Question Number	Scheme	Marks
5 (a)	$y^2 = 2x^2 + 15x + 10y \Rightarrow 2y\frac{dy}{dx} = 4x + 15 + 10\frac{dy}{dx}$	**M1 A1**
	$(2y - 10)\frac{dy}{dx} = 4x + 15 \Rightarrow \frac{dy}{dx} = \frac{4x+15}{2y-10}$ oe	**M1, A1**
		(4)
(b)	Deduces that $2y - 10 = 0 \Rightarrow y = 5$	**B1ft**
	Substitutes $y = 5$ into $y^2 = 2x^2 + 15x + 10y \Rightarrow 2x^2 + 15x + 25 = 0$ and solves for x	**M1**
	$(p =) -5, (q =) -\frac{5}{2}$	**A1**
		(3)
		(7 marks)

Notes:

(a)

M1: Correct differentiation of one of the y terms, ie $y^2 \to 2y\frac{dy}{dx}$ or $10y \to 10\frac{dy}{dx}$.

A1: Fully correct differentiation $2y\frac{dy}{dx} = 4x + 15 + 10\frac{dy}{dx}$ o.e.

M1: Rearranges to make $\frac{dy}{dx}$ the subject. The differentiated expression must contain exactly two $\frac{dy}{dx}$ terms - one from each y term, not an extra $\frac{dy}{dx} = \ldots$.

A1: $\frac{dy}{dx} = \frac{4x+15}{2y-10}$ oe

(b)

B1ft: Deduces that $2y - 10 = 0 \Rightarrow y = 5$. Follow through on a denominator of form $ay + b$, $a, b \neq 0$. This deduction may arise from use of the symmetry of a hyperbola.

E.g. $x = 0 \Rightarrow y^2 - 10y = 0 \Rightarrow y = 0, 10$ so p, q when $y = 5$

M1: Substitutes their $y = 5$ into $y^2 = 2x^2 + 15x + 10y \left(\Rightarrow 2x^2 + 15x + 25 = 0\right)$ and solves for x (usual rules, if no working shown (by calculator) they must give correct values for their quadratic).

A1: $(p =) -5, (q =) -\frac{5}{2}$ Correct values, do not be concerned about the labels and accept if they give as the end points of the interval (ie accept if they give $\left(-5, -\frac{5}{2}\right)$ as their answer).

(b) Alt method 1

$y^2 = 2x^2 + 15x + 10y \Rightarrow y^2 - 10y - \left(2x^2 + 15x\right) = 0$

B1: Deduces that roots for x don't exist when $100 + 4 \times \left(2x^2 + 15x\right) < 0$

M1: Solves their $2x^2 + 15x + 25 < 0$

A1: $\left(p =\right) -5, \left(q =\right) -\frac{5}{2}$ Correct values, see note on main scheme.

(b) Alt method 2

B1: $y = 0 \Rightarrow 2x^2 + 15x = 0 \Rightarrow x = 0, -\frac{15}{2}$ Correct values found for x when $y = 0$

M1: Full method to use symmetry to deduce the required values of x. E.g. by symmetry, values required are one third and two thirds way between these $\Rightarrow x = \frac{1}{3} \times -\frac{15}{2}, \frac{2}{3} \times -\frac{15}{2}$

A1: $\left(p =\right) -5, \left(q =\right) -\frac{5}{2}$ Correct values, see note on main scheme.

Question Number	Scheme	Marks
6 (a)(i)	$\overrightarrow{AB} = (\pm)\left[\left(8\mathbf{i}+3\mathbf{j}-7\mathbf{k}\right)-\left(2\mathbf{i}-3\mathbf{j}+5\mathbf{k}\right)\right] = ...$	**M1**
	$\overrightarrow{AB} = 6\mathbf{i}+6\mathbf{j}-12\mathbf{k}$	**A1**
(ii)	$\mathbf{r} = \begin{pmatrix}2\\-3\\5\end{pmatrix}+\lambda\begin{pmatrix}1\\1\\-2\end{pmatrix}$ o.e. such as $\mathbf{r} = \begin{pmatrix}8\\3\\-7\end{pmatrix}+\lambda\begin{pmatrix}6\\6\\-12\end{pmatrix}$	**B1ft**
		(3)
(b)	Attempts $\pm\overrightarrow{CP} = \pm\begin{pmatrix}2+\lambda-3\\-3+\lambda-5\\5-2\lambda-2\end{pmatrix}$	**M1**
	$\overrightarrow{CP}\bullet k\begin{pmatrix}1\\1\\-2\end{pmatrix} = 0 \Rightarrow \begin{pmatrix}\lambda-1\\\lambda-8\\-2\lambda+3\end{pmatrix}\bullet k\begin{pmatrix}1\\1\\-2\end{pmatrix} = 0 \Rightarrow 1\left(\lambda-1\right)+1\left(\lambda-8\right)-2\left(-2\lambda+3\right)=0$ Alt: $\left(\lambda-1\right)^2+\left(\lambda-8\right)^2+\left(-2\lambda+3\right)^2 = 6\lambda^2-30\lambda+74 = 6\left(\lambda-\frac{5}{2}\right)^2+\frac{73}{2}$	**dM1**
	$\Rightarrow \lambda = \frac{5}{2}$ $\left[\text{use of } \overrightarrow{AB} \text{ in } \overrightarrow{CP} \text{ gives } \lambda = \frac{5}{12}, \text{use of } \overrightarrow{OB}\ \lambda = \frac{-7}{2} \text{ or } \frac{-7}{12}\right]$	**A1**
	$\overrightarrow{OP} = \begin{pmatrix}2\\-3\\5\end{pmatrix}+\frac{5}{2}\begin{pmatrix}1\\1\\-2\end{pmatrix} = \frac{9}{2}\mathbf{i}-\frac{1}{2}\mathbf{j}$	**ddM1, A1** **(5)**
		(8 marks)

Notes:

Accept either form of vector notation throughout. Accept with **i**,**j** and **k** in their column vectors.

(a)(i)

M1: Attempts to subtract vectors $\overrightarrow{OA}$ and $\overrightarrow{OB}$ either way around. May be implied by two correct components.

A1: $\overrightarrow{AB} = 6\mathbf{i}+6\mathbf{j}-12\mathbf{k}$ o.e.

(a)(ii)

B1ft: Any correct equation for the line, may use a correct or follow through multiple of $\overrightarrow{AB}$ for direction and with any point on the line. Must start **r** = … or accept $x\mathbf{i}+y\mathbf{j}+z\mathbf{k} = ...$ (l = … is B0).

(b)

M1: Attempts $\pm\overrightarrow{CP}$ using point C and a general point on their l

dM1: Sets the scalar product of their $\overrightarrow{CP}$ (either direction) and their direction of l (or $\overrightarrow{AB}$) to 0 and proceeds to an equation in λ. Condone sign slips in components if the intention is clear.

Alternatively attempts to minimise the distance CP (by completing square as shown, or by differentiation) to obtain a linear equation in λ.