1	$\left(\frac{-1+5}{2}, \frac{6-4}{2}\right)$ or $\left(\frac{4}{2}, \frac{2}{2}\right)$ or (2, 1)		6	M1	for finding midpoint
	$\frac{-4-6}{5--1}$ or $\frac{6--4}{-1-5}$ or $-\frac{10}{6}$ or $-\frac{5}{3}$			M1	indep for finding the gradient of PQ
	$\frac{-1}{-\frac{10}{6}}$ or $\frac{6}{10}$ or $\frac{-1}{-\frac{5}{3}}$ or $\frac{3}{5}$ or 0.6			M1	for finding the perpendicular gradient to PQ (ft their stated gradient)
	$1=\frac{3}{5}(2)+c$ or $c=-\frac{1}{5}$ or $c=-\frac{2}{10}$ or $c=-0.2$			M1	dep on 1st and 3rd M1 for substituting '(2, 1)' into $y='\frac{3}{5}'x+c$ or find the value of c oe eg $y-'1'='\frac{3}{5}'(x-'2')$
	$y=\frac{3}{5}x-\frac{1}{5}$ or $y=0.6x-0.2$ or $5y=3x-1$			A1	for a correct equation in any form
		$3x-5y-1=0$		A1	for $3x-5y-1=0$ or $5y-3x+1=0$ or $6x-10y-2=0$ oe accept in the form $ax+by=-c$ eg $3x-5y=1$ or $5y-3x=-1$ oe
					Total 6 marks

Alternative Mark Scheme for Q1					
1	$(x+1)^2+(y-6)^2$ or $(x-5)^2+(y+4)^2$		6	M1	
	$(x+1)^2+(y-6)^2=(x-5)^2+(y+4)^2$			M1	using $PA^2=QA^2$ (for some point A on the line)
	$x^2+2x+1+y^2-12y+36$ or $x^2-10x+25+y^2+8y+16$			M1	
	$x^2+2x+1+y^2-12y+36=x^2-10x+25+y^2+8y+16$			M1	
	eg $2x+1-12y+36=-10x+25+8y+16$ or $12x+37=20y+41$			A1	for a correct linear equation in x and y
		$3x-5y-1=0$		A1	for $3x-5y-1=0$ oe
					Total 6 marks

2	$y=-\frac{7}{2}x(+10)$ **or** (gradient =) $-\frac{7}{2}$		4	B1	for correct gradient which may be seen in an equation. Condone $-\frac{7}{2}x$
	$'-\frac{7}{2}'m=-1$ **or** $(m=)'\frac{2}{7}'$			M1	ft their gradient for use of $m_1 \times m_2=-1$
	$-11='\frac{2}{7}'\times 6+c$ **or** $y--11='\frac{2}{7}'(x-6)$ oe			M1	ft dep on M1
		$\left(0, -\frac{89}{7}\right)$		A1	accept $\left(0, -12\frac{5}{7}\right)$ must be exact values
					Total 4 marks

3	Gradient of $\mathbf{L_2}=-10\div-5)$ (= 2)		5	M1	Method to find gradient of $\mathbf{L_2}$
	$6=2\times 8+c \rightarrow c=-10$ $y=2x-10$ oe			A1	Equation for $\mathbf{L_2}$
	$0=2x-10 \rightarrow x=5$ or (5, 0) $y=2\times-3-10 \rightarrow y=-16$ or (−3, −16)			A1	Finding point A and point B
	(Area =) $0.5\times5\times16$ or $(0.5\times5\times10)+(0.5\times10\times3)$ or $0.5\times5\times\sqrt{265}\times\sin 100.6°$ or $0.5\times\sqrt{320}\times\sqrt{265}\times\sin 15.9°$			M1	Method to find area of triangle
		40		A1 cao	Dep on M2
					Total 5 marks

4	(a)		$y = -4x + k$ (oe)	1	B1	for $y = -4x$ or $y = -4x + k$ where k is any numerical value $k \neq 7$ Could be written in another form e.g. $3y + 12x = 20$
	(b)	$m = \frac{-2-1}{2--3}$ *or* $m = \frac{1--2}{-3-2}$ or $-\frac{3}{5}$ or -0.6		4	M1	for using $m = \frac{y_2-y_1}{x_2-x_1}$
		$m_p = \frac{5}{3}$			M1ft	for using $m_1 \times m_2 = -1$
		$4 = \frac{5}{3}(-6) + c$ oe eg $4 = -10 + c$ $(c = 14)$ $y - 4 = \frac{5}{3}(x - -6)$			M1ft	dep on previous M1 for substituting $(-6, 4)$ into linear equation formula $4 = \frac{5}{3}x + c$ to find value of c or $y = \frac{5}{3}x + 14$ or $y = 1.66...x + 14$
			Eg $5x - 3y + 42 = 0$		A1	for correct simplified equation where all values are integers $10x - 6y + 84 = 0$ or $3y = 5x + 42$ oe
						Total 5 marks

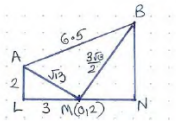
5	eg $\frac{4-(-1)}{6-4}$ $(= \frac{5}{2} = 2.5)$		4	M1	for a method to find the gradient of **L**
	eg $\frac{-1}{"2.5"}$ $(= -\frac{2}{5} = -0.4)$ or $\frac{-1}{\textit{their}\text{ gradient}}$ oe			M1	ft for a method to find the gradient of **M** if *their* gradient of **L** clearly stated (even if no method shown for gradient of **L**)
	$y =$ "-0.4"$x + 8$ oe eg $y - 8 = -\frac{2}{5}(x - 0)$ **or** $(8 \div 2) \times 5$ $(= 20)$ oe **or** $8 \div (-$'*their gradient of* **M**'$)$			M1	dep on previous M1 for substitution of (0, 8) into equation for a line **or** use of $(8 \div 2) \times 5$ $(= 20)$ (maybe on diagram) NB: 20 gains M3 if clearly intended as x coordinate (stated or on a diagram)
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	(20, 0)		A1	
					Total 4 marks

6	$\left(\frac{-1+2}{2}, \frac{5+10}{2}\right)$ **or** (0.5, 7.5) oe		5	M1	
	$\frac{10-5}{2-(-1)}\left(= \frac{5}{3}\right)$ oe			M1	
	$m \times$ '$\frac{5}{3}$' $= -1$ oe **or** $m = -\frac{3}{5}$oe			M1	ft their gradient for use of $m_1 \times m_2 = -1$
	'7.5' $=$ '$-\frac{3}{5}$' $\times$ '0.5' $+ c$ **or** $c = 7.8$ oe **or** $y -$ '7.5' $=$ '$-\frac{3}{5}$'$(x -$ '0.5'$)$			M1	ft dep on first M1 and third M1
		$5y + 3x = 39$		A1	oe where p, q and r must be integers
					Total 5 marks

7	(b)		$\frac{1}{4}$	1	B1 accept 0.25 or $-\frac{1}{-4}$ oe

8	(a)			4	B1	$b = 14$
		(Gradient AB =) $\frac{12}{5}$ oe or eg $\frac{10--2}{1--4}$ oe			M1	For the gradient of AB
		(Gradient BC =) $-\frac{5}{12}$ oe			M1	Ft correct use of $m_1 \times m_2 = -1$ for *their* gradient of AB or $a = 2.5$ or $c = -9.5$
			$a = 2.5$, $c = -9.5$		A1	for $a = 2.5$ and $c = -9.5$
	(b)	$(AB =) \sqrt{(1--4)^2 + (10--2)^2}$ $(=\sqrt{5^2 + 12^2}\ (=13))$		3	M1	
		$(BC =) \sqrt{(19-1)^2 + (10-2.5)^2}$ $(=\sqrt{18^2 + 7.5^2}\ (= 19.5))$ **or** $\sqrt{(19-1)^2 + (10 - \text{their } a)^2}$ **or** $1.5 \times$ "13"			M1	ft their value of a
			65		A1	
						Total 7 marks

9	(gradient AM =) $\frac{4-2}{-3-0}$ oe $(=-\frac{2}{3})$		7	M1	A correct method to find gradient of AM
	$y = \frac{3}{2}x + 2$ or eg $\frac{y-2}{x} = \frac{3}{2}$ oe			M1	For the correct equation of the line passing through BD or for a correct expression involving the x and y coordinates of point B or point D
	$(x--3)^2 + (y-4)^2 = 6.5^2$ or $(x-0)^2 + (y-2)^2 = 6.5^2 - [(-3-0)^2 + (4-2)^2]$ oe eg $x^2 + (y-2)^2 = 29.25$			M1	A correct equation in x and y to find the coordinates of B and D
	eg $x^2 + 6x + 9 + y^2 - 8y + 16 - 42.25 = 0$ oe or $x^2 + y^2 - 4y + 4 - 29.25 = 0$ oe			M1	Brackets expanded
	eg $x^2 + 6x + 9 + \left(\frac{3}{2}x + 2\right)^2 - 8\left(\frac{3}{2}x + 2\right) + 16 - 42.25 = 0$ $\left(\frac{2y-4}{3}\right)^2 + y^2 - 4y + 4 - 29.25 = 0$ oe			M1	For a correct substitution into a correct equation to get an equation in either x only or y only
	eg $\frac{13}{4}x^2 = \frac{117}{4}$ or oe $13y^2 - 52y - 211.25 = 0$			M1	A fully correct simplified equation in x or in y – all brackets expanded and like terms grouped.
		(3, 6.5) (−3, −2.5)		A1	correct coordinates SCB3 for one pair of correct coordinates or both x values correct or both y values correct
					Total 7 marks

9 Alt 1	$(AM=)\sqrt{3^2+2^2}\ (=\sqrt{13}=3.605...)$ or $(AM^2=)3^2+2^2(=13)$		7	M1	Use of Pythagoras for point A to point M
	$(BM=)\sqrt{6.5^2-"\sqrt{13}"^2}\ (=\sqrt{29.25}=\dfrac{3\sqrt{13}}{2}=5.4083...)$			M1	A correct method to find the length of BM or DM
	$(\text{SF}=)\dfrac{\sqrt{29.25}}{\sqrt{13}}=\dfrac{3}{2}$ oe **or** $MN=x$, $BN=1.5x$ (*see diag*) or $(LAM=)\sin^{-1}\dfrac{3}{\sqrt{13}}(=56.3...)$ oe **or** $(LMA=)\cos^{-1}\dfrac{3}{\sqrt{13}}(=33.6...)$ **or**			M1	A correct method to find the SF of the enlargement of the sides AM to BM or angle LAM OR LMA 
	eg $\overrightarrow{MB}_x=\dfrac{3}{2}\times2$ or $\overrightarrow{MB}_y=\dfrac{3}{2}\times3$ or $\overrightarrow{MD}_x=-\dfrac{3}{2}\times2$ or $\overrightarrow{MD}_y=-\dfrac{3}{2}\times3$ oe or $x^2+(1.5x)^2=\sqrt{29.25}^2$ **or** $MN=\sqrt{29.25}\cos56.3...(=3)$ oe **or** $BN=\sqrt{29.25}\sin56.3...(=4.5)$ oe *turn over*			M1	A correct method to find the translation of at least one component of MB or MD (need not be written in vector form) OR correct Pythagoras statement using the SF to find x coordinates OR 1 correct trig statement to find translations from M
	$\overrightarrow{MB}_x=\dfrac{3}{2}\times2$ **and** $\overrightarrow{MB}_y=\dfrac{3}{2}\times3$ **or** $\overrightarrow{MD}_x=-\dfrac{3}{2}\times2$ **and** $\overrightarrow{MD}_y=-\dfrac{3}{2}\times3$ oe **or** $x^2+2.25x^2=29.25$ **or** $MN=\dfrac{3\sqrt{13}}{2}\cos56.309...(=3)$ **and** $BN=\dfrac{3\sqrt{13}}{2}\sin56.309...(=4.5)$ oe			M1	A correct method to find the translation of both components of MB or MD (need not be written in vector form) OR correct Pythagoras statement with no brackets using the SF to find x coordinates OR 2 correct trig statements to find translations from M
	eg (0, 2) is translated $\begin{pmatrix}3\\4.5\end{pmatrix}$ or $(0+3,\ 2+4.5)$ $(=(3,\ 6.5))$ or (0, 2) is translated $\begin{pmatrix}-3\\-4.5\end{pmatrix}$ or $(0-3,\ 2-4.5)$ $(=(-3,\ -2.5))$ oe **or** $3.25x^2=29.25$			M1	correct method to find the coordinates of B or D or one pair of correct coordinates or a correct method to find both x coordinates or both y coordinates OR a fully correct simplified equation in x all brackets expanded and like terms grouped.
		(3, 6.5) (−3, −2.5)		A1	correct coordinates SCB3 for one correct coordinate or both x values correct or both y values correct
					Total 7 marks

10	$\left(\dfrac{dy}{dx}=\right)16x-14$		5	M1	Differentiation to obtain 2 terms with at least 1 correct
	$16x-14=10$			M1	their $dy/dx=10$ dep on M1
	(1.5, –9) or $x=1.5$, $y=-9$			A1	coordinates of point on curve at which gradient is 10 – allow given as coordinates or as x worked out and y worked out if meaning is clear
	eg $y--9=-\dfrac{1}{10}(x-\dfrac{3}{2})$ oe or eg $-9=-\dfrac{1}{10}\times1.5+c$ oe			M1	A correct method to find the equation for line **Q** using (1.5, –9)
	Correct answer scores full marks (unless from obvious incorrect working)	$2x+20y+177=0$		A1	oe where a, b, c are integers eg $10x+100y+885=0$
					Total 5 marks

11	eg $\left(\frac{-4+2}{2}, \frac{6+3}{2}\right)$ **or** (−1, 4.5) oe		6	M1 for method to find the midpoint of *AB*
	eg $\frac{6-3}{-4-2}\left(=\frac{3}{-6}\right)$ oe **or** $-\frac{1}{2}$ oe **or** −0.5			M1 for method to find the gradient of *AB*
	eg $m \times "-0.5" = -1$ oe **or** $m = 2$			M1 for use of $m_1 m_2 = -1$ to find the gradient of the line of symmetry
	eg $y-8="-0.5"(x-(-1))$ **or** 8 = "−0.5" × −1 + *c* **or** $\frac{y-8}{x-(-1)}="-0.5"$ **or** $y-4.5="2"(x-(-1))$ **or** 4.5 = "2" × −1 + *c* **or** $\frac{y-4.5}{x-(-1)}="2"$			M1 for method to find an equation for *CD* **or** the line of symmetry
	eg $2x + 6.5 = -0.5x + 7.5$ **or** $\frac{y-6.5}{2}=\frac{y-7.5}{-0.5}$			M1 for a correct linear equation to find the *x* or *y* coordinate of *E*
	Correct answer scores full marks (unless from obvious incorrect working)	(0.4, 7.3)		A1 oe
				Total 6 marks

ALTERNATIVE (using the length of *CD*):				
11	eg $\frac{6-3}{-4-2}\left(=\frac{3}{-6}\right)$ oe **or** $-\frac{1}{2}$ oe **or** −0.5		6	M1 for method to find the gradient of *AB*
	eg $y-8="-0.5"(x+1)$ **or** 8 = "−0.5" × −1 + *c* **or** $\frac{y-8}{x-(-1)}="-0.5"$			M1 for method to find an equation for *CD*
	eg $\sqrt{(-1-(-4))^2+(8-6)^2}\ (=\sqrt{13})$			M1 for method to find the length of *AD* or AD^2
	eg $\sqrt{(x-2)^2+(7.5-0.5x-3)^2}="\sqrt{13}"$ **or** $\sqrt{(15-2y-2)^2+(y-3)^2}="\sqrt{13}"$			M1 for setting up an equation for the *x* or *y* coordinate of *C*
	(1.8, 6.6) oe			M1 for the correct coordinates for *C*
	Correct answer scores full marks (unless from obvious incorrect working)	(0.4, 7.3)		A1 oe
				Total 6 marks

12	$y=\frac{3}{5}x\left(+\frac{6}{5}\right)$ or $y=0.6x(+1.2)$ **or** (gradient =) $\frac{3}{5}$ or 0.6 oe		6	M1 for correct gradient which may be seen in an equation. Condone $\frac{3}{5}x$ or $0.6x$
	$k=-2$			B1 for $k=-2$
	$\left(\frac{"-2"+8}{2}, \frac{1+7}{2}\right)$ oe or (3, 4)			M1 for finding the midpoint (use of their *k* where $k<0$)
	$"\frac{3}{5}"m=-1$ **or** $(m=)"-\frac{5}{3}"$			M1ft their gradient for use of $m_1 \times m_2 = -1$ Allow $-\frac{5}{3} = -1.67$ or better
	$"4"="-\frac{5}{3}"\times"3"+c$ or $c=9$ or $y-"4"="-\frac{5}{3}"(x-"3")$			M1 dep on M3
	Working required	$5x + 3y = 27$		A1 allow equation in any form where *p*, *q* and *r* are integers
				Total 6 marks

13	(gradient of AB =) "$-\frac{1}{2}$" or "2" $m=-1$		6	M1 for the use of $m_1 \times m_2 = -1$ or for "$-\frac{1}{2}$" embedded in a linear equation eg $y =$ "$-\frac{1}{2}$" $x + c$
	(gradient of AB =) $\frac{k-7}{6-j}$ oe **or** (midpoint of AB =) $\left(\frac{j+6}{2}, \frac{k+7}{2}\right)$ oe			M1 for a correct expression for the gradient which may be seen in an equation **or** for a correct expression for the midpoint which may be seen in an equation.
	$\frac{k-7}{6-j} = -\frac{1}{2}$ oe or $2k - j = 8$ oe **or** $\left(\frac{k+7}{2}\right) - 2\left(\frac{j+6}{2}\right) = 7$ oe or $k - 2j = 19$ oe			M1 for setting up a **correct** equation for AB in terms of gradient **or** for setting up a **correct** equation for the line given and the midpoint
	$\frac{k-7}{6-j} = -\frac{1}{2}$ oe or $2k - j = 8$ oe **and** $\left(\frac{k+7}{2}\right) - 2\left(\frac{j+6}{2}\right) = 7$ oe or $k - 2j = 19$ oe			A1 for 2 **correct** equations
	$k = -1$ **and** $j = -10$			A1 for a correct value of k **and** a correct value of j
	Working required	(−2, 3)		A1 dep on previous M1
				Total 6 marks

14	$\frac{-5-10}{4--2}$ $(=-\frac{5}{2})$		6	M1	A correct method to find the gradient of AC
	$y - 10 = -\frac{5}{2}(x+2)$ oe eg $y = -\frac{5}{2}x + 5$ or $y - -5 = -\frac{5}{2}(x-4)$ oe or $5x + 2y = 10$ oe			M1	ft (if M1 scored) correct equation of AC
	$y - 4 = \frac{2}{5}(x - -\frac{27}{5})$ oe or $4 = \frac{2}{5}\left(-\frac{27}{5}\right) + c$ $\left(y = \frac{2}{5}x + 6.16\right)$ $\frac{4-y}{-\frac{27}{5}-x} = \frac{2}{5}$ oe or $5y - 2x = \frac{154}{5}$ oe			M1	ft (if first M1 scored) equation of BD or correct equation using gradient of BD
	solves $-\frac{5}{2}x + 5 = \frac{2}{5}x + 6.16$ oe eg $\begin{matrix}10x + 4y = 20\\ -10x + 25y = 154\end{matrix}$ oe, with operation of addition **or** $\begin{matrix}25x + 10y = 50\\ -4x + 10y = 61.6\end{matrix}$ oe, with operation of subtraction **or** $x = \frac{5}{2}y - \frac{154}{10}$ oe or $y = \frac{2}{5}x + \frac{154}{25}$ oe substituted in other equation			M1	Solve equation OR Solve simultaneously the correct equations of lines of AC and BD or correct equation from gradient or other correct equation. If elimination: same coefficient of x or y with suitable sign used to eliminate. If substitution: x or y substituted into other equation.
	Coordinates of intersection of AC and BD : $x = -\frac{2}{5}$, $y = 6$			M1	oe value of x and y at intersection of AC and BD
	Correct answer scores full marks (unless from obvious incorrect working)	(4.6, 8)		A1	oe coordinates of D
	See next page for working with *AD = AB, CD = CB* or gradients				**Total 6 marks**

14	eg $(10-4)^2+\left(-2+\frac{27}{5}\right)^2$ $(=47.56)$ $(AB=6.896\ldots)$ **or** eg $(-5-4)^2+(4+\frac{27}{5})^2(=169.36)$ $(CB=13.013\ldots)$ **or** eg $\frac{-5-10}{4--2}$ **or** $\frac{4-y}{-\frac{27}{5}-x}$ oe		6	M1	A correct method to find AB^2 or CB^2 or AB or CB or a correct gradient expression for AC or DB
	eg $(y-10)^2+(x+2)^2=(10-4)^2+\left(-2+\frac{27}{5}\right)^2$ **or** eg $(y+5)^2+(x-4)^2=(-5-4)^2+(4+\frac{27}{5})^2$ **or** $\frac{-5-10}{4--2}\times\frac{4-y}{-\frac{27}{5}-x}=-1$ oe eg $-60+15y=6x+32.4$			M1	Using D (x, y) form a correct equation $AD^2=AB^2$ **or** $CD^2=CB^2$ **or** gradients $AC\times DB=-1$ (Using D (x, y))
	eg $2x-5y=-30.8$ **or** $x=2.5y-15.4$ **or** $y=0.4x+6.16$ oe			M1	uses rearrangement or solving simultaneous equations to find a correct 3 term linear equation
	eg $(y-10)^2+(2.5y-15.4+2)^2=(10-4)^2+\left(-2+\frac{27}{5}\right)^2$ eg $(0.4x+6.16+5)^2+(x-4)^2=(-5-4)^2+(4+\frac{27}{5})^2$			M1	uses substitution to obtain a correct quadratic equation in one unknown
	$7.25y^2-87y+232=0$ oe or $1.16x^2+0.928x-28.8144=0$ oe			M1	for a 3 term quadratic that can be used to find the value of x or the value of y at D
		(4.6, 8)		A1	oe coordinates of D
					Total 6 marks