	$\left(\frac{23}{9}, -\frac{16}{9}, \frac{31}{9}\right)$	A1
		(3)
		Total 10

Notes

(a)

M1: Attempts the direction of l

Two out of three components correct in the direction implies the M mark.

A1: Any correct equation including '**r** =' Do not accept **l** = …..

Accept column vectors throughout, e.g., $\mathbf{r} = \begin{pmatrix} 3 \\ -2 \\ 3 \end{pmatrix} + \lambda \begin{pmatrix} -2 \\ 1 \\ 2 \end{pmatrix}$ but do **NOT** accept $\mathbf{r} = \begin{pmatrix} 3\mathbf{i} \\ -2\mathbf{j} \\ 3\mathbf{k} \end{pmatrix} + \lambda \begin{pmatrix} -2\mathbf{i} \\ 1\mathbf{j} \\ 2\mathbf{k} \end{pmatrix}$

(b)

M1: Uses the z component to find the value of the parameter for their equation and uses their parameter value to find the value of α and the value of β.

A1: Correct values or vector.

(c)

M1: Attempts the scalar product $\pm \overrightarrow{OC} \bullet \overrightarrow{AB}$ Ft their $\overrightarrow{OC}$ and $\overrightarrow{AB}$

Look for at least two correct products can be implied by the correct answer.

dM1: A complete method to find the angle (allow acute or obtuse, 20.13º or 159.87° respectively allow working in radians for the M marks)

A1: Awrt 20.1°

(d)

M1: Attempts the scalar product between their $\overrightarrow{OD}$ and the direction of l, sets = 0 and solves for λ for their equation.

M1: Uses their λ correctly to find D

A1: Correct exact coordinates (condone vector)

Do **NOT** accept the final answer in the form $\begin{pmatrix} \frac{23}{9}\mathbf{i} \\ -\frac{16}{9}\mathbf{j} \\ \frac{31}{9}\mathbf{k} \end{pmatrix}$

Question Number	Scheme	Marks
8(a)	$\int x\cos 2x\,\mathrm{d}x = \frac{1}{2}x\sin 2x - \int \frac{1}{2}\sin 2x\,\mathrm{d}x$	M1A1
	$= \frac{1}{2}x\sin 2x + \frac{1}{4}\cos 2x + c$	A1
		(3)
(b)	$V = (\pi)\int (4x+3\cos 2x)^2\ \mathrm{d}x$ $V = (\pi)\int (16x^2 + 24x\cos 2x + 9\cos^2 2x)\mathrm{d}x$	M1
	$\int 24x\cos 2x\,\mathrm{d}x = 12x\sin 2x + 6\cos 2x(+c)$	M1
	$\int 9\cos^2 2x\,\mathrm{d}x = \frac{9}{2}\int (1+\cos 4x)\mathrm{d}x$	M1
	$\left[(\pi)\int (16x^2 + 24x\cos 2x + 9\cos^2 2x)\mathrm{d}x\right]$ $= (\pi)\left(\frac{16x^3}{3} + 12x\sin 2x + 6\cos 2x + \frac{9x}{2} + \frac{9}{8}\sin 4x(+c)\right)$	A1
	$V = \pi\int_{\frac{\pi}{4}}^{\frac{\pi}{2}} (4x+3\cos 2x)^2\,\mathrm{d}x = \pi\left(\frac{16\pi^3}{24} + 0 - 6 + \frac{9\pi}{4} + 0 - \left(\frac{16\pi^3}{192} + 3\pi + 0 + \frac{9\pi}{8} + 0\right)\right)$	M1
	$\pi\left(\frac{7\pi^3}{12} - \frac{15\pi}{8} - 6\right)$	A1
		(6)
		Total 9

Notes

(a)

M1: Applies integration by parts to obtain the form $...x\sin 2x \pm ...\int \sin 2x\,\mathrm{d}x$

A1: Correct expression

A1: Completes the integration to obtain the correct answer including + *c*

If the "DI" method is used:

x	$\cos 2x$
1	$\frac{1}{2}\sin 2x$
0	$-\frac{1}{4}\cos 2x$