(b)	$12u+5\equiv A(2u+1)+Bu(2u+1)+Cu^2 \Rightarrow A=...\text{or } B=...\text{or } C=...$ or e.g. $12u+5\equiv (2B+C)u^2+(2A+B)u+A\Rightarrow A=...\text{or } B=...\text{or } C=...$	M1
	2 of: $A=5,\ B=2\ ,C=-4$	A1
	$\frac{5}{u^2}+\frac{2}{u}-\frac{4}{(2u+1)}$	A1
		(3)

(b)

M1: Attempts to find at least one of the values for *A*, *B* and *C* by multiplying up and substituting values or by multiplying up and comparing coefficients.
When multiplying up must have at least one of the terms on the rhs correct for their lhs.

A1: Two of $A=5,\ B=2,\ C=-4$

A1: Correct **fractions**: $\frac{5}{u^2}+\frac{2}{u}-\frac{4}{(2u+1)}$ oe. Allow $\frac{5}{u^2}+\frac{2}{u}+-\frac{4}{(2u+1)}$

If the correct fractions are not seen in part (b), allow this mark to score if the correct fractions are seen in part (c).

(c)	$\int \frac{5}{u^2}+\frac{2}{u}-\frac{4}{(2u+1)}\,\mathrm{d}u=-5u^{-1}+2\ln u-2\ln(2u+1)\ \ (+c)$	M1A1ft
	$\left[-5u^{-1}+2\ln u-2\ln(2u+1)\right]_{2.5}^{7.5}$ $=\left(-5\times 7.5^{-1}+2\ln 7.5-2\ln(16)\right)-\left(-5\times 2.5^{-1}+2\ln 2.5-2\ln(6)\right)$ or $\left[-5\left(\mathrm{e}^x-\frac{1}{2}\right)^{-1}+2\ln\left(\mathrm{e}^x-\frac{1}{2}\right)-2\ln(2\left(\mathrm{e}^x-\frac{1}{2}\right)+1)\right]_{\ln 3}^{\ln 8}$ $=\left(-5\times 7.5^{-1}+2\ln 7.5-2\ln(16)\right)-\left(-5\times 2.5^{-1}+2\ln 2.5-2\ln(6)\right)$	**d**M1
	$\frac{4}{3}+\ln\left(\frac{81}{64}\right)$	A1
		(4)
		(11 marks)

(c)

M1: Integrates either $\frac{"2"}{u}\rightarrow ...\ln ku$ **or** $\frac{"4"}{(2u+1)}\rightarrow ...\ln k(2u+1)$

A1ft: $-5u^{-1}+2\ln u-2\ln(2u+1)$ oe following through on their non-zero *A*, *B* and *C* from part (b). Allow unsimplified.

dM1: Substitutes in their changed limits from part (a) or transforms back in terms of *x* i.e. ln3 and ln8 and subtracts either way round.
Depends on the previous method mark.

A1: $\frac{4}{3}+\ln\left(\frac{81}{64}\right)$ or equivalent in the required form i.e. $p+\ln q$

Question Number	Scheme	Marks
8(a)(i)	$\pm\left(\left(3\mathbf{i}+4\mathbf{j}-6\mathbf{k}\right)-\left(2\mathbf{i}-\mathbf{j}+5\mathbf{k}\right)\right)$	M1
	$=\mathbf{i}+5\mathbf{j}-11\mathbf{k}$	A1
(ii)	e.g. $\mathbf{r}=2\mathbf{i}-\mathbf{j}+5\mathbf{k}+\lambda\left(\mathbf{i}+5\mathbf{j}-11\mathbf{k}\right)$ or $\mathbf{r}=3\mathbf{i}+4\mathbf{j}-6\mathbf{k}+\lambda\left(\mathbf{i}+5\mathbf{j}-11\mathbf{k}\right)$ o.e.	A1ft
		(3)

(a)

(i)

M1: Attempts to find the difference between the two vectors either way round.
The expression e.g. $\left(\left(3\mathbf{i}+4\mathbf{j}-6\mathbf{k}\right)-\left(2\mathbf{i}-\mathbf{j}+5\mathbf{k}\right)\right)$ is sufficient.
If no working is shown, it may be implied by 2 correct components of $\pm\left(\mathbf{i}+5\mathbf{j}-11\mathbf{k}\right)$ or e.g. $\pm\left(1,\ 5,\ -11\right)$

A1: $\mathbf{i}+5\mathbf{j}-11\mathbf{k}$ o.e. e.g. $\begin{pmatrix}1\\5\\-11\end{pmatrix}$ and condone $\begin{matrix}1\\5\\-11\end{matrix}$ but **not** $\begin{pmatrix}\mathbf{i}\\5\mathbf{j}\\-11\mathbf{k}\end{pmatrix}$ and not (1, 5,−11)
But allow this mark once a correct form is seen.

(ii)

A1ft: Any correct vector equation for the line **following through** their $\overrightarrow{AB}$ **but must follow M1.**
Must include "**r** =" (not e.g. "*l* =") and allow any parameter.
e.g. $\mathbf{r}=\begin{pmatrix}2\\-1\\5\end{pmatrix}+\lambda\begin{pmatrix}1\\5\\-11\end{pmatrix}$ or e.g. $\mathbf{r}=\begin{pmatrix}3\\4\\-6\end{pmatrix}+\mu\begin{pmatrix}-1\\-5\\11\end{pmatrix}$

Do **not** allow e.g. $\mathbf{r}=\begin{pmatrix}2\\-1\\5\end{pmatrix}+t\begin{pmatrix}\mathbf{i}\\5\mathbf{j}\\-11\mathbf{k}\end{pmatrix}$ **unless** the notation $\begin{pmatrix}\mathbf{i}\\5\mathbf{j}\\-11\mathbf{k}\end{pmatrix}$ has already been penalised on the previous A mark and this is the only error in their notation.

Do **not** allow e.g. $l=\begin{pmatrix}2\\-1\\5\end{pmatrix}+\lambda\begin{pmatrix}1\\5\\-11\end{pmatrix}$ or e.g. $l:\begin{pmatrix}2\\-1\\5\end{pmatrix}+\lambda\begin{pmatrix}1\\5\\-11\end{pmatrix}$

But condone $l:\mathbf{r}=\begin{pmatrix}2\\-1\\5\end{pmatrix}+\lambda\begin{pmatrix}1\\5\\-11\end{pmatrix}$

(b)	$\overrightarrow{CA} = (2-p)\mathbf{i} - 5\mathbf{j} + 6\mathbf{k} \qquad \overrightarrow{CB} = (3-p)\mathbf{i} - 5\mathbf{k}$	M1
	$(2-p)(3-p) - 30 = 0$	**d**M1
	$\Rightarrow 6 - 5p + p^2 - 30 = 0 \Rightarrow p^2 - 5p - 24 = 0 \Rightarrow p = ...$	**dd**M1
	$p = -3, \quad p = 8$	A1
		(4)
(c)	$\left\|\overrightarrow{CA}\right\| = \sqrt{(2-8)^2 + (-5)^2 + 6^2}$ or $\left\|\overrightarrow{CB}\right\| = \sqrt{(3-8)^2 + (-5)^2}$	M1
	$\left\|\overrightarrow{CA}\right\| = \sqrt{97}$ or $\left\|\overrightarrow{CB}\right\| = \sqrt{50}$	A1
	Area of triangle $= \frac{1}{2} \times \left\|\overrightarrow{CA}\right\| \times \left\|\overrightarrow{CB}\right\| = \frac{1}{2} \times \sqrt{50} \times \sqrt{97} =$ awrt 34.8 units^2 or e.g. $\frac{1}{2} \times \left\|\overrightarrow{CA}\right\| \times \left\|\overrightarrow{AB}\right\| \sin BAC = \frac{1}{2} \times \sqrt{50} \times \sqrt{147} \sin\left(\cos^{-1}\frac{\sqrt{50}}{\sqrt{147}}\right) =$ awrt 34.8 units^2	**d**M1A1
		(4)
		(11 marks)

(b) **Allow all marks in (b) for correct work using** $\pm\overrightarrow{CA}$ and/or $\pm\overrightarrow{CB}$

M1: Attempts to find either $\pm\overrightarrow{CA}$ or $\pm\overrightarrow{CB}$ using subtraction.
If no working is shown, it may be implied by 2 correct components.

dM1: **Depends on the previous method mark.**
Attempts both $\pm\overrightarrow{CA}$ **and** $\pm\overrightarrow{CB}$ using subtraction and attempts the scalar product between their $\pm\overrightarrow{CA}$ and their $\pm\overrightarrow{CB}$ **and** sets = 0 to obtain $\pm(2-p) \times \pm(3-p) \pm k = 0$ where $k \neq 0$

ddM1: **Depends on both previous method marks.**
Multiplies out, collects terms and attempts to solve their three term quadratic (usual rules apply – see general guidance). May be implied by correct roots for their 3TQ.
Do not condone work where they lose or ignore their *k*.

A1: Correct values $p = -3, \quad p = 8$

(c)

M1: Uses at least one of their values of *p* from part (b) (which may be negative) and attempts $\left|\overrightarrow{CA}\right|$ **or** $\left|\overrightarrow{CB}\right|$ using Pythagoras. May be implied.

A1: For $\left|\overrightarrow{CA}\right| = \sqrt{97}$ or $\left|\overrightarrow{CB}\right| = \sqrt{50}$ seen or implied.

dM1: **Depends on the previous method mark.**
Attempts to find the area of the triangle using a correct method e.g. $\frac{1}{2} \times$ their $\left|\overrightarrow{CA}\right| \times$ their $\left|\overrightarrow{CB}\right|$
It is dependent on the previous method mark and it is dependent on having used a **positive** value for *p*.
If they use a less direct method e.g. $\frac{1}{2} \times \left|\overrightarrow{CA}\right| \times \left|\overrightarrow{AB}\right| \sin BAC$ then it must be a correct method, including an attempt to find $\left|\overrightarrow{AB}\right|$ using Pythagoras.

A1: awrt 34.8 This answer and no others. Do not allow for exact answers.
If they use the other value of *p* and give another area which is not rejected, score A0