

Question 1 [3 + 3 Marks]

- a) Find the values of a , b , and c such that the vector $\mathbf{u} = a\mathbf{i} + b\mathbf{j} + c\mathbf{k}$ is orthogonal to both

$$\mathbf{v} = \mathbf{i} + 2\mathbf{j} + \mathbf{k} \text{ and } \mathbf{w} = \mathbf{i} - \mathbf{j} + \mathbf{k}.$$

- b) Let $\mathbf{l} = \langle 2, 3, 4 \rangle$, $\mathbf{m} = \langle -1, 3, 5 \rangle$ and $\mathbf{n} = 2\mathbf{l} + 3\mathbf{m}$. Show that:
 $(\mathbf{l} \times \mathbf{m}) \cdot \mathbf{n} = 0$.

Question 2 [3 + 3 Marks]

- (a) Find the parametric equations of the line passing through point $P(5, -2, 4)$ and is normal to the plane containing points $A(2, 3, 1)$, $B(4, 3, 2)$ and $C(1, 4, 5)$.
- (b) Use the cross product to find the distance from the point $P(3, 3, 1)$ to the line passing through the points $A(1, 1, 1)$ and $B(1, 2, 3)$.

Question 3 [3 + 3 Marks]

Let $A(0, 1, 0)$, $B(-1, 1, 2)$ and $C(2, 1, -1)$ be three points

- (a) Find the area of triangle ABC .
- (b) Find the value of y , if $D(2, y, 1)$ is a point such that the volume of the box with adjacent sides AB , AC , and AD is 3 units³.

Question 4 [4 + 3 Marks]

The motion of a point moving along a curve is given by

$$\mathbf{r}(t) = (t - 5)\mathbf{i} + (2t^3 - 5)\mathbf{j} + (t^2 + 4)\mathbf{k}.$$

- (a) Find the velocity, acceleration and speed at time $t = 1$.
- (b) Also find the components of velocity and acceleration in direction of vector

$$\mathbf{b} = \mathbf{i} - \mathbf{j} + 2\mathbf{k}$$

at time $t = 1$.