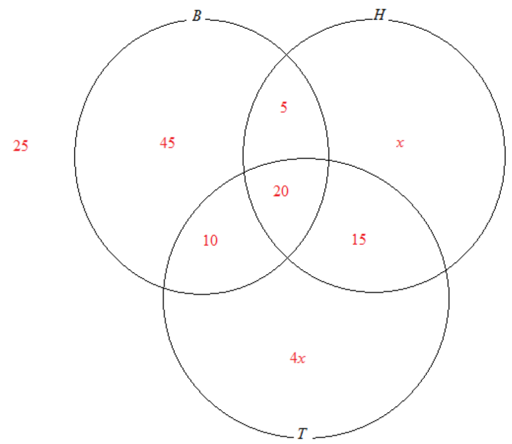


Question	Scheme	Mark	Notes
3 (a)	$576 = \dfrac{\alpha}{\left(\dfrac{1}{2}\right)^3}$ $\alpha = 72$ $\quad \therefore f = \dfrac{72}{r^3}$	3	M1 A1 A1
(b)	$f = 5 + \dfrac{1}{t} = \dfrac{"72"}{2^3}$ (= 9) (oe) $\quad\quad$ $t = \dfrac{1}{4}$	2	M1 A1

Question	Scheme		Mark	Notes
4	One of $(1,1): \quad -7+2x^2=1$ (ie 1st column) $(2,1): \quad -21-4x^2=-37$ $(3,1): \quad 35-6x^2=11$	$x=2$	6	M1 A1
	One of $(1,2): \quad 1+2(\text{"}x\text{"}+2y)=1$ (ie 2nd column) $(2,2): \quad 3-4(\text{"}x\text{"}+2y)=3$ $(3,2): \quad -5-6(\text{"}x\text{"}+2y)=-5$	$y=-1$		M1 (DEP) A1
	One of $(1,3): \quad -\text{"}x\text{"}z-2\text{"}y\text{"}=-4$ (ie 3rd column) $(2,3): \quad -3\text{"}x\text{"}z+4\text{"}y\text{"}=-22$ $(3,3): \quad 5\text{"}x\text{"}z+6\text{"}y\text{"}=24$	$z=3$		M1 (DEP) A1

 PMT

Question		Scheme		Mark	Notes
5	(a)			4	B1 25 correctly positioned B1 5, 10 and 15 correctly positioned B1 45 and 20 correctly positioned B1 4x correctly positioned in T and x correctly positioned in H
	(b)		150 = 25 + "45" + "5" + x + "10" + 20 + "15" + 4x (oe) (ie 150 = their 8 values)	1	B1 ft
	(c)	(eg 150 = "120" + 5x (oe)) (cao)	$x = 6$	2	M1 Collecting "their" two x terms and equating them to "their" 7 constant values A1
	(d)	$\left(\dfrac{"10"+"20"}{"45"+"5"+"10"+"20"} =\right)$ $\dfrac{"30"}{"80"}$ (oe), "0.375", "37.5"%		1	B1 Ft **NB**: ft on their diagram

Question		Scheme	Mark	Notes
6	(a)	$\frac{3}{5}$, 0.6	1	B1
	(b)	$\frac{3}{2}$ OR 1.5 OR not 3/2	1	B1
	(c)	$y(2x-3)=6$ (oe) OR $x(2y-3)=6$ (oe) $\mathrm{h}^{-1}: x \mapsto \frac{6+3x}{2x}$, $\frac{3(2+x)}{2x}$, $\frac{3}{x}+\frac{3}{2}$, $\mathrm{h}^{-1}=\frac{6+3x}{2x}$ (oe)	2	M1 A1
	(d)	$18x-x(2x-3)=3(2x-3)$ (removing denominators, oe, allow 1 minor slip) $2x^2-15x-9(=0)$ (oe) $x=\frac{-(-15)\pm\sqrt{((-15)^2-4\times2\times(-9))}}{2\times2}$ **NB:** on their trinomial quadratic. -0.558 8.06		M1 A1 M1 (INDEP) A1 A1

Question		Scheme		Mark	Notes
7	(a)	$65 < t <\leq 70$ fd = 4 (8 x 1cm squares) units $70 < t \leq 80$ freq = 50 runners $80 < t \leq 95$ fd=4units $95 < t \leq 115$ fd = 4.5 units $115 < t \leq 140$ freq = 75 and fd = 3 units		5	B1 B1 B1 B1 B1 ft
	(b)		$95 < t \leq 115$	1	B1 Ft **NB:** ft on "50" for $70 < t \leq 80$
	(c)	Using a correct mid-pt At least 3 correct products $\frac{10\times62.5+20\times67.5+"50"\times75+60\times87.5+90\times105+"75"\times127.5}{305}$ $\left(=\frac{625+1350+"3750"+5250+9450+9562.5}{305}=\frac{29987.5}{305}\right)$	98 (minutes)	4	M1 M1 (DEP) M1 (DEP) A1 (cao)

Question			Scheme		Mark	Notes
8	(a)	(i)		$\overrightarrow{AB} = 8\mathbf{b} - 4\mathbf{a}$	1	B1
		(ii)		$\overrightarrow{PO} = -\mathbf{a}$	1	B1
	(b)		$\overrightarrow{PQ} = \alpha\,"(8\mathbf{b} - 4\mathbf{a})" = -\mathbf{a} + \frac{8}{m}\mathbf{b} \quad \left(= \overrightarrow{PO} + \overrightarrow{OQ}\right)$	$\boldsymbol{\alpha} = \frac{1}{4}$ $m = 4$	3	M1 A1 A1 **NB:** Cand. must use vectors as required by question.
	(c)		$\overrightarrow{PR} = \overrightarrow{PA} + \overrightarrow{AR} = 3\mathbf{a} + \frac{1}{n}"(8\mathbf{b} - 4\mathbf{a})"$ $\overrightarrow{PR} = \left(3 - \frac{4}{n}\right)\mathbf{a} + \frac{8}{n}\mathbf{b}$, $\quad 3\mathbf{a} - \frac{4}{n}\mathbf{a} + \frac{8}{n}\mathbf{b}$, $\frac{3n\mathbf{a} - 4\mathbf{a} + 8\mathbf{b}}{n}$		2	M1 A1 **NB:** So **a** and **b** terms separated
	(d)		*PR* parallel to *OB* means "comp of **a**" in $\overrightarrow{PR}$ above is zero (**OR** since triangles *AOB* and *ARB* are similar, $\frac{AP}{AO} = \frac{3}{4} = \frac{PR}{OB}$, Comp of **b** in (c) means that $\therefore \overrightarrow{PR} = 6\mathbf{b} = \frac{8}{n}\mathbf{b}$ (M1)**)**	$n = \frac{4}{3}$	2	M1 A1
	(e)		Triangles *OAB* and *OPQ* are similar (oe) $\therefore \ \lvert\Delta OAB\rvert = 4^2 \times \lvert\Delta OPQ\rvert$ *APQB* = 150 = Triangle *OAB* □□Triangle *OPQ* $\therefore 150 = 4^2\lvert\Delta OPQ\rvert - \lvert\Delta OPQ\rvert$ (oe) $\therefore \lvert\Delta OPQ\rvert = \mathbf{10}\left(\text{cm}^2\right)$		3	M1 M1 (DEP) A1

Question		Scheme	Mark	Notes
9	(a)	Triangle S drawn and labelled	1	B1
	(b)	Triangle T drawn and labelled $\left(\Delta T = \begin{pmatrix} 2 & 3 & 3 \\ 4 & 4 & 6 \end{pmatrix}\right)$	2	B2 (-1ee)
	(c)	Either point (-2,2) indicated **OR** At least two construction lines through (-2,2) Triangle U $\left(\Delta U = \begin{pmatrix} -6 & -7 & -7 \\ 0 & 0 & -2 \end{pmatrix}\right)$ **NB:** Award M1 A2 if (-2,2) not indicated and no construction lines but ΔU drawn correctly Award M1 A1 A0 if ΔU drawn correctly except for one Vertice.	3	M1 A2 (-1ee)
	(d)	Triangle V drawn and labelled $\left(\Delta V = \begin{pmatrix} -1 & -2 & -2 \\ -1 & -1 & -3 \end{pmatrix}\right)$ **NB:** ft on "triangle U"	2	B2) ft (-1ee
	(e)	$\begin{pmatrix} -3 & 1 \\ 1 & 1 \end{pmatrix}"\begin{pmatrix} -1 & -2 & -2 \\ -1 & -1 & -3 \end{pmatrix}"$ Triangle W drawn and labelled $\left(\Delta W = \begin{pmatrix} 2 & 5 & 3 \\ -2 & -3 & -5 \end{pmatrix}\right)$		M1 A2 (-1ee)
	(f)	-4	1	B1
	(g)	1 : 4	1	B1

Question		Scheme	Mark	Notes
10	(a)	$\sin 25 = \frac{20}{AB}$ 47.3240→**47.3** (cm)	2	M1 A1
	(b)	$\cos 20 = \frac{FC}{15}$ 14.0954→**14.1** (cm)	2	M1 A1
	(c)	$AC^2 = "AB"^2 + 15^2 - 2\times "AB"\times 15\times \cos 95$ $AC = \sqrt{\left("AB"^2 + 15^2\right) - \left(2\times "AB"\times 15\times \cos 95\right)}$ **50.9** (cm)	3	M1 M1 (DEP) A1
	(d)	<u>Method 1:</u> $ABCD = \lvert\Delta ABC\rvert + \lvert\Delta ACD\rvert$ **<u>Scheme:</u> Δ*ABC*:** M1 (angle for area formula), M1(area formula) **Δ*ACD*:** M1 (angle or side for area formula), M1(area formula) **A*BCD*:** M1 (adding areas) A1 $\angle ABC = 25 + (180 - 90 - 20) \quad (= 95)$ **NB:** $\angle ABC$ must be evaluated to **95** $\lvert\Delta ABC\rvert = \frac{1}{2}\times 15\times "AB"\times \sin "\angle ABC" \quad \left(= \begin{cases} 353.6 & \text{using 4sf} \\ 353.4 & \text{using 3sf} \end{cases} \right)$	6	M1 (DEP) M1 M1 (DEP)) M1

	(Point *X* is st *AD* is perpendicular to *CX* $\therefore AX = 20 + "FC"$) $\therefore \cos\angle CAD = \frac{"AX"}{"AC"}$ $\left(\angle CAD = \begin{cases} 47.94^\circ \text{ using 3sf answers} \\ 47.92^\circ \text{ using 4sf answers} \end{cases}\right)$ $\therefore \lvert\Delta ACD\rvert = \frac{1}{2}\times 40\times "AC"\times \sin"\angle CAD"$ $\left(= \begin{cases} 755.2 & \text{using 4sf} \\ 755.8 & \text{using 3sf} \end{cases}\right)$ [OR $\therefore CX = \sqrt{"AC"^2 - "AX"^2}$ $\therefore \lvert\Delta ACD\rvert = \frac{1}{2}\times 40\times "CX"$] (OR $\angle ABC = 25 + (180 - 90 - 20)$ $(=95)$ **NB:** $\angle ABC$ must be evaluated to **95** $\angle BAC = \sin^{-1}\left(\frac{15\times\sin 95}{"50.9"}\right)$ $(=17.07)$ $\lvert\Delta ABC\rvert = \frac{1}{2}\times "47.324"\times "50.9"\times \sin"\angle BAC"$		(M1) (M1 M1) (DEP)) (M1 (DEP)) (M1 (DEP)) (M1

	$\angle CAD = 65 - "17.07" \quad (= 47.93)$ $\therefore \lvert \Delta ACD \rvert = \frac{1}{2} \times 40 \times "50.9" \times \sin"(65 - 17.07)"$) Finally: $\therefore ABCD = "\lvert \Delta ABC \rvert" + "\lvert \Delta ACD \rvert" \quad \left(= \begin{cases} 1108.8 & \text{using 4sf} \\ 1109.2 & \text{using 3sf} \end{cases} \right)$ *ABCD* = **1110** (cm^2)		M1 (DEP) A1
	<u>Method 2</u>: <u>*ABCD* = ($\Delta ABE + \Delta BCF$) + *CFED*</u> <u>**Scheme:**</u> **Δ*ABE* + Δ*BCF*:** M1(full method for area) ***CFED*:** M1(side or angle need to find *CX*), M1(full method for *CX*), M1(area formula for *CFED*) ***ABCD*:** M1(adding areas), A1 <u>*ABCD* = ($\lvert \Delta ABE \rvert + \lvert \Delta BCF \rvert$) + *CFED*</u> ($\Delta ABE + \Delta BCF$) = $\left(\frac{1}{2} \times "AB" \times 20 \times \sin 65\right) + \left(\frac{1}{2} \times "FC" \times 15 \times \sin 20\right)$ M1		M1 M1 M1 (DEP) M1 (DEP) M1 (DEP) A1

	$\left(=\begin{cases}464.852 & \text{using 3sf}\\ 465.06 & \text{using 4sf}\end{cases}\right)$ Point *X* is st *AD* is perpendicular to *CX* $\therefore AX = 20 + "FC"$ M1 $\therefore CX = \sqrt{"AC"^2 - "AX"^2}$ $\left(=\begin{cases}37.79 & \text{using 3sf}\\ 37.76 & \text{using 4sf}\end{cases}\right)$ M1 (DEP) $\Big($OR $\tan 25 = \dfrac{20}{BE}$ (*BE* = 42.89) (M1) *FE* = *CX* = $"BE" - 15\sin 20$ (M1(DEP))$\Big)$ $\therefore CFED = \frac{1}{2}\times"CX"\times("FC"+20)$ $\left(=\begin{cases}644.32 & \text{using 3sf}\\ 643.71 & \text{using 4sf}\end{cases}\right)$ M1 (DEP) ∴ *ABCD* = "($\Delta BCF + \Delta ABE$)" + "*CFED*" $\left(=\begin{cases}1108.8 & \text{using 4sf}\\ 1109.2 & \text{using 3sf}\end{cases}\right)$ M1 (DEP) *ABCD* = **1110** (cm^2)		
	<u>Method 3: $\Delta ABC + \Delta ACX + \Delta CXD$</u> **<u>Scheme: ΔABC</u>**:M1 (angle for area formula), M1(area formula)	6	M1 (DEP) M1 M1 M1 (DEP)

	Δ*ACX*: M1(full method for area formula) **Δ*CXD*:** M1(full method for area formula) ***ABCD*:** M1 (Adding areas) A1 *ABCD* = $\lvert\Delta ABC\rvert + \lvert\Delta ACX\rvert + \lvert\Delta CXD\rvert$ $\angle ABC = 25 + (180 - 90 - 20) \quad (= 95)$ M1 **NB:** $\angle ABC$ must be evaluated to **95** $\lvert\Delta ABC\rvert = \frac{1}{2} \times 15 \times "AB" \times \sin "\angle ABC" \qquad \left(= \begin{cases} 353.6 & \text{using 4sf} \\ 353.4 & \text{using 3sf} \end{cases}\right)$ M1(DEP) (Point *X* is st *AD* is perpendicular to *CX* $\therefore AX = 20 + "FC"$) $(BE = 20\tan 65 = 42.89 \quad \text{and} \quad BF = 15\sin 20 = 5.130 \quad \therefore\ FE = 37.7598)$ $\lvert\Delta ACX\rvert = \frac{1}{2} \times "34.095" \times "37.76" \quad (= 643.718)$ M1 $(DX = 20 - "14.095" = 5.905)$ $\lvert\Delta CXD\rvert = \frac{1}{2} \times 37.76 \times 5.905 \quad (= 111.479)$ M1		M1 A1

	$\therefore ABCD = 353.4 + 643.718 + 111.479$ (=111.479) M1(DEP) $ABCD = 1108.6 \rightarrow$ **1110** A1 Method 4: $\underline{\Delta ABE + \Delta BED + \Delta BCD}$ **Scheme: Δ*ABE* + Δ*BED* :** M1(area formula for Δ*ABE*), M1(Δ*ABE* = Δ*BED*) **Δ*BCD*:** M1(full method for ∠*DBC*), M1(area formula) ***ABCD*:** M1 (Adding areas), A1 $\underline{\Delta ABE + \Delta BED + \Delta BCD}$ (*BE* = 20tan65 = 42.89) $\lvert\Delta ABE\rvert = \frac{1}{2} \times 20 \times "42.89"$ (= 428.9) M1 and $\lvert\Delta ABE\rvert = \lvert\Delta BED\rvert$ (Congruence) M1 $\angle DBE = 25 \;\therefore\; \angle DBC = 70 - 25 = 45$ M1 $\lvert\Delta BCD\rvert = \frac{1}{2} \times 15 \times "47.324" \times \sin "45" \quad (= 250.97)$ M1(DEP) *ABCD* = "428.9" + "428.9" + "250.97" M1(DEP) $ABCD = 1108.77 \rightarrow$ **1110**	6	M1 M1 M1 M1 (DEP) M1 (DEP) A1

Question		Scheme	Mark	Notes
11	(a)	$3x^4 - 11x^3 + 6x^2 + 9x - 6$ (Expanding, allow 1 slip) (OR $3\left(\frac{2}{3}\right)^4 + a\left(\frac{2}{3}\right)^3 + 6\left(\frac{2}{3}\right)^2 + 9\left(\frac{2}{3}\right) - 6 = 0$ (M1)) cc	2	M1 A1
	(b)	$\frac{dy}{dx} = 3x^2 - 6x$ (differentiating, one term correct) $"3x^2 - 6x" = 0$ $3x(x-2)$ (solving 2 term quadratic) (0, 3) and (2, -1) **NB:** Working must be seen	4	M1 M1 (DEP) M1 (DEP) A1
	(c)	(3), [Accept $-0.38, -0.375, -0.37, -\frac{3}{8}$], ($-1$), [Accept $-0.13, -0.125, -0.12, -\frac{1}{8}$], 1.11 [Accept $\frac{71}{64}$] **NB** : **(1)** Do **not** award respective A1 for (b) in (c). **(2)** 2dp answers required, penalise ONCE	3	B3 (-1eeoo)

Question	Scheme	Mark	Notes
(d)	Curve -1 mark for straight line segments each point missed each missed segment each point not plotted each point incorrectly plotted tramlines very poor curve **NB: (1)** Accuracy for both plotting and drawing is $\pm\frac{1}{2}ss$ = ±0.05 **(2)** Deduct errors starting with the last ePEN mark box	3	B3 (−1eeoo)
(e)	−0.88 (−0.91 to −0.85) 0.67 (Accept $\frac{2}{3}$), 1.35 (ie 1.32 to 1.38), 2.53 (ie 2.50 to 2.56)	4	B1 B1 B1 B1