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Mechanical Engineering 100lv/

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MAT 102

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

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

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

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

$$= -17i - 22j - 37k$$

ii.)  $K = 2A + 4B - C$

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

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

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

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

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

$$|K| = \sqrt{1669}$$

$$|K| = 40.85$$

$$\cos \alpha = \frac{12}{|K|} = \frac{12}{40.85}$$

$$\cos \beta = \frac{-2}{40.85}$$

$$\cos \gamma = \frac{-39}{40.85}$$

$$= 22i + 44j + 10k$$

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

$$\begin{vmatrix} i & j & k \\ 33 & 66 & 15 \\ 22 & 44 & 10 \end{vmatrix}$$

$$i \begin{vmatrix} 66 & 15 \\ 44 & 10 \end{vmatrix} - j \begin{vmatrix} 33 & 15 \\ 22 & 10 \end{vmatrix} + k \begin{vmatrix} 33 & 66 \\ 22 & 44 \end{vmatrix}$$

$$i(660 - 660) - j(330 - 330) + k(1452 - 1452) = 0$$

$$(3A \times B) \cdot (A \times 2B) = 0$$

$$v \cdot A - 2B - C$$

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

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

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

$$A - 2B - C = -8i - 7j + 27k$$

2i) Two vectors are said to be perpendicular when their dot product is equal to zero.

i) Vectors are said to be co-planar when their scalar triple product is equal to zero.

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

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

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

$$i(-5 - (-44)) - j(-15 - (-44)) + k(12 - 4)$$

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

$$B \times C = 39i - 29j + 8k$$

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

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

$$i(-8 - 0) - j(16 - 0) + k(-58 - (-84))$$

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

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

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

$$3A = 3(2i - j) = 6i - 3j$$

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

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

$$i(-33 - 0) - j(-66 - 0) + k(6 + 9)$$

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

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

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

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

$$i(22 - 0) - j(-44 - 0) + k(4 - (-6))$$