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INTERNATIONAL SECONDARY CERTIFICATE EXAMINATION
MAY 2024

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) (i) $m_{AB} = m_{AC}$

$$m_{AB} = \frac{2 - (-3)}{-3 - 0} = \frac{5}{-3}$$

$$\frac{5}{-3} = \frac{4 - 2}{k - (-3)}$$

$$5(k + 3) = -3(2)$$

$$5k + 15 = -6$$

$$k = \frac{-21}{5} \text{ or } -4\frac{1}{5} \text{ or } -4,2$$

(ii) $m_{AB} = \frac{5}{-3}$

$$\therefore m_{BC} = \frac{3}{5}$$

$$\frac{-3 - 4}{0 - k} = \frac{3}{5}$$

$$-3k = -35$$

$$k = \frac{-35}{3} \text{ or } -11\frac{2}{3} \text{ or } -11,3$$

(iii) $\tan 45^\circ = \frac{4 - 2}{k + 3}$

$$1 = \frac{2}{k + 3}$$

$$k + 3 = 2$$

$$k = -1$$

(b) Circle A: $x^2 + y^2 = 49$
 Circle B: $(x - 10)^2 + y^2 = 9$

QUESTION 2

(a) N\$11 685,71

(b) N\$4 768,78

(c) $\bar{x} + \theta = 11\,685,71 + 4\,768,78$
 $= \text{N\$}16\,454,49$
 $\therefore$ only one person would receive a rating of 'good'

QUESTION 3

- (a) 25%
- (b) 110 minutes
- (c) More than 1 hour on their phone:
Only 25% of pupils spend more than an hour on their homework while 50% of pupils spend more than an hour on their phones.
- (d) positively skewed
since mean > median
or since there is more extreme values toward the positive end.

QUESTION 4

- (a) $\frac{-\sin 2\theta}{2 \cos \theta} = \frac{-2 \sin \theta \cos \theta}{2 \cos \theta} = -\sin \theta$
- (b) $\cos^2 75^\circ - \sin^2 75^\circ = \cos 2(75^\circ)$
 $= \cos 150^\circ$
 $= -\cos 30^\circ$
 $= -\frac{\sqrt{3}}{2}$
- (c) $5^{\tan x} = 5^{-1}$
 $\tan x = -1$
 $x = -45^\circ$ or $x = 135^\circ$
- (d) $\cos 72^\circ = \cos^2 (2.36^\circ)$
 $= 1 - 2 \sin^2 36^\circ$
 $= 1 - 2k^2$
- (e) $\sin x = \frac{1 + (1 - 2 \sin^2 x)}{1 + \sin x}$
 $\sin x = \frac{2(1 + \sin x)(1 - \sin x)}{1 + \sin x}$
 $\sin x = 2 - 2 \sin x$
 $\sin x = \frac{2}{3}$
 $\text{ref} < = 41,8^\circ$
 $x = 41,8^\circ + k.360^\circ$ or $x = 138,2^\circ + k.360^\circ; k \in \mathbb{Z}$

$$\begin{aligned}
 \text{(f) LHS} &= \frac{3(2 \cos^2 \beta - 1) + \cos \beta - 2}{3(2 \sin \beta \cos \beta) - 5 \sin \beta} \\
 &= \frac{6 \cos^2 \beta + \cos \beta - 5}{6 \sin \beta \cos \beta - 5 \sin \beta} \\
 &= \frac{(6 \cos \beta - 5)(\cos \beta + 1)}{\sin \beta (6 \cos \beta - 5)} \\
 &= \frac{\cos \beta + 1}{\sin \beta} \\
 &= \text{RHS}
 \end{aligned}$$

QUESTION 5

(a) (i) Cyclic

(ii) Join OD and OB.

$$\hat{O}_1 = 2\hat{A} \quad \angle \text{ at centre} = 2 \times \angle \text{ at circumf.}$$

$$\text{and } \hat{O}_2 = 2\hat{C} \quad \angle \text{ at centre} = 2 \times \angle \text{ at circumf.}$$

$$\text{but } \hat{O}_1 + \hat{O}_2 = 360^\circ \quad \angle \text{ 's around point or revolution}$$

$$\therefore 2\hat{A} + 2\hat{C} = 360^\circ$$

$$\therefore \hat{A} + \hat{C} = 180^\circ$$

(b) (i) $\hat{E}_2 = 90^\circ - 56^\circ = 34^\circ$ $\angle$ in semi-circle

(ii) $\hat{B}_2 = 32^\circ$ tan-chord theorem

$$\hat{B}_3 = \hat{E}_2 = 34^\circ \quad \angle \text{ 's in same segment}$$

$$\therefore \hat{EBC} = 66^\circ$$

(iii) $\hat{D} = 180^\circ - (90^\circ + 32^\circ) = 58^\circ$ int $\angle$'s of Δ

$$\hat{F} = 180^\circ - 58^\circ = 122^\circ \quad \text{opp. } \angle \text{ 's of cyclic quad.}$$

QUESTION 6

- (a) $\frac{1}{2}$ line parallel to one side of Δ
- (b) $12 \div 3 \times 2 = 8$ cm line parallel to one side of Δ
 $\therefore BD = DE$
 $\therefore D$ is the midpt of BE
- (c) 6 cm midpoint theorem
- (d) $\frac{\text{area } \Delta KEC}{\text{area } \Delta KBC} = \frac{\frac{1}{2}BC \cdot h}{\frac{1}{2}EC \cdot h}$
 $= \frac{BC}{EH} = \frac{20}{4} = 5$ both Δ 's have the same height

SECTION B**QUESTION 7**

- (a) 500
- (b) $60\% = 90 \text{ marks} \dots 300 \text{ students above } 60\%$
 $\frac{300}{500} = 60\% \text{ or } 0,6$
- (c) (i) The mean increased and the standard deviation remained the same
 (ii) The mean increased and the standard deviation decreased

QUESTION 8

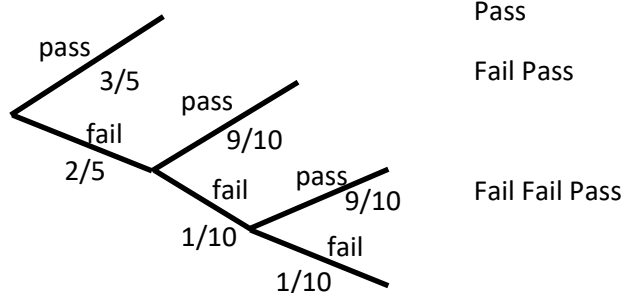
- (a) $(x-2)^2 + (y-1)^2 = 8$
 Subst (2;1) in $y - x + 1 = 0$: $1 - 2 + 1 = 0$
 Thus LHS = RHS thus the line passes through the centre of the circle.
- (b) C(4;3)
 $y - 3 = -1(x - 4)$
 $y = -x + 7$
- (c) E(7;0); A(1;0) and C(4;3)
 $CE = \sqrt{(7-4)^2 + (0-3)^2} = \sqrt{18}$
 $AC = \sqrt{(1-4)^2 + (0-3)^2} = \sqrt{18}$
 $\text{Area } \triangle CAE = \frac{1}{2}(\sqrt{18})(\sqrt{18}) = 9 \text{ units}^2$

QUESTION 9

- (a) $1 \times 9 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$ fund. counting principle
 $= 900\,000\,000$
- (b) $1 \times 4^3 \times 5^5$
 $= 200\,000$
- (c) $P(\text{specific number}) = \frac{1}{1 \times 10 \times 9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2}$
 $= \frac{1}{3\,628\,800}$

QUESTION 10

(a)

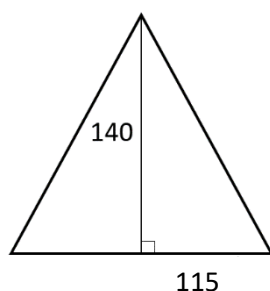


(b) $\frac{3}{5} + \frac{2}{5} \times \frac{9}{10} = \frac{24}{25}$ or 0,96

QUESTION 11

(a) $\tan E = \frac{140}{115}$
 $\hat{E} = 50,6^\circ$

(b)



$$h = \sqrt{140^2 + 115^2} = 181,1767\dots$$

$$\text{Area} = \frac{1}{2}(230)(181,1767\dots)$$

$$= 20835,3$$

QUESTION 12

- (a) (i) In
- $\triangle BCR$
- and
- $\triangle SPR$
- :

$$\hat{R}_3 = \hat{R}_1$$

vert. opp. $\angle$'s =

$$\hat{B}_1 = \hat{C}$$

corr. $\angle$'s QB//SC

$$\hat{B}_1 = \hat{P}$$

tan-chord theorem

$$\therefore \hat{C} = \hat{P}$$

$$\hat{B}_3 = \hat{S}_2$$

3rd $\angle$ of $\triangle$

$$\therefore \triangle BCR \sim \triangle SPR$$

AAA

(ii) $\frac{BC}{SP} = \frac{BR}{SR} \quad \triangle BCR \sim \triangle SPR$

$$BC \cdot SR = BR \cdot SP$$

$$\text{but } BC = \frac{1}{2}AC$$

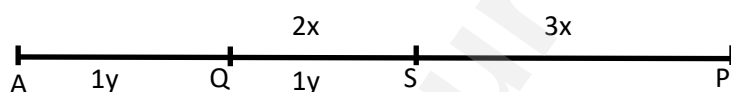
given AB = BC

$$\therefore \frac{1}{2}AC \cdot SR = BR \cdot SP$$

$$\therefore 2BR \cdot SP = SR \cdot CA$$

(b) $\frac{BR}{RP} = \frac{2}{3} = \frac{QS}{SP} \quad \text{line } \parallel \text{ to one side of } \triangle$

and $\frac{AQ}{AS} = \frac{AB}{BC} = \frac{1}{1} \quad \text{line } \parallel \text{ to one side of } \triangle$



$$2x = 1y$$

$$\frac{AQ}{QP} = \frac{1y}{5x} = \frac{1y}{5\left(\frac{1}{2}\right)y}$$

$$\frac{1}{\frac{5}{2}} = 2:5$$

QUESTION 13

(a) $\frac{V \text{ of sphere}}{V \text{ of cylinder}} \times 100 = \frac{\frac{4}{3}\pi r^3}{\pi r^2(2r)} \times 100$

$$= \frac{\frac{4}{3}\pi r^3}{2\pi r^3} \times 100$$

$$= \frac{2}{3} \times 100$$

$$= 66,7\%$$

(b) $\pi(5)^2 h = 33,3\% \times \pi(5)^2(10)$

$$25\pi h = \frac{333\pi}{4}$$

$$h = \frac{333}{100} \text{ or } 3,3 \text{ cm}$$

QUESTION 14

(a) $\frac{120}{360}(\pi)(20)^2 = 418,879..... \approx 419\text{cm}^2$

(b) $A = \pi r l$
 $419 = \pi r(20)$

$r = 6,6685...$

$20^2 - 6,6685...^2 = 355,5298...$

$h = 18,9 \text{ cm}$

or $r \approx 6,7$

$20^2 - 6,7^2 = 355,11$

$h = 18,8 \text{ cm}$

QUESTION 15

(a) (i) $y \in [r + p; r - p]$

(ii) (1) $f(x) = p + r$
 2 solutions

(2) $f(x) = r$
 5 solutions

(b) $q = 1$ produces 2 solutions

$q = 2$ produces 4 solutions

$q = 3$ produces 6 solutions

$\frac{101}{2} = 50,5 \quad \therefore q = 50,5$ produces 101 solutions.

Total: 150 marks