

1. Determine the cross product of  $\langle 2, 1, 1 \rangle$  and  $\langle -4, 3, 1 \rangle$ .
2. Determine the area of the triangle with vertices  $P(1, -1, 0)$ ,  $Q(2, 1, -1)$  and  $R(-1, 1, 2)$ .
3. Determine the torque of the force  $\vec{F} = \langle 3, -1, 2 \rangle$  N if it is applied to a moment arm  $\vec{r} = \langle -1, -1, 1 \rangle$  m.

Answers:

$$1. \quad \langle 2, 1, 1 \rangle \times \langle -4, 3, 1 \rangle = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 1 & 1 \\ -4 & 3 & 1 \end{vmatrix} = \langle 1 - 3, -(2 + 4), 6 + 4 \rangle = \langle -2, -6, 10 \rangle$$

$$2. \quad \text{Area} = \frac{1}{2} |\overrightarrow{QP} \times \overrightarrow{QR}| = \frac{1}{2} |\langle -1, -2, 1 \rangle \times \langle -3, 0, 3 \rangle| = \frac{1}{2} \left| \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -1 & -2 & 1 \\ -3 & 0 & 3 \end{vmatrix} \right| = \frac{1}{2} |\langle -6 - 0, -(3 - 3), 0 - 6 \rangle| =$$
$$\frac{1}{2} \|\langle -6, 0, -6 \rangle\| = \frac{1}{2} * 6\sqrt{2} = 3\sqrt{2}$$

$$3. \quad \text{Torque} = \vec{r} \times \vec{F} = \langle -1, -1, 1 \rangle \times \langle 3, -1, 2 \rangle = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -1 & -1 & 1 \\ 3 & -1 & 2 \end{vmatrix} = \langle -2 + 1, -(-2 - 3), 1 + 3 \rangle = \langle -1, 5, 4 \rangle \text{ J}$$