Question 1.4.15

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September 10, 2025

If **a**, **b**, **c** are three non-zero unequal vectors such that $\mathbf{a} \cdot \mathbf{b} = \mathbf{a} \cdot \mathbf{c}$, then find the angle between **a** and $\mathbf{b} - \mathbf{c}$.

Solution:

The dot product formula is

$$\mathbf{a} \cdot \mathbf{b} = |\mathbf{a}||\mathbf{b}| \cos \theta \qquad (1)$$

Where θ is the angle between vectors $\mathbf{a}$ and $\mathbf{b}$.

$$\therefore \theta = \arccos(\frac{\mathbf{a} \cdot \mathbf{b}}{|\mathbf{a}||\mathbf{b}|}) \qquad (2)$$

In this case, we would need to find

$$\theta = \arccos(\frac{\mathbf{a} \cdot (\mathbf{b} - \mathbf{c})}{|\mathbf{a}||\mathbf{b} - \mathbf{c}|}) \qquad (3)$$

$$\theta = \arccos(\frac{\mathbf{a} \cdot \mathbf{b} - \mathbf{a} \cdot \mathbf{c}}{|\mathbf{a}||\mathbf{b} - \mathbf{c}|}) \qquad (4)$$

$$\theta = \arccos(0) = 90° \qquad (5)$$

$$\because \mathbf{a} \cdot \mathbf{b} = \mathbf{a} \cdot \mathbf{c} \text{ and } |\mathbf{a}| \neq 0, |\mathbf{b} - \mathbf{c}| \neq 0 \qquad (6)$$

Therefore, the angle between the vectors $\mathbf{a}$ and $\mathbf{b} - \mathbf{c}$ is $90°$.