2)

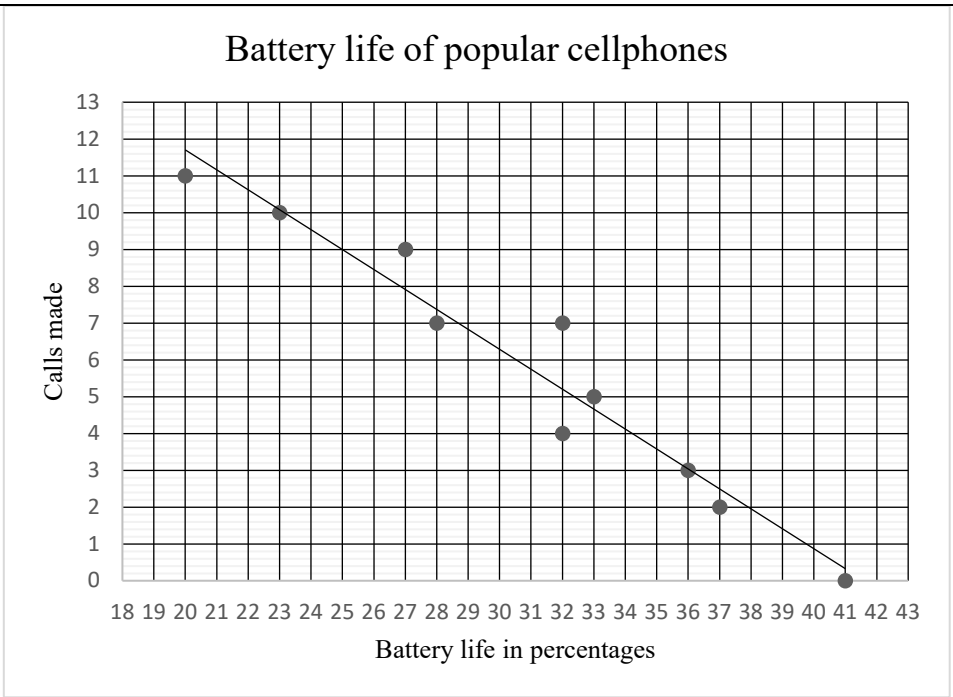
	1.3.3	AB = $2r$... diameter✓ AB = $2\sqrt{13} = \sqrt{52}$✓	1 for S/distance formula (A) 1 for either answer (A)	(2)
	1.3.4	$m_{AB} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3-0}{-2-0} = -\frac{3}{2}$✓	1 for answer (A)	(1)
	1.3.5	$m_{TANGENT} = -1 \times -\frac{2}{3} = \frac{2}{3}$✓ $(-2;3)$: $y - 3 = \frac{2}{3}(x+2)$✓ $y = \frac{2}{3}x + \frac{4}{3} + 3$ $y = \frac{2}{3}x + \frac{13}{3}$✓	1 for answer (CA) 1 for subst. in formula (CA) 1 for answer (CA)	(3)
				[25]

QUESTION 2			
2.1	$\cos\theta = 0{,}726$ Ref ∠: $\theta = \cos^{-1}0{,}726 = 43{,}4°$✓ $\therefore \theta = 360° - 43{,}4° = 316{,}6°$✓	1 for ref angle (A) 1 for answer (A)	(2)
2.2	$\frac{\sin^2\theta}{\sin(180° - \theta) \times \cos(90° + \theta) + \tan 45°}$ $= \frac{\sin^2\theta}{\sin\theta \times (-\sin\theta) + 1}$ $= \frac{\sin^2\theta}{-\sin^2\theta + 1}$ $= \frac{\sin^2\theta}{1 - \sin^2\theta}$ $= \frac{\sin^2\theta}{\cos^2\theta}$✓ $= \tan^2\theta$ ✓	½ for each term (A) ½ for simplifying (A) 1 for denominator (A) 1 for answer (A)	(4)
2.3	$2\cos^2 2x - 1 = -\frac{1}{2}$ $\cos 4x$✓ $= -0{,}5$ $4x = \pm 120°$✓ $+ 360°k$✓ ; $k \in \mathbb{Z}$ $x = \pm 30° + 90°k; k \in \mathbb{Z}$✓ **OR** $x = 30° + 90°k; 60° + 90°k$; $k \in \mathbb{Z}$	1 for double angle (A) 1 for angle, 1 for 360k (CA) 1 for answer (CA)	(4)

2.4	$\frac{\sin A}{\sin B} - \frac{\cos A}{\cos B} = \frac{2\sin(A-B)}{\sin 2B}$ $\text{LHS} = \frac{\sin A}{\sin B} - \frac{\cos A}{\cos B}$ $= \frac{\sin A\cos B - \cos A\sin B}{\sin B\cos B}$ ✓✓ $= \frac{\sin(A-B)}{\sin B\cos B}$ ✓ $= \frac{\sin(A-B)}{\sin B\cos B} \times \frac{2}{2}$ $= \frac{2\sin(A-B)}{2\sin B\cos B}$ ✓ $= \frac{2\sin(A-B)}{\sin 2B}$ ✓ $= \text{RHS}$	1 for numerator (A) 1 for denominator (A) 1 for compound angle (A) 1 for setup (A) 1 for answer (A)	(5)
2.5	$\frac{\cos(45° - \theta)}{\cos 45° \times \cos\theta} - \tan\theta$ $= \frac{\cos 45°\cos\theta + \sin 45°\sin\theta}{\cos 45° \times \cos\theta}$ ✓ $- \frac{\sin\theta}{\cos\theta}$ ✓ $= \frac{\cos 45°\cos\theta + \sin 45°\sin\theta - \cos 45\sin\theta}{\cos 45° \times \cos\theta}$ $= \frac{\frac{1}{\sqrt{2}}\cos\theta + \frac{1}{\sqrt{2}}\sin\theta - \frac{1}{\sqrt{2}}\sin\theta}{\frac{1}{\sqrt{2}} \times \cos\theta}$ ✓ $= \frac{\frac{1}{\sqrt{2}}\cos\theta + \frac{1}{\sqrt{2}}\sin\theta - \frac{1}{\sqrt{2}}\sin\theta}{\frac{1}{\sqrt{2}} \times \cos\theta}$ ✓ $= \frac{\frac{1}{\sqrt{2}}\cos\theta}{\frac{1}{\sqrt{2}} \times \cos\theta}$ $= 1$ ✓	Allocate as indicated All accuracy marks	(5)
2.6	$BC^2 = AC^2 + AB^2 - 2AC.AB\cos 20°$ $BC^2 = 20^2 + 16^2 - 2 \times 20 \times 16 \times \cos 20°$ ✓ $BC = \sqrt{54{,}6} = 7{,}39\text{m}$ ✓ $D\hat{C}B = 70°$ ✓ ... alt. angles $\frac{DB}{BC} = \tan 70°$ ✓ $DB = 7{,}39\ \tan 70°$ $= 20{,}3\text{m}$ ✓	1 for substitution (A) 1 for answer (A) 1 for answer (A) 1 for ratio (A) 1 for answer (CA)	(5)
			[25]

QUESTION 3

3.1 and 3.3



Plotting points:
All 10 points correct: 4 marks
7 – 9 points correct: 3 marks
4 – 6 points correct: 2 mark
2 – 3 points correct: 1 mark

(4)

3.3 Line of best fit✓ (1)

3.2

Internal examinations (x)	Final examinations (y)	$x.y$	x^2
32	7	224	1 024
20	11	220	400
27	9	243	729
37	2	74	1 369
32	4	128	1 024
28	7	196	784
41	0	0	1 681
23	10	230	529
33	5	165	1 089
36	3	108	1 296
$\sum x = 309$√	$\sum y = 58$√	$\sum x.y = 1\,588$ √	$\sum x^2 = 9\,925$√
$\bar{x} = 30{,}9$√	$\bar{y} = 5{,}8$√		

Allocate marks as indicated.

	$b = \frac{n\sum x.y - \sum x \sum y}{n\sum x^2 - (\sum x)^2}$		
	$= \frac{10 \times 1\,588 - (309)(58)}{10 \times 9\,925 - (309)^2}\sqrt{}$	½ for substitution (A)	
	$= \frac{15\,880 - 17\,922}{99\,250 - 95\,481}$		
	$= \frac{-2\,042}{3\,769}$		
	$b = -0{,}542\sqrt{}$	½ for b-value (A)	
	$a = \bar{y} - b\bar{x}$		
	$a = 5{,}8 - (-0{,}542)(30{,}9)$		
	$a = 22{,}54\sqrt{}$	½ for a-value (A)	
	$\therefore y = a + bx$		
	$y = 22{,}486 + (-0{,}542)x\sqrt{}$	½ for equation (A)	(5)

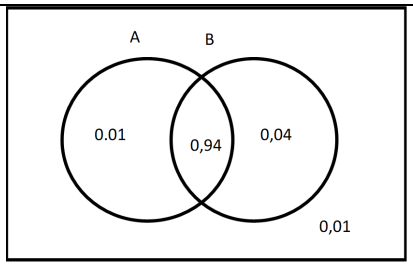
Alternative:

Internal examinations (x)	Final examinations (y)	$(x-\bar{x})(y-\overline{y})$	$(x-\bar{x})^2$
32	7	1,32	1,21
20	11	-56,68	118,81
27	9	-12,48	15,21
37	2	-23,18	37,21
32	4	-1,98	1,21
28	7	-3,48	8,41
41	0	-58,58	102,01
23	10	-33,18	62,41
33	5	-1,68	4,41
36	3	-14,28	26,01
$\sum x = 309$	$\sum y = 58$	$\Sigma(x-\bar{x})(y-\bar{y}) = -204{,}2$✓	$\Sigma(x-\bar{x})^2 = 376{,}9$✓
$\bar{x} = 30{,}9\sqrt{}$	$\bar{y} = 5{,}8\sqrt{}$		

Allocate marks as indicated.

	$b = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sum(x-\bar{x})^2}$ $b = \frac{-204{,}12}{376{,}9}\surd$ $= 0{,}54\surd$ $a = \bar{y} + b\bar{x}$ $a = 5{,}8 - (-0{,}542)(30{,}9)$ $a = 22{,}54\surd$ $y = a + bx$ $y = 22{,}54 + (-0{,}542)x\surd$	½ for substitution (A) ½ for b-value (A) ½ for a-value (A) ½ for equation (A)	
3.4	The fewer the calls made, the longer the battery life.	1 for answer (A)	(2)
3.5	$y = 22{,}54 + (-0{,}542)x$✓ $y = 22{,}54 + (-0{,}542)(31)$✓ $y = 5{,}738$✓	Allocate marks as indicated.	(3)
			[15]

QUESTION 4					
4.1	4.1.1	(a)	$\text{P(male)} = \frac{120}{236}$✓ $= 0{,}51$	As allocated (A)	(1)
		(b)	$\text{P(female and not sterilised)} = \frac{67}{236}$✓ $= 0{,}28$	As allocated (A)	(1)
	4.1.2		$\text{P(male and sterilised)} = \frac{51}{236}$ $= 0{,}22$✓ $\neq 0$ Not mutually exclusive✓	1 for correct calculation (A) 1 for answer (A)	(2)
	4.1.3		$\text{P(male)} \times \text{P(sterilised)}$ $= \frac{120}{236} \times \frac{100}{236}\surd$ $= 0{,}22$ $\text{P(male and sterilised)} = \frac{51}{236}$✓ $= 0{,}22$ $\therefore \text{P(male)} \times \text{P(sterilised)}$ $= \text{P(male and sterilised)}\surd$ $\therefore$ independent events correct to 2 decimial places✓	All accuracy marks as indicated	(3)

4.2	4.2.1	 ✓✓	2 for Venn diagram	
		$P(A \cup B) = 0{,}01 + 0{,}94 + 0{,}04$✓ $= 0{,}99$✓ **OR** $P(A \cup B) = P(A) + P(B) - P(A \cap B)$✓ $= 0{,}95 + 0{,}98 - 0{,}94 = 0{,}99$✓	2 accuracy marks as indicated	(4)
	4.2.2	$P(A \cup B)'$✓ $= 0{,}01$ or 1%✓ **OR** $P(A \cup B)' = 1 - P(A \cup B)$✓ $= 1 - 0,$ $= 0{,}01$✓	2 for correct answer from Venn diagram	(2)
	4.2.3	P(device B only) $= 0{,}04$✓✓	2 for correct answer from Venn diagram	(2)
				[15]

QUESTION 5

5.1	Price in 2023 $= P(1+i)^4$√ $= 22{,}50(1+0{,}07)^4$√ $=$ R29,493✓			(2)
5.2	Refilwe: $A = P(1 + i \times n)$√ $=$ R6 000$(1 + 0{,}085 \times 5)$✓ $= 6\,000(1{,}425)$ $=$ R8 550✓ Johnny: $A = P(1+i)^n$√ $A =$ R6 000$(1+0{,}02)^{20}$✓ $=$ R8 915,68✓ ∴ John will receive a bigger amount.✓		½ for formula (A) 1 for substitution (A) 1 for answer (CA) ½ for formula (A) 1 for substitution (A) 1 for answer (CA) 1 for answer (CA)	(6)
5.3	5.3.1	$A = P(1-i)^n$✓ $A = 120\,000(1-0{,}09)^5$✓ $=$ R74 883,86✓	Allocate according to ticks.	(3)
	5.3.2	$A = P(1+i)^n$✓ $A = 120\,000(1+0{,}07)^5$✓ $=$ R168 306,21✓	Allocate according to ticks.	(3)

5.4	5.4.1	**Gross income** Income from salary = R36 000 × 12 = R432 000 Yearly bonus = R 45 000 One– off incentive bonus = R26 000 TOTAL = R503 000√ **Deductions** Pension = R2 500 × 12 = R30 000 UIF = R360 × 12 = R4 320 TOTAL = R34 320√ ∴ Annual taxable income = Gross income − (pension + UIF) = R503 000 − (R30 000 + R4 320) = R46 8680✓		(2)
	5.4.2	**Normal tax** $= \text{R}100\,263 + \frac{36}{100}(\text{R}468\,680 - \text{R}423\,300)$ = R116 599,80✓ **Less rebates and tax credits** Primary: R14 067 + R7 713 = R 21 780√ Medical aid tax credit: R310 × 12 = R 3 720√ **Total tax due** = payable tax – (rebates + tax credits) = R116 599,80 − R25 500 = R91 099,80✓ Total tax already paid = R 95 000 **Due to Barry** = tax paid – payable tax = R95 000 – R91 099,80 = R3900,20✓		(4)
				[20]

TOTAL:	**100**

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