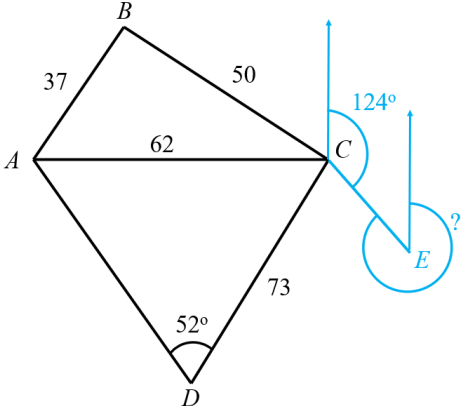


2025 Sec 4E Math Prelim Paper 2 Marking Scheme

Qn		Working	Mark Awarded	Sub-total	Remarks
1	(a)	$-5 \leq 2x - 1 < x + 3$ $-5 \leq 2x - 1$ and $2x - 1 < x + 3$ $-4 \leq 2x$ $x < 4$ $-2 \leq x$ $-2 \leq x < 4$ Primes that satisfy the inequality: 2, 3	M2 A1	3	M1 for $-2 \leq x$ M1 for $x < 4$
	(b)	$\frac{30x^2y^2}{11z} \div \frac{25xz^3}{22y}$ $= \frac{30x^2y^2}{11z} \times \frac{22y}{25xz^3}$ $= \frac{12xy^3}{5z^4}$	B3	2	4 terms to simplify: $\frac{12}{5}, x, y^3, z^4$. B1 for one correct term in the correct position (numerator or denominator). B2 for two or three correct terms. B3 for all four correct terms.
	(c)	$\left(\frac{p^{12}}{81q^{16}}\right)^{-\frac{3}{4}}$ $= \left(\frac{81q^{16}}{p^{12}}\right)^{\frac{3}{4}}$ $= \frac{27q^{12}}{p^9}$	B2	2	B1 for numerator, B1 for denominator.
	(d)	$\frac{x}{x-1} + 2 = \frac{4}{2-x}$ $\frac{x+2(x-1)}{x-1} = \frac{4}{2-x}$ $\frac{3x-2}{x-1} = \frac{4}{2-x}$ $(3x-2)(2-x) = 4(x-1)$ $6x - 3x^2 - 4 + 2x = 4x - 4$ $-3x^2 + 4x = 0$ $x(-3x + 4) = 0$ $x = 0$ or $-3x + 4 = 0$ $x = \frac{4}{3}$	M1 M1 A1	3	M1 for correct quadratic equation. M1 for correct factorisation or correct substitution into quadratic formula A1 for both correct answers.

[illegible]

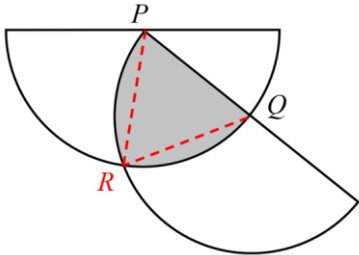
Qn	Working	Mark Awarded	Sub-total	Remarks
3	(a) <u>Cosine Rule</u> $62^2 = 37^2 + 50^2 - 2(37)(50)\cos \angle ABC$ $62^2 - 37^2 - 50^2 = -2(37)(50)\cos \angle ABC$ $\frac{62^2 - 37^2 - 50^2}{-2(37)(50)} = \cos \angle ABC$ $\angle ABC = \cos^{-1}\left(\frac{62^2 - 37^2 - 50^2}{-2(37)(50)}\right)$ $\angle ABC = 89.61286341^\circ$ $\angle ABC = 89.6^\circ \text{ (to 1 d.p.)}$	M1 M1 A1	3	M1 for correct substitution of values into Cosine Rule. M1 for rearranging and making $\angle ABC$ the subject of the equation.
	(b)  <u>Method 1: Interior angles</u> $180^\circ - 124^\circ = 56^\circ \text{ (interior angles, parallel lines)}$ $360^\circ - 56^\circ = 304^\circ \text{ (angles at a point)}$ <u>Method 2: Alternate angles</u> $180^\circ + 124^\circ = 304^\circ$	B1 [B1]	1	B1 for 304° Angle properties not required.
	(c) <u>Sine Rule</u> $\frac{\sin \angle CAD}{73} = \frac{\sin 52^\circ}{62}$ $\sin \angle CAD = \frac{73 \sin 52^\circ}{62}$ $\angle CAD = \sin^{-1}\left(\frac{73 \sin 52^\circ}{62}\right)$ Let the North of A be N. Since A is due west of C, $\angle NAC = 90^\circ$	M1 M1		M1 for substituting the values correctly into Sine Rule. M1 for rearranging the equation and finding the value of $\angle CAD$.

Qn		Working	Mark Awarded	Sub-total	Remarks									
		Bearing of D from A $= \angle NAC + \angle CAD$ $= 90^\circ + \sin^{-1}\left(\frac{73 \sin 52^\circ}{62}\right)$ $= 158.0973671^\circ$ $= 158.1^\circ$ (to 1 d.p.)	A1	3										
	(d)	Using TOA CAH SOH, $\tan 8^\circ = \frac{CF}{50}$ $CF = 50 \tan 8^\circ$ $\tan \angle FDC = \frac{CF}{73}$ $\tan \angle FDC = \frac{50 \tan 8^\circ}{73}$ $\angle FDC = \tan^{-1}\left(\frac{50 \tan 8^\circ}{73}\right)$ $\angle FDC = 5.498398955^\circ$ $\angle FDC = 5.5^\circ$ (to 1 d.p.)	M1 A1	 3	M1 to find correct height of flagpole. M1 for correct equation involving $\angle FDC$ and CF .									
4	(a)	<table><tr><td>Town A to Town B</td><td>Town B</td><td>Town B to Town C</td></tr><tr><td>Speed x km/h</td><td></td><td>Speed $(x - 20)$ km/h</td></tr><tr><td>Time 1 h</td><td>30 min</td><td>x min</td></tr></table> Total distance $= (x)(1) + (x - 20)\left(\frac{x}{60}\right)$ $= x + \frac{x(x - 20)}{60}$ $x + \frac{x(x - 20)}{60} = 120$ $60x + x(x - 20) = 7200$ $60x + x^2 - 20x = 7200$ $x^2 + 40x - 7200 = 0$ (shown)	Town A to Town B	Town B	Town B to Town C	Speed x km/h		Speed $(x - 20)$ km/h	Time 1 h	30 min	x min	M1 M1 A1	 3	M1 for correct distance from Town B to Town C $\frac{x(x - 20)}{60}$. M1 for equating total distance to 120. Correct expansion and simplification of equation
Town A to Town B	Town B	Town B to Town C												
Speed x km/h		Speed $(x - 20)$ km/h												
Time 1 h	30 min	x min												

Qn	Working	Mark Awarded	Sub-total	Remarks
	(b) $x^2 + 40x - 7200 = 0$ $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $x = \frac{-40 \pm \sqrt{40^2 - 4(1)(-7200)}}{2(1)}$ $x = \frac{-40 \pm \sqrt{30400}}{2}$ $x = 67.17797887$ or $x = -107.1779789$ $x = 67.18$ (to 2 d.p.) or $x = -107.18$ (to 2 d.p.)	M1 A2	3	M1 for substitution of values into quadratic formula correctly. A1 for each correct x. Deduct one mark if not 2 d.p.
	(c) $x = -107.18$ is rejected as <u>time/speed cannot be negative.</u>	B1	1	
	(d) Difference in time $= 67.17797887 - 60$ minutes $= 7.17797887$ minutes $= 7$ minutes (0.17797887×60) seconds $= 7$ minutes 10.67873225 seconds $= 7$ minutes 11 seconds	B1	1	
	(e) Total distance = 120 km Total time $= 1 \text{ h} + 0.5 \text{ h} + \frac{67.17797887}{60} \text{ h}$ $= 2.619632981 \text{ h}$ Average speed $= \frac{\text{total distance}}{\text{total time}}$ $= \frac{120}{2.619632981}$ $= 45.8 \text{ km/h}$	M1 M1 A1	3	M1 for correct calculation of total time. M1 for substitution of total distance / total time.
5	(a)(i) $150 < x \leq 160$	B1	1	
	(a)(ii) Estimate of Mean Height $= \frac{3(145) + 10(155) + 7(165) + 4(175) + 1(185)}{25}$ $= 161 \text{ cm}$	B1	1	

Qn	Working	Mark Awarded	Sub-total	Remarks
	(a)(iii) 10.19803903 = 10.2 (to 3 s.f.)	B1	1	
	(a)(iv) We do not know the actual heights of the students.	B1	1	
	(a)(v) The <u>mean height</u> of the five students is <u>less than 161 cm.</u>	B1	1	
5	(b)(i) $\frac{3}{15} = \frac{1}{5}$	B1	1	
	(b)(ii) P(both different colours) = 1 – P(both same colours) = 1 – [P(red, red) + P(blue, blue) + P(Y, Y)] = 1 – $\left[\left(\frac{5}{15} \times \frac{4}{14} \right) + \left(\frac{7}{15} \times \frac{6}{14} \right) + \left(\frac{3}{15} \times \frac{2}{14} \right) \right]$ = $1 - \frac{34}{105}$ = $\frac{71}{105}$ <u>Alternative Method</u> P(red, blue) + P(red, yellow) + P(blue, red) + P(blue, yellow) + P(yellow, red) + P(yellow blue) = $\left(\frac{5}{15} \times \frac{7}{14} \right) + \left(\frac{5}{15} \times \frac{3}{14} \right) + \left(\frac{7}{15} \times \frac{5}{14} \right)$ + $\left(\frac{7}{15} \times \frac{3}{14} \right) + \left(\frac{3}{15} \times \frac{5}{14} \right) + \left(\frac{3}{15} \times \frac{7}{14} \right)$ = $\frac{71}{105}$	M1 A1 [M1] [A1]	2 [2]	M1 for correct calculation. M1 for correct calculation.
	(b)(iii) P(two red, one blue) = P(R, R, B) + P(R, B, R) + P(B, R, R) = $\frac{5}{15} \times \frac{5}{15} \times \frac{7}{15} \times 3$ = $\frac{7}{45}$	M2 A1	3	M1 for $\frac{5}{15} \times \frac{5}{15} \times \frac{7}{15}$ M1 for $\times 3$
6	(a) $\frac{30}{10} = 3 \text{ m/s}^2$	B1	1	

Qn		Working		Mark Awarded	Sub-total	Remarks
	(b)	Duration of deceleration $= \frac{30}{2} = 15 \text{ s}$ Total time = 45 s OR <u>Method 2: Use gradient</u> $\frac{30 - 0}{t - 30} = 2$ $30 = 2(t - 30)$ $30 = 2t - 60$ $t = 45$ ----- Total distance = area of trapezium $= \frac{1}{2} \times (20 + 45) \times 30$ $= 975 \text{ km}$		M1 		

Qn		Working	Mark Awarded	Sub-total	Remarks
		<u>Alternative Method</u> $\left(\frac{h}{15}\right)^3 = \frac{1200}{400}$ $\frac{h}{15} = \sqrt[3]{3}$ $h = \sqrt[3]{3} \times 15$ $h = 21.6 \text{ cm}$	[M1] [A1]	[2]	[M1 for $\left(\frac{h}{15}\right)^3 = \frac{1200}{400}$]
	(b)	 $PR = PQ = QR$ (radii) $\triangle RQR$ is an equilateral triangle. Area of sector $= \frac{60}{360} \times \pi \times 4^2$ $= \frac{8}{3} \pi \text{ cm}^2$ Area of triangle $= \frac{1}{2} (4)(4) \sin 60^\circ$ $= 8 \sin 60^\circ \text{ cm}^2$ Area of shaded region $= \frac{8}{3} \pi + \frac{8}{3} \pi - 8 \sin 60^\circ$ $= 9.826951589$ $= 9.83 \text{ cm}^2$ (to 3 s.f.)	M1 M1 M1 M1 A1	5	M1 for recognizing that $\triangle RQR$ is an equilateral triangle, or that $\angle PQR = \angle PRQ = \angle RPQ = 60^\circ$. M1 for area of sector M1 for area of triangle M1 for relating area of sector and area of triangle with area of shaded region
8	(a)	$\begin{pmatrix} 48 & 30 & 12 \\ 36 & 24 & 18 \end{pmatrix}$	B1	1	

Qn		Working	Mark Awarded	Sub-total	Remarks
		Sales of each type of cake flavour $= \begin{pmatrix} 32 & 20 & 8 \\ 30 & 20 & 15 \end{pmatrix} \begin{pmatrix} 17 \\ 25.50 \\ 34 \end{pmatrix}$ $= \begin{pmatrix} 32(17) + 20(25.50) + 8(34) \\ 30(17) + 20(25.50) + 15(34) \end{pmatrix}$ $= \begin{pmatrix} 1326 \\ 1530 \end{pmatrix}$ Total sales: $(1 \ 1) \begin{pmatrix} 1326 \\ 1530 \end{pmatrix} = (2856)$ Total profit $= 2856 - 2250$ $= \\$606$	A1	4	
		<u>Alternative Method</u> $\frac{2}{3}(1170)(1.7) + \frac{5}{6}(1080)(1.7)$ $= 1326 + 1530$ $= 2856$ Total profit $= 2856 - 2250$ $= \\$606$	[M2] [M1] [A1]	[3]	[M1 for $\frac{2}{3}(1170)$ and $\frac{5}{6}(1080)$] [M1 for multiplying both by 1.7] [M1 for adding both together to find total sales]
9	(a)	-1, -1	B1	1	
	(b)	B1 for 4 correctly plotted points. B2 for 7 correctly plotted points. B1 for smooth curve. Deduct one mark if graph goes beyond -1 or 3.	B2 B1	3	
	(c)	Draw a tangent – M1 Gradient = 3 ± 0.5	M1 A1	2	M1 for drawing a tangent on the graph where $x = 1$.

Qn		Working	Mark Awarded	Sub-total	Remarks
	(d)	$3 - x = \frac{1}{x^2} - \frac{1}{x}$ $3x^2 - x^3 = 1 - x$ $3x^2 - x^3 - 1 = -x$ Draw the line $y = -x$. Acceptable range: $x = -0.55$ to -0.8 and $x = 0.35$ to 0.55	M1 M1 A1	3	M1 for obtaining $3x^2 - x^3 - 1 = -x$ M1 for drawing the line $y = -x$. A1 for both correct answers.
10	(a)	1 m = 3.28 feet 1 m² = 3.28² feet² 60×3.28^2 feet² = 645.504 feet² = 646 feet² (to 3 s.f.)	M1 A1	2	M1 for correct ratio of m² to feet². A1 for 60×3.28^2 and 645.504 (more 3 s.f.).
	(b)	$\\$990 \times 645.504$ = \$639 048.96 OR $\\$990 \times 646$ = \$639 540	B1 [B1]	1	Exact floor area is used. Rounded-off floor area from part (a) is used.
	(c)	Let \$x be the cost of the unit. Amount to be covered using housing loan = \$0.55x Simple interest = $\frac{PRT}{100}$ = $\frac{0.55x \times 3.0 \times 25}{100}$ = 0.4125x Total amount to be repaid for housing loan = 0.55x + 0.4125x = 0.9625x Each monthly instalment	M1 M1		M1 for calculating simple interest M1 for calculating the total loan amount to be repaid.

Qn	Working	Mark Awarded	Sub-total	Remarks
	$\begin{aligned} &= \frac{0.9625x}{12 \times 25} \\ &= \frac{77x}{24000} \end{aligned}$ 30% of gross monthly salary $= 30\% \times 7500$ $= \\$2250$ $\frac{77x}{24000} \leq 2250$ $x \leq 701\,298.70 \text{ (to 2 d.p.)}$ Amount for additional levels $= 701\,298.70 - 639\,048.96$ $= \\$62\,249.74$ Maximum number of additional levels $= \frac{62\,249.74}{16\,000}$ $= 3.89060875$ $= 3 \text{ (round down to nearest integer)}$ Maximum level that Lisa can afford to purchase $= 1 + 3$ $= 4^{\text{th}} \text{ level}$	M1 M1 M1 M1 A1	7	M1 for calculating one monthly instalment. M1 for inequality between monthly instalment and 30% of gross monthly income. M1 for calculating amount for additional levels M1 for rounding down to find number of additional levels.
	<u>Alternative Method 2:</u> (Calculate price of unit on the first level then increase of each level). <u>Unit on the First Level:</u> Total amount to be repaid for housing loan $= \frac{0.55 \times 639048.96 \times 3 \times 25}{100} + 0.55 \times 639048.96$ $= 615\,084.63$ Each monthly instalment $= \frac{615084.62}{25 \times 12}$ $= 2050.28$ <u>Increase per level</u>	[M1] [M1]		M1 for calculating simple interest. ECF from (b). M1 for calculating one monthly instalment.

Qn	Working	Mark Awarded	Sub-total	Remarks
	Increase in amount to be covered using housing loan per level $= 16000 \times 0.55$ $= \\$8800$ Increase in amount to be repaid for housing loan per level $= \frac{8800 \times 3 \times 25}{100} + 8800$ $= \\$15\,400$ Increase in each monthly instalment per level $= \frac{15400}{12 \times 25}$ $= \\$51.33$ 30% of gross monthly salary $= 30\% \times 7500$ $= \\$2250$ Let x be the maximum number of additional levels possible. $2050.28 + 51.33x \leq 2250$ $2050.28 + 51.33x \leq 2250$ $51.33x \leq 199.72$ $x \leq 3.8909$ $x = 3$ The maximum level that Lisa can afford to purchase is the 4th level.	[M1] [M1] [M1] [M1] [A1]	[7]	M1 for calculating simple interest. M1 for calculating increase in each monthly instalment per level. M1 for inequality between monthly instalment and 30% of gross monthly income. M1 for finding the maximum number of additional levels.
	<u>Method 3: Guess and Check</u> <u>If the unit is on the 4th level, then</u> the price of the flat $= \\$639\,048.96 + 3(16000)$ $= \\$687\,048.96$ Amount to be covered using housing loan $= 0.55 \times 687048.96$ Simple interest Total amount to be repaid for housing loan	[M1]		M1 for calculating price of unit on 4th level.

Qn	Working	Mark Awarded	Sub-total	Remarks
	$= \frac{0.55 \times 687048.96 \times 3 \times 25}{100} + 0.55 \times 687048.96$ $= \$661\,284.62$ Each monthly instalment $= \frac{661284.62}{12 \times 25}$ $= \$2204.28$ 30% of gross monthly salary $= 30\% \times 7500$ $= \$2250$ $2204.28 < 2250$ 4th floor is within Lisa's budget. <u>If the unit is on the 5th level, then</u> the price of the flat $= \$639\,048.96 + 4(16000)$ $= \$703\,048.96$ Amount to be covered using housing loan $= 0.55 \times 703048.96$ Simple interest Total amount to be repaid for housing loan $= \frac{0.55 \times 703048.96 \times 3 \times 25}{100} + 0.55 \times 703048.96$ $= \$676\,684.62$ Each monthly instalment $= \frac{676684.62}{12 \times 25}$ $= \$2255.62$ 30% of gross monthly salary $= 30\% \times 7500$ $= \$2250$ $2255.62 > 2250$ 5th floor is out of Lisa's budget. Therefore, the maximum level that Lisa can afford to purchase is the 4th level.	[M1] [M1] [M1] [M1] [M1] [M1] [A1]		M1 for simple interest. M1 for monthly instalment M1 for inequality. M1 for considering 5th unit (as a form of comparison). M1 for inequality showing how level 5 is not suitable.

Qn	Working	Mark Awarded	Sub-total	Remarks
				A1 for correct conclusion.
	<u>Method 4: Calculate maximum cost of 3-room unit from maximum cost to be paid by monthly instalments.</u> Assuming gross monthly salary remains constant across 25 years. Maximum cost of each monthly instalment $= 30\% \times 7500$ $= \\$2250$ Maximum total cost of all monthly instalments $= \\$2250 \times 25 \times 12$ $= \\$675\ 000$ Let P be the remaining amount to be paid by monthly instalments (55% of the price of the unit). $P + \frac{P \times 3 \times 25}{100} = 675\ 000$ $\frac{7}{4}P = 675\ 000$ $P = \$385714.2857 \text{ (to 4 d.p.)}$ Total cost of planned 3-room unit $= \frac{385714.2857}{55} \times 100$ $= \\$701297.7013 \text{ (to 4 d.p.)}$ Maximum number of additional levels $= \frac{701297.7013 - 639048.96}{16000}$ $= 3.8906 \text{ (5.s.f.)}$ $= 3 \text{ (round down to nearest whole number)}$ Maximum level that Lisa can afford to purchase $= 1 + 3$ $= 4^{\text{th}} \text{ level}$	[M1] [M1] [M1] [M1] [M1] [M1] [M1] [M1]	[7]	[M1 for total cost of all monthly instalments, aka \$675 000] [M1 for calculating simple interest correctly] [M1 for finding 55% of cost of unit] [M1 for calculating 100% of cost of unit] [M1 for calculating additional levels] [M1 for rounding down and finding exact number of additional levels].