Question Number	Scheme	Marks
5(a)	$\frac{dx}{dt} = \frac{2(1-t)-(-1)(3+2t)}{(1-t)^2} = \frac{5}{(1-t)^2}$ and $\frac{dy}{dt} = -2t$	
	At $t=2 \Rightarrow \frac{dy}{dx} = \frac{(-1)^2}{5} \times (-2(2)) = -\frac{4}{5}$	M1A1
	$(-7, -3)$	B1
	$y+3 = \frac{5}{4}(x+7)$	M1
	$5x-4y+23=0$	A1
		(5)
(b)	$x = \frac{3+2t}{1-t} \rightarrow t = \frac{x-3}{x+2}$	M1
	$y = 1-\left(\frac{x-3}{x+2}\right)^2 = \frac{(x+2)^2-(x-3)^2}{(x+2)^2} = \frac{10x-5}{(x+2)^2}$	dM1A1
	$x \neq -2$	B1
		(4)
		(9 marks)

FYI $x = \frac{3+2t}{1-t} = \frac{5}{1-t} - 2$

(a) Note: A cartesian approach in (a) can score a maximum of 1 mark (the B1) as it does not satisfy the demand of the question.

M1: Attempts to find $\frac{dy}{dx}$ at $t=2$ by finding $\frac{dy}{dt} \div \frac{dx}{dt}$.

Condone slips when differentiating $\frac{dx}{dt}$ and $\frac{dy}{dt}$ but look for a minimum of

- $\frac{dx}{dt} = \frac{\alpha(1-t) \pm \beta(3+2t)}{(1-t)^2}$ with $\alpha > 0$ or equivalent using the product rule or division and chain rule
- $\frac{dy}{dt} = \pm \varpi t$
- Substitution of $t=2$ into $\frac{dy}{dt} \div \frac{dx}{dt}$ which may have been simplified incorrectly. Note that a simplified $\frac{dy}{dx} = \frac{-2t(1-t)^2}{5}$

Note that using the quotient rule the wrong way around $\frac{uv'-vu'}{v^2}$ would be M0

A1: $-\frac{4}{5}$ following M1. It may be implied by a normal gradient of $\frac{5}{4}$

B1: $(-7, -3)$ which may be implied from terms within an attempt at the equation of the normal

M1: Attempts to find the equation of the normal at *P*. They must be using the negative reciprocal of their $\frac{dy}{dx}$ at $t = 2$ with their point *P* . It is dependent on having found $\frac{dy}{dx}$ from $\left(\text{their } \frac{dy}{dt}\right) \div \left(\text{their } \frac{dx}{dt}\right)$ Condone poor attempts at $\frac{dx}{dt}$ and $\frac{dy}{dt}$ or what they believe are $\frac{dx}{dt}$ and $\frac{dy}{dt}$ so 0, 0, 1, 1, 0 is possible. Condone one sign slip when using their coordinate of *P*. e.g $(-7, -3) \rightarrow (7, -3)$

If the form $y = mx + c$ is used the method must proceed as far as $c = \ldots$

A1: $5x - 4y + 23 = 0$ or any integer multiple with terms on one side of an equation. The order of the terms is not important. ISW after sight of a correct answer in a correct form

……

Other more complicated methods do exist so look carefully at what is attempted. For example, candidates could find $\frac{dx}{dy}$ at $t = 2$ by finding $\frac{dx}{dt} \div \frac{dy}{dt}$ and use the value of $-\frac{dx}{dy}$ as the gradient of the normal.

……

(b)

M1: Attempts to rearrange the parametric equation for *x* to make *t* the subject. Expect to see cross multiplying (or equivalent) and collection of terms with $t = \frac{f(x)}{g(x)}$ where f(*x*) and g(*x*) are linear functions in *x*.

dM1: Substitutes their expression for *t* in terms for *x* into the parametric equation for *y* and attempts to manipulate the right-hand side into a single fraction. It is dependent on the previous method mark.

For example, look for $y = 1 - \left(\frac{f(x)}{g(x)}\right)^2 = \frac{(g(x))^2 - (f(x))^2}{(g(x))^2}$

A1: $y = \frac{10x - 5}{(x+2)^2}$

B1: $x \neq -2$ or $k = -2$ but must follow correct work. E.g. Sight of $(x+2)$ o.e. on the denominator of either the expression for *t* or the expression for *y*.

.....

Other more complicated methods do exist but are unlikely to lead to any success. If you see a solution that you feel deserves credit please send to review and alert your TL.

For example, if they start with $t = \sqrt{1-y}$ and then write down $x = \frac{3 + 2\sqrt{1-y}}{1 - \sqrt{1-y}}$ the first M mark will not be scored until they make $\sqrt{1-y}$ the subject (in terms of just *x*) which reverts to the original method

Question Number	Scheme	Marks
6(a)	Attempts $\pm\left(\left(5\mathbf{i}+2\mathbf{j}+\mathbf{k}\right)-\left(\mathbf{i}+2\mathbf{j}-3\mathbf{k}\right)\right)=\pm\left(4\mathbf{i}+4\mathbf{k}\right)$	M1
	e.g. $\mathbf{r}=\mathbf{i}+2\mathbf{j}-3\mathbf{k}+\lambda(4\mathbf{i}+4\mathbf{k})$ or $\mathbf{r}=5\mathbf{i}+2\mathbf{j}+\mathbf{k}+\lambda(4\mathbf{i}+4\mathbf{k})$ oe	A1
		(2)
(b)	$\overrightarrow{AC}=2\mathbf{i}+(\alpha-2)\mathbf{j}+8\mathbf{k}$	B1
	$\left\lvert\overrightarrow{AB}\right\rvert=\sqrt{4^2+4^2}$ or $\left\lvert\overrightarrow{AC}\right\rvert=\sqrt{2^2+(\alpha-2)^2+8^2}$	M1
	$\left\lvert\overrightarrow{AB}\right\rvert=\sqrt{32}$ and $\left\lvert\overrightarrow{AC}\right\rvert=\sqrt{68+(\alpha-2)^2}$	A1
	$\cos 45°=\dfrac{8+32}{\sqrt{32}\times\sqrt{68+(\alpha-2)^2}}$	dM1
	$\cos 45°=\dfrac{40}{\sqrt{32}\times\sqrt{68+(\alpha-2)^2}}\Rightarrow\alpha^2-4\alpha-28=0$	ddM1
	$\alpha=2\pm4\sqrt{2}$	A1
		(6)
		(8 marks)

Allow vectors to be written in any acceptable form. E.g. column vectors are fine

(a)

M1: Attempts to find the difference between the two vectors.
If no method is shown look for two correct components from $\pm(4\mathbf{i}),(0\mathbf{j}),\pm(4\mathbf{k})$

A1: Any correct equation for the line in the form given.
Examples of correct equations are;
$\mathbf{r}=\mathbf{i}+2\mathbf{j}-3\mathbf{k}+\lambda(4\mathbf{i}+4\mathbf{k})$, $\mathbf{r}=5\mathbf{i}+2\mathbf{j}+1\mathbf{k}+\mu(\mathbf{i}+\mathbf{k})$

$\mathbf{r}=\begin{pmatrix}5\\2\\1\end{pmatrix}+\lambda\begin{pmatrix}-4\\0\\-4\end{pmatrix}$, $\mathbf{r}=\begin{pmatrix}2\\2\\-2\end{pmatrix}+k\begin{pmatrix}2\\0\\2\end{pmatrix}$ and $\mathbf{r}=\begin{pmatrix}3\\2\\-1\end{pmatrix}+\delta\begin{pmatrix}-1\\0\\-1\end{pmatrix}$

Note that the LHS must be correct so $l=\mathbf{i}+2\mathbf{j}-3\mathbf{k}+\lambda(4\mathbf{i}+4\mathbf{k})$ is A0

Condone the vectors not being bold or underlined

Condone incorrect vector notation for the M but not the A mark. E.g. $\mathbf{r}=\begin{pmatrix}5\mathbf{i}\\2\mathbf{j}\\\mathbf{k}\end{pmatrix}+\lambda\begin{pmatrix}-4\mathbf{i}\\0\\-4\mathbf{k}\end{pmatrix}$ is M1A0

