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$A = 2i - j \quad B = 3i + j - 11k \quad C = 4i + 4j - 5k$

$-3A + 7B - 8C$

$= -3(2i - j) + 7(3i + j - 11k) - 8(4i + 4j - 5k)$

$= -6i + 3j + 21i + 7j - 77k - 32i - 32j + 40k$

$= -17 - 22j - 37k$

$K = 2A + 4B - C$

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

$k = 4i - 2j + 12i + 4j - 44k - 4i - 4j + 5k$

$k = 12i - 2j - 39k$

$|k| = \sqrt{12^2 + (-2)^2 + (-39)^2} = \sqrt{144 + 4 + 1521} = \sqrt{1669} = 40.85$

$\therefore$ direction cosines of k is $\cos\alpha = \frac{12}{\sqrt{1669}}$ $\cos\beta = \frac{-2}{\sqrt{1669}}$

$\cos\gamma = \frac{-39}{\sqrt{1669}}$

$A \times (B \times C)$

$B \times C = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & 1 & -11 \\ 4 & 4 & -5 \end{vmatrix} = +i\begin{vmatrix} 1 & -11 \\ 4 & -5 \end{vmatrix} - j\begin{vmatrix} 3 & -11 \\ 4 & -5 \end{vmatrix} + k\begin{vmatrix} 3 & 1 \\ 4 & 4 \end{vmatrix}$

$= 39i - 29j + 8k$

$A \times (B \times C) = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & -1 & 0 \\ 39 & -29 & 8 \end{vmatrix} = +i\begin{vmatrix} -1 & 0 \\ -29 & 8 \end{vmatrix} - j\begin{vmatrix} 2 & 0 \\ 39 & 8 \end{vmatrix} + k\begin{vmatrix} 2 & -1 \\ 39 & -29 \end{vmatrix}$

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

$\therefore A \times (B \times C) = -8i - 16j - 19k$

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

$3A \times B = 3(2i - j) \times (3i + j - 11k)$

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

$= 33i + 66j + 15k$

$A \times 2B = 2i - j \times 2(3i + j - 11k)$

$= 2i - j \times 6i + 2j - 22k$

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

$= 22i + 44j + 10k$

$(3A \times B) \cdot (A \times 2B) = (33i + 66j + 15k) \cdot (22i + 44j + 10k)$

$= (33 \times 22) + (66 \times 44) + (15 \times 10)$

$= 726 + 2904 + 150$

$= 3780$

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

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

$= (2 - 6 - 4)i + (-1 - 2 - k)j + (22 + 15)k$

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

2 ⇒ Perpendicular vectors are vectors in which their scalar or dot product is equal to zero, that is $a \cdot b = 0$ given a and b are vectors

⇒ Given A, B and C are vectors, they are said to be coplanar when $A \cdot (B \times C) = 0$