

**PH-210 Engineering: Maths Test - Vectors**

Name:

1. (a) Write down (or draw) a vector parallel to  $\vec{a} = (5, 6)$ .

(b) What are the unit vectors  $\hat{i}$  and  $\hat{j}$ ?

(c) Write  $\vec{a}$  in terms of  $\hat{i}$  and  $\hat{j}$ .

(d) What are the components of  $\vec{a}$ ?

(e) Write down the unit vector  $\hat{a}$  parallel to  $\vec{a}$ .

(f) Give the components of  $\hat{a}$ .

2. Let  $\vec{a} = (1, 1, 1)$  and  $\vec{b} = (4, 0, 6)$ . Find  $6\vec{a} + 2\vec{b}$  and  $6\vec{a} - 2\vec{b}$ .

3. Find the dot products of (a)  $\vec{a} = (1, 1, 1)$ ,  $\vec{b} = (1, -1, 1)$  and (b)  $\vec{a} = 3\hat{i} + 2\hat{j}$ ,  $\vec{b} = 4\hat{i} + 6\hat{k}$ .

4. Two vectors  $\vec{a}$  and  $\vec{b}$  are mutually perpendicular. What is their dot product?

5. Calculate the dot product  $\hat{j} \cdot (3\hat{i} + 2\hat{j} + 3\hat{k})$ .

6. Find the vector products  $\vec{a} \times \vec{b}$  and  $\vec{b} \times \vec{a}$  where  $\vec{a} = 2\hat{i} - \hat{j} + 3\hat{k}$  and  $\vec{b} = -\hat{i} + 2\hat{j} + 4\hat{k}$

7. (a) Find the magnitude of the vector  $\vec{a} = (1, 2, -2)$ .

- (b) Now calculate the direction cosines of  $\vec{a}$ .

8. Find the numbers  $\alpha$ ,  $\beta$  and  $\gamma$  that make vectors  $\vec{\mathbf{a}} = \alpha\hat{\mathbf{i}} + \hat{\mathbf{j}} + 2\hat{\mathbf{k}}$ ,  $\vec{\mathbf{b}} = \hat{\mathbf{i}} + \beta\hat{\mathbf{j}} - \hat{\mathbf{k}}$  and  $\vec{\mathbf{c}} = \hat{\mathbf{i}} - \hat{\mathbf{j}} + \gamma\hat{\mathbf{k}}$  mutually perpendicular (hint: you will need to write down and solve three simultaneous equations).