

**Question**

Given  $\mathbf{p} = (2, 1, 0)$ ,  $\mathbf{q} = (-1, -1, -1)$ ,  $\mathbf{r} = (1, 2, 1)$ , find: (a)  $(\mathbf{p} \times \mathbf{r}) \cdot \mathbf{q}$ , (b)  $(\mathbf{p} \times \mathbf{r}) \times \mathbf{q}$

**Answer**

$$\mathbf{p} = (2, 1, 0) \quad \mathbf{q} = (-1, -1, -1) \quad \mathbf{r} = (1, 2, 1)$$

Then  $\mathbf{p} \times \mathbf{r}$  is given by 
$$\begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ 2 & 1 & 0 \\ 1 & 2 & 1 \end{vmatrix}$$

$$\text{Thus } \mathbf{p} \times \mathbf{r} = (1 \times 1 - 2 \times 0, 0 \times 1 - 1 \times 2, 2 \times 2 - 1 \times 1) = (1, -2, 3)$$

(a)

$$\begin{aligned} (\mathbf{p} \times \mathbf{r}) \cdot \mathbf{q} &= (1, -2, 3) \cdot (-1, -1, -1) \\ &= 1 \times -1 + -2 \times -1 + 3 \times -1 \\ &= -2 \end{aligned}$$

(b)

$$\begin{aligned} (\mathbf{p} \times \mathbf{r}) \times \mathbf{q} &= (1, -2, 3) \times (-1, -1, -1) \\ &= (-2 \times 1 - (-1 \times 3), 3 \times -1 - (-1 \times 1), 1 \times 1 - (-1 \times -2)) \\ &= (5, -2, -3) \end{aligned}$$