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INTERNATIONAL SECONDARY CERTIFICATE EXAMINATION
MAY 2025

MATHEMATICS: PAPER II

MARKING GUIDELINES

Time: 3 hours

150 marks

These marking guidelines are prepared for use by examiners and sub-examiners, all of whom are required to attend a standardisation meeting to ensure that the guidelines are consistently interpreted and applied in the marking of candidates' scripts.

The IEB will not enter into any discussions or correspondence about any marking guidelines. It is acknowledged that there may be different views about some matters of emphasis or detail in the guidelines. It is also recognised that, without the benefit of attendance at a standardisation meeting, there may be different interpretations of the application of the marking guidelines.

SECTION A**QUESTION 1**

(a) $r = 0,860$

Strong, positive relationship between the amounts spent on petrol and the distance each team travels to the stadium.

(b) $\hat{y} = 17,801 + 114,529x$

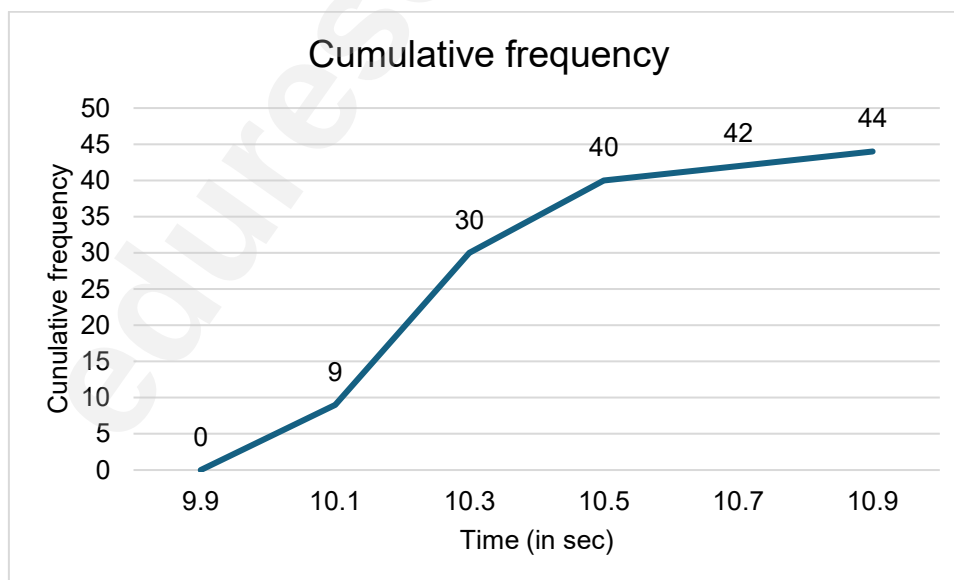
(c) $17,801 + 114,529(13) = \text{R}1\,506,68$ subst answer, rounded correctly. If only 2 d.p. was used from 1(b): R1506,69.

(d) Yes, since there is a strong positive relationship between the amounts spent on petrol and the distance each team travels to the stadium, OR It is within the data set, interpolation.

QUESTION 2

(a) Skewed to the right or positive skew.

(b) curve; coordinates; starting coordinates; end coordinates.
(Curve must be smoother, not straight lines.)



(c) $x \approx 10,2$ seconds (10,15–10,25 accepted). (Read from the pupil's graph.)

$$(d) \quad \bar{x} = \frac{9 \times 10 + 21 \times 10,2 + 10 \times 10,4 + 2 \times 10,6 + 2 \times 10,8}{44} = \frac{41}{4} = 10,25$$

(Answer only is acceptable.)

- (e) (i) Does not affect range.
 (ii) Mean will be 0,1 second higher (increased).

QUESTION 3

- (a) $0,5(a + 0,2) = 0,2$ subst and knowing $P(X \text{ and } Y) = P(X) \times P(Y)$
 $0,5a + 0,1 = 0,2$ simplify
 $a = 0,2$ and $b = 0,3$

- (b)
 $P(L) = 0,65 \times 0,2 + 0,35 \times 0,55$
 $= 0,3225$ OR $32,25\%$
 $P(L) = 0,65 \times 0,2 + 0,35 \times 0,55 = 0,3225$ or $32,25\%$

QUESTION 4

(a) $AB = \sqrt{(4 + 4)^2 + (10 - 1)^2} = \sqrt{145}$

$$BC = \sqrt{(8 + 4)^2 + (2 - 1)^2} = \sqrt{145}$$

$\therefore AB = BC \therefore \triangle ABC$ is isosceles

(b) $D(16;11)$

(c) Perimeter $= 4(\sqrt{145}) = 48,17$

(d) $m_{AB} = \frac{9}{8}$ inclination of $AB = 48,36646066 \dots$

$$m_{BC} = \frac{1}{12} \quad \text{inclination of } BC = 4,763641691 \dots$$

$$\hat{A}BC = 43,6^\circ$$

OR cosine rule:

$$AC = 4\sqrt{5}$$

$$80 = 145 + 145 - 2 \times 145 \times 145 \cos B$$

$$\cos B = \frac{80}{190}$$

$$B = 43,6^\circ$$

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QUESTION 5

$$(a) \quad \frac{\sin 10^\circ \cdot \cos 10^\circ}{\sin 20^\circ} = \frac{\sin 10^\circ \cdot \cos 10^\circ}{2 \sin 10^\circ \cdot \cos 10^\circ} = \frac{1}{2}$$

$$(b) \quad \frac{\sin x}{2} = \frac{2 \cos x}{3} \quad (\text{proportionality theorem; PQ//BC})$$

$$\frac{\sin x}{\cos x} = \frac{4}{3}$$

$$\tan x = \frac{4}{3}$$

$$x = 53,1^\circ + k \cdot 180^\circ, k \in \mathbb{Z}$$

$$x \in \{53,1^\circ; 133,1^\circ; 313,1^\circ\}$$

$$(c) \quad (i) \quad \begin{aligned} \cos 234^\circ &= -\cos 54^\circ \\ &= -\sin 36^\circ = -p \end{aligned}$$

$$(ii) \quad \begin{aligned} \sin(40^\circ + 32^\circ) &= \sin 72^\circ = 2 \sin 36^\circ \cos 36^\circ \\ &= 2p(\sqrt{1-p^2}) \end{aligned}$$

QUESTION 6

$$(a) \quad p = 45^\circ \quad q = -\frac{1}{2}$$

$$(b) \quad (i) \quad y = \tan(x + 25^\circ) - \frac{1}{2}$$

$$(ii) \quad \tan\left(\frac{1}{2}x\right) - \frac{1}{2}$$

$$(c) \quad k \in [-1; 1]$$

$$(d) \quad (i) \quad 3 - (-1) = 4$$

$$(ii) \quad x = -135^\circ$$

QUESTION 7

(a)	Statement	Reason
	$\hat{OSQ} = 32^\circ$	radius $\perp$ tangent
	$\hat{SQR} = 32^\circ$	$\angle$ at centre = $2 \times \angle$ at circumf
	$\hat{QPS} = 58^\circ$	tan – chord
	$\hat{QRS} = 122^\circ$	opp $\angle$ s of cyclic quad
	QR//OS	alt $\angle$ s =
	$\hat{QRO} = 64^\circ$	alt $\angle$ s; QR / OS

(b) $\frac{OP}{PA} = \frac{OQ}{QB}$ PQ//AB Prop. theorem

$\frac{OQ}{QB} = \frac{OR}{RC}$ QR//BC Prop theorem

$\therefore \frac{OP}{PA} = \frac{OR}{RC}$

$\therefore PR // AC$ converse of prop. th.

SECTION B**QUESTION 8**

(a) $SA = \text{area of square} + 4(\text{area of triangle})$

$$= s^2 + 4\left(\frac{1}{2}sh\right)$$

$$= s^2 + 2sh$$

(b) $SA = (3s)^2 + 2(3s)(3h)$

$$= 9s^2 + 18sh$$

9 times more

(c) Original $V = \frac{1}{3}s^2a$

$$\text{New } V = \frac{1}{3}(ks)^2(ka) = k^3\left(\frac{1}{3}s^2a\right)$$

$$k^3 : 1$$

QUESTION 9

$$6! - 5! \cdot 2! = 480 \text{ ways}$$

QUESTION 10

(a) $m_{OP} = \frac{4}{3}$ and $c = 0 \therefore y = \frac{4}{3}x$

(b) $m_{AN} = -\frac{3}{4}$ $\tan \perp \text{radius}$

$$y - 4 = -\frac{3}{4}(x - 3)$$

$$y = -\frac{3}{4}x + \frac{25}{4}$$

subst $x = 5$: $y = -\frac{3}{4}(5) + \frac{25}{4} = \frac{5}{2}$

$A\left(5; \frac{5}{2}\right)$ must give coordinates

(c) $(x - 5)^2 + (y + 2)^2 = 49$

SUM of radii: $7 + \frac{5}{2} = 9,5$

DIFFERENCE of radii: $7 - \frac{5}{2} = 4,5$

Distance between centers = $\sqrt{(5 - 5)^2 + \left(-2 - \frac{5}{2}\right)^2} = \frac{9}{2} = 4,5$

$10,04 \neq \frac{9}{2}$ and $3,96 \neq \frac{9}{2} \therefore$ touches internally.

QUESTION 11

(a) $\tan \beta = \frac{x}{AF}$

$$AF = \frac{x}{\tan \beta}$$

(b) $\frac{AB}{\sin(180^\circ - 2a)} = \frac{AF}{\sin a}$ sine rule subst

$$AB = \frac{x \sin 2a}{\tan \beta \sin a} \text{ reduction}$$

$$= \frac{x \cdot 2 \sin a \cos a}{\tan \beta \sin a} \text{ double } \angle$$

$$= \frac{2x \cos a}{\tan \beta}$$

(c) $AB = \frac{2(0,7) \cos 50^\circ}{\tan 25^\circ}$ subst
 $= 1,93 \text{ m}$

(d) $\hat{ABC} = 123,5^\circ$ $\angle$ at centre $= 2 \times \angle$ at circumf
 $AC^2 = 1,92^2 + 0,85^2 - 2(1,92)(0,85) \cos 123,5^\circ$ subst in cosine rule
 $AC = 2,5 \text{ m}$
 Can also use cos rule in $\triangle ACF$

QUESTION 12

(a) $\frac{AD}{DB} = \frac{AG}{GF}$ prop.theorem

$$\frac{x}{9} = \frac{\frac{2x}{3}}{x+3} \quad \text{subst}$$

$$x^2 + 3x = 6x$$

$$x^2 - 3x = 0$$

$$x = 3$$

$$\therefore GF = 6 \text{ and } FC = 6 \therefore \text{midpoint}$$

(b) $GF = FC$ proven

$DG \parallel EF$ given

$\therefore DG = 2,$ mdpt. th.

(c) $\text{Area}\triangle ADG = \frac{1}{2}(\frac{3}{2})(3)h = 2,7 = 2,7 \text{ units}^2$

$h = 2,7$

$$\text{Area}\triangle ACD = \frac{1}{2} \times (\frac{2}{3} \times 3 + 6 + 6) \times 2,7$$

$$= 18,9 \text{ units}^2$$

QUESTION 13

(a) $\hat{A}_1 = \hat{C}_1$ tan chord theorem

$$\hat{A}_1 = \hat{E}_2 \quad \text{alt } \angle\text{s}; DE \parallel AB$$

$$\hat{C}_1 = \hat{E}_2$$

$\therefore DFEC$ is a cyclic quad converse $\angle$ s in same segment

(b) In $\triangle CDF$ and $\triangle AEB$:

$$\hat{A}_1 = \hat{C}_1 \quad \text{proven above or tan chord theorem}$$

$$\hat{F}_2 = \hat{E}_1 \quad \angle\text{s in same segment}$$

$$\hat{E}_1 = \hat{B} \quad \text{corr. } \angle\text{s}; AB \parallel DE$$

$$\hat{F}_2 = \hat{B}$$

$$\therefore \triangle CDF \parallel \triangle AEB \quad \angle\angle\angle$$

$$\text{Also: } E_3 = D_2 + D_3 \quad \text{ext } \angle \text{ of cyclic quad}$$

(c) $\frac{CD}{AE} = \frac{FD}{BE} \quad \triangle CDF \parallel \triangle AEB$

$$CD = \frac{AE \cdot FD}{BE}$$

$$\text{In } \triangle CAH: \frac{CD}{DA} = \frac{CG}{GH}$$

$$CD = \frac{DA \cdot CG}{GH}$$

$$\therefore \frac{AE \cdot FD}{BE} = \frac{DA \cdot CG}{GH}$$

QUESTION 14

$$\tan \hat{C}OD = \frac{8}{4}$$

$$\hat{C}OD = 63,43494882 \dots$$

$$\hat{C}OD = \hat{B}OA$$

$$\begin{aligned}\hat{B}OC &= 180^\circ - 2(63,4349882 \dots) \\ &= 53,13010235^\circ\end{aligned}$$

$$r = \sqrt{8^2 + 4^2} = \sqrt{80}$$

$$\text{Area } OBXC = \left(\frac{53,13010235}{360^\circ} \right) (\pi) (\sqrt{80})^2 = 37,1 \text{ cm}^2$$

$$\text{Area } OBC = 8^2 - 2 \left(\frac{1}{2} \times 4 \times 8 \right) = 32 \text{ cm}^2$$

$$\text{Area } BCX = 37,1 - 32 = 5,1 \text{ cm}^2$$

Total: 150 marks