HW01

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Question 08:

The vector $\vec{D} = 2\hat{i} - 4\hat{j} + \hat{k}$ is orthogonal to the vector $\vec{G} = 3\hat{i} + 4\hat{j} + 10\hat{k}$ if they are perpendicular and angle between them is 90°. As a result, condition of vectors orthogonality that two vectors $\vec{D} = 2\hat{i} - 4\hat{j} + \hat{k}$ and $\vec{G} = 3\hat{i} + 4\hat{j} + 10\hat{k}$ are orthogonal if their dot product is equal to zero.

Now,

$$\vec{D} \cdot \vec{G} = (2\hat{i} - 4\hat{j} + \hat{k})(3\hat{i} + 4\hat{j} + 10\hat{k})$$

$$= (2)(3) + (-4)(4) + (1)(10) = 6 - 16 + 10$$

$$= 0$$

$$\therefore |\vec{D}| = \sqrt{(2)^2 + (-4)^2 + (1)^2} = \sqrt{21}$$

$$\therefore |\vec{G}| = \sqrt{(3)^2 + (4)^2 + (10)^2} = 5\sqrt{5}$$

$$\therefore \theta = \cos^{-1} \frac{\vec{D} \cdot \vec{G}}{|\vec{D}||\vec{G}|} = \cos^{-1} \frac{0}{(\sqrt{21})(5\sqrt{5})} = \cos^{-1}(0) = 90^\circ$$

$\therefore$ The force vector $\vec{D} = 2\hat{i} - 4\hat{j} + \hat{k}$ is orthogonal to the force vector $\vec{G} = 3\hat{i} + 4\hat{j} + 10\hat{k}$.

(showed).