**9** Relative to an origin $O$, the position vectors of the points $A$ and $B$ are given by

$$\overrightarrow{OA} = \begin{pmatrix} 4 \\ 1 \\ -2 \end{pmatrix} \quad \text{and} \quad \overrightarrow{OB} = \begin{pmatrix} 3 \\ 2 \\ -4 \end{pmatrix}.$$

**(i)** Given that $C$ is the point such that $\overrightarrow{AC} = 2\overrightarrow{AB}$, find the unit vector in the direction of $\overrightarrow{OC}$. [4]

The position vector of the point $D$ is given by $\overrightarrow{OD} = \begin{pmatrix} 1 \\ 4 \\ k \end{pmatrix}$, where $k$ is a constant, and it is given that

$\overrightarrow{OD} = m\overrightarrow{OA} + n\overrightarrow{OB}$, where $m$ and $n$ are constants.

**(ii)** Find the values of $m$, $n$ and $k$. [4]