

$$\begin{aligned} (V) &= \mathbf{A} - 2\mathbf{B} - \mathbf{C} \\ &= (2\mathbf{i} - \mathbf{j} + 0\mathbf{k}) - 2(3\mathbf{i} + \mathbf{j} - 11\mathbf{k}) - (4\mathbf{i} + 4\mathbf{j} - 5\mathbf{k}) \\ &= (2\mathbf{i} - \mathbf{j} + 0\mathbf{k}) - (6\mathbf{i} + 2\mathbf{j} - 22\mathbf{k}) - (4\mathbf{i} + 4\mathbf{j} - 5\mathbf{k}) \\ &= (2 - 6 - 4)\mathbf{i} + (-1 - 2 - 4)\mathbf{j} + (0 + 22 + 5)\mathbf{k} \\ &= -8\mathbf{i} - 7\mathbf{j} + \underline{\underline{27\mathbf{k}}} \end{aligned}$$

(2) Define perpendicular and Co-planar Vectors.

Perpendicular Vectors:

Two vectors  $\mathbf{A}$  and  $\mathbf{B}$  are said to be perpendicular if  $\mathbf{A} \cdot \mathbf{B}$  equals zero (0).

CO-Planar Vectors:

Three vectors  $\mathbf{A}$ ,  $\mathbf{B}$  and  $\mathbf{C}$  are said to be Co-planar Vectors if  $\mathbf{A} \cdot (\mathbf{B} \times \mathbf{C}) = 0$

$$(III) A \times (B \times C) = \begin{matrix} i & j & k \\ 3 & 1 & -11 \\ 4 & 4 & -5 \end{matrix}$$

$$i = 1 \quad -11 \quad j = 3 \quad -11 \quad k = 3 \quad 1 \\ 4 \quad -5 \quad 4 \quad -5 \quad 4 \quad 4$$

$$i = -5 + 44 \quad j = -15 + 44 \quad k = 12 - 4 \\ = 39i - 29j + 8k$$

$$A \times (B \times C) = \begin{matrix} 2 & 1 & 0 \\ 39 & -29 & 8 \end{matrix}$$

$$i = 1 \quad 0 \quad -j = 2 \quad 0 \quad k = 2 \quad 1 \\ -29 \quad 8 \quad 39 \quad 8 \quad 39 \quad -29$$

$$i = 8 - 0 \quad -j = 16 - 0 \quad k = -58 - 39$$

~~8i~~

$$A \times (B \times C) = 8i - 16j - 97k$$

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

$$3A = 3(2i - j + 0k) = 6i - 3j + 0k$$

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

$$(3A \times B) = \begin{matrix} i & j & k \\ 6 & -3 & 0 \\ 3 & 1 & -11 \end{matrix}$$

$$i = -3 \quad 0 \quad -j = 6 \quad 0 \quad k = 6 \quad -3 \\ 1 \quad -11 \quad 3 \quad -11 \quad 3 \quad 1$$

$$= 33i + 66j + 15k$$

$$(A \times 2B) = \begin{matrix} 2 & 1 & 0 \\ 6 & 2 & -22 \end{matrix}$$

$$i = 1 \quad 0 \quad -j = 2 \quad 0 \quad k = 2 \quad 1 \\ 2 \quad -22 \quad 6 \quad -22 \quad 6 \quad 2$$

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

$$(3A \times B) \cdot (A \times 2B) = (33i + 66j + 15k) \cdot (-22i + 44j - 2k)$$

$$(3A \times B) \cdot (A \times 2B) = -726 + 2904 + (-30) = 2148$$

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If  $A = 2i - j$ ,  $B = 3i + j - 11k$  and  $C = 4i + 4j - 5k$  find

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

$$A = -3(2i - j + 0k) = -6i + 3j - 0k$$

$$B = 7(3i + j - 11k) = 21i + 7j - 77k$$

$$C = -8(4i + 4j - 5k) = -32i - 32j + 40k$$

$$\begin{aligned} \therefore -3A + 7B - 8C &= (-6i + 3j - 0k) + (21i + 7j - 77k) + (-32i - 32j + 40k) \\ &= -17i - 22j - 37k \end{aligned}$$

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

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

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

$$= \sqrt{144 + 4 + 1521}$$

$$= \sqrt{1669}$$

$$|K| = 40.85$$

$$\approx 40.9$$

$$L = \cos \alpha = \frac{12}{40.9}$$

$$M = \cos \beta = \frac{-2}{40.9}$$

$$N = \cos \gamma = \frac{-39}{40.9}$$