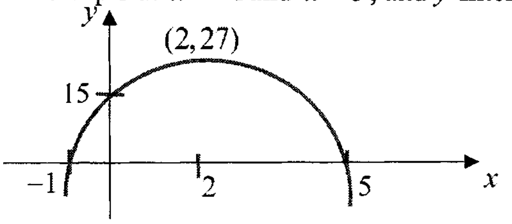
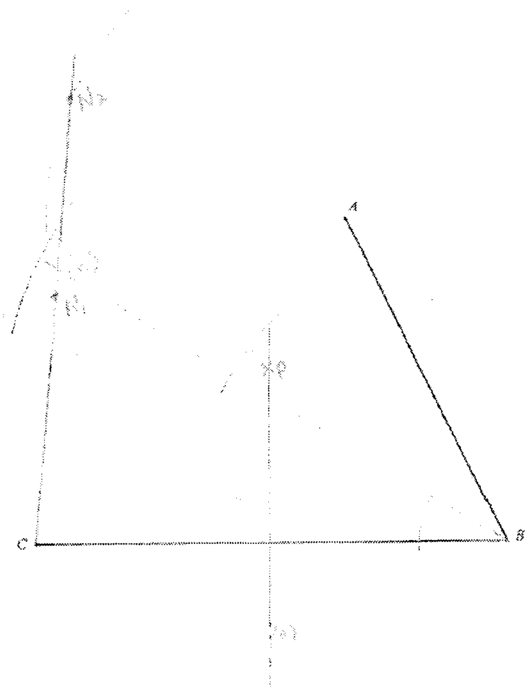
P1 - Ans

1(a)	$\dfrac{33.17\times 55.2^{\frac{1}{3}}}{-(-1)+\sqrt[3]{647.9}}$ $=13.08359745$ $=10$	B1
1(b)	$\dfrac{3m}{s}=\dfrac{0.003km}{\frac{1}{3600}h}$ $=10.8km/h$	B1
2(a)	$10^{2m-n}=(10^m)^2\div 10^n$ $=2^2\div 11$ $=\dfrac{4}{11}$	B1
2(b)	$\dfrac{7mn^{-1}}{m^2}\div\dfrac{(mn^2)^3}{7}$ $=\dfrac{7m}{m^2n}\div\dfrac{m^3n^6}{7}$ $=\dfrac{7m}{m^2n}\times\dfrac{7}{m^3n^6}$ $=\dfrac{49}{m^4n^7}$	M1 for either simplying or change of sign A1
3	$T=k\sqrt{L}$ $1.25T=k\sqrt{L_{New}}$ $1.25k\sqrt{L}=k\sqrt{L_{New}}$ $1.25\sqrt{L}=\sqrt{L_{New}}$ $(1.25)^2L=L_{New}$ $\%change$ $=\dfrac{L_{New}-L}{L}\times 100\%$ $\dfrac{(1.25)^2L-L}{L}\times 100\%$ $=0.5625\times 100\%$ $=56.25\%$	M1 $\times 100\%$ A1

4(a)	37 min	B1
4(b)	25% of 28 = $\frac{25}{100}\times 28$ = 7 From the stem and leaf diagram, 7 workers took less than 19 minutes to assemble a toy. $p = 19$ min.	A1
5	$P = \$12000,\ R = \frac{7}{2} = 3.5\%$, $n = 4$ $A = P\left(1+\frac{R}{100}\right)^n$ $A = 12000\left(1+\frac{3.5}{100}\right)^4$ $= 13770.27601$ $= \$13770.28$ Compound interest $= 13770.27601 - \$12000$ $= \$1770.27601$ $= \$1770.28(2d.p)$	M2,1,0 A1
6	$z = \frac{\sqrt{x^2+y}}{2}$ $2z = \sqrt{x^2+y}$ $4z^2 = x^2 + y$ $x^2 = 4z^2 - y$ $x = \pm\sqrt{4z^2 - y}$	M1 A1 (minus 1 m if no ±)
7(a)(i)	$x^2 - 6x - 16$ $= (x-3)^2 - 16 - (-3)^2$ $= (x-3)^2 - 16 - 9$ $= (x-3)^2 - 25$	B2
7(a)(ii)	$(3,-25)$	B1

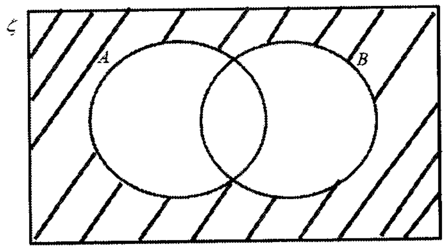
7(a)(iii)	$x=3$	B1
7(b)	B1 – Shape + turning point (2,27) B1 – x-intercepts at $x=-1$ and $x=5$, and y-Intercept at (0,15)  	
8	3 Three points A, B and C are shown below.  (a) Construct the perpendicular bisector of BC. (b) Construct the bisector of angle ABC. (c) Mark clearly a possible point which is equidistant from B and C, and is nearer to AB tha[n] to BC. Label this point P. (d) The point N is such that angle $BCN = 85°$ and $AN = 7$ cm. Find the two possible positions of N and label them N_1 and N_2.	
9(a)	$sum = n(3n-2)$ 1st term $=1[3(1)-2]=1$	

	Sum of 2 terms $=2[3(2)-2]=8$ 2nd term $=8-1=7$ Sum of 3 terms $=3[3(3)-2]=21$ 3rd term $=21-8=13$ First 3 terms: 1, 7, 13	B2,1,0
9(b)	$6n-5$	B1
10(a)	$(5-2)\times180^\circ=90^\circ+90^\circ+3y$ $540^\circ=180^\circ+3y$ $3y=360^\circ$ $y=120^\circ$ $x=360^\circ-120^\circ=240^\circ$ $\frac{y}{x}=\frac{120^\circ}{240^\circ}=\frac{1}{2}$	M1 A1
10(b)	$(12-2)\times180^\circ=1800^\circ$ $\frac{1800^\circ}{12}=150^\circ$ $360^\circ-150^\circ-90^\circ=120^\circ$ $180^\circ-120^\circ=60^\circ$ $\frac{360^\circ}{60^\circ}=6sides$	M1 A1
11	1. The title is biased • It does not allow reader to make his/her own judgement OR 2. Horizontal axis does not start from zero • This exaggerates the differences between the data	B1 – Misleading Feature AND – Effect of the misleading feature on interpretation of data

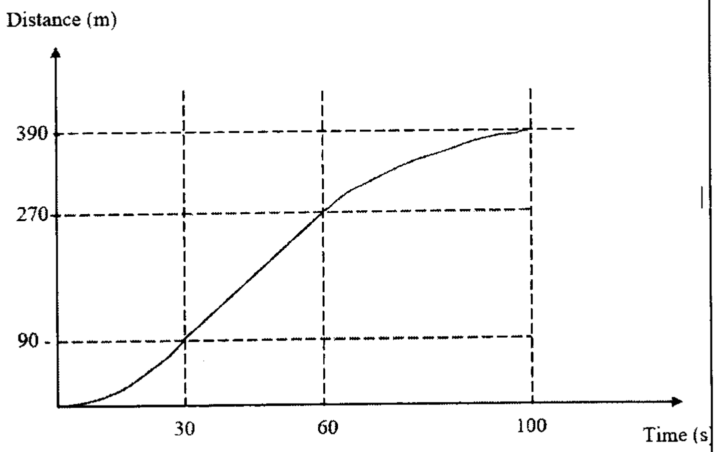
12(a)	$\overrightarrow{CD}=\overrightarrow{OD}-\overrightarrow{OC}$ $=\begin{pmatrix}3\\-1\end{pmatrix}-\begin{pmatrix}-2\\5\end{pmatrix}$ $=\begin{pmatrix}5\\-6\end{pmatrix}$	B1
12(b)	$\overrightarrow{CE}=n\overrightarrow{CD}$ $=n\begin{pmatrix}5\\-6\end{pmatrix}$ $\lvert\overrightarrow{CE}\rvert=n\lvert\overrightarrow{CD}\rvert$ $=n\times\sqrt{5^2+(-6)^2}$ $=n\times\sqrt{61}=2\sqrt{61}(given)$ Since x-coordinate of C is greater than the x-coordinate of E, $\lvert\overrightarrow{CE}\rvert=n\times\sqrt{61}=-2\times\sqrt{61}$ $n=-2$ $\overrightarrow{CE}=\begin{pmatrix}-10\\12\end{pmatrix}$	M1 $n\times\sqrt{61}=2\sqrt{61}(seen)$ A1
13(a)	$(-6,\ 5)$, and $(-3,\ -2)$ *Gradient* $=\frac{5-(-2)}{-6-(-3)}$ $=\frac{7}{-3}$ $y=\frac{7}{-3}x+c$ Sub $(-6,\ 5)$ $5=\frac{7}{-3}(-6)+c$ $c=-9$ $y=\frac{7}{-3}x-9$	M1 A1

13(b)	$y=\frac{7}{-3}x+c$ Sub (9, 5) $5=\frac{7}{-3}(9)+c$ $c=26$ $y=\frac{7}{-3}x+26$	M1 A1
13(c)	$9-(-6)=15$ $5-(-2)=7$ $Area=\frac{1}{2}\times 15\times 7=52.5$	M1 A1
13(d)	(9, 5) (−3, −2) $BC=\sqrt{(9-(-3))^2+(5-(-2))^2}$ $BC=\sqrt{144+49}=\sqrt{193}$ $Area=\frac{1}{2}\times d\times\sqrt{193}=52.5$ $d=\frac{52.5}{\frac{1}{2}\times\sqrt{193}}$ $=7.558065$ $=7.56(3sf)$	M1 A1
13(e)	$y=\frac{7}{-3}x-9$ Sub $y=0$ $\frac{7}{3}x=-9$ $x=\frac{-27}{7}$ $P(\frac{-27}{7},0)$	 M1 A1
14(a)	$AC=\sqrt{12^2+5^2}=13$ $\cos\angle ACD$ $=-\cos\angle ACB$ $=-\frac{5}{13}$	M1 A1

14(b)	Using angles in a semicircle, AC is diameter. Radius = $=\frac{13}{2}=6.5$	B1
15(a)	500	A1
15(b)	$\frac{500(4)^2-500}{500}\times 100\%$ $=1500\%$	M1 A1
15(c)	t=3.5	A1
16(a)	$\frac{x^2+xy}{x^2+2xy+y^2}$ $=\frac{x(x+y)}{(x+y)^2}$ $=\frac{x}{(x+y)}$	M1 A1
16 (b)	$10yz-5y^2-2xz+xy$ $=5y(2z-y)-x(2z-y)$ $=(5y-x)(2z-y)$	M1 A1
17(a)	$\frac{3}{5},\frac{4}{9}$	B1,0
17(b) (i)	$\frac{3}{5}\times\frac{4}{9}+\frac{2}{5}\times\frac{2}{3}$ $=\frac{8}{15}$	M1 A1
17(b) (ii)	$1-\frac{3}{5}\times\frac{5}{9}$ $=\frac{2}{3}$	M1 A1
18(a)	Deposit $=\frac{20}{100}\times\$1200=\$240$ Remaining amount $=\$1200-\$240=\$960$ Monthly payment $=\frac{1.5}{100}\times\$960\times 12$ $=\$172.80$ Total amount paid $=\$172.80+\$1200$ $=\$1372.80$	M1 A1

18(b)(i)	3	B1
18b)(ii)		B1
19(a)	1 cm : 10 km 1 cm² : 100 km² Area (map) = $\frac{225}{100}$ = 2.25 cm²	M1 A1
19b)	36 cm² : 225 km² 6 cm : 15 km 1 cm : 2.5 km 1 cm : 250000 cm Map scale is 1:250000	M1 A1
20(a)(i)	$4624 = 2^4 \times 17^2$	B1
20(a)(ii)	$4624 \times \frac{p}{q} = 2^4 \times 17^2 \times \frac{p}{q}$ $p = 17, q = 2$	B1
20(b)	$a = 27, b = 29, c = 32$	B2
21(a)	$\angle AED = \angle BEC$ (vert. opp. $\angle$s) $\angle EAD = \angle EBC = 24°$ ($\angle$s in the same segment) $\angle EDA = \angle ECB = 67°$ ($\angle$s in the same segment) ΔAED is similar to ΔBEC (AA similarity test)	M1 (1 pair of correct corresponding angles with reasons) A1
21(b)	$\frac{2}{4} = \frac{3.5}{EB}$ $EB = 7$ Alternative solution	M1 A1 M1

	$\frac{4}{\sin 24°}=\frac{EB}{\sin 67°}$ $EB=\frac{4\sin 67°}{\sin 24°}=9.05cm(3s.f)$	A1
21(c)	$\angle AOD=180°-67°-67°=46°$ $\angle BOC=180°-24°-24°=132°$ $\dfrac{\frac{46}{360}\times 2\pi r}{\frac{132}{360}\times 2\pi r}$ $=\frac{46}{132}$ $=\frac{23}{66}$	M1 A1
22(a)	$\frac{\text{Base area of Vase } B}{\text{Base area of Vase } A}=\left(\frac{\text{Base radius of Vase } B}{\text{Base radius of Vase } A}\right)^2$ $\frac{\text{Base area of Vase } B}{50}=\left(\frac{3}{1}\right)^2$ Base area of Vase $B=\frac{9}{1}\times 50=450\ cm^2$	M1 A1
22(b)(i)	$\frac{\text{Curved surface area of Vase } C}{\text{Curved surface area of Vase } A}$ $=\frac{\text{Base area of Vase } C}{\text{Base area of Vase } A}$ $=\frac{800}{50}=\frac{16}{1}$ The required ratio is 16: 1	A1
22(b)(ii)	$\frac{\text{Base area of Vase } C}{\text{Base area of Vase } A}=\frac{16}{1}$ $\frac{\text{height of Vase } C}{\text{height of Vase } A}=\frac{\sqrt{16}}{\sqrt{1}}=\frac{4}{1}$ $\frac{\text{Volume of Vase } C}{\text{Volume of Vase } A}=\left(\frac{4}{1}\right)^3$ $\frac{\text{Volume of Vase } C}{400}=\frac{64}{1}$ Volume of Vase $C=\frac{64}{1}\times 400=25600\ cm^3$	M1 A1

23 (a)	$gradient(acceleration) = \frac{speed}{time}$ $= \frac{6-0}{60-100} = -0.15$ $\frac{v-0}{70-100} = -0.15$ $\frac{v}{-30} = -0.15$ $v = 4.5\ m/s$	M1 A1
23 (b)	 B1 – correct values for distance and time (must be proportionate) B1 – correct shape	

Solutions

1(a)	$-\frac{2x+1}{3} \le \frac{3x-1}{-5}$ $-\frac{2x+1}{3} \le -\frac{3x-1}{5}$ $5(2x+1) \ge 3(3x-1)$ $10x+5 \ge 9x-3$ $x \ge -8$	**M1** **A1**
1(b)	$-\frac{x}{1-3x}+\frac{7}{(3x-1)^2}$ $=\frac{x}{3x-1}+\frac{7}{(3x-1)^2}$ $=\frac{x(3x-1)}{(3x-1)^2}+\frac{7}{(3x-1)^2}$ $=\frac{x(3x-1)+7}{(3x-1)^2}$ $=\frac{3x^2-x+7}{(3x-1)^2}$ **Alt method** $-\frac{x}{1-3x}+\frac{7}{(3x-1)^2}$ $=-\frac{x}{1-3x}+\frac{7}{(1-3x)^2}$ $=\frac{7}{(1-3x)^2}-\frac{x(1-3x)}{(1-3x)^2}$ $=\frac{7-x+3x^2}{(3x-1)^2}$ $=\frac{3x^2-x+7}{(3x-1)^2}$	**M1** **M1** **A1** **M1** **M1** **A1**

1(c)	$5x = 49 - 4y$ ----------(1) $4x - 5y = -10$ ---------(2) From (1) : $5x + 4y = 49$ -------(3) $(3)\times 4 : 5x + 4y = 49$ ---------(4) $(2)\times 5 : 20x - 25y = -50$ -------(5) $(4)-(5)$: $16 - (-25y) = 196 - (-50)$ $41y = 246$ $y = 6$ Subt $y = 6$ into (1) $5x = 49 - 4(6)$ $5x = 25$ $x = 5$ **Ans $x = 5$, $y = 6$**	**M1** **A1** **A1**
1(d)	$\left(\frac{h^{15}}{64f^{12}}\right)^{-\frac{2}{3}} = \left(\frac{64f^{12}}{h^{15}}\right)^{\frac{2}{3}}$ $= \left(\frac{64f^{12}}{h^{15}}\right)^{\frac{2}{3}}$ $= \frac{16f^{8}}{h^{10}}$	**M1** **A1**
2(a)	$\begin{pmatrix} 164 & 144 & 50 \\ 128 & 90 & 40 \end{pmatrix}$	**B1**
2(b)	$\begin{pmatrix} 30 \\ 25 \\ 20 \end{pmatrix}$	**B1**
2(c)	**AP** $= \begin{pmatrix} 164 & 144 & 50 \\ 128 & 90 & 40 \end{pmatrix}\begin{pmatrix} 30 \\ 25 \\ 20 \end{pmatrix}$ $= \begin{pmatrix} 9520 \\ 6890 \end{pmatrix}$ $(1\ 1)$**AP** $= (1\quad 1)\begin{pmatrix} 9520 \\ 6890 \end{pmatrix}$ $= (16\,410)$	**M1** **A1**

	The element 16410 represents the total amount collected from the sales of tickets for Saturday and Sunday for the 1st weekend.	**B1**
2(d)(i)	$\begin{pmatrix} 1.25 & 0 & 0 \\ 0 & 1.5 & 0 \\ 0 & 0 & 0.8 \end{pmatrix}$	**B1**
2(d)(ii)	Each element in matrix **FP** represents **the total amount collected from the sales of tickets for Saturday and Sunday respectively** for the 2nd weekend.	**B1**
3(a)	By sine rule, $\frac{BD}{\sin 85°} = \frac{9}{\sin 30°}$ $BD = 17.9315$ (6s.f) $BD = 17.9$ m (3 s.f)	**M1** **A1**
3(b)	$\cos \measuredangle BDA = \frac{6^2 + 17.9315^2 - 14.5^2}{2(6)(17.9315)}$ $= 46.8039°$ (4 d.p) Bearing $= 180° + 46.8039°$ $= 226.804°$ $= 226.8°$	**M1** **M1** **A1**
3(c)	Note : Greatest angle of elevation/depression occurs at shortest distance *CX*. In triangle DCX, $\sin 65° = \frac{CX}{9}$ $CX = 9 \sin 65°$ Let θ be the greatest angle of elevation $\tan \theta = \frac{12}{9 \sin 65°}$ $\theta = 55.7948°$ (4 d.p) $\theta = 55.8°$ (1 d.p) Students may use area of triangle to find *CX*.	**M1** **M1** **A1**
4(a)	Vol. of container $= \pi(1.5)^2(10) + \frac{1}{2}\pi(1.5)^2(2)$ $= 75.3982$ cm^3 (4 s.f) $= 75.4$ cm^3 (3 s.f)	**M1, M1 for each working** **A1**

4(b)	Vol. of water = $\frac{75}{100}\times 75.3982$ =56.5487 (4 s.f) Height of water = $\frac{56.5487}{\pi(1.5)^2}$ = 8.00 cm $d = 10 + 2 - 8.0000$ = 4.00 (3 s.f)	M1 M1 A1
4(c)	Let the height of pyramid be h cm. $\frac{1}{3}\times 4\times 4\times h = 56.5487$ $h = 10.6029$ (6 s.f) $h = 10.6$ cm (3 s.f)	M1 A1
4(d)	Time = $\left[1-\left(\frac{2}{3}\right)^3\right]x$ = $\frac{19}{27}x$ minutes Accept $\frac{1}{27}x$ minutes (as students may see it in another perspective)	B1
5(a)	$P = -0.05$	B1
5(b)	Refer to graph paper	
5(c)	The graph $y = \frac{x^2}{7}+\frac{2}{x}-2$ **cuts the x-axis at 2 points.** Hence, $\frac{x^2}{7}+\frac{2}{x}-2=0$ has 2 solutions	B1
5(d)	Accurate tangent line drawn Gradient = $\frac{1.8}{1.8}$ = 1 (accepts 1.02 ± 0.05)	M1 A1
5(e)	$x^3+7x^2-28x+14=0$ $x^2+7x-28+\frac{14}{x}=0$ $\frac{x^2}{7}+x-4+\frac{2}{x}=0$ $\frac{x^2}{7}+\frac{2}{x}-2=-x+2$ Line $y = 2 - x$ drawn From graph, $\underline{x = 2.35} \pm 0.05$	M1 M1 A1

6(a)(i)	$\measuredangle OBI = 90°$ (tan perpendicular rad) $\measuredangle OCI = 90°$ (tan perpendicular rad) OI is a common line. $OB = OC$ (radii of the same circle) By **RHS,** triangle *OBI* is congruent to triangle *OCI.*	M1 A1
6(a)(ii)(a)	$\measuredangle DCB = 180-(62+70)$ ($\measuredangle$in opposite segment) $= 48°$	B1
6(a)(ii)(b)	$\measuredangle GCE = \measuredangle GAB$ $= 62°$ ($\measuredangle$in the same segment) $OC = OE$ (radii of the same circle) $\measuredangle OCE = \measuredangle OEC = 76°$ (base of isos triangle) $\measuredangle GOC = 76-62$ $= 14°$ Accepts other methods (eg. Find angle *OBC* first)	M1 A1
6(a)(ii)(c)	$\measuredangle OCH = 90°$(tan perpendicular rad) $\measuredangle BCH = 90+14$ $= 104°$	B1
(b)	Major arclength $= (2\pi - 2.18)\times 8$ $= 16\pi - 17.44$ $AD^2 = 8^2 + (8+3.6)^2 - 2(8)(8+3.6)\cos 2.18$ $AD = 17.4575$ (6s.f) Perimeter = $16\pi - 17.44 + 3.6 + 17.4575$ = 53.9 cm (3 s.f)	M1 M1 M1 A1
(c)	$\dfrac{\text{area of sector ABCO}}{\text{area of triangle AOD}} = \dfrac{\frac{1}{2}\times(8)^2\times(2\pi-2.18)}{\frac{1}{2}\times(8)\times(8+3.6)\sin 2.18}$ = 3.45052 (5 d.p) = 3.45 (2 d.p)	**M1 for denominator** **M1 for numberator** A1
7(a)	Mean $= \dfrac{22(8)+26(10)+30(21)+34(7)+38(4)}{50}$ =29.12 minutes $\dfrac{\sum fx^2}{N} = \dfrac{8(22)^2+10(26)^2+21(30)^2+7(34)^2+4(38)^2}{50}$ $= 868$ Standard deviation = $\sqrt{868-29.12^2}$ = 4.474997	M1 M1 A1
7(b)	The **mean waiting time for hospital A** and hospital **are the same (29.12 min).** Hence, the average waiting time is generally the same for both hospital.	B1

	However, the **standard deviation for waiting times in hospital B (3.2 min) is lower than the waiting times in hospital A (4.47 min)**. Hence, the waiting times in hospital B are more consistent.	B1
7(c)	P(required) $= \frac{8}{50}\times\frac{11}{49}+\frac{11}{50}\times\frac{8}{49}$ $= \frac{88}{1225}$ Accepts other relevant method	M1 A1
8(a)(i)	$-\underset{\sim}{a}+\underset{\sim}{b}$	B1
8(a)(ii)	$\overrightarrow{CD}=\overrightarrow{CO}+\overrightarrow{OD}$ $=\frac{2}{3}(-\underset{\sim}{a})+\frac{1}{2}(\underset{\sim}{b})$ $=-\frac{2}{3}\underset{\sim}{a}+\frac{1}{2}\underset{\sim}{b}$ $\overrightarrow{CE}=\frac{1}{2}\left(-\frac{2}{3}\underset{\sim}{a}+\frac{1}{2}\underset{\sim}{b}\right)$ $=-\frac{1}{3}\underset{\sim}{a}+\frac{1}{4}\underset{\sim}{b}$	M1 A1
8(b)(i)	$\overrightarrow{OF}=\overrightarrow{OA}+\overrightarrow{AF}$ $=\underset{\sim}{a}+m(-\underset{\sim}{a}+\underset{\sim}{b})$ $=(1-m)\underset{\sim}{a}+m\underset{\sim}{b}$	M1 A1
8(b)(ii)	$\overrightarrow{OE}=\frac{3}{5}\overrightarrow{OF}$ Since $\overrightarrow{OE}$ is a scalar multiple of $\overrightarrow{OF}$ and there is a common point *O*, *O*, *E* and *F* lie on a straight line.	M1 A1
8(c)(i)	$\frac{\text{area of triangle AEC}}{\text{area of triangle OEC}}=\frac{\frac{1}{2}\times1\times h}{\frac{1}{2}\times2\times h}$ $=\frac{1}{2}$	B1
8(c)(ii)	$\frac{\text{area of triangle OCD}}{\text{area of triangle OAD}}=\frac{\text{area of triangle OCD}}{\text{area of triangle OAD}}\times\frac{\text{area of triangle OAD}}{\text{area of triangle OAB}}$ $=\frac{2}{3}\times\frac{1}{2}$ $=\frac{1}{3}$ **Accepts other methods**	B1
9(a)	Time taken by Ali $=\frac{42}{x}$ h Time taken by Robert $=\frac{42}{x-2}$ h	

	$\frac{42}{x-2}-\frac{42}{x}=\frac{1}{2}$	M1 ($\frac{42}{x}$ and $\frac{42}{x-2}$ seen)
	$\frac{42x-42(x-2)}{x(x-2)}=\frac{1}{2}$	M1
	$\frac{84}{x(x-2)}=\frac{1}{2}$ $x(x-2)=168$	M1
	$x^2-2x-168=0$	M1 (able to reduce)
9(b)	$x^2-2x-168=0$ $(x+12)(x-14)=0$ $x=-12$ *or* $x=14$ Accept by Formula method	M1 A1
9(c)	Since x represents speed, x cannot be negative.	B1
9(d)	Time taken = $\frac{42}{14-2}$ $=3.5\text{h}$	B1
10(a)	Total time taken = 13 h 50 min + 2 h = 15h 50 min Time = 8.05 am	B1
10(b)	Total per day = £25 + £10 + £15 = £50 Total for 6 days = 6×50 = £300	M1
	Assuming that he needs to save 10% of the total amount of \$700 Total planned spending = 300(1.65) + $\frac{10}{100}\times700$ = \$565	M1
	Sufficient	A1
	Alternative Solutions : Assuming that he needs to save 10% of the total amount planned for 6 days : Total planned spending = 300(1.65) + $\frac{10}{100}\times(300\times1.65)$ = \$544.50	M1*

10(c)	Budget = 15×4 =£60 **Option A** Full price = £60 Discount = $\frac{5}{100}\times90$ = £4.50 Final cost = 60 - 4.50 = £55.50 Exceed budget **Option B** 8 attractions $\times12.50$ =£100 Exceed budget **Option C** 2 day pass = £35 Remaining 2 days = 4 attractions $\times6$ =£24 Total cost = £35 + £24 =£59 Cover all attractions with sufficient budget. Money left = £60 – £59 = £1 I would recommend C. It meets all her sightseeing needs at the lowest cost and meeting her budget of $60.	**M1** **M1** **M1** **M1** **A1**