Question	Scheme	Marks
6 (a)	$p=1,\ q=8$	B1B1 [2]
(b)	$\left(\text{Gradient of } l = \dfrac{12-2}{3--2} =\right)2$	B1
	(Gradient of the perpendicular =) $-\dfrac{1}{"2"}$	B1ft
	Equation of k $$y-"8"="-\frac{1}{2}"(x-"1")$$	M1
	$\Rightarrow 2y+x-17=0 \quad *$	A1 cso [4]
(c)	When $y=0$, $\left(2\times 0 + x - 17 = 0 \Rightarrow\right)x=17$	B1
	$(\lvert CD\rvert =)\sqrt{\left(0-"8"\right)^2 + \left("17"-"1"\right)^2} = \sqrt{320} = \left[8\sqrt{5}\right]$	M1A1 [3]
(d)	(Length of $CX =$) $\dfrac{2\times 80}{8\sqrt{5}}\left(=4\sqrt{5}\right)$	B1
	$\left("4\sqrt{5}"\right)^2 = \left(m-"1"\right)^2 + \left(n-"8"\right)^2$	M1
	$"2"=\dfrac{n-"8"}{m-"1"}\Rightarrow\left[n=2m+6\right]$ oe **or** $y-2="2"(x+2)\Rightarrow\left[y=2x+6\right]$	M1
	or $\quad y-12="2"(x-3)\Rightarrow\left[y=2x+6\right]$ oe	
	$\Rightarrow "80"=\left(m-"1"\right)^2 + \left(2m+6-"8"\right)^2\left(\Rightarrow 0=5m^2-10m-75 \text{ oe eg } 0=m^2-2m-15\right)$	ddM1
	$\Rightarrow\left(5m+15\right)\left(m-5\right)=0$ oe eg $\left(m+3\right)\left(m-5\right)=0$	M1
	$m=5,\left(-3\right)$	A1 A1
	$n\left(=2m+6=2\times5+6\right)=16$	[7]
ALT1	(Length of $CX =$) $\dfrac{2\times 80}{8\sqrt{5}}\left(=4\sqrt{5}\right)$	B1
	$\left(m-"17"\right)^2 + \left(n\right)^2 = \left("4\sqrt{5}"\right)^2 + \left("8\sqrt{5}"\right)^2$	M1
	$"2"=\dfrac{n-"8"}{m-"1"}\Rightarrow\left[n=2m+6\right]$ oe **or** $y-2="2"(x+2)\Rightarrow\left[y=2x+6\right]$	M1
	or $\quad y-12="2"(x-3)\Rightarrow\left[y=2x+6\right]$ oe	
	$\Rightarrow "400"=\left(m-"17"\right)^2 + \left(2m+6\right)^2\left(\Rightarrow 0=5m^2-10m-75 \text{ oe eg } 0=m^2-2m-15\right)$	ddM1
	$\Rightarrow\left(5m+15\right)\left(m-5\right)=0$ oe eg $\left(m+3\right)\left(m-5\right)=0$	M1
	$m=5,\left(-3\right)$	A1
	$n\left(=2m+6=2\times5+6\right)=16$	A1 [7]

ALT2	(Length of $CX =$) $\dfrac{2\times 80}{8\sqrt5}\left(=4\sqrt5\right)$	B1
	Length of $AB = \sqrt{(12-2)^2 + (3--2)^2}\left(=5\sqrt5\right)$	M1
	Vector $\overrightarrow{AB} = \begin{bmatrix} 3--2 \\ 12-2 \end{bmatrix}\left(=5\begin{bmatrix} 1 \\ 2 \end{bmatrix}\right)$	M1
	$\left(\left|\overrightarrow{CX}\right| = 4\sqrt5 \Rightarrow\right)\overrightarrow{CX} = 4\begin{bmatrix} 1 \\ 2 \end{bmatrix} = \begin{bmatrix} 4 \\ 8 \end{bmatrix}$	ddM1
	$\Rightarrow$ Coordinates of X are $(1,8)+(4,8)=(5,16)$ $(m=5 \qquad n=16)$	M1A1 A1 [7]
ALT3	$\dfrac{1}{2}\begin{vmatrix} 17 & m & 1 & 17 \\ 0 & n & 8 & 0 \end{vmatrix}$	B1
	$\dfrac{1}{2}\begin{vmatrix} "17" & m & "1" & "17" \\ 0 & n & "8" & 0 \end{vmatrix}=80 \Rightarrow \dfrac{1}{2}\left(17n+"8"m-("136"+n)\right)=80\left(\Rightarrow 2n+m=37\right)$	M1
	$"2"=\dfrac{n-8}{m-1}\Rightarrow [n=2m+6]$ oe **or** $y-2="2"(x+2)\Rightarrow [y=2x+6]$ oe **or** $y-12="2"(x-3)\Rightarrow [y=2x+6]$ oe	M1
	$\dfrac{1}{2}\begin{vmatrix} "17" & m & "1" & "17" \\ 0 & "2m+6" & "8" & 0 \end{vmatrix}$ or $\dfrac{1}{2}\left(17("2m+6")+"8"m-("136"+"2m+6")\right)=80$	ddM1
	or $2("2m+6")+m=37 \Rightarrow m=$	M1
	$m=5,\ n=16$	A1A1 [7]
		Total 16 marks

Part	Mark	Notes
(a)	B1	For $p = 1$ OR $q = 8$ Allow anything that clearly implies these values eg (1, 8) or 1, 8
	B1	For $p = 1$ AND $q = 8$ Allow anything that clearly implies these values eg (1, 8) or 1, 8
(b)	B1	For the gradient of $l = 2$
	B1ft	For the gradient of $k = -\dfrac{1}{"2"}$. Ft their calculation of the gradient of l.
	M1	For the correct unsimplified equation for k, using their p and q and any **changed** gradient. If the candidate uses $y = mx + c$, a fully correct rearrangement to find c must be shown (this can be implied by a correct c for their equation) and concluded with the equation of the line written.
	A1 cso	For the equation of k in the required form. Minimum steps shown, no errors or omissions. This must from a correct p and q
		Watch for methods using vectors. If the candidate arrives at the correct unsimplified equation with no obviously incorrect work, following vector work, allow B1 B1ft M1 and the final A1 if the equation is given in the correct form. (See example in Practice)
(c)	B1	For the x coordinate of $D = 17$
	M1	For a correct **method** to find the length of CD using their p and q and their 17
	A1	For the correct length of $\sqrt{320}$ oe
(d)	B1	Any correct unsimplified calculation for CX
	M1	For correctly using Pythagoras to form an equation in terms of m and n or x and y. Follow through their CX (ie coming from correct calculation with their p, q, their point D).
	M1	For an unsimplified equation in terms of m and n or x and y correctly using the gradient of l. Follow through their gradient for l, their p and their q. Allow working in p, q or x, y Note this work is sometimes being seen in (b). **As long as it is used in part (d),** the equation found in (b) may be given credit.
	ddM1	For eliminating either m or n from either equation and forming a 3TQ. Allow errors in processing if an initial correct method following from 2 correct unsimplified equations to eliminate one of the variables is seen. Allow working in p, q or x, y Dependent on both previous method marks. Note, the previous M mark is for the unsimplified equation, so if simplified incorrectly, this can be used here to gain this mark (general principle of marking).
	M1	For a minimally acceptable attempt to solve (see general guidance) their 3TQ This mark can be implied from a correct value of m = 5. If the quadratic is not the correct quadratic, method must be shown.
	A1	For one of $m = 5$ or $n = 16$
	A1	For both $n = 16$ and $m = 5$
ALT1		First B, final 2 A marks – as main scheme
	M1	For correctly using Pythagoras to form an equation in terms of m and n or x and y. Follow through their CX and CD (ie coming from correct calculation with their p, q, their point D).
	M1	For an unsimplified equation in terms of m and n or x and y correctly using the gradient of l. Follow through their gradient for l, their p and their q. Allow working in p, q or x, y Note this work is sometimes being seen in (b). **As long as it is used in part (d),** the equation found in (b) may be given credit.
	ddM1	For eliminating either m or n from either equation and forming a 3TQ. Allow errors in processing if an initial correct method following from 2 correct unsimplified equations to eliminate one of the variables is seen. Allow working in p, q or x, y Dependent on both previous method marks. Note, the previous M mark is for the unsimplified equation, so if simplified incorrectly, this can be used here to gain this mark (general principle of marking).
	M1	For a minimally acceptable attempt to solve (see general guidance) their 3TQ This mark can be implied from a correct value of m = 5. If the quadratic is not the correct quadratic, method must be shown.

ALT2	B1	Any correct unsimplified calculation for *CX*
	M1	Correct method to find the length of *AB*
	M1	Correct method to find vector *AB*
	ddM1	Correctly deduces the relationship between their vectors *CX* and *AB* Dependent on both previous method marks.
	M1	Correct method to find the coordinates of *X* using their vector work.
	A1	For one of *m* = 5 or *n* = 16
	A1	For both *n* = 16 and *m* = 5
ALT3	B1	For a fully correct array as shown oe
	M1	For placing their array (though ft their *p* and *q* and their "17") = 80 and correctly multiplying out the discriminant to form an unsimplified equation in *m* and *n*
	M1	For an unsimplified equation in terms of *m* and *n* or *x* and *y* correctly using the gradient of *l*. Follow through their gradient for *l,* their *p* and their *q*. Allow working in *p, q* or *x, y* Note this work is sometimes being seen in (a). **As long as it is used in part (d),** the equation found in (a) may be given credit.
	ddM1	For eliminating either *m* or *n* seen either in the array or in their equation formed. Allow errors in processing if an initial correct method following from 2 correct unsimplified equations to eliminate one of the variables is seen. Allow working in *p, q* or *x, y* Dependent on both previous method marks. Note, the previous M mark is for the unsimplified equation, so if simplified incorrectly, this can be used here to gain this mark (general principle of marking).
	M1	For solving their linear equation, allow one error in processing, leading to a value of *m* or *n*
	A1	For one of *m* = 5 or *n* = 16
	A1	For both *n* = 16 and *m* = 5
If a partial method is seen, with correct answers not from obvious incorrect working, marks may be given (general point of marking unless precluded from the mark scheme for a question). If a partial method is seen and marks cannot be fitted to the main or ALT schemes – send to review.		