

# B 'VECTORS'

- 8 Let  $a = (3, -1)$  and  $b = (-4, 3)$  in the plane  $\mathbb{R}^2$ .
- Determine  $c = a + b$ .
  - Determine  $d = 3a + 2b$ .
  - Draw a rough sketch of the plane and mark the points  $a, b, c, d$  on it.
  - Determine the length of  $d$ .
  - Show that the vectors  $d$  and  $a$  are perpendicular.

(26)

- 9 The position vectors of the points  $A, B$  and  $C$  are  
 $a = (4, -3), b = (1, 3)$  and  $c = (2, 1)$ .

- Show that  $OC$  is perpendicular to  $AB$ .
- Write down the position vector of a general point on the line  $AB$  and hence show that  $C$  lies on  $AB$ .
- State the ratio in which  $C$  divides the line segment  $AB$ .

(95)

- 10 Consider the points  $a = (4, 2)$  and  $b = (1, 5)$  in the plane  $\mathbb{R}^2$ .

- Draw a rough sketch of  $\mathbb{R}^2$  marking the points  $a$  and  $b$ , and the line  $\ell$  through  $a$  and  $b$ .
- Determine the point  $c$  on  $\ell$  which is one third of the way along  $\ell$  from  $a$  to  $b$ .
- Prove that the vector  $c$  is perpendicular to the line  $\ell$ .

[2]

[2] (88)

[1]

- 11 Let  $a = (1, -2, 2)$  and  $b = (1, 4, 8)$  be vectors in  $\mathbb{R}^3$ .

Determine  $\|a\|, \|b\|$  and  $a \cdot b$ , and hence determine the cosine of the angle between  $a$  and  $b$ .

(27)

[4]

- 12 The vectors  $e_1, e_2$  and  $e_3$  are defined by

$$e_1 = \left(\frac{2}{3}, -\frac{1}{3}, \frac{2}{3}\right), e_2 = (2, -2, -3) \text{ and } e_3 = (4, 0, 1).$$

(94)

- Show that  $e_1$  and  $e_2$  are orthogonal.
- Find the cosine of the angle between  $e_2$  and  $e_3$ .
- Find a vector  $e_4$  that is orthogonal to  $e_1$  and  $e_2$ .
- Find an orthonormal basis for  $\mathbb{R}^3$  that includes the vector  $e_1$ .

[6]

- 13 The position vectors of points  $a$  and  $b$  are  $a = (-2, 1)$  and  $b = (1, -3)$  respectively.

- Draw a sketch showing the points  $a$  and  $b$  in the plane, and the line  $l$  through  $a$  and  $b$ .
- The point  $c$  has position vector

$$c = \frac{3}{5}a + \frac{2}{5}b.$$

- Does  $c$  lie on  $l$ ? Justify your answer briefly.
- Find the length of  $Oc$ .
- Show that  $Oc$  is perpendicular to  $l$ .

[5]

(93)

- 13<sup>A</sup> The position vectors of points  $a$  and  $b$  are  $a = (-1, 8)$  and  $b = (5, -1)$  respectively.

(91)

- Draw a sketch showing the points  $a$  and  $b$  in the plane, and the line  $l$  through  $a$  and  $b$ .
- Find the position vector  $r$  of a general point  $r$  on the line  $l$ .
- Find the point  $p$  on  $l$  which is such that  $Op$  and  $Oa$  are perpendicular, and mark it on your sketch.

[5]

- 14 Let  $a = (-3, 1)$  and  $b = (0, 5)$  in the plane  $\mathbb{R}^2$ .

(89)

- Draw a rough sketch of the plane, marking the points with position vectors  $a$  and  $b$  on it.
- Determine the position vector  $c$  of the centroid of the triangle  $Oab$ .
- Find the angle between the vectors  $a$  and  $c$ .

[1]

[1]

[2]