

5. The point  $A$  has position vector  $7\mathbf{i} + 2\mathbf{j} - 7\mathbf{k}$  and the point  $B$  has position vector  $12\mathbf{i} + 3\mathbf{j} - 15\mathbf{k}$ .

(a) Find a vector for the line  $L_1$  which passes through  $A$  and  $B$ .

(2)

The line  $L_2$  has vector equation

$$\mathbf{r} = -4\mathbf{i} + 12\mathbf{k} + \mu(\mathbf{i} - 3\mathbf{k}).$$

(b) Show that  $L_2$  passes through the origin  $O$ .

(1)

(c) Show that  $L_1$  and  $L_2$  intersect at a point  $C$  and find the position vector of  $C$ .

(3)

(d) Find the cosine of  $\angle OCA$ .

(3)

(e) Hence, or otherwise, find the shortest distance from  $O$  to  $L_1$ .

(3)

(f) Show that  $|\overrightarrow{CO}| = |\overrightarrow{AB}|$ .

(2)

(g) Find a vector equation for the line which bisects  $\angle OCA$ .

(5)