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## MATHEMATICS PRELIM PAPER II 2020

## MEMORANDUM

## QUESTION 1

(a) (1)  $y = -\frac{x}{2} + 9$  ✓

$m_{AC} = 2$  (Perp lines) ✓ (2)

(2)  $\tan \theta = 2$  ✓

$\therefore \theta = 63^\circ$  rounded to nearest whole number. ✓ (2)

(b)  $y - (-5) = 2(x - (-2))$  ✓

$y + 5 = 2x + 4$

$y = 2x - 1$  ✓ (2)

(c)  $-\frac{x}{2} + 9 = 2x - 1$  ✓

$x = 4$  ✓

Subs into one of the equations

$y = 7$  ✓ (3)

$T(4; 7)$

(d) (1)  $4 = \frac{-2+x}{2}$  ✓

$\therefore x = 10$  ✓

$\therefore y = 11$  ✓ (3)

$C(10; 19)$

$$(2) \quad CT = \sqrt{(10 - 4)^2 + (19 - 7)^2} \quad \checkmark$$

$$CT = 6\sqrt{5} \quad \checkmark$$

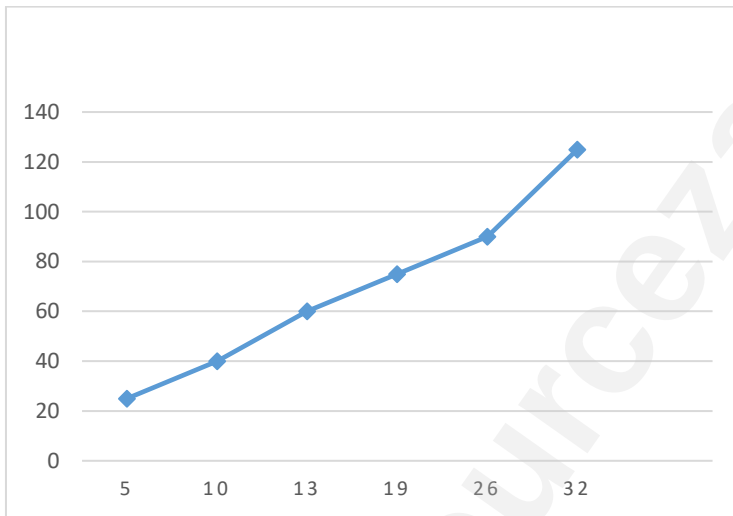
$$15^2 = (6\sqrt{5})^2 + BT^2 \quad \checkmark$$

$$BT = 3\sqrt{5} \quad \checkmark$$

(4)

## QUESTION 2

(a)



✓ heading and axes labelled

✓✓ points

(3)

$$(b) \quad (1) \hat{y} = 8,04 + 3,49x \quad \checkmark \checkmark$$

(2)

$$(2) r = 0,98 \quad \checkmark$$

(1)

$$(c) \quad \hat{y} = 8,04 + 3,49(35) \quad \checkmark$$

$$y = 130,19 \text{ Watts} \quad \checkmark$$

(2)

(d) valid as correlation coefficient is very high ✓

(1)

**QUESTION 3**

(a)  $120^\circ$  ✓ (1)

(b)  $\frac{360}{120} = b \quad \therefore b = 3$  ✓ (1)

(c)  $x = 67,5^\circ, -22,5^\circ, -45^\circ$  ✓✓✓ (3)

(d)  $\sin bx < -\cos x$   
 $x \in (-45^\circ; -22,5^\circ)$  ✓✓  $\cup (67,5^\circ; 90^\circ]$  ✓✓ (4)

(e) reflect about the  $x$ -axis ✓  
 and shifted  $30^\circ$  to the right ✓ (2)

#### QUESTION 4

(a)

$$\frac{\sin\theta - (-\sin\theta)}{\sin 2\theta} \checkmark \checkmark$$

$$\frac{2\sin\theta}{2\sin\theta\cos\theta} \checkmark$$

$$= \frac{1}{\cos\theta} \checkmark$$

(b) (1)  $\overset{\checkmark}{\sin x}(-\overset{\checkmark}{\sin x}) - \overset{\checkmark}{\cos x}(-\overset{\checkmark}{\cos x})$

$$= -\sin^2 x + \cos^2 x$$

$$= \cos^2 x - \sin^2 x$$

$$= \cos 2x \quad \checkmark \quad (5)$$

$$= RHS$$

(2)  $\cos 2x = -1 \quad \checkmark$

$$2x = \pm 180^\circ + k \cdot 360^\circ; k \in \mathbb{Z} \quad \checkmark$$

$$x = \pm 90^\circ + k \cdot 180^\circ \quad \checkmark \quad (3)$$

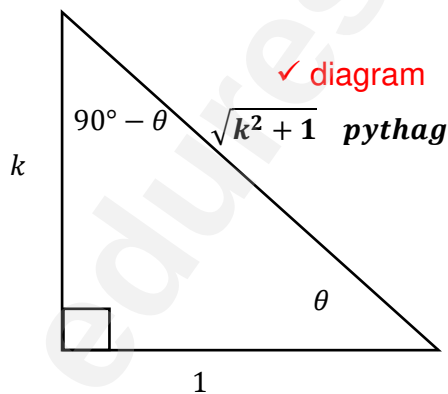
(c)  $LHS = \frac{\overset{\checkmark}{\sin\theta}}{\overset{\checkmark}{\cos\theta}} + \frac{\overset{\checkmark}{\cos\theta}}{\overset{\checkmark}{\sin\theta}}$

$$= \frac{\overset{\checkmark}{\sin^2\theta} + \overset{\checkmark}{\cos^2\theta}}{\overset{\checkmark}{\cos\theta\sin\theta}}$$

$$= \frac{1}{\cos\theta\sin\theta} \quad \checkmark$$

$$RHS = \frac{2}{2\sin\theta\cos\theta} = \frac{1}{\sin\theta\cos\theta} \quad \checkmark \quad (4)$$

(d)



$$\sin 2\theta$$

$$= 2\sin\theta\cos\theta$$

$$= 2\left(\frac{k}{\sqrt{k^2+1}}\right)\left(\frac{1}{\sqrt{k^2+1}}\right)$$

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

**QUESTION 5**

(a) Theory (5)

$$(b) \widehat{W}_1 = 18^\circ \text{ isos } \Delta; \text{radii } \checkmark$$

$$\widehat{O}_2 = 36^\circ < \text{at centre} = 2 < \text{at circle } \checkmark$$

$$O\hat{R}S = 72^\circ < s \text{ in } \Delta; \text{radii } \checkmark$$

$$\hat{T} = 108^\circ \text{ Opp } < s \text{ cyclic quad } \checkmark \quad (4)$$

$$(c) O\hat{S}R = x \text{ radii } \checkmark$$

$$\hat{O}_1 = 180^\circ - 2x < s \text{ in } \Delta \checkmark$$

$$\hat{P} = 180^\circ - 2x \text{ Opp } < s \text{ cyclic quad } \checkmark$$

$$\hat{P} = \hat{T} < s \text{ in same segment } \checkmark \quad (4)$$

**QUESTION 6**

$$\frac{AE}{ED} = \frac{AB}{BC} \text{ Line parallel one side } \Delta; BE \parallel CD \checkmark$$

$$\therefore \frac{AE}{6} = \frac{10}{5} \checkmark$$

$$\therefore AE = 12 \text{ mm } \checkmark$$

$$\frac{AF}{FE} = \frac{AB}{BC} \text{ Line parallel one side } \Delta; BF \parallel CE \checkmark$$

$$2k + k = 12 \checkmark$$

$$k = 4 \text{ mm } \therefore FE = 4 \text{ mm } \checkmark \quad (6)$$

## QUESTION 7

$$(a) M(8; -4) \checkmark \quad (1)$$

$$(b) OM = \sqrt{(8-0)^2 + (-4-0)^2} \checkmark$$

$$OM = 4\sqrt{5} \checkmark \quad (2)$$

$$(c) ON = OM - NM \checkmark$$

$$ON = 4\sqrt{5} - \sqrt{45} \checkmark$$

$$ON = \sqrt{5} \text{ units} \checkmark \quad (3)$$

$$(d) \hat{MTP} = 90^\circ \text{ tan perp. radii} \checkmark$$

$$\hat{OMT} = 90^\circ \text{ Alt } \angle s; TP \parallel OM \checkmark \quad (2)$$

$$(e) m_{MT} \cdot m_{OM} = -1 \checkmark$$

$$m_{OM} = \frac{-4-0}{8-0} = -\frac{1}{2} \checkmark$$

$$\therefore m_{MT} = 2 \checkmark$$

$$y - (-4) = 2(x - 8) \checkmark$$

$$\therefore y = 2x - 20 \checkmark \quad (5)$$

$$(f) (x-8)^2 + (y+4)^2 = 45$$

$$(x-8)^2 + (2x-20+4)^2 = 45 \checkmark$$

$$x^2 - 16x + 64 + 4x^2 - 64x + 256 - 45 = 0 \checkmark$$

$$x^2 - 16x + 55 = 0 \checkmark$$

$$x = 11 \checkmark \text{ or } x = 5$$

n/a

$$y = 2(11 \checkmark) - 20 = 2 \checkmark \quad (6)$$

$$\therefore T(11; 2)$$

## QUESTION 8

$$\begin{aligned}
 \text{(a)} \quad & \frac{\sin(180^\circ - 76^\circ)[2 \cos^2 15^\circ - 1]}{\tan 38^\circ \cdot \sin^2(412^\circ - 360^\circ)} \\
 &= \frac{\sin 76^\circ \cdot \cos 2(15^\circ)}{\tan 38^\circ \cdot \sin^2 52^\circ} \\
 &= \frac{\sin(2 \times 38^\circ) \cdot \cos 30^\circ}{\frac{\sin 38^\circ}{\cos 38^\circ} \cdot \cos^2 38^\circ} \\
 &= \frac{2 \sin 38^\circ \cos 38^\circ \cdot \frac{\sqrt{3}}{2}}{\sin 38^\circ \cdot \cos 38^\circ} \\
 &= \sqrt{3}
 \end{aligned} \tag{7}$$

$$\begin{aligned}
 \text{(b) (1)} \quad & \frac{\sin x}{\cos x} - 2 \sin x = 0 \\
 \sin x - 2 \sin x \cos x &= 0 \quad (\cos x \neq 0) \\
 \sin x(1 - 2 \cos x) &= 0 \\
 \sin x = 0 \quad \text{or} \quad \cos x &= \frac{1}{2}
 \end{aligned} \tag{5}$$

$$\begin{aligned}
 \text{(2)} \quad \sin x &= 0 & \text{OR} & & \cos x &= \frac{1}{2} \\
 x = 0^\circ + k \cdot 180^\circ & & & & x = \pm 60^\circ + k \cdot 360^\circ
 \end{aligned} \tag{2}$$

$$\begin{aligned}
 \text{(c) (1)} \quad BD^2 &= x^2 + x^2 - 2(x)(x) \cos(180^\circ - 2\beta) \\
 &= 2x^2 - 2x^2(-\cos 2\beta) \\
 &= 2x^2[1 + \cos 2\beta] \\
 BD &= x\sqrt{2[1 + \cos 2\beta]}
 \end{aligned} \tag{4}$$

$$\text{(2) In } \triangle ABD: \tan \theta = \frac{AB}{BD}$$

$$\therefore AB = BD \cdot \tan \theta$$

*subs BD from (1) above*

$$AB = x\sqrt{2[1 + \cos 2\beta]} \cdot \tan \theta$$

$$AB = x\sqrt{2[1 + 2 \cos^2 \beta - 1]} \cdot \tan \theta$$

$$AB = x\sqrt{2 + 4 \cos^2 \beta - 2} \cdot \tan \theta$$

$$AB = x\sqrt{4 \cos^2 \beta} \cdot \tan \theta$$

$$AB = x \cdot 2 \cos \beta \cdot \tan \theta$$

(5)

### QUESTION 9

- (a) 75% ✓ (1)
- (b)  $0,55 \times 1224$  ✓ = 612 people ✓ (2)
- (c) young people in community, holiday venue etc. ✓ (1)
- (d) Ballito ✓ – fewer fast runner/fewer entries etc. ✓ (2)
- (e) Delta = 0,0545 ✓  
 Bryanston = 0,28445 ✓ Delta is less skewed. Perhaps Delta has more serious  
 Runners who are competitive. (or the difference  
 between mean and median is higher for Bryanston. ✓  
 (3)

### QUESTION 10

- (a)  $\hat{P}_4 = \hat{L}$  *tan chord theorem*  
 $L\hat{P}R = 90^\circ$  *< in a semi circle*  
 $\therefore \hat{R}_2 = 90^\circ - \hat{P}_4$  *< of  $\Delta LPR$*   
 $\therefore \hat{R}_1 = 90^\circ - \hat{P}_4$  *< of  $\Delta RPQ$*
- (b) In  $\Delta PNM$  and  $\Delta PRQ$ :
- (1)  $\hat{N}_1 = \hat{Q}$  *both  $90^\circ$*   
 $\hat{P}_2 = \hat{L}$  *< s opp = sides*  
 $\hat{P}_4 = \hat{L}$  *tan chord theorem*
- (2)  $\therefore \hat{P}_2 = \hat{P}_4$
- (3)  $\hat{M}_2 = \hat{R}_1$  *3rd < of  $\Delta$*   
 $\therefore \Delta PNM \parallel \Delta PRQ$  *aaa*

(c) In  $\triangle PLR$  and  $\triangle PRQ$ :

$$\angle \hat{P}R = \angle \hat{Q} \quad \text{Both} = 90^\circ$$

$$\hat{R}_2 = \hat{R}_1 \quad \text{Proven}$$

$$\hat{L} = \hat{P}_4 \quad \text{3rd } \angle \text{ of triangle}$$

$$\triangle PLR \equiv \triangle QPR \quad (\text{AAA})$$

$$\frac{LR}{PR} = \frac{PR}{QR} \quad \text{By } \triangle S$$

$$LR = \frac{30^2}{15} = 60$$

(d)  $NM \parallel PR$   $\therefore$  co-int  $\angle$ s or corr  $\angle$ s

$$\therefore NM = \frac{1}{2}PR \quad \text{Mid point theorem}$$

$$\sin x = \frac{30\sqrt{3}}{15}$$

$$\therefore x = 60^\circ$$

## QUESTION 11

$$(a) V = \frac{1}{3}\pi(7^2)(24) \checkmark$$

$$V = 392\pi \text{ cm}^3 \checkmark \quad (2)$$

$$(b) h = \frac{24}{3} = 8\text{cm} \checkmark$$

$$\frac{r}{R} = \frac{h}{H}$$

$$r = \frac{(7)(8)}{24} \checkmark = \frac{7}{3}\text{cm} \checkmark \quad (3)$$

$$(c) V_{air} = V_{cone} - V_{water}$$

$$V = 392\pi - \frac{1}{3}\pi\left(\frac{7}{3}\right)^2(8) \checkmark$$

$$V = 377,48\pi \text{ cm}^3 \checkmark \quad (2)$$

$$(d) \frac{24}{7} = \frac{h_{air}}{r}$$

$$h = \frac{24r}{7} \checkmark$$

$$V_{air} = 337,48\pi = \frac{1}{3}\pi r^2 \left(\frac{24r}{7}\right) \checkmark$$

$$r = 6,91 \text{ cm} \checkmark$$

$$\therefore h = 23,70 \text{ cm}$$

$$h_{water} = 24 - 23,70 = 0,3 \text{ cm} \checkmark \quad (4)$$

Or

$$lsf = \frac{1}{3}$$

$$\therefore vsf = \frac{1}{27}$$

$$\therefore vsf \text{ of air} = \frac{26}{27}$$

$$\therefore lsf \text{ of air} = \sqrt[3]{\frac{26}{27}}$$

$$\therefore \sqrt[3]{\frac{26}{27}} \times 24$$

$$= 23,70 \dots$$

$$\therefore \text{height of water} = 24 - 23,70 \dots$$

$$= 0,3\text{cm}$$

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