Assignment 1

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Abstract—**This document solves a problem from Points and Vectors, where it finds the angle between a given Force and displacement vector**

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1 PROBLEM

Find the angle between the force $\mathbf{F} = \begin{pmatrix} 3 \\ 4 \\ -5 \end{pmatrix}$ and

displacement $\mathbf{d} = \begin{pmatrix} 5 \\ 4 \\ 3 \end{pmatrix}$

2 EXPLANATION

Let the angle between $\mathbf{F}$ and $\mathbf{d} = \theta$ Then,

$$\cos(\theta) = \frac{\mathbf{F}^T \mathbf{d}}{\|\mathbf{F}\| \, \|\mathbf{d}\|} \tag{2.0.1}$$

where $\mathbf{F}^T \mathbf{d}$ is scalar product of vectors $\mathbf{F}$ and $\mathbf{d}$
And, $\|\mathbf{F}\|$ and $\|\mathbf{d}\|$ are their respective magnitudes

3 SOLUTION

So,

$$\mathbf{F}^T \mathbf{d} = \begin{pmatrix} 3 \\ 4 \\ -5 \end{pmatrix}^T \begin{pmatrix} 5 \\ 4 \\ 3 \end{pmatrix} \tag{3.0.1}$$

$$\implies \mathbf{F}^T \mathbf{d} = \begin{pmatrix} 3 & 4 & -5 \end{pmatrix} \begin{pmatrix} 5 \\ 4 \\ 3 \end{pmatrix} \tag{3.0.2}$$

$$= 16 \tag{3.0.3}$$

$$\|\mathbf{F}\| = \sqrt{3^2 + 4^2 + (-5)^2} = 5\sqrt{2} \tag{3.0.4}$$

$$\|\mathbf{d}\| = \sqrt{5^2 + 4^2 + 3^2} = 5\sqrt{2} \tag{3.0.5}$$

Substituting these values in Equation 2.0.1,

$$\cos(\theta) = \frac{16}{(5\sqrt{2})(5\sqrt{2})} \tag{3.0.6}$$

$$= \frac{8}{25} \tag{3.0.7}$$

$$\implies \theta = \arccos\left(\frac{8}{25}\right) \tag{3.0.8}$$

$$\implies \theta \approx 71.3° \tag{3.0.9}$$

Thus, angle between $\mathbf{F}$ and $\mathbf{d} \approx 71.3°$