INTERNATIONAL SECONDARY CERTIFICATE EXAMINATION
NOVEMBER 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.

QUESTION 1

(a) (i) 50

(ii) 5

(iii) 75% of 50 = 37,5
$\pm$57% (allow $\pm$2)

(b) (i) C

(ii) C

QUESTION 2

(a) (i) $\dfrac{8!}{2! \times 2!} = 10\ 080$

(ii) $\dfrac{2 \times 6!}{2!} \div 10\ 080 = \dfrac{1}{14}$

(b) (i) $\dfrac{1}{4} \times \dfrac{1}{4} = \dfrac{1}{16}$

(ii) $\left(\dfrac{1}{4} + \dfrac{1}{4}\right) - \dfrac{1}{16} = \dfrac{7}{16}$

QUESTION 3

(a) All <'s of equilateral $\Delta = 60^\circ$

(b) Shaded area = area of large Δ-area of small Δ

$= \dfrac{1}{2}(80)(80)\sin 60^\circ - \dfrac{1}{2}(60)(60)\sin 60^\circ$

$= 1\ 212{,}44\ \text{cm}^2$

QUESTION 4

(a) (i) D(4;0)

(ii) $m_{DE} = \dfrac{-2-0}{-4-4} = \dfrac{1}{4}$

(iii) $y - 8 = \dfrac{1}{4}(x-4)$

$y = \dfrac{1}{4}x + 7$

(iv) $\tan\theta = \dfrac{1}{4}$

$\theta = 14{,}04^\circ$

$P\hat{R}B = 90^\circ - 14{,}04^\circ = 75{,}96^\circ$

(v)

Q(–4;6)

(b) (i) Midpt of AB = (1;2)

(ii) $m_{AB} = \dfrac{3-1}{4+2} = \dfrac{1}{3}$

(iii) $\perp m = -3$

$y - 2 = -3(x-1)$

$y - 2 = -3x + 3$

$y = -3x + 5$

(iv) Perp. bisector of AB passes through M.

$y = -3x + 5$ and $x = 0$

$\therefore y = -3(0) + 5 = 5$

$\therefore M(0;5)$

(v) $r^2 = MB^2$

$= (4-0)^2 + (3-5)^2$

$= 20$

or $r^2 = MA^2$

$= (-2-0)^2 + (1-5)^2$

$\therefore (x-0)^2 + (y-5)^2 = 20$

$x^2 + y^2 - 10y + 25 = 20$

$x^2 + y^2 - 10y + 5 = 0$

QUESTION 5

(a) $$\frac{(-2\sin\theta)(-\sin 36^\circ)(\cos 36^\circ)}{\sin 72^\circ} = \frac{\sin\theta \sin 72^\circ}{\sin 72^\circ}$$
$$= \sin\theta$$

(b) $$2\sin\theta\cos\theta - 4\sin^2\theta = 0$$
$$2\sin\theta(\cos\theta - 2\sin\theta) = 0$$

$\sin\theta = 0^\circ$ or $\tan\theta = \dfrac{1}{2}$

$\theta = 0^\circ + k.180^\circ$ $\theta = 26,57^\circ + k.180^\circ$ $k \in Z$

(c) (i) $$\frac{1 - 2\sin x\cos x}{\cos^2 x - \sin^2 x} = \frac{\sin^2 x + \cos^2 x - 2\sin x\cos x}{\cos^2 x - \sin^2 x}$$
$$= \frac{(\cos x - \sin x)(\cos x - \sin x)}{(\cos x - \sin x)(\cos x + \sin x)}$$
$$= \frac{\cos x - \sin x}{\cos x + \sin x}$$

(ii) $$\frac{1 - \sin 30^\circ}{\cos 30^\circ} = \frac{1 - \frac{1}{2}}{\frac{\sqrt{3}}{2}}$$
$$= \frac{1}{2} \times \frac{2}{\sqrt{3}}$$
$$= \frac{\sqrt{3}}{3}$$

QUESTION 6

(a) (i) $\frac{MN}{45}=\frac{108}{36}$ Prop. theorem PQ//LM

$MN=135$

(ii) In ΔNPQ and ΔNLM:

$\hat{N}$ is common

$N\hat{P}Q=N\hat{L}M$ corr $<$'s $PQ//LM$

$P\hat{Q}N=L\hat{M}N$ 3rd ∠ of Δ or corr $<$'s; $PQ//LM$

∴ΔNPQ///ΔNLM ∠∠∠

$\frac{y}{x}=\frac{108}{72}$

$=\frac{3}{2}$ or 1,5

(b) (i) tan-chord theorem

(ii) $B\hat{A}D=90°-x$ tan⊥radius

$\hat{E}_1=90°-x$ ext < of cyclic quad.

OR

$\hat{E}_3=90°$ < in semi-circle

$\hat{E}_2=x$ <s in same segm

$\hat{E}_1=90°-x$ <s on str. line

(iii) $\hat{F}_1=90°-x$ int <s of Δ

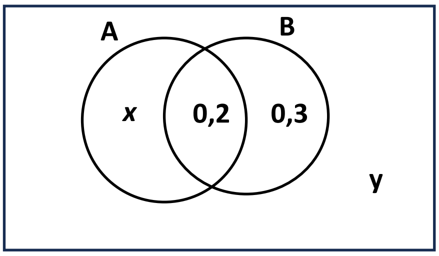
$\hat{F}_1=\hat{E}_1$

∴ *CFDE* is a cyclic quad ext < = int. opp. <

SECTION B

QUESTION 7

P(A and B) = P(A) $\times$ P(B)



$0{,}2 = (x + 0{,}2)(0{,}5)$
$0{,}2 = 0{,}5x + 0{,}1$
$x = 0{,}2$
$y = 1\text{-}0{,}7 = 0{,}3$

QUESTION 8

(a) $x = 30{,}78$

(b) 4,80

(c) (i) $\dfrac{3 \times 5 + 9 \times 1}{12} = 2\ ^\circ\text{C}$ per month or add 26 to total

(ii) Standard deviation will decrease.
Range will decrease.

QUESTION 9

(a)	GA//CD	given
	$\hat{O}_1 = \hat{D}_1$	tan chord
	$\hat{O}_1 = \hat{C}$	tan chord
	$\therefore \hat{D}_1 = \hat{C}$	
	but they are corresponding <s	
	GC//AD	
	AGCD is a parm	both pairs of opp sides //
(b)	$\hat{G}_1 = \hat{C}$	corr <s EA//CO
	$\hat{C} = \hat{D}_1$	proven above
	$\hat{D}_1 = \hat{A}_2$	alt <s EA//CO
	$\hat{A}_2 = \hat{O}_2$	tan chord
	$\therefore$ GAOC is a cyclic quad	ext < = int. opp. <

QUESTION 10

(a) In Δ ABP:

$\frac{AR}{RB} = \frac{AS}{SP}$ line || one side of Δ

$\frac{AS}{SP} = \frac{4}{3}$

(b) In Δ ABP:

AP = PC = 7k P given as mdpt

$\frac{AS}{SC} = \frac{4}{10} = \frac{2}{5}$

(c) In ΔRSC

$\frac{SP}{PC} = \frac{RT}{TC} = \frac{3}{7}$ line || one side of Δ

(d)
$$\frac{Area\,\Delta TPC}{Area\,\Delta RSC} = \frac{\frac{1}{2}TC.PC\sin A\hat{C}R}{\frac{1}{2}RC.SC\sin A\hat{C}R}$$
$$= \frac{TC}{RC}\cdot\frac{PC}{SC}$$
$$= \frac{7}{10}\times\frac{7}{10}$$
$$= \frac{49}{100}$$

QUESTION 11

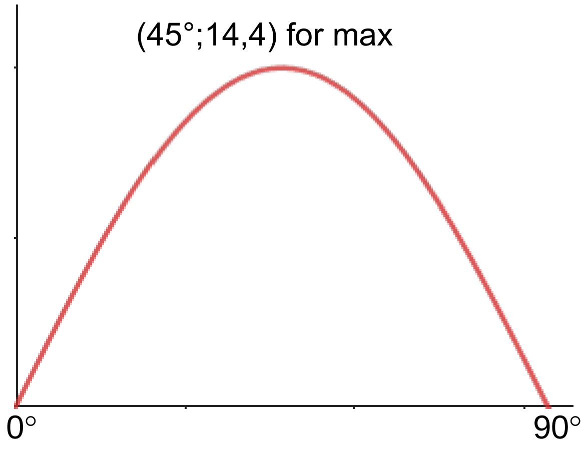
(a)
$$\frac{\sin E}{20} = \frac{\sin 30^\circ}{8}$$
$$\sin E = \frac{5}{4}$$

but $-1 < \sin E < 1$

∴ Δ *DEF* does not exist

$d \geq 10$, thus $d = 10$ is the min value for Δ*DEF* to exist

(b) (i) $y = \frac{144}{10}\sin 2x$
$= 14,4\sin 2x$



(ii) $y \in [0;14,4]$ or $0 \le y \le 14,4$

(iii) 14,4 m

(iv) $14,4 = 14,4\sin 2x$
$1 = \sin 2x$
$x = 45°$ (can also read from graph)

(v) $7,2 = 14,4\sin 2x$
$\sin 2x = \frac{1}{2}$
$2x = 30°$ or $2x = 150°$
$x = 15°$ or $x = 75°$

(vi) $\frac{v^2}{10}\sin(2 \times 48°) = 23,37$
$v^2 = \frac{23,37 \times 10}{\sin 96°}$
$v^2 = 234,9872...$
$v = 15,33$ m/sec

QUESTION 12

$$x^2 + 3x + \left(\frac{3}{2}\right)^2 + y^2 - 6y + (-3)^2 = 9 + \frac{9}{4} + 9$$

$$\left(x + \frac{3}{2}\right)^2 + (y-3)^2 = \frac{81}{4}$$

$$\text{radius of MP} = \frac{9}{2} + 1 = \frac{11}{2}$$

$$\left(x + \frac{3}{2}\right)^2 + (y-3)^2 = \frac{121}{4}$$

QUESTION 13

Area semi-circle $ADC = \frac{1}{2}\pi\left(\frac{1}{2}AC\right)^2$

Area semi-circle $AB = \frac{1}{2}\pi\left(\frac{1}{2}AB\right)^2$

Area semi-circle $BC = \frac{1}{2}\pi\left(\frac{1}{2}BC\right)^2$

Area ADC – area AB – area BC

$$= \frac{1}{2}\pi\left(\frac{1}{2}AC\right)^2 - \frac{1}{2}\pi\left(\frac{1}{2}AB\right)^2 - \frac{1}{2}\pi\left(\frac{1}{2}BC\right)^2$$
$$= \frac{1}{8}\pi(AC^2 - AB^2 - BC^2)$$
$$= \frac{1}{8}\pi\left[(AB+BC)^2 - AB^2 - BC^2\right]$$
$$= \frac{1}{8}\pi\left[AB^2 + 2AB.BC + BC^2 - AB^2 - BC^2\right]$$
$$= \frac{1}{8}\pi\left[2AB.BC\right]$$
$$= \frac{1}{4}\pi AB.BC \text{ \_\_\_\_\_\_\_\_ (1)}$$

Join AD and DC

$A\hat{D}C = 90^\circ$ < in semi-circle

In $\triangle$ABD and $\triangle$DBC:

$A\hat{B}D = D\hat{B}C = 90^\circ$

$\hat{A} = B\hat{D}C$ because $\hat{D}_1 + \hat{D}_2 = 90^\circ$ and $\hat{A} + \hat{D}_1 = 90^\circ$

$\therefore \Delta ABD /// \Delta DBC$ <<<

$$\frac{AB}{DB} = \frac{BD}{BC} = \frac{AD}{DC}$$

$BD^2 = AB.BC$ ______ (2)

$t^2 = AB.BC$

Substitute (2) in (1): Area $= \frac{1}{4}\pi t^2$

Total: 150 marks