1 Fig. 6 shows a lean-to greenhouse ABCDHEFG. With respect to coordinate axes Oxyz, the coordinates of the vertices are as shown. All distances are in metres. Ground level is the plane $z = 0$.

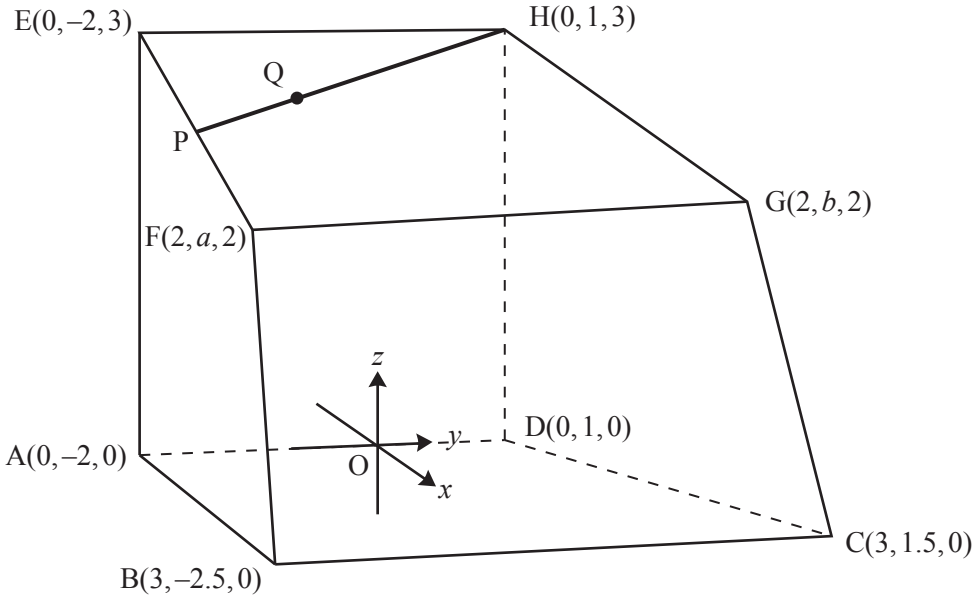

Fig. 6

(i) Verify that the equation of the plane through A, B and E is $x + 6y + 12 = 0$.

Hence, given that F lies in this plane, show that $a = -2\frac{1}{3}$. **[4]**

(ii) (*A*) Show that the vector $\begin{pmatrix} 1 \\ -6 \\ 0 \end{pmatrix}$ is normal to the plane DHC. **[2]**

(*B*) Hence find the cartesian equation of this plane. **[2]**

(*C*) Given that G lies in the plane DHC, find b and the length FG. **[2]**

(iii) Find the angle EFB. **[5]**

A straight wire joins point H to a point P which is half way between E and F. Q is a point two-thirds of the way along this wire, so that HQ = 2QP.

(iv) Find the height of Q above the ground. **[3]**

2 Fig. 7 shows a tetrahedron ABCD. The coordinates of the vertices, with respect to axes O*xyz*, are A(–3, 0, 0), B(2, 0, –2), C(0, 4, 0) and D(0, 4, 5).

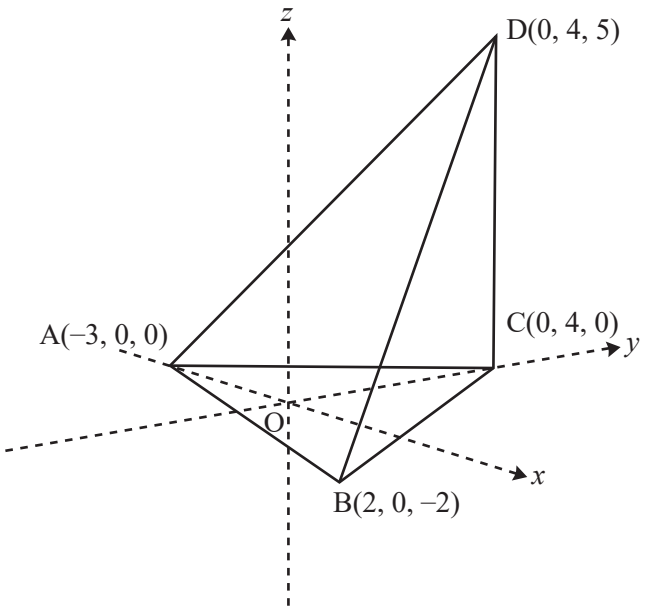

Fig. 7

(i) Find the lengths of the edges AB and AC, and the size of the angle CAB. Hence calculate the area of triangle ABC. **[7]**

(ii) (*A*) Verify that $4\mathbf{i} - 3\mathbf{j} + 10\mathbf{k}$ is normal to the plane ABC. **[2]**

(*B*) Hence find the equation of this plane. **[2]**

(iii) Write down a vector equation for the line through D perpendicular to the plane ABC. Hence find the point of intersection of this line with the plane ABC. **[5]**

The volume of a tetrahedron is $\frac{1}{3}$ × area of base × height.

(iv) Find the volume of the tetrahedron ABCD. **[2]**

3 **(i)** Find a vector equation of the line l joining the points $(0, 1, 3)$ and $(-2, 2, 5)$. **[2]**

(ii) Find the point of intersection of the line l with the plane $x + 3y + 2z = 4$. **[3]**

(iii) Find the acute angle between the line l and the normal to the plane. **[3]**