Anglo-Chinese School (Barker Road)

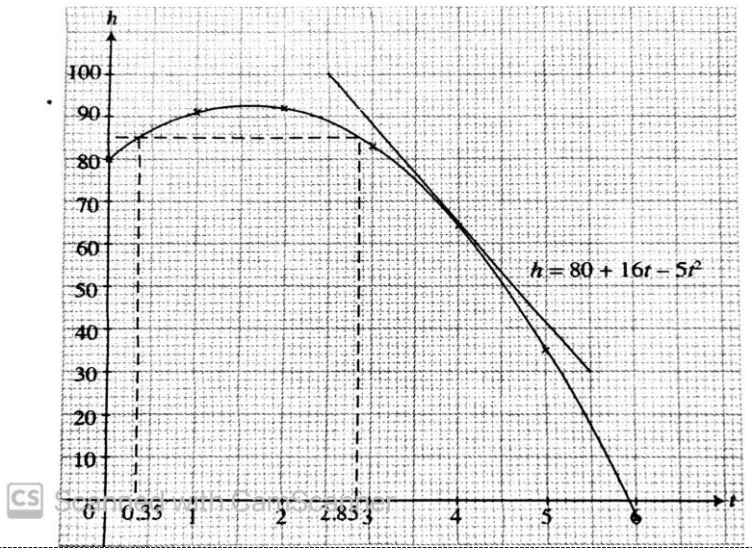
Mathematics Paper 2 Marking Scheme
Secondary 4 Express / 5 Normal Academic
Preliminary Exams 2024

Qn		Steps/Answer	Remarks
1	(a)	USD $= \frac{10000}{x}$	
	(b)	$\frac{10000}{x-0.030} - \frac{10000}{x} = 166$	
		$10000x - 10000(x-0.030) = 166x(x-0.030)$	
		$166x^2 - 4.98x - 300 = 0$	
		$83x^2 - 2.49x - 150 = 0$	
	(c)	$x = \frac{2.49 \pm \sqrt{(-2.49)^2 - 4(83)(-150)}}{2(83)}$	
		$x = 1.359$ or $x = -1.329$	
	(d)	$\frac{20000}{1.359 - 0.030}$	
		= USD 15 049	Accept 15 048
2	(ai)	$s = [5 - 3(-3)^2] \div (-3)^2$ $s = -2\frac{4}{9}$ or $s = -\frac{22}{9}$	Cannot accept 3 sf
	(aii)	$sq^2 = r - 3q^2$	
		$sq^2 + 3q^2 = r$	
		$q^2(s+3) = r$	
		$q = \pm\sqrt{\frac{r}{(s+3)}}$	
	(b)(i)	$(7n-1)^2 - (n-1)^2$ $= [(7n-1) + (n-1)][(7n-1) - (n-1)]$ $= 6n(8n-2)$	
		$= 12n(4n-1)$	$= 12(4n^2 - n)$ is also accepted
	(b)(ii)	$\frac{p - 3n + 12n^2 - 4np}{(7n+1)^2 - (n-1)^2}$	
		$= \frac{p(1-4n) - 3n(1-4n)}{12n(4n-1)}$	
		$= \frac{(3n-p)(4n-1)}{12n(4n-1)}$	
		$= \frac{3n-p}{12n}$	

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3	(a)	<u>One possible answer</u> • *ET* = *AT* (tangents from external points are equal) • *TO* is common • *OE* = *OA* (radii of circle) Triangle *TOA* is congruent to triangle *TOE* (SSS test)	
		<u>Another possible answer</u> • angle *TAO* = angle *TEO* = 90° (tangent perpendicular to radius) • *TO* is common • *OE* = *OA* (radii of circle) Triangle *TOA* is congruent to triangle *TOE* (RHS test)	
	(bi)	angle *AOT* = (180 – 90 – 32)° = 58° (tangent perpendicular to radius)	
		angle *ABF* = $\frac{1}{2}$angle *AOT* $\frac{1}{2}(58°) = 29°$ (angle at centre is twice angle at circumference)	
		angle *OFG* = angle *ABF* = 29° (alternate angles, *OF* //*BA*)	
	(bii)	angle *ACF* = angle *ABF* =29° (angles in the same segment)	
		angle *CAE* = 180 – 90 – 29 = 61° (*OT* is perpendicular bisector of chord *AE*)	
		angle *CDE* = 180 – 61 = 119° (angles in opposite segments)	
	(c)	As angle *OET* and angle *OAT* are right-angles, by the property of **right angle in a semicircle**, *OT* is a diameter and points *E* and *A* will lie on the circumference. *OETA* are thus four points on the circumference of this circle. <u>Or</u> Angle *AOE* + angle *ATE* = $(58 \times 2) + (32 \times 2) = 180°$ Angle *OET* + angle *OAT* = 180°. By the property of **angles in opposite segments,** *OETA* are thus four points on the circumference of this circle.	
4	(a)(i)	$\overrightarrow{AB} = 2b - a$	
	(a)(ii)	$\overrightarrow{BC} = -\frac{3}{4}\overrightarrow{BA} = -\frac{3}{4}(2b - a)$	
		$\overrightarrow{OC} = \overrightarrow{OB} + \overrightarrow{BC} = 2b - \frac{3}{4}(2b - a) = \frac{3}{4}a + \frac{1}{2}b$	
	(b)(i)	$\overrightarrow{OP} = \overrightarrow{OB} + \overrightarrow{BP} = 2b + 3a$	
	(b)(ii)	$\overrightarrow{OP} = 3a + 2b.\ \ \overrightarrow{OC} = \frac{1}{4}(3a + 2b)$	
		As $\overrightarrow{OC} = \frac{1}{4}\overrightarrow{OP}$,	
		and *O* is a common point, *O, C* and *P* lie on a straight line.	

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	(ci)	3:1	
	(cii)	*OAC* : *OAB* : *OAD* 1 : 4 2 : 1 4 : 2 Therefore, *OAC* : *OAD* is 1 : 2.	
5	(a)	$p = -4$	
	(b)		
	(c)	The maximum point of the curve is 93m.	$\pm$1m
	(d)	2.9 – 0.3 = 2.6	$\pm$0.2s
	(e)	Tangent drawn correctly	
		–24 (±4)	
		m/s	

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6	(a)	volume of water = $\pi(10^2)(80) + (\frac{2}{3})(\pi)(10^3)$		
		$= 8666\frac{2}{3}\pi$		
	(b)	Capacity of one conical cup = $(\frac{1}{3})(\pi)(3^2)(5.3)$		
		= 50 cm^3		
			<u>Alternative</u>	
	(c)	Volume of water remaining after dispensing 250 cups $= 8666\frac{2}{3}\pi - (250 \times \frac{1}{3}\pi(3^2)(5.3)$	Volume of water dispensed for 250 cups $= 250 \times 15.9\pi$	
		$= 4691\frac{2}{3}\pi$ or 14739 cm^2.		
		Volume of water in cylinder $= 4691\frac{2}{3}\pi - \frac{2}{3}\pi(10^3)$	Height of water dispensed for 250 cups $= \frac{250\times15.9\pi}{100\pi}$	
		$= 4025\pi$ or 12645 cm^2.		
		Height of water in cylindrical section $= \frac{4025\pi}{\pi(10^2)}$ or $\frac{12645}{\pi(10^2)}$	Height of water remaining in dispenser $= 90 - \frac{125}{\pi}$	
		$= 40.25$ or 40.250		
		Height of water remaining in dispenser = 40.25+10 or 40.250+10		
		= 50.25 cm or 50.3 cm	= 50.2 (3sf)	
	(d)	Slant height of cup = $\sqrt{3^2 + 5.3^2}$ = 6.0902		
		Curved surface area of cup = $\pi(3)(6.0902)$ = 57.399 cm^2		
		250 cups will cost $57.399 \times 250 \times 0.003$		
		= 43 cents		Accept 44 cents

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7	(a)	$18.5 \times 7500 \div 100000$ 1.3875 km	M1 A1	 c.a.o.
	(b)	$6^2 = 7^2 + 5.5^2 - 2(7)(5.5)\,cos \angle PQR$	M1	Or equivalent method leading to the correct bearing
		$cos \angle PQR = \dfrac{-43.25}{-77}$	M1	
		$angle\ PQR = 55.827°$	M1	
		Bearing of Q from R is (180+55.827) = 235.8°	A1	
	(c)	Area of $QPR = \frac{1}{2}(7 \times 75)(5.5 \times 75)\,sin\,5\,5.827°$	√M2	
		= 89 585 m^2		
		= 89 600 m^2	A1	
	(d)	Let shortest distance from R to PQ be X.		
		$sin \angle PQR = \dfrac{RX}{QR}$		
		$sin\,5\,5.827° = \dfrac{RX}{412.5}$	M1	Or equivalent method
		$RX = 341.28$m	M1	
		Let greatest angle of elevation be y.		
		$tan\,y = \dfrac{75}{their\ RX}$	M1	
		y =12.4°	A1	

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8	(ai)	15 marks	
	(aii)	18 – 12	
		6 marks	
	(b)	20.5 marks	
	(c)	<table><tr><td>Marks (x)</td><td>$4 \leq x < 10$</td><td>$10 \leq x < 15$</td><td>$15 \leq x < 20$</td><td>$20 \leq x < 24$</td></tr><tr><td>Number of students</td><td>6</td><td>14</td><td>14</td><td>6</td></tr></table>	
	(ci)	$\frac{(6\times7)+(14\times12.5)+(14\times17.5)+(6\times22)}{40} = 14.85$	
	(cii)	4.62	
		Alternative answer	
	(c)	<table><tr><td>Marks (x)</td><td>$4 \leq x < 10$</td><td>$10 \leq x < 15$</td><td>$15 \leq x < 20$</td><td>$20 \leq x < 24$</td></tr><tr><td>Number of students</td><td>7</td><td>13</td><td>14</td><td>6</td></tr></table>	
	(ci)	$\frac{(6\times7)+(14\times12.5)+(14\times17.5)+(6\times22)}{40} = 14.7125$	
	(cii)	4.76	
	(d)	15	
	(e)	The students performed better in Mathematics as the median score (15 marks) was higher than Chemistry's (14 marks) The students performed more consistently in Chemistry as the interquartile range (3 marks) is lower than Mathematics (6 marks)	

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9	(a)	$\$4100\left(1+\frac{4}{100}\right)^5 = \$4988$	
		= $5000	
	(b)	Justification: Choose the highest COE price recorded in the past 12 months to cover the worst-case scenario	
			EV 60kWh
		Cost price of car	$(100,000+105,000 – 30,000 =$175,000
		Minimum downpayment	$40\% \times \$175{,}000 = \$70{,}000$
			1998cc petrol car
		Cost price of car	$(110,000+150,000) = $260,000
		Minimum downpayment	$30\% \times \$260{,}000 = \$78{,}000$
		6 months of Lee's salary	$= 6 \times \$5000 = \$30{,}000$
		Savings – downpayment	EV 60kWh: $(105,000 – 70,000) = $35,000 1998cc petrol car: $(105,000 – 78,000) = $27,000
		conclusion	Lee can only afford the downpayment for the EV 60kWh. ($35,000 – $30,000 = $5000)
	(c)	To determine is Lee can afford the car in Jan 2024.	
		i) Road Tax	$[250 + 3.75(60 - 30)] \times 0.7826 \div 6$ = $47.246
		ii) Loan amount	175000 – 70000 = $105,000
		Interest	$\frac{105{,}000 \times 2.78 \times 7}{100} = \$20{,}433$
		(iii) Monthly Instalment	$(105{,}000 + 20{,}433) \div 84$ =$1493.25
		iv) Other costs (monthly basis)	$\frac{4700}{12} + 600 = \$991.667$
		Total monthly expense	$2532.1625
		Spare cash for the month	5000 – 2700 = $2300
		v) Affordability Spare cash – total monthly expenses	2300 – 2532.1625 = – $232.1625 Lee would not be able to afford the car.
			However, if we take into consideration that Lee still has $5,000 remaining after making the downpayment in part (b), with $30,000 already set aside, he would be able to afford the car

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