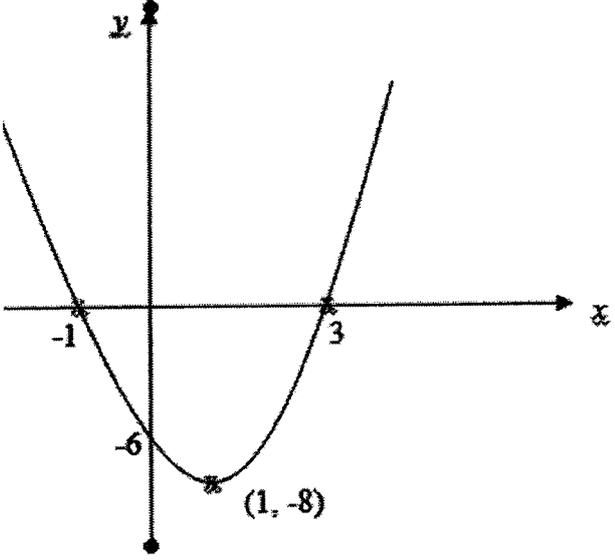


Mathematics Department
Sec 4/5 Preliminary Examination 2025
Marking Scheme
Paper 1

1	$3 \text{ units} = \$150$ $1 \text{ unit} = \$50$ $9 \text{ units} = 9 \times 50$ $= \$450$	M1 A1
2 (a)	$\sqrt[3]{64y^6} = 4y^2$	B1
2(b)	$3^{1-2x} = 3^{-1}$ $\therefore 1-2x = -1$ $-2x = -2$ $x = 1$	M1 A1
3(a)	$40.2^\circ (1\text{dp})$ or $139.8^\circ (1\text{dp})$	B2
3(b)	$\frac{\pi}{180} \times 240$ $= \frac{4\pi}{3} \text{ rad}$	A1
4	$10506.25 = 10000 \left(1 + \frac{x}{100}\right)^2$ $\left(1 + \frac{x}{100}\right)^2 = \frac{10506.25}{10000}$ $\frac{x}{100} = \sqrt{\frac{10506.25}{10000}} - 1$ $x = 100 \left(\sqrt{\frac{10506.25}{10000}} - 1\right)$ $x = 2.5\%$	M1 M1 A1
5(a)	25200	B1
5(b)	$\sqrt{2^6 \times 3^2 \times 5^3 \times 7 \times k}$ $\therefore k = 3 \times 7^2$ $k = 147$	A1

6(a)(i)	$\frac{107}{100} \times 3500 \times 12$ $= \$44940$	A1
6(a)(ii)	$\frac{106}{100} \times 3500 \times 12 + 250 \times 3$ $= \$45270$	M1 A1
6(b)	$\frac{45270}{3500 \times 12} \times 100$ $= 107.7857143$ $\approx 107.8\%(\text{1d.p})$	M1 A1
7(a)	$x^2 + 8x + k$ $= x^2 + 8x + (4)^2 + k - (4)^2$ $= (x + 4)^2 + k - 16$ <p>If $x^2 + 8x + k$ is a perfect square, $k - 16 = 0$ $k = 16$</p>	M1 A1
7(b)	$(-4, 0)$	B1
8	$\frac{4}{7p-1} - \frac{1}{2(p+1)}$ $= \frac{8(p+1) - 1(7p-1)}{2(p+1)(7p-1)}$ $= \frac{8p+8-7p+1}{2(p+1)(7p-1)}$ $= \frac{p+9}{2(p+1)(7p-1)}$	M1 A1
9	$2500 \times 1.20 = \text{A\$}3000$ $\text{A\$}3000 - \text{A\$}1400 = \text{A\$}1600$ 1600×0.84 $= \text{S\$}1344$	M1 A1

15	$\frac{49x^2 - 16}{7x^2 + 3x - 4}$ $= \frac{(7x)^2 - (4)^2}{(7x-4)(x+1)}$ $= \frac{(7x+4)(7x-4)}{(7x-4)(x+1)}$ $= \frac{7x+4}{x+1}$	<p>M2: 1m each for each correct factorisation (numerator & denominator)</p> <p>A1</p>
16		<p>Correct shape: B1</p> <p>Correct x and y intercepts and turning point: B1</p>

20(a)	The sizes of the sectors representing each purchase are not proportional to the relative percentages.	B1
20(b)(i)	$\frac{40-19}{3} = 7$ $-7n+54$	A1
20(b)(ii)	$-7n+54 = -88$ $-7n = -142$ $n = 20\frac{2}{7}$ Since n is not a positive integer, it is not possible for the sequence to have -88 as one of the terms.	A1/follow-through
21(a)	$C = (3 \quad 2.10 \quad 4.30)$	B1
21(b)	$P = (3 \quad 2.70 \quad 4.10) \begin{pmatrix} x & 27 \\ 19 & 18 \\ 23 & 21 \end{pmatrix}$ $= (3x+145.60 \quad 215.70)$	A1
21(c)	The elements in P represents the <u>total amount of money collected for the sale of all 3 types of buns on a particular Saturday and Sunday respectively.</u>	B1
21(d)	$0.95(3x+145.60) + 0.9(215.70) = 360.95$ $2.85x = 28.5$ $x = 10$	M1 A1

22(a)	$\frac{k}{(3-1)^2} + \frac{k}{(5-1)^2} = 20$ $\frac{k}{4} + \frac{k}{16} = 20$ $\frac{4k+k}{16} = 20$ $5k = 320$ $k = 64$ $\therefore y = \frac{64}{(x-1)^2}$	M1 A1
22(b)	$16 = \frac{64}{(x-1)^2}$ $16(x-1)^2 = 64$ $(x-1)^2 = 4$ $x-1 = \pm 2$ $x = 3 \text{ or } x = -1$	M1 A1 (both)
23(a)	<p>Using sine rule,</p> $\frac{BC}{\sin 61^\circ} = \frac{50}{\sin 26^\circ}$ $BC = \frac{50}{\sin 26^\circ} \times \sin 61^\circ$ $BC = 99.75790076$ $BC \approx 99.8\text{km}(3 \text{ sf})$	M1 A1
23(b)	$\angle NAB = 130^\circ - 61^\circ$ $= 69^\circ$ $180^\circ - 69^\circ = 111^\circ$ $\text{Bearing of C from B} = 360^\circ - 26^\circ - 111^\circ$ $= 223^\circ$	M1 A1

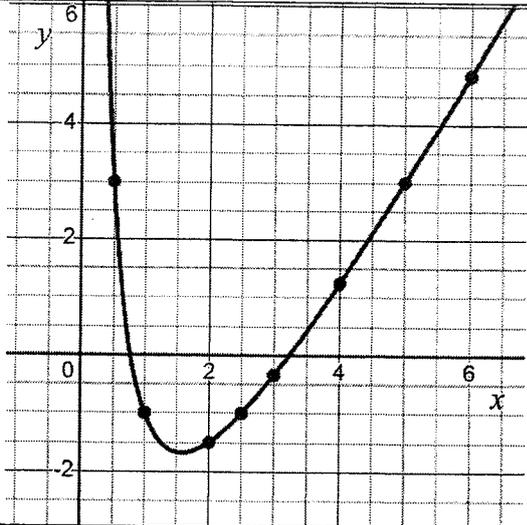
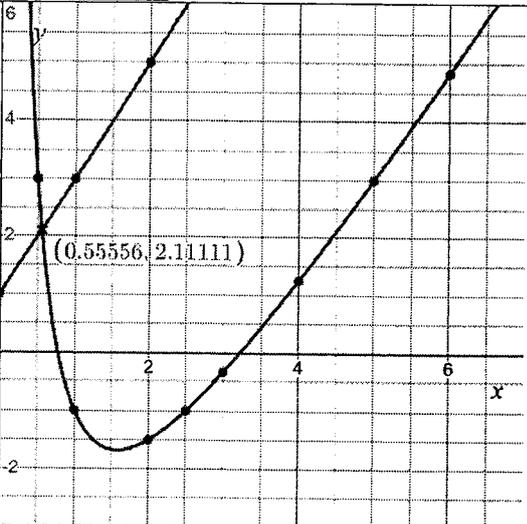
24(a)	$5x + 5x + y + y + 6x = 150$ $16x + 2y = 150$ $8x + y = 75$ $y = 75 - 8x$	M1 A1
24(b)	<p>Using Pythagoras' theorem, Height of triangle PTS</p> $= \sqrt{(5x)^2 - (3x)^2}$ $= \sqrt{16x^2}$ $= 4x \text{ cm}$ <p>Area of PQRST</p> $= \frac{1}{2} \times 6x \times 4x + 6x(75 - 8x)$ $= 12x^2 + 450x - 48x^2$ $= 450x - 36x^2 \text{ (shown)}$	M1 M1 A1
25(a)	<p>Using cosine rule,</p> $AB^2 = 5^2 + 3^2 - 2(5)(3)\cos 75^\circ$ $AB = 5.122053167$ $AB \approx 5.12\text{cm} \text{ (3 sf)}$	M1 A1
25(b)	<p>Volume of prism</p> $= \frac{1}{2} \times 5 \times 3 \times \sin 75^\circ \times 4$ $= 28.97777479$ $\approx 29.0\text{cm}^3 \text{ (3sf)}$	A1
25(c)	<p>Let x be the shortest distance from C to AB.</p> $\frac{1}{2} \times 5.122053167 \times x \times 4 = 28.97777479$ $x = \frac{28.97777479}{10.24410633}$ $x \approx 2.83\text{cm} \text{ (3 sf)}$	M1 A1

26(a)	$\overline{PR} = -4\mathbf{a} + 2\mathbf{b}$	B1
26(b)	$\overline{QS} = \overline{QR} + \overline{RS}$ $= -4\mathbf{a} + 2\mathbf{b}$	B1
26(c)	$\overline{ON} = \overline{OR} + \overline{RN}$ $\overline{ON} = \overline{OR} + \frac{1}{2}\overline{RQ}$ $= 2\mathbf{b} + 2\mathbf{a} / \text{OR}$ $= 2(\mathbf{b} + \mathbf{a})$	B1
26(d)	$\overline{OT} = \overline{OS} + \overline{ST}$ $= 4\mathbf{b} + \frac{2}{3}(4\mathbf{a} - 2\mathbf{b})$ $= \frac{8}{3}(\mathbf{a} + \mathbf{b}) \text{ OR } \frac{8}{3}\mathbf{a} + \frac{8}{3}\mathbf{b}$	M1 A1
26(e)	$\overline{OT} = \frac{4}{3}(2\mathbf{a} + 2\mathbf{b})$ $\therefore \overline{OT} = \frac{4}{3}\overline{ON}$ Since OT and ON are <i>parallel</i> and O is a common point, O, N and T lie on the same straight line. Or Since, $\overline{OT} = \frac{8}{3}(\mathbf{a} + \mathbf{b})$ and $\overline{ON} = 2(\mathbf{b} + \mathbf{a})$, OT and ON are parallel	M1 A1

4E5N 2025 Prelim Math Paper 2 Mark Scheme		
Qn	Solutions	Marks
1(a)	$6 - 5x = 4(1 - 3x)$ $6 - 5x = 4 - 12x$ $7x = -2$ $x = \frac{-2}{7}$	M1 A1
(b)	$3 < 8 - y \leq 11$ $3 < 8 - y \text{ and } 8 - y \leq 11$ $-5 < -y \text{ and } -y \leq 3$ $y < 5 \text{ and } y \geq -3$ $-3 \leq y < 5$	M1 A1
(c)	$b = \frac{1}{a} - \frac{c}{2-c}$ $\frac{c}{2-c} = \frac{1}{a} - b$ $\frac{c}{2-c} = \frac{1-ab}{a}$ $ac = (1-ab)(2-c)$ $ac = 2 - c - 2ab + abc$ $ac + c - abc = 2 - 2ab$ $c = \frac{2-2ab}{a+1-ab}$	M1 M1 – cross multiply A1
(d)	$\frac{5}{x+4} = 4 + \frac{x}{1-2x}$ $\frac{5}{x+4} = \frac{4-8x+x}{1-2x}$ $5(1-2x) = (x+4)(4-7x)$ $5-10x = 4x-7x^2+16-28x$ $7x^2+14x-11=0$ $x = \frac{-14 \pm \sqrt{14^2 - 4(7)(-11)}}{2(7)}$ $x = 0.60 \text{ or } x = -2.60$	M1 – simplifying algebraic fraction M1 – cross multiply M1 – using formula A2
2(ai)	2.76×10^{-10} $= \frac{2.76 \times 10^{-10} \times 10^{-2}}{10^{-2}}$ $= 276 \text{ picometre}$	B1
(aii)	$276 \times \left(\frac{100-65}{100} \right)$ $= 96.6 \text{ picometre}$	M1 A1

(aiii)	$\frac{0.01}{3.4 \times 10^{-9}}$ $= 2.94117 \times 10^6$ $\left(2.94117 \times 10^6\right)^3$ $= 2.54 \times 10^{19}$	M1 A1
(bi)	$21 \text{ cm}^2 : 84 \text{ km}^2$ $1 \text{ cm}^2 : 4 \text{ km}^2$ $1 \text{ cm} : 2 \text{ km}$ $1 : 200000$	M1 A1
(bii)	$1 : 50000$ $1 \text{ cm} : 500 \text{ m}$ $6.5 \text{ cm} : 3250 \text{ m}$	M1 A1
3(a)	$\frac{2}{3} \pi (2r)^3$ $= \frac{16}{3} \pi r^3$	M1 AG1
(b)	$\frac{1}{3} \pi (3r)^2 h = 2 \times \frac{16}{3} \pi r^3$ $h = \frac{32 \pi r^3}{9 \pi r^2}$ $= \frac{32}{9} r$	M1 M1 A1
(c)	$3\pi(2r)^2 = 600$ $12\pi r^2 = 600$ $r = \sqrt{\frac{50}{\pi}}$ <p>Surface Area of Cone</p> $= \pi(3r)^2 + \pi(3r)\left(\sqrt{h^2 + (3r)^2}\right)$ $= \pi(3r)^2 + \pi(3r)\left(\sqrt{\left(\frac{32}{9}r\right)^2 + (3r)^2}\right)$ $= 9\pi r^2 + 3\pi r^2 \frac{\sqrt{1753}}{9}$ $= \left(9 + \frac{\sqrt{1753}}{3}\right) \pi \left(\frac{50}{\pi}\right)$ $= 1147.81$ $= 1150 \text{ cm}^2 \text{ (to 3sf)}$	M1 M1 – using $\pi r l$ M1 – sub h in terms of r Or sub r in terms of π A1

[Turn over

4(a)	$y = 4.8$	B1
(b)		<p>Points correctly plotted: -B1 for 4 to 7 points correct -B2 for all correct</p> <p>Smooth curve -B1</p>
(c)	$2x + \frac{5}{x} = 10$ $2x + \frac{5}{x} - 8 = 2$ <p>Draw $y = 2$, the <u>number of solutions = the number of points of intersections.</u></p>	<p>M1</p> <p>B1</p>
(d)(i)		B1 – blue line drawn correctly
(d)(ii)	$x = 0.5 \pm 0.1$	B1
(d)(iii)	$2x + \frac{5}{x} - 8 = 2x + 1$ $\frac{5}{x} = 9$ $9x - 5 = 0$ $A = 9 ; B = -5$ <p style="text-align: center;">or</p> $-9x + 5 = 0$ $A = -9 ; B = 5$	<p>M1</p> <p>B1, B1</p>

5(a)	$\angle OUD = \angle ODU$ $= \frac{180-140}{2}$ (base of isosceles Δ) $= 20^\circ$ $\angle UDE = \angle OUD$ (alt \angle , OU//DE) $= 20^\circ$ Since $\angle ODU = \angle UDE$, UD bisects $\angle ODE$. (explained)	B1 – either seen AG1
(bi)	Reflex $\angle OUD = 360 - 140$ (\angle s at a point) $= 220^\circ$ $\angle UED = \frac{220}{2}$ (\angle at centre = 2 \angle at circumference) $= 110^\circ$	M1 A1
(bii)	$\angle EUD = 180 - 20 - 110$ (\angle sum of Δ) $= 50^\circ$	A1
(biii)	$\angle VOD = 180 - 2 \times 28$ (base of isosceles Δ) $= 124^\circ$ $\angle VOY = 360 - 124 - 140$ (\angle s at a point) $= 96^\circ$ $\angle AOU = \frac{96}{2}$ (tangent from an external point) $= 48^\circ$	M1 – either seen A1
(c)	In ΔOAU , $\tan 48 = \frac{AU}{6}$ $AU = 6 \tan 48$ Minor Arc length VU = $\frac{96}{360} \times 2 \times \pi \times 6$ Perimeter = $2 \times 6 \tan 48 + \frac{96}{360} \times 2 \times \pi \times 6$ $= 23.3804$ $= 23.4 \text{ cm}$	M1 M1 A1
6(ai)	IQR of Class A = 30 – 15 $= 15$ hours	B1
(aii)	Agree. The median of Class A (25 hrs) > the median of Class B (22 hrs).	B1
	Disagree. The IQR of Class A (15 hours) > the IQR of Class B (10 hrs).	B1
	Disagree. <u>30 students (75%) worked more than 15 hrs in Class A, while ≥ 30 students (>75%) worked more than 15 hrs in Class B.</u>	B1
(bi)	$\frac{26}{26+9+15+13+7} = \frac{13}{35}$	B1

[Turn over

(bii)(a)	$\frac{13}{70} \times \frac{12}{69}$ $= \frac{26}{805}$	M1 A1
(bii)(b)	$\frac{35}{70} \times \frac{20}{69} \times 2$ $= \frac{20}{69}$	M1 A1
7(a)(i)	$\sqrt{8^2 + a^2} = 17$ $a = -15 \text{ (rej) or } a = 15$	M1 A1
(a)(ii)	<p>Let $\overline{OD} = \begin{pmatrix} x \\ y \end{pmatrix}$</p> $\begin{pmatrix} -8 \\ 15 \end{pmatrix} = \begin{pmatrix} 2 \\ 5 \end{pmatrix} - \begin{pmatrix} x \\ y \end{pmatrix}$ $\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 2+8 \\ 5-15 \end{pmatrix} = \begin{pmatrix} 10 \\ -10 \end{pmatrix}$ $D = (10, -10)$	M1 cao A1
(a)(iii)	$C = (2, 5)$ $D = (10, -10)$ $\text{gradient of } CE = \frac{-10-5}{10-2}$ $= \frac{-15}{8}$ $\text{sub } (2, 5) \text{ into } y = \frac{-15}{8}x + c$ $5 = \frac{-15}{8}(2) + c$ $c = \frac{35}{4}$ <p>Equation of CE :</p> $y = -\frac{15}{8}x + \frac{35}{4}$	M1 M1 – find c A1
(a)(iv)	$E = (4, -4)$	B1

7(b)	<p>when $x = -1, y = 8,$ $8 = a - b + 3$ $5 + b = a$ -----(1) when $x = 2, y = 5,$ $5 = 4a + 2b + 3$ $2 = 4a + 2b$ $1 = 2a + b$ -----(2) Sub (1) into (2), $1 = 2(5 + b) + b$ $3b = -9$ $b = -3$ $a = 2$</p>	<p>M1 for sub (-1,8)</p> <p>M1 for sub (2,5)</p> <p>M1 for substitution or elimination</p> <p>A1 – correct a and b</p>																
8(ai)	<table border="1" data-bbox="443 741 935 909"> <thead> <tr> <th>n</th> <th>T_n</th> <th>F_n</th> <th>L_n</th> </tr> </thead> <tbody> <tr> <td>5</td> <td>9</td> <td>17</td> <td>25</td> </tr> <tr> <td>6</td> <td>11</td> <td>26</td> <td>36</td> </tr> <tr> <td>7</td> <td>13</td> <td>37</td> <td>49</td> </tr> </tbody> </table> <p>$L_5 = 25$ $F_6 = 26$ $T_7 = 13$</p>	n	T_n	F_n	L_n	5	9	17	25	6	11	26	36	7	13	37	49	<p>B1</p> <p>B1</p> <p>B1</p>
n	T_n	F_n	L_n															
5	9	17	25															
6	11	26	36															
7	13	37	49															
(aii)	$L_n = n^2$	B1																
(aiii)	<p>$F_n = (n-1)^2 + 1$ or $F_n = n^2 - 2n + 2$</p>	B1																
(b)	<p>$\angle QAD = \angle PBC = 90^\circ$ (1) $QD = PC$ (given) $AD = BC$ (opp sides of rectangle are equal) (2) $\triangle AQD \cong \triangle BPC$ (RHS congruence)</p> <p>Or $QD = PC$ (given) $AD = BC$ (opp sides of rectangle are equal) (1) $AQ = BP$ (By Pythagoras Thm) (2) $\triangle AQD \cong \triangle BPC$ (SSS congruence)</p>	<p>B1 [for one correct reason (1) and or (2)]</p> <p>B1 stating RHS</p> <p>B1 [for one correct reason (1) and or (2)]</p> <p>B1 stating SSS</p>																

[Turn over

9(a)	Average fare = $4.60 + (0.20 \times 30) + (0.80 \times 24.5)$ = \$30.20	B1
(b)	From 4 to 6 pm : No of 30-min trips each day = $2 \div 0.5$ = 4 Total Fare = $\$30.20 \times 4 \times 0.85$ = \$102.68 From 6 to 8 pm No of 30-min trips each day = $2 \div 0.5$ = 4 Total Fare = $\$30.20 \times 4 \times 1.6 \times 0.85$ = \$164.288 Total Fare = $\$102.68 + \164.288 = \$266.968 = \$266.97	M1 M1 A1
(c)	Total Earnings = $\$266.968 \times 30 = \8009.04 Car rental = $\$118 \times 30 = \3540 Total distance travelled in a day = $24.5 \times 8 = 196$ km Number of litres used per day = $\frac{196}{100} \times 8 = 15.68$ 75% full tank = $\frac{75}{100} \times 65 = 48.75$ litres Number of days per petrol top-up = $\frac{48.75}{15.68} = 3.10905 = 3$ Fuel cost per 3 days = $\left[\left(48.75 \times 2.65 \times \frac{75}{100} \right) - 3 \right] \times 1.09 = \102.3407 Fuel cost in a month = $102.3407 \times 10 = \$1023.407$ Monthly Income = $8009.04 - 1023.407 - 3540 = \$3445.633 (< \$4000)$ No, Sam cannot earn his expected monthly income.	} B1 (either seen) Accept 3304 rental for 28 days B1 (distance/day) Accept 5580 km (distance/month) M1 (No. of litres) } M1 (either seen) M1 (rebate or GST seen) (no mark awarded for 25% discount only) M1 (Fuel cost in a month) A1 (conclusion)

