4Exp E Math Prelim 2022 Paper 1 Marking Scheme

MAYFLOWER

Qn	Solution	Mark
1a	$(-a^2)^3 \div 4b^0 = -a^6 \div 4$ $= -\frac{1}{4}a^6$	B1 for $-a^6$ A1
1b	$(a^{-1}b)^2 \times (\sqrt{b})^3 = a^{-2}b^2 \times b^{\frac{3}{2}}$ $= \frac{b^{\frac{7}{2}}}{a^2}$	B1 for $a^{-2}b^2$ or $b^{\frac{3}{2}}$ A1
2	The vertical axis does not start from zero. The increase in the number of years on the horizontal axis is not a constant.	B1 B1 Ignore any subsequent explanations given by students
3a	2.5014×10^9 cm^3	B1 (exact ans only)
3b	Time needed $= \frac{2.5014 \times 10^9}{(8 \times 10^2 + 1.2 \times 10^3) \times 1000}$ $= 1250.7$ minutes	M1 for $\frac{\text{their (a)}}{(8 \times 10^2 + 1.2 \times 10^3) \times 1000}$ A1 (exact ans only)
4	$y = ka^{-x}$ $3 = ka^{-0}$ $k = 3$ $6 = 3(a^1)$ $a = 2$	B1 B1
5a	$1400 = 2^3 \times 5^2 \times 7$	B1
5b	Not all the index / power of the prime factors of 1400 are even numbers.	B1
5c	$a = 5$ $b = 7$	B1 B1

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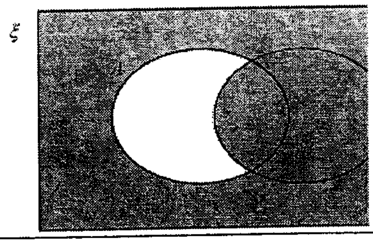
6a	Area = 4 cm^2 : 2.56 km^2 Length = 2 cm : 1.6 km = 1 cm : 0.8 km = 1 : 80000	M1 for finding length ratio in any units A1
6b	Actual distance = 16 km	B1
7a	$A = \{1, 2, 3, 4\}$ $B = \{2, 3, 5, 7, 11\}$ $A \cap B' = \{1, 4\}$	B1
7b		B1
8	$M = kr^3$ $k = \frac{M}{r^3}$ new $M = k(\text{new } r)^3$ $8M = \frac{M}{r^3}(\text{new } r)^3$ $(\text{new } r)^3 = 8r^3$ new $r = 2r$ % increase in $r = 100\%$ OR $\frac{M_1}{(r_1)^3} = \frac{M_2}{(r_2)^3}$ $\frac{M_1}{(r_1)^3} = \frac{8M_1}{(r_2)^3}$ $r_2 = 2r_1$ % increase in $r = 100\%$	M1 for relationship between new and old sets of values of M and r A1 M1 for relationship between new and old sets of values of M and r A1
9	$\left(\frac{h}{45}\right)^3 = \frac{1}{2}$ $h = 35.716$ $h = 35.7$ cm (3sf)	M1 for relationship between height ratio and volume ratio A1
10ai	$x^2 - 4x + 8 = (x-2)^2 - 2^2 + 8$ $= (x-2)^2 + 4$	B1

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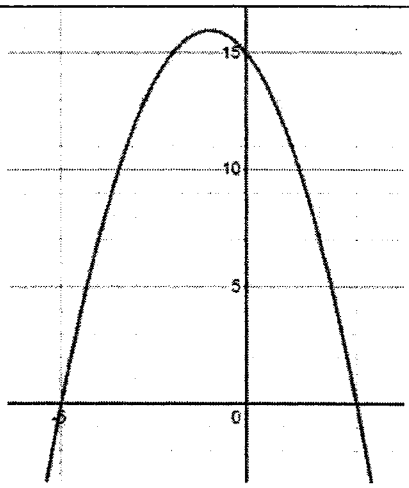
10aii	The minimum value of x^2-4x+8 is bigger than 0. OR The minimum turning point of $y=x^2-4x+8$ is (2,4) which is above the x-axis. Hence, graph of $y=x^2-4x+8$ does not intersect the x-axis. OR $y=x^2-4x+8$ is a U-shaped graph and its turning point is (2,4) which is above the x-axis. Hence, graph of $y=x^2-4x+8$ does not intersect the x-axis. OR When $(x-2)^2+4=0$, $(x-2)^2=-4$. But $(x-2)^2$ cannot be negative and hence, the graph of $y=x^2-4x+8$ does not intersect the x-axis.	B1
10b		B1 for turning point (– 1, 16) B1 for x-intercepts at – 5 and 3; and y-intercept at 15 B1 for correct shape of curve passing through their turning point and intercepts with their axes
11	$x^2-8xy+16y^2=0$ $(x-4y)^2=0$ $x-4y=0$ $x=4y$ $\frac{x}{y}=4$	B1 for $(x-4y)^2$ A1

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12a	$\frac{AE}{AC}=\frac{7}{14}=\frac{1}{2}$ (given) $\frac{AB}{AD}=\frac{10}{20}=\frac{1}{2}$ (given) $\angle CAD=\angle EAB$ (common) ACD similar to AEB (SAS)	M1 for showing $\frac{AE}{AC}=\frac{AB}{AD}$ (given) - accept if length ratio of $\frac{1}{2}$ not mentioned A1 for complete proof, reasons and conclusion
12b	$AF=\frac{1}{4}\times 10=2.5$ cm	B1
13a	$a=52$ $b=58$ $c=74$	B1 B1 B1
13b	58	B1
13c	Every student's test score is used to calculate the standard deviation while the interquartile range is calculated using the lower and upper quartiles only.	B1
14a	$-2x^2+x+3=(-x-1)(2x-3)$	B1 accept $-(x+1)(2x-3)$
14b	$8x^3-18xy^2=2x(4x^2-9y^2)$ $=2x(2x-3y)(2x+3y)$	M1 for factorising $2x$ A1
15a	[redacted]	M1 for showing all 3 construction lines to draw angle bisector A1 for marking the point P
15b	050°	B1 (accept 049° to 051°)

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16a	$\mathbf{B}=\begin{pmatrix}300\\500\\1000\end{pmatrix}$	B1
16b	$\mathbf{X}=\begin{pmatrix}0.5 & 0.5\end{pmatrix}\begin{pmatrix}80 & 42 & 20\\120 & 62 & 30\end{pmatrix}\begin{pmatrix}300\\500\\1000\end{pmatrix}$ $=\begin{pmatrix}0.5 & 0.5\end{pmatrix}\begin{pmatrix}65000\\97000\end{pmatrix}$ $=\begin{pmatrix}81000\end{pmatrix}$	M1 for correct matrix multiplication of any 2 matrices A1 do not award for answer left as 81000
16c	The mean / average amount of money collected from the semi-final and the final football matches. OR It represents half the total amount of money collected from the semi-final and the final football matches. OR It represents the total amount of money collected from the semi-final and the final football matches if there is a 50% discount on all tickets.	B1
17	$\frac{(2n-2)\times180}{2n}=\frac{(n-2)\times180}{n}+30$ $90(2n-2)=180(n-2)+30n$ $3(2n-2)=6(n-2)+n$ $6n-6=6n-12+n$ $n=6$	M1 for forming relationship M1 for changing to linear equation A1
18	$(2n-1)^2+3=4n^2-4n+1+3$ $=4n^2-4n+4$ $=4(n^2-n+1)$ Since n^2-n+1 is an integer, $4(n^2-n+1)$ is a multiple of 4.	B1 for $4(n^2-n+1)$ A1 for conclusion

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19a	$\frac{v-20}{80}=\frac{5}{25}$ $v=36$ Speed at 20 sec = 36 m/s $=\frac{0.036}{1/3600}$ km/h =129.6 km/h	M1 for forming relationship B1 for 36 m/s at $t=20$ sec A1 (exact ans only)
19b	Distance $=\frac{1}{2}(100+20)(25)$ $=1500$ m	M1 to find area under speed-time graph A1
19c	$\frac{100-20}{25}=2\times\frac{k-20}{62.5-25}$ $3.2=\frac{4}{75}(k-20)$ $k=80$	M1 for forming relationship between deceleration in first 25sec and acceleration after 25sec A1
20a	$PQ=PO+OQ$ $=\begin{pmatrix}-3\\1\end{pmatrix}+\begin{pmatrix}-5\\5\end{pmatrix}$ $=\begin{pmatrix}-8\\6\end{pmatrix}$ $\lvert PQ\rvert=\sqrt{(-8)^2+6^2}$ $=10$	B1 for $PQ=\begin{pmatrix}-8\\6\end{pmatrix}$ or M1 for finding length of line segment PQ A1
20b	$m=\frac{-1-5}{3-(-5)}=-\frac{3}{4}$ $-1=-\frac{3}{4}(3)+c$ $c=\frac{5}{4}$ $y=-\frac{3}{4}x+\frac{5}{4}$ Subs $y=0, x=\frac{5}{3}$ $R=(\frac{5}{3},0)$ OR	B1 for $y=-\frac{3}{4}x+\frac{5}{4}$ Or M1 for applying $m_{PQ}=m_{PR}$ A1

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	$\overrightarrow{PQ}=\begin{pmatrix}-8\\6\end{pmatrix}$ $m=\frac{6}{-8}=-\frac{3}{4}$ $R(x,0)\ P(3,-1)$ $\frac{0-(-1)}{x-3}=-\frac{3}{4}$ $x=\frac{5}{3}$ $R=(\frac{5}{3},0)$ OR $PR=kPQ$ $OR-\begin{pmatrix}-3\\1\end{pmatrix}=k\begin{pmatrix}-8\\6\end{pmatrix}$ $OR=\begin{pmatrix}-8k+3\\6k-1\end{pmatrix}$ $6k-1=0$ $k=\frac{1}{6}$ $OR=\begin{pmatrix}-8(\frac{1}{6})+3\\0\end{pmatrix}=\begin{pmatrix}\frac{5}{3}\\0\end{pmatrix}$ $R=(\frac{5}{3},0)$	M1 for forming relationship A1 M1 for finding $k=\frac{1}{6}$ A1
20c	$S=(-3,0)$	B1
21	New BMI $=\frac{0.992m}{(1.02h)^2}$ $=0.95347\left(\frac{m}{h^2}\right)$ $=0.95347(\text{old BMI})$ % change $=\frac{0.95347-1}{1}\times 100\%$ $=-4.65\%$ (3sf)	M1 to express new BMI in terms of old BMI B1 for 0.95347 A1

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22a	$x = 7 \times 5 = 35$ $y = 150 - 60 - 35 = 55$	B1 B1
22b	$\frac{n}{150+n} \times \frac{n}{150+n} = \frac{1}{256}$ $\frac{n^2}{22500+300n+n^2} = \frac{1}{256}$ $256n^2 = 22500 + 300n + n^2$ $255n^2 - 300n - 22500 = 0$ $17n^2 - 20n - 1500 = 0$	M1 for forming equation M1 for simplifying LHS into single fraction A1
22c	$17n^2 - 20n - 1500 = 0$ $(17n+150)(n-10) = 0$ $n = -\frac{150}{17}$ (rej), $n = 10$	M1 for factorisation or quadratic formula A1 (SC1 for $n = 10$ without working)
23a	$\tan \angle ABO = \frac{15}{8}$ $\angle ABO = 1.0808$ rad (4 dp)	A1
23b	$\angle BAO = \pi - \frac{\pi}{2} - 1.0808$ $= 0.48999$ Area of unshaded $POB = \frac{1}{2}(15)(8) - \frac{1}{2}(15^2)(0.48999)$ 4.8761 Area of shaded region $= \frac{1}{2}(8^2)(1.0808) - 4.8761$ $= 29.709$ $= 29.7$ cm^2 (3sf)	M1 to find area of sector *APO* or sector *BOQ* (accept if student converts angles to degrees to compute area) B1 for area of unshaded *POB* = 4.8761 A1

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2022 MF Mathematics Preliminary Examination Paper 2 Marking Scheme

Qn		Solutions	Marks	
1	(a)	$\frac{(3x-y)}{(x+2y)} = \frac{1}{3}$		AO1
		$3(3x-y) = x+2y$		
		$9x-3y = x+2y$		
		$9x-x = 2y+3y$	M1	Group the like terms together
		$8x = 5y$		
		$\frac{x}{y} = \frac{5}{8}$		
		$x : y = 5 : 8$	A1	
1	(b)	$\frac{2-3x}{3} < \frac{2x-1}{6}$		AO1
		Multiply the inequality by 6		
		$2(2-3x) < 2x-1$		
		$4-6x < 2x-1$	M1	Form a linear inequality without bracket
		$-6x-2x < -1-4$		
		$-8x < -5$		
		$x > \frac{5}{8}$	A1	
1	(c)	Method 1		AO2
		$\frac{1}{x} + \frac{1}{y^2} = \frac{1}{w-3}$		
		$\frac{1}{y^2} = \frac{1}{w-3} - \frac{1}{x}$		
		$\frac{1}{y^2} = \frac{x-(w-3)}{(w-3)x}$	M1	Combine 2 fractions into a single fraction
		$\frac{1}{y^2} = \frac{x-w+3}{x(w-3)}$		
		$y^2 = \frac{x(w-3)}{x-w+3}$	M1	Make y^2 be the subject
		$y = \pm\sqrt{\frac{x(w-3)}{x-w+3}}$	A1	

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1	(c)	Method 2 Multiply the equation by $xy^2(w-3)$: $y^2(w-3)+x(w-3)=xy^2$ $y^2(w-3)-xy^2=x(w-3)$ $y^2(w-3-x)=x(w-3)$ $y^2=\dfrac{x(w-3)}{(w-3-x)}$ $y=\pm\sqrt{\dfrac{x(w-3)}{(w-3-x)}}$	M1 M1 A1	Form a non-fractional equation Make y^2 be the subject
2	(a)	Cost Price $=\$1288\times\dfrac{85}{100}\times\dfrac{100}{125}$ $=\$875.84$	M1 M1 A1	AO2 For multiply $\frac{85}{100}$ For multiply $\frac{100}{125}$
2	(b)	Amount paid by instalment $=\$125\times18=\$2250$ Amount borrowed $=\$2388-\$295=\$2093$ Total Interest $=\$2250-\$2093=\$157$ $I=\dfrac{PRT}{100}$ $157=\dfrac{2093\times R\times\frac{18}{12}}{100}$ $R=\dfrac{157\times100}{2093}\times\dfrac{12}{18}$ $R=5.00$ (3s.f)	M1 M1 A1	AO1 For Total Interest For arithmetic expression for R
2	(c)	$A=P\left(1+\dfrac{r}{100}\right)^n$ where $r=-x$ $1200=2000\left(1-\dfrac{x}{100}\right)^4$ $\left(1-\dfrac{x}{100}\right)^4=\dfrac{1200}{2000}$ $1-\dfrac{x}{100}=\left(\dfrac{12}{20}\right)^{\frac{1}{4}}$ $-\dfrac{x}{100}=\left(\dfrac{12}{20}\right)^{\frac{1}{4}}-1$ $\dfrac{x}{100}=1-\left(\dfrac{12}{20}\right)^{\frac{1}{4}}$	M1 M1	AO2 Forming equation in x For taking 4^{th} root on both sides of equation

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		$x = \left[1-\left(\frac{12}{20}\right)^{\frac{1}{4}}\right]\times 100$ $x = 11.9888$ $x = 12.0$ (3 s.f)		A1	
3	(a)	Total surface area $= \frac{1}{2}\times 4\pi\times 30^2 + 2\pi\times 30\times 70 + \pi\times 30^2$ $= 1800\pi + 4200\pi + 900\pi$ cm^2 $= 6900\pi$ cm^2 $= 21676.989$ cm^2 $= 21700$ cm^2 (3 s.f)		M1 M1 A1	AO1 For finding surface area of hemisphere For finding curved surface area of cylinder
3	(b)	(i)	Volume of water $= \frac{1}{2}\times\frac{4}{3}\pi\times 30^3 + \pi\times 30^2\times 70$ cm^3 $= 18000\pi + 63000\pi$ cm^3 $= 81000\pi$ cm^3 $= 81000\pi \div 1000$ litres (1 litre = 1000 cm^3) $= 81\pi$ litres $= 254.469$ litres $= 254$ litres (3 s.f)	M1 M1 A1	AO1 For volume of hemisphere OR volume of cylinder For total volume in cm^3
3	(b)	(ii)	Time taken $= 81\pi \div 3$ seconds $= 84.823$ seconds $= 1$ minutes 25 seconds	M1 A1	AO1
3	(b)	(iii)	Volume of the bath $= 81000\pi$ cm^3 $= \frac{81000\pi}{1000000}$ m^3 (1m =100cm, 1m^3 =1000000cm^3) $= 0.254469$ m^3 $\frac{1}{2}(0.4+0.6)\times 0.3\times l = 0.254469$ $l = \frac{0.254469\times 2}{0.3}$ $l = 1.69646$ m $l = 1.70$ m (3s.f)	M1 M1 A1	AO2 For converting volume from cm^3 to m^3 Forming equation to find l.

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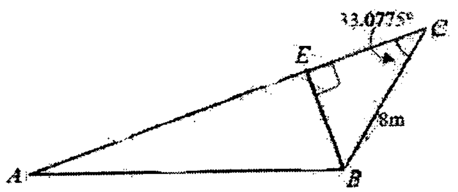
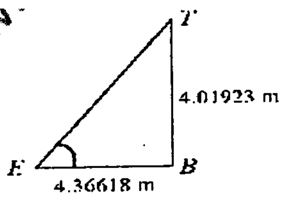
4	(a)	Area of the parallelogram $ABCD$ $= 2\times\frac{1}{2}\times15\times8\times\sin 50°$ $= 91.9253\ \text{m}^2$ $= 91.9\ \text{m}^2$ (3s.f)	M1 A1	AO1
4	(b)	$\angle ABC = 180° - 50° = 130°$ (int.$\angle s$, $AD \parallel BC$) By Cosine Rule, $AC^2 = 15^2 + 8^2 - 2\times15\times8\times\cos130°$ $AC^2 = 443.269$ $AC = 21.0539$ m $AC = 21.1$ m (3s.f)	M1 M1 A1	AO1
4	(c)	$\angle ADC = 180° - 50° = 130°$ (int.$\angle s$, $DC \parallel AB$) By Sine Rule, $\frac{\sin\angle DAC}{15} = \frac{\sin 130°}{21.0539}$ $\sin\angle DAC = \frac{\sin130°}{21.0539}\times15$ $\angle DAC = 33.0775°$ $\angle DAC = 33.1°$ (1d.p)	M1 A1	AO1 Make $\sin\angle DAC$ be the subject
4	(d)	$\angle ACB = \angle DAC$ (alt.$\angle s$, $AD \parallel BC$) $\angle ACB = 33.1°$ (1 d.p) Bearing of A from $C = 180° + 33.1° = 213.1°$ (1d.p)	B1	AO1
4	(e)	$\tan15° = \frac{TB}{15}$ $TB = 15\times\tan15°$ $TB = 4.01923$ $TB = 4.02$ m (3 s.f)	M1 A1	AO1
4	(f)	The smallest angle of $\theta = 15°$ as A is farthest away from B. The greatest angle of $\theta = \angle TEB$ as E is nearest to B.  $\sin 33.0775° = \frac{BE}{8}$ $BE = 8\times\sin33.0775° = 4.36618$ m $\tan\angle TEB = \frac{4.01923}{4.36618}$ $\angle TEB = 42.6307°$ $= 42.6$ (1d.p)  Hence $15° \le \theta \le 42.6°$	M1 M1 A1 A1	AO2 For finding shortest distance from B to AC For finding the greatest θ

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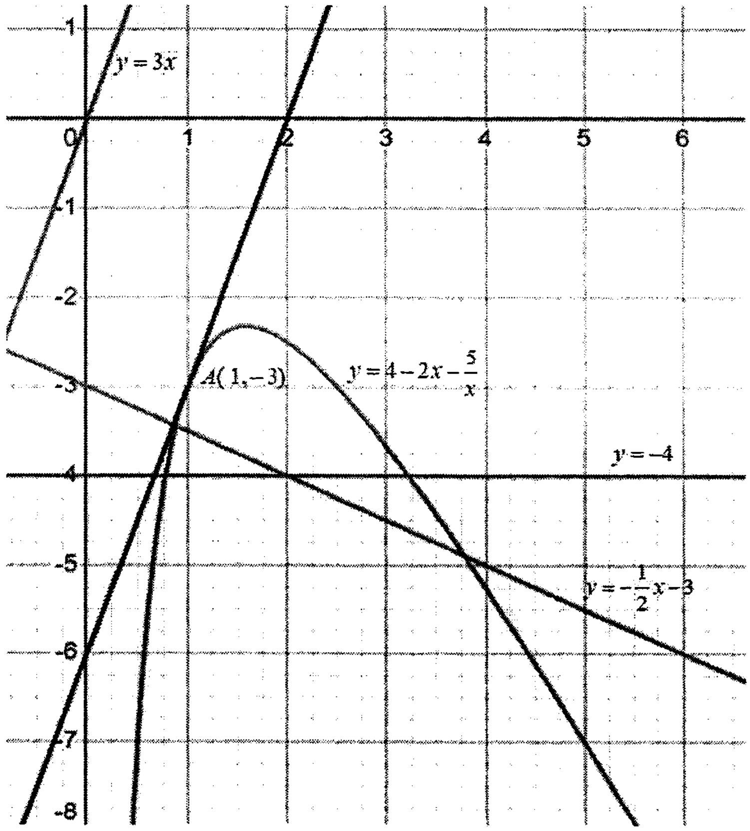
5	(a)	$p=-3.7$	B1	AO1
5	(b)		B1 B1 B1	AO1 Mark the points Accurately Draw the curve passes through all the marked points Smooth curve with correct shape
5	(c)	$2x+\frac{5}{x}=8$ $-2x-\frac{5}{x}=-8$ $4-2x-\frac{5}{x}=4-8$ $4-2x-\frac{5}{x}=-4$ Plot the line $y=-4$ From the graph, $x\approx0.75$ *or* $x\approx3.2$ (accepted: 0.65, 0.7, 0.8, 0.85, or 3.1, 3.15, 3.25, 3.3)	B1 B1	AO2
5	(d)	Plot the line $y=3x$ as guiding line From the graph, coordinates of A are $(1,-3)$	B1 B1	AO2

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5	(e)		$3x^2-14x+10=0$ Divide the equation by $(-2x)$: $-\frac{3}{2}x+7-\frac{5}{x}=0$ $-\frac{5}{x}=\frac{3}{2}x-7$ Add $(4-2x)$ to both sides of the equation: $4-2x-\frac{5}{x}=4-2x+\frac{3}{2}x-7$ $4-2x-\frac{5}{x}=-\frac{1}{2}x-3$ Plot the line $y=-\frac{1}{2}x-3$, From the graph, the x-coordinates of the intersecting points between the curve and the line are $x\approx 0.85$ *or* $x\approx 3.80$ (accepted: 0.75, 0.8, 0.9, 0.95 or 3.7, 3.75, 3.85, 3.9)	M1 B1 A1 A1	AO2 For forming the equation For plotting the line
6	(a)	(i)	Area added on Day n $=1+4(n-1)$ $=4n-3$	B1	AO2
6	(a)	(ii)	$4\times 20-3=77$	B1	AO1
	(a)	(iii)	Area Added $=4n-3$ As n is a positive integer, $4n$ is always an even number. Subtracting odd number 3 from an even number will give us an odd number.	B1	AO3
6	(b)	(i)	Total area of pavement at Day 6 $=6\times 11=66$	B1	AO2
6	(b)	(ii)	$n=1,\ A=1\times 1$ $n=2,\ A=2\times 3$ $n=3,\ A=3\times 5$ From observation, $A=n\times(2n-1)$ $A=2n^2-n$	M1 A1	AO2
6	(b)	(iii)	Method 1 3 weeks = 21 days When n = 21, $A=2\times 21^2-21=861\text{m}^2$ Yes, as 861 > 780, hence an area of 780 m² can be completed in 3 weeks.	M1 A1	AO3

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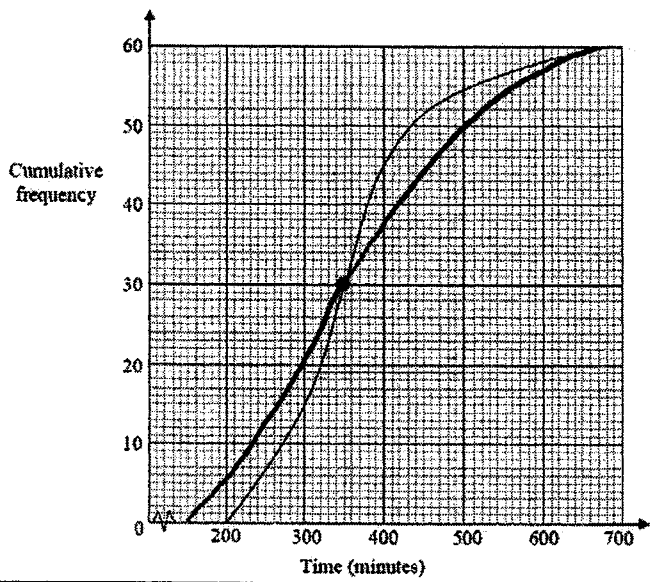
			Method 2 $2n^2 - n = 780$ $2n^2 - n - 780 = 0$ $(2n+39)(n-20) = 0$ $n = -19.5$ *or* $n = 20$ Yes, since it takes only 20 days to cover 780m^2	M1 A1	
7	(a)		$\angle GAO = 90°$ (tangent $\perp$ radius) $\angle GOA = 180° - 90° - 32°$ ($\angle$ sum of Δ) $= 58°$	M1 A1	AO1 M0 if the reason is wrong
	(b)		$\angle FCD = 90°$ (rt $\angle$ in semi-circle) $\angle BCF = 106° - 90° = 16°$	M1 A1	AO2 M0 if the reason is wrong
	(c)		$\angle BDF = 16°$ ($\angle s$ in same segment) $\angle FDA = 58° \div 2 = 29°$ ($\angle$ at centre $= 2\angle$ at circumference) $\angle BDA = 16° + 29° = 45°$	M1 A1	AO2 M0 if the reason is wrong
	(d)		$\angle BAD = 180° - 106° = 74°$ ($\angle s$ in opp.segments) $\angle DEA = 180° - 74° - 29° = 77°$ ($\angle$sum of Δ)	M1 A1	AO2 M0 if the reason is wrong
8	(a)	(i)	(a) Median = 350 minutes	B1	AO1
			(b) Lower quartile = 300 Upper quartile = 400 Interquartile range = 400-300=100 minutes	B1	AO1
8	(a)	(ii)	20% spent $\geq x$ minutes on social media in a week 80% spent $< x$ minutes on social media in a week. $\frac{80}{100} \times 60 = 48$ students From the graph, 48 students spent < 420 minutes Hence $x = 420$	M1 A1	AO2
8	(a)	(iii)		B1	AO2 Any curve with same median and gentler slope for IQR

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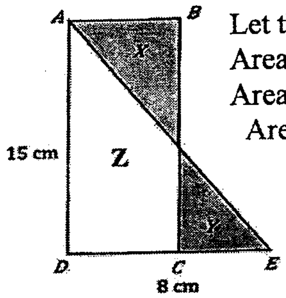
8	(b)	(i)	(a)	$\frac{8+30}{240}=\frac{38}{240}=\frac{19}{120}$	B1	AO1
			(b)	$\frac{5+40}{240}=\frac{45}{240}=\frac{3}{16}$	B1	AO1
8	(b)	(ii)		$P(\text{ at least one of them spent} \leq 40 \text{ minutes})$ $= 1-P(\text{none of them spent} \leq 40 \text{ minutes})$ $= 1-P(\text{both of them spent} > 40 \text{ minutes})$ $= 1-\frac{240-15-8}{240}\times\frac{240-15-8-1}{240-1}$ $= 1-\frac{217}{240}\times\frac{216}{239}$ $= \frac{437}{2390}$	M1 A1	AO2
9	(a)			 Let the unshaded region be Z. $\text{Area } X = \text{Area } Y + 12$ $\text{Area } X + \text{Area } Z = \text{Area } Y + \text{Area } Z + 12$ $\text{Area of } ABCD = \text{Area of } ADE + 12$ $AB\times 15 = \frac{1}{2}\times 8\times 15 + 12$ $AB\times 15 = 72$ $AB = 4.8\text{cm}$	M1 M1 A1	AO2
9	(b)	(i)		$OC = OA + AC$ $= OA + \frac{2}{3}AB$ $= OA + \frac{2}{3}(AO + OB)$ $= a + \frac{2}{3}(-a + b)$ $= \frac{1}{3}a + \frac{2}{3}b$	M1 A1	AO2
9	(b)	(ii)		$CD = CO + OD$ $= -OC + \frac{5}{3}OB$ $= -\left(\frac{1}{3}a + \frac{2}{3}b\right) + \frac{5}{3}b$ $= -\frac{1}{3}a + b$	M1 A1	AO2

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9	(b)	(iii)	From (ii) $\overrightarrow{CD} = -\frac{1}{3}\underset{\sim}{a} + \underset{\sim}{b}$ $\overrightarrow{EC} = \overrightarrow{EO} + \overrightarrow{OC}$ $= -\frac{5}{9}\underset{\sim}{a} + \left(\frac{1}{3}\underset{\sim}{a} + \frac{2}{3}\underset{\sim}{b}\right)$ $\overrightarrow{EC} = -\frac{2}{9}a + \frac{2}{3}\underset{\sim}{b}$ $EC = \frac{2}{3}\left(-\frac{1}{3}a + b\right)$ $EC = \frac{2}{3}CD$ $\Rightarrow$ EC is parallel to CD and C is the common point $\Rightarrow$ D, C and E are collinear.	M1 M1 A1	AO3 For finding $\overrightarrow{EC}$ For connecting EC and CD by a scaler
		(iv)	$\frac{\text{area of } \Delta OEC}{\text{area of } \Delta OCD}$ $= \frac{EC}{CD}$ $= \frac{2}{3}$	B1	AO2
		(v)	$\frac{\text{area of } \Delta EAC}{\text{area of } \Delta OAB}$ $= \frac{\text{area of } \Delta EAC}{\text{area of } \Delta OAC} \times \frac{\text{area of } \Delta OAC}{\text{area of } \Delta OAB}$ $= \frac{4}{9} \times \frac{2}{3} = \frac{8}{27}$	B1	AO2
10		Real World Context Problem			AO3
	(a)		Mean $= \frac{\sum fx}{\sum f} = \frac{3321}{1000} = 3.321$ Standard deviation $= \sqrt{\frac{\sum fx^2}{\sum f} - \bar{x}^2} = \sqrt{\frac{11325}{1000} - 3.321^2} = 0.544$ (3s.f)	B1 B1	
	(b)		Mr Chew should recommend Mr Tan to produce Model X. Because the mean for X is larger than the mean for Y, which may suggest that more people are likely to buy Model X.	B1	B0 if reason is wrong

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10	(c)	For Model Y, let the missing values for **SD** and **A** be ***a*** and ***b*** respectively. Then the missing value for **SA** $= 1000-31-14-a-b$ $= 955-a-b$ Mean $= \dfrac{\sum fx}{\sum f} = 1.907$ $\dfrac{a+62+42+4b+5(955-a-b)}{1000} = 1.907$ $4879-4a-b = 1907$ $4a+b = 2972$ ------(1) Standard deviation $= \sqrt{\dfrac{\sum fx^2}{\sum f} - (\bar{x})^2} = 1.611$ $\sqrt{\dfrac{a+124+126+16b+25(955-a-b)}{1000} - 1.907^2} = 1.611$ $24125 - 24a - 9b = 6231.97$ $24a + 9b = 17893.03$------(2) (1)× 6 : $24a+6b = 17832$-------(3) (2)−(3): $3b = 61.03$ $b = 20.3$ Since b is a whole number, then $b = 20$. Hence the missing value for **A** is $b = 20$. Subst. $b = 20$ in (1) : $4a + 20 = 2972$ $a = 738$ Hence the missing value for **SD** is $a = 738$. Hence the missing value for **SA** is $955-a-b$ $= 955-738-20$ $= 197$	M1 M1 A1 A1 A1	For forming the correct equation for mean For forming the correct equation for standard deviation Accept any correct method of solving simultaneous equations
	(d)	Mr Tan should produce Model Y. Because there are 197 people (about 20% of those surveyed) who strongly agree that they will buy Model Y, but only 2 people strongly agree that they will buy Model X. Although 347 people agree that they will buy Model X, it was not a strong agreement that they will do it. OR Mr Tan should produce Model X. Because there are 349 people who agree and strongly agree that they will buy Model X but only 217 people agree and strongly agree that they will buy Model Y.	B1 B1	B0 if reason is wrong Accept any reasonable explanation based on same idea given in mark scheme

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