Question Number	Scheme	Marks
7(a)	$\frac{3x-1}{x+2}=3+\frac{...}{x+2}$ or $...-\frac{7}{x+2}$	M1
	$\frac{3x-1}{x+2}=3-\frac{7}{x+2}$	A1
		(2)
(b)	$V=(\pi)\int\left(3-\frac{7}{x+2}\right)^2\mathrm{d}x=...$	M1
	$=(\pi)\int\left(9-\frac{42}{x+2}+\frac{49}{(x+2)^2}\right)\mathrm{d}x=...-42\ln(x+2)+...$ **or** $=(\pi)\int\left(9-\frac{42}{x+2}+\frac{49}{(x+2)^2}\right)\mathrm{d}x=...+...-\frac{49}{x+2}$	M1
	$=(\pi)\int\left(9-\frac{42}{x+2}+\frac{49}{(x+2)^2}\right)\mathrm{d}x=...-42\ln(x+2)+...$ **and** $=(\pi)\int\left(9-\frac{42}{x+2}+\frac{49}{(x+2)^2}\right)\mathrm{d}x=...+...-\frac{49}{x+2}$	dM1
	$=(\pi)\int\left(9-\frac{42}{x+2}+\frac{49}{(x+2)^2}\right)\mathrm{d}x=9x-42\ln(x+2)-\frac{49}{x+2}$	A1
	$V=(\pi)\left[9x-42\ln(x+2)-\frac{49}{x+2}\right]_1^4=(\pi)\left\{36-42\ln 6-\frac{49}{6}-\left(9-42\ln 3-\frac{49}{3}\right)\right\}$	M1
	$=\pi\left(\frac{211}{6}-42\ln 2\right)$	A1
		(6)
		Total 8

(a)

M1: Obtains either $A = 3$ or $B=-7$

A1: $3-\frac{7}{x+2}$ Just stating the values of A and B is insufficient but you may award this mark if it is seen in (b). Allow $3+\frac{-7}{x+2}$ and $3+-\frac{7}{x+2}$

(b) **Condone transcription errors for the method marks** e.g. $\frac{...}{x+2}\rightarrow ...\ln(x-2)$ **provided no incorrect method is seen. Condone invisible brackets for the M marks**

M1: Uses their result from part (a) and applies the volume formula (with or without the π and condone 2π) and attempts to square the bracket. Condone if they just square the two terms in the brackets or if their squaring is poor.

M1: Integrates to obtain the correct form for one of the fractional terms i.e. $\frac{\cdots}{x+2} \to \ldots \ln(x+2)$ or $\frac{\cdots}{(x+2)^2} \to \frac{\cdots}{x+2}$. This can be scored even if they have not squared any terms originally if they have one of these terms of the required form. Condone invisible brackets for $\ln x+2$

dM1: Integrates to obtain the correct form for both fractional terms i.e. $\frac{\cdots}{x+2} \to \ldots \ln(x+2)$ and $\frac{\cdots}{(x+2)^2} \to \frac{\cdots}{x+2}$. It is dependent on the previous method mark. Condone invisible brackets for $\ln x+2$

A1: $9x-42\ln(x+2)-\frac{49}{x+2}$ o.e. May be implied by further work.

M1: Applies the limits 1 and 4 to an expression of the form $Ax \pm B\ln(x+2) \pm C(x+2)^n$ where $A, B, C, n \neq 0$ and subtracts the correct way round. The expression with values embedded is sufficient. Condone slips and invisible brackets.

A1: $\pi\left(\frac{211}{6}-42\ln 2\right)$

Correct expression in the **required form**. The fraction does not need to be in simplest form.

Alternative methods (including not using part (a)) requiring use of a substitution e.g. $u=x+2$ or e.g. $u=\frac{7}{x+2}$**. Watch out for these longer methods which can still score full marks.**

M1: If using $u=x+2$ then $(\pi)\int\left(\frac{3x-1}{x+2}\right)^2 \mathrm{d}x \Rightarrow (\pi)\int 9-\frac{42}{u}+\frac{49}{u^2}\,\mathrm{d}u$ (They will need to divide their numerator by the denominator to achieve $\alpha+\frac{\beta x+\gamma}{(x+2)^2}$). Condone slips.

If using $u=\frac{7}{x+2}$ then $(\pi)\int \frac{42}{u}-\frac{63}{u^2}-7\,\mathrm{d}u$ Condone slips.

M1: As above in the main scheme notes for one of the fractional terms i.e. $\frac{\cdots}{u} \to \ldots \ln u$ or $\frac{\cdots}{u^2} \to \frac{\cdots}{u}$.

dM1: Integrates to obtain the correct form for both fractional terms

A1: $9u-42\ln u-\frac{49}{u}$ if using $u=x+2$ **or** $42\ln u+\frac{63}{u}-7u$ if using $u=\frac{7}{x+2}$

M1: Applies the limits 1 and 4 to an expression of the required form (see above in main scheme notes) if the expression is converted back to being in terms of x
or applies the limits 3 and 6 if in terms of u if using $u=x+2$
or e.g. $\frac{7}{3}, \frac{7}{6}$ if using $u=\frac{7}{x+2}$

A1: As above in main scheme notes.

Question Number	Scheme	Marks
8(a)	$\pm\left(-6\mathbf{i}+4\mathbf{j}-\mathbf{k}-\left(-10\mathbf{i}+5\mathbf{j}-4\mathbf{k}\right)\right)$	M1
	e.g. $\mathbf{r}=-10\mathbf{i}+5\mathbf{j}-4\mathbf{k}\pm\lambda\left(4\mathbf{i}-\mathbf{j}+3\mathbf{k}\right)$ e.g. $\mathbf{r}=-6\mathbf{i}+4\mathbf{j}-\mathbf{k}\pm\lambda\left(4\mathbf{i}-\mathbf{j}+3\mathbf{k}\right)$	A1
		(2)
(b)	$3+3\mu=-6\Rightarrow\mu=-3$	M1
	$p+12=4\Rightarrow p=\ldots$ or $q-3=-1\Rightarrow q=\ldots$	dM1
	$p=-8,\quad q=2$	A1
		(3)
(c)	$\left(4\mathbf{i}-\mathbf{j}+3\mathbf{k}\right)\left(3\mathbf{i}-4\mathbf{j}+\mathbf{k}\right)=12+4+3$	M1
	$\left(4\mathbf{i}-\mathbf{j}+3\mathbf{k}\right)\left(3\mathbf{i}-4\mathbf{j}+\mathbf{k}\right)=\sqrt{26}\sqrt{26}\cos\theta=19\Rightarrow\cos\theta=\ldots$	M1
	$\left(\cos\theta=\right)\ \frac{19}{26}$	A1
		(3)
(d)	$AC=AB\sin\theta=\sqrt{26}\sqrt{1-\left(\frac{19}{26}\right)^2}$	M1
	$\frac{3\sqrt{910}}{26}$ o.e.	A1
		(2)
		Total 10

(a)

M1: Attempts the direction of l_1. The expression is sufficient condoning one sign slip or may be implied by 2 correct components of $\pm\left(4\mathbf{i}-\mathbf{j}+3\mathbf{k}\right)$

A1: Any correct equation including '$\mathbf{r}=$'. Allow any parameter to be used including μ.

Allow $\mathbf{r}=-10\mathbf{i}+5\mathbf{j}-4\mathbf{k}\pm\lambda\left(4\mathbf{i}-\mathbf{j}+3\mathbf{k}\right)$, $\mathbf{r}=\begin{pmatrix}-10\\5\\-4\end{pmatrix}\pm\lambda\begin{pmatrix}4\\-1\\3\end{pmatrix}$, $\mathbf{r}=\begin{pmatrix}-6\\4\\-1\end{pmatrix}\pm\lambda\begin{pmatrix}-4\\1\\-3\end{pmatrix}$

Do not accept i, j, k notation in either bracket using column vector notation

e.g. $\mathbf{r}=\begin{pmatrix}-10\\5\\-4\end{pmatrix}\pm\lambda\begin{pmatrix}4\mathbf{i}\\-1\mathbf{j}\\3\mathbf{k}\end{pmatrix}$

(b)

M1: Equates the *x* component of l_2 to -6 and proceeds to find a value for μ.

dM1: Uses the value of μ to find *p* or *q*. It is dependent on the previous method mark.

Alternatively,

- forms a correct equation for the *x* component using their l_1 and l_2
- proceeds to find λ
- uses this value of λ with the value of μ correctly to find *p* or *q* by forming an equation for the *y* or *z* component.