1 **(i)** Find the point of intersection of the line $\mathbf{r} = \begin{pmatrix} -8 \\ -2 \\ 6 \end{pmatrix} + \lambda \begin{pmatrix} -3 \\ 0 \\ 1 \end{pmatrix}$ and the plane $2x - 3y + z = 11$. **[4]**

(ii) Find the acute angle between the line and the normal to the plane. **[4]**

2 The points A, B and C have coordinates (1, 3, −2), (−1, 2, −3) and (0, −8, 1) respectively.

(i) Find the vectors $\overrightarrow{AB}$ and $\overrightarrow{AC}$. **[2]**

(ii) Show that the vector $2\mathbf{i} - \mathbf{j} - 3\mathbf{k}$ is perpendicular to the plane ABC. Hence find the equation of the plane ABC. **[5]**

3 **(i)** Write down normal vectors to the planes $2x - y + z = 2$ and $x - z = 1$.

Hence find the acute angle between the planes. **[4]**

(ii) Write down a vector equation of the line through (2, 0, 1) perpendicular to the plane $2x - y + z = 2$. Find the point of intersection of this line with the plane. **[4]**

4 **(i)** Find the cartesian equation of the plane through the point $(2, -1, 4)$ with normal vector

$$\mathbf{n} = \begin{pmatrix} 1 \\ 1 \\ 2 \end{pmatrix}. \qquad [3]$$

(ii) Find the coordinates of the point of intersection of this plane and the straight line with equation

$$\mathbf{r} = \begin{pmatrix} 7 \\ 12 \\ 9 \end{pmatrix} + \lambda \begin{pmatrix} 1 \\ 3 \\ 2 \end{pmatrix}. \qquad [4]$$

5

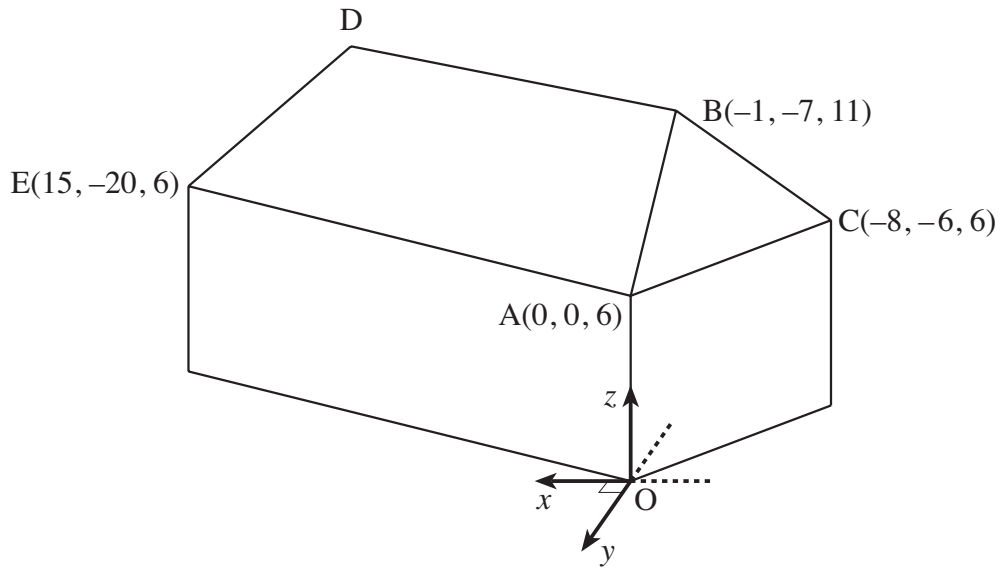

Fig. 7

Fig. 7 illustrates a house. All units are in metres. The coordinates of A, B, C and E are as shown. BD is horizontal and parallel to AE.

(i) Find the length AE. [2]

(ii) Find a vector equation of the line BD. Given that the length of BD is 15 metres, find the coordinates of D. [4]

(iii) Verify that the equation of the plane ABC is

$$-3x + 4y + 5z = 30.$$

Write down a vector normal to this plane. [4]

(iv) Show that the vector $\begin{pmatrix} 4 \\ 3 \\ 5 \end{pmatrix}$ is normal to the plane ABDE. Hence find the equation of the plane ABDE. [4]

(v) Find the angle between the planes ABC and ABDE. [4]