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Assignment

Topic: Vectors, Geometry & dynamics

\* If  $A = 2i - j$ ,  $B = 3i + j - 11k$  and  $C = 4i + 4j - 5k$  find the following.

(i)  $-3A + 7B - 8C$

Solu

$$\begin{aligned} & -3(2i - j + 0k) + 7(3i + j - 11k) - 8(4i + 4j - 5k) \\ & -6i + 3j + 21i + 7j - 77k - 32i - 32j + 40k \\ & (-6i + 21i - 32i) \quad 3j + 7j - 32j \\ & \quad -17i \quad -22j \quad -37k \\ & = -17i - 22j - 37k // \end{aligned}$$

(ii) If  $K = 2A + 4B - C$  find the direction cosine of  $K$

Solu

$$\begin{aligned} & 2(2i - j + 0k) + 4(3i + j - 11k) - (4i + 4j - 5k) \\ & 4i - 2j + 0k + 12i + 4j - 44k - 4i - 4j + 5k \\ & (4i + 12i - 4i) \quad (-2j + 4j - 4j) \quad (0k - 44k + 5k) \\ & \quad 12i \quad -2j \quad -39k \\ & \quad \quad \quad 12i - 2j - 39k // \end{aligned}$$

$$\therefore |K| = \sqrt{(12)^2 + (-2)^2 + (-39)^2}$$

$$|K| = 40.85$$

$$l_i, l_j, l_k = \cos \alpha, \cos \beta, \cos \gamma = \frac{12}{40.85}, \frac{-2}{40.85}, \frac{-39}{40.85} //$$

$$(ii) A \times (B \times C)$$

$$\text{Solve } \begin{array}{c} + \\ - \\ + \\ \hline i \quad j \quad k \\ \hline 3 \quad 1 \quad -11 \\ 4 \quad 4 \quad -5 \end{array}$$

$$i \begin{vmatrix} 1 & -11 \\ 4 & -5 \end{vmatrix} - j \begin{vmatrix} 3 & -11 \\ 4 & -5 \end{vmatrix} + k \begin{vmatrix} 3 & 1 \\ 4 & 4 \end{vmatrix}$$

$$i [-5 + 44] - j [-15 + 44] + [12 - 4]$$

$$39i - 29j + 8k$$

$$\therefore A \times (B \times C)$$

$$\begin{array}{c} + \\ - \\ + \\ \hline i \quad j \quad k \\ \hline 2 \quad -1 \quad 0 \\ 39 \quad -29 \quad 8 \end{array}$$

$$i \begin{bmatrix} 1 & 0 \\ -29 & 8 \end{bmatrix} - j \begin{bmatrix} 2 & 0 \\ 39 & 8 \end{bmatrix} + k \begin{bmatrix} 2 & -1 \\ 39 & -29 \end{bmatrix}$$

$$i [(8) - 0] - [16 - 0] + k [-29 - 78]$$

$$8i - 16j + 19k$$

$$(iv) (3A \times B) \cdot (A \times 2B)$$

$$3(2i - 1j + 0k) \cdot (6i - 3j + 0k) = A \cdot B = 3i + 1j - 11k$$

$$2B = 2(3i + 1j - 11k) = 6i + 2j - 22k$$

$$\therefore (3A \times B) = \begin{array}{c} + \\ - \\ + \\ \hline i \quad j \quad k \\ \hline 6 \quad -3 \quad 0 \\ 3 \quad 1 \quad -11 \end{array}$$

$$\therefore \begin{bmatrix} 3 & 0 \\ 1 & -11 \end{bmatrix} - j \begin{bmatrix} 6 & 0 \\ 3 & -11 \end{bmatrix} + k \begin{bmatrix} 6 & -3 \\ 3 & 1 \end{bmatrix}$$

$$i \begin{bmatrix} -33 \end{bmatrix} + j \begin{bmatrix} 66 \end{bmatrix} + k \begin{bmatrix} -1 \end{bmatrix}$$

$$(3A \times B) = -33i + 66j - 15k$$

$$\therefore (A \times 2B)$$

$$\begin{vmatrix} + & - & + \\ i & j & k \\ 2 & -1 & 0 \\ 6 & 2 & -22 \end{vmatrix}$$

$$i \begin{bmatrix} -1 & 0 \\ 2 & -22 \end{bmatrix} - j \begin{bmatrix} 2 & 0 \\ 6 & -22 \end{bmatrix} + k \begin{bmatrix} 2 & -1 \\ 6 & 2 \end{bmatrix}$$

$$i \begin{bmatrix} 22 \end{bmatrix} - j \begin{bmatrix} 44 \end{bmatrix} + k \begin{bmatrix} 10 \end{bmatrix}$$

$$(A \times 2B) = 22i + 44j + 10k$$

$$\therefore (3A \times B) \cdot (A \times 2B)$$

$$(-33i + 66j - 15k) \cdot (22i + 44j + 10k)$$

$$726 + 2904j - 150k = 3480$$

$$= \cancel{22i + 44j + 10k} \cdot \cancel{22i + 44j + 10k}$$

(V)  $A - 2B - C$

Solu

$$A = 2i - j + 0k - 2(3i + j - 11k) - C = (4i + 4j - 5k)$$

$$A = 2i - j + 0k - 6i - 2j + 22k - 4i - 4j + 5k$$

$$(2i - 6i - 4i) - (j + 2j + 4j) - (0k + 22k + 5k)$$

$$= -8i - 7j + 27k$$

\* ~~A~~ Perpendicular vector: 2 vectors A & B are said to be perpendicular

$$\text{If } A \cdot B = 0.$$

Or

\* A Co-planar vector: 3 vectors A, B & C are said to be co-planar

$$\text{If vector } A \cdot (B \times C) = 0$$