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MAT 102
Mechanical Engr. S/N: 37

1.) $-3A+7B-8C$

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

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

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

ii) $K = 2A+4B-C$ find direction cosine

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

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

~~$K = 12i+6j-49k$~~ $K = 12i-2j-39k$

$|K| = \sqrt{(12)^2+(-2)^2+(39)^2}$ $|K| = \sqrt{1669} = 40.85$ //

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

~~$|K| = \sqrt{2581} = 50.80$~~

$l = \cos\alpha = 12/40.85$

$\alpha = \cos^{-1}\left(\frac{12}{40.85}\right)$

$\alpha = \cos^{-1}(0.2938)$

$\alpha = 72.91°$ //

$m = \cos\alpha = 2/40.85$

$\alpha = \cos^{-1}\left(\frac{2}{40.85}\right)$

$\alpha = \cos^{-1}(0.1469)$

$\alpha = 83.22$ //

$n = \cos\alpha = 39/40.85$

$\alpha = \cos^{-1}\left(\frac{39}{40.85}\right)$

$\alpha = \cos^{-1}(1.1995)$

$\alpha = 17.31°$ //

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

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

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

$$\hat{i}(-5-(-44)) \quad -\hat{j}(-15-(-44)) \quad \hat{k}(12-4)$$

$$\hat{i} \quad 39\hat{i} + 29\hat{j} + 8\hat{k}$$

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

$$= \hat{i}\begin{vmatrix} -1 & 0 \\ 29 & 8 \end{vmatrix} \quad -\hat{j}\begin{vmatrix} 2 & 0 \\ 39 & 8 \end{vmatrix} \quad +\hat{k}\begin{vmatrix} 2 & -1 \\ 39 & 29 \end{vmatrix}$$

$$= -8\hat{i} - 16\hat{j} + \hat{k}(58-(-39))$$

$$= -8\hat{i} - 16\hat{j} + 97\hat{k}$$

IV) $3A = 3(2i - j)$ $\qquad\qquad$ $2B = 2(3\hat{i} + j - 11k)$

$= 6\hat{i} - 3\hat{j}.$ $\qquad\qquad$ $= 6\hat{i} + 2j - 22\hat{k}$

$$(3A \times B) = \begin{array}{c} \begin{array}{ccc} + & - & + \end{array} \\ \begin{vmatrix} \hat{i} & j & \hat{k} \\ 6 & -3 & 0 \\ 6 & 2 & -22 \end{vmatrix} \end{array}$$

$$\hat{i}\begin{vmatrix} -3 & 0 \\ 2 & -22 \end{vmatrix} - \hat{j}\begin{vmatrix} 6 & 0 \\ 6 & -22 \end{vmatrix} \quad \hat{k}\begin{vmatrix} 6 & -3 \\ 6 & 2 \end{vmatrix}$$

$= 66\hat{i} + 132\hat{j} + \hat{k}(12 - (-18))$

$= 66\hat{i} + 132j + 30\hat{k},$

$$(A \times 2B) = \begin{array}{c} \begin{array}{ccc} + & - & + \end{array} \\ \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & -1 & 0 \\ 6 & 2 & -22 \end{vmatrix} \end{array}$$

$$\hat{i}\begin{vmatrix} -1 & 0 \\ 2 & -22 \end{vmatrix} - \hat{j}\begin{vmatrix} 2 & 0 \\ 6 & -22 \end{vmatrix} \quad \hat{k}\begin{vmatrix} 2 & -1 \\ 6 & 2 \end{vmatrix} \; -(-6)$$

$22\hat{i} + 44\hat{j} + 10\hat{k}$ //

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

$(66\hat{i} + 132\hat{j} + 30\hat{k}) \cdot (22\hat{i} + 44\hat{j} + 10\hat{k})$

$= 1452\hat{i} + 5808\hat{j} + 300\hat{k}$ //

v) $A - 2B - C$

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

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

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

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2) i) Vectors are said to be <u>coplanar</u> when their scalar triple product is zero i.e $a \cdot (b \times c) = 0$.

ii) Two vectors A and B are <u>perpendicular</u> if and only if their scalar product is equal to zero.