Question	Scheme	Marks
2	$\overrightarrow{OA}=\begin{pmatrix}7\\2\\-5\end{pmatrix}$ $\overrightarrow{AB}=\begin{pmatrix}-2\\4\\3\end{pmatrix}$ $\overrightarrow{OC}=\begin{pmatrix}a\\5\\-1\end{pmatrix}$	
(a)	$\overrightarrow{OB}=\overrightarrow{OA}+\overrightarrow{AB}=\begin{pmatrix}7\\2\\-5\end{pmatrix}+\begin{pmatrix}-2\\4\\3\end{pmatrix}=...$	**M1**
	$=\begin{pmatrix}5\\6\\-2\end{pmatrix}$, $5\mathbf{i}+6\mathbf{j}-2\mathbf{k}$ or $(5,6,-2)$	**A1**
		(2)
(b)	$\overrightarrow{BC}=\overrightarrow{OC}-"\overrightarrow{OB}"=\begin{pmatrix}a\\5\\-1\end{pmatrix}-"\begin{pmatrix}5\\6\\-2\end{pmatrix}"=...$	**M1**
	$\overrightarrow{OC}."\overrightarrow{BC}"=0\Rightarrow\begin{pmatrix}a\\5\\-1\end{pmatrix}."\begin{pmatrix}a-5\\-1\\1\end{pmatrix}"=0\Rightarrow a(a-5)-5-1=0$	**dM1**
	$a^2-5a-6=0\Rightarrow(a-6)(a+1)=0\Rightarrow a=...$	**ddM1**
	$a=-1,\ 6$	**A1**
		(4)
		(6 marks)

(a)

M1: Attempts to add $\overrightarrow{OA}$ and $\overrightarrow{AB}$, which may be implied by two correct coordinates out of three if there is no direct statement as in the main scheme.

A1: Correct coordinates, in either vector or Cartesian form. (See main scheme).

Withhold the mark for hybrid versions such as $(5\mathbf{i},6\mathbf{j},-2\mathbf{k})$ but isw after you have seen a correct answer

(b)

M1: Attempts $\overrightarrow{BC}$ by subtracting their $\overrightarrow{OB}$ (look at their answer to (a)) and $\overrightarrow{OC}$, subtracted either way round, which may be implied by two correct coordinates out of three following through on their (a).

dM1: Applies the scalar product with $\overrightarrow{OC}$ and their $\overrightarrow{BC}$, sets equal to 0 and forms a quadratic equation in *a*. Dependent upon the previous M.

An alternative method is via Pythagoras' theorem $OC^2+BC^2=OB^2\Rightarrow$

$(a^2+5^2+1^2)+((a-5)^2+1^2+1^2)=5^2+6^2+(-2)^2\Rightarrow 2a^2-10a-12=0$

ddM1: Depends on both previous Ms. Solves their 3- term quadratic equation (which must have real roots) by any valid means including a calculator (check roots if done this way).

A1: Correct values for *a*. If the candidate goes on to reject a value it is A0.

Question	Scheme	Marks
3	$8x^3 - 3y^2 + 2xy = 9$	
	Either $3y^2 \to ky\dfrac{\mathrm{d}y}{\mathrm{d}x}$ **or** $2xy \to \alpha y + \beta x\dfrac{\mathrm{d}y}{\mathrm{d}x}$	**M1**
	Both $3y^2 \to ky\dfrac{\mathrm{d}y}{\mathrm{d}x}$ **and** $2xy \to \alpha y + \beta x\dfrac{\mathrm{d}y}{\mathrm{d}x}$	**dM1**
	$8x^3 - 3y^2 + 2xy = 9 \to 24x^2 - 6y\dfrac{\mathrm{d}y}{\mathrm{d}x} + 2y + 2x\dfrac{\mathrm{d}y}{\mathrm{d}x} = 0$	**A1**
	$(2, 5) : 96 - 30\dfrac{\mathrm{d}y}{\mathrm{d}x} + 10 + 4\dfrac{\mathrm{d}y}{\mathrm{d}x} = 0 \Rightarrow \dfrac{\mathrm{d}y}{\mathrm{d}x} = ...\left(= \dfrac{53}{13}\right)$	**M1**
	$\dfrac{\mathrm{d}y}{\mathrm{d}x} = \dfrac{53}{13}$ or $\dfrac{\mathrm{d}x}{\mathrm{d}y} = \dfrac{13}{53}$ o.e.	**A1**
	Normal: $y - 5 = "-\dfrac{13}{53}"\left(x - 2\right)$	**M1**
	$13x + 53y - 291 = 0$	**A1**
		(7)
		(7 marks)