Question	Scheme	Marks	AOs
2	$\overrightarrow{OA} = 2\mathbf{i}+3\mathbf{j}-4\mathbf{k}$, $\overrightarrow{OB} = 4\mathbf{i}-2\mathbf{j}+3\mathbf{k}$, $\overrightarrow{OC} = a\mathbf{i}+5\mathbf{j}-2\mathbf{k}$, $a<0$ $\overrightarrow{AB} = \overrightarrow{BD}$, $\left\lvert\overrightarrow{AB}\right\rvert = 4$		
(a)	E.g. $\overrightarrow{OD} = \overrightarrow{OB}+\overrightarrow{BD} = \overrightarrow{OB}+\overrightarrow{AB}$ **or** $\overrightarrow{OD} = \overrightarrow{OB}+\overrightarrow{BD} = \overrightarrow{OB}+\overrightarrow{AB} = \overrightarrow{OB}+\overrightarrow{OB}-\overrightarrow{OA} = 2\overrightarrow{OB}-\overrightarrow{OA}$ **or** $\overrightarrow{OD} = \overrightarrow{OB}+\overrightarrow{BD} = \overrightarrow{OB}+\overrightarrow{AB} = \overrightarrow{OA}+\overrightarrow{AB}+\overrightarrow{AB} = \overrightarrow{OA}+2\overrightarrow{AB}$		
	$= \begin{pmatrix}4\\-2\\3\end{pmatrix}+\begin{pmatrix}4\\-2\\3\end{pmatrix}-\begin{pmatrix}2\\3\\-4\end{pmatrix}$ $\left\{= \begin{pmatrix}4\\-2\\3\end{pmatrix}+\begin{pmatrix}2\\-5\\7\end{pmatrix}\right\}$ **or** $= \begin{pmatrix}2\\3\\-4\end{pmatrix}+2\left(\begin{pmatrix}4\\-2\\3\end{pmatrix}-\begin{pmatrix}2\\3\\-4\end{pmatrix}\right)$ $\left\{= \begin{pmatrix}2\\3\\-4\end{pmatrix}+2\begin{pmatrix}2\\-5\\7\end{pmatrix}\right\}$	M1	3.1a
	$= \begin{pmatrix}6\\-7\\10\end{pmatrix}$ or $6\mathbf{i}-7\mathbf{j}+10\mathbf{k}$	A1	1.1b
		(2)	
(b)	$(a-2)^2+(5-3)^2+(-2--4)^2$	M1	1.1b
	$\left\{\left\lvert\overrightarrow{AC}\right\rvert = 4 \Rightarrow\right\} (a-2)^2+(5-3)^2+(-2--4)^2 = (4)^2$ $\Rightarrow (a-2)^2 = 8 \Rightarrow a = ...$ **or** $\Rightarrow a^2-4a-4=0 \Rightarrow a = ...$	dM1	2.1
	(as $a<0 \Rightarrow$) $a = 2-2\sqrt{2}$ (or $a = 2-\sqrt{8}$)	A1	1.1b
		(3)	
			(5 marks)

Notes for Question 2

(a)	
M1:	Complete ***applied*** strategy to find a vector expression for $\overrightarrow{OD}$
A1:	See scheme
Note:	Give M0 for subtracting the wrong way wrong to give e.g. $(4\mathbf{i}-2\mathbf{j}+3\mathbf{k})+(2\mathbf{i}+3\mathbf{j}-4\mathbf{k})-(4\mathbf{i}-2\mathbf{j}+3\mathbf{k}) = (4\mathbf{i}-2\mathbf{j}+3\mathbf{k})+(-2\mathbf{i}+5\mathbf{j}-7\mathbf{k}) = (2\mathbf{i}+3\mathbf{j}-4\mathbf{k})$
Note:	Writing e.g. $\overrightarrow{OD} = \overrightarrow{OB}+\overrightarrow{AB}$ or $\overrightarrow{OD} = 2\overrightarrow{OB}-\overrightarrow{OA}$ with no other work is M0
Note:	Finding ***coordinates***, i.e. $(6, -7, 10)$ without reference to the correct position vectors is A0
Note:	Allow M1A1 for writing down $6\mathbf{i}-7\mathbf{j}+10\mathbf{k}$ with no working
Note:	M1 can be implied for at least two correct components in their position vector of D
(b)	
M1:	Finds the difference between $\overrightarrow{OA}$ and $\overrightarrow{OC}$, then squares and adds each of the 3 components **Note:** Ignore labelling
dM1:	Complete method of ***correctly*** applying Pythagoras' Theorem on $\left\lvert\overrightarrow{AC}\right\rvert = 4$ and using a correct method of solving their resulting quadratic equation to find at least one of $a = ...$
Note:	Condone at least one of either awrt 4.8 or awrt -0.83 for the dM mark
A1:	Obtains **only one** exact value, $a = 2-2\sqrt{2}$
Note:	Writing $a = 2\pm 2\sqrt{2}$, without evidence of rejecting $a = 2+2\sqrt{2}$ is A0
Note:	Allow exact alternatives such as $2-\sqrt{8}$ or $\frac{4-\sqrt{32}}{2}$ for A1, and isw can be applied
Note:	Writing $a = -0.828...$, without reference to a correct exact value is A0