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MECHANICAL ENGINEERING
19/ENG06/051

MATH 102

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

i) -3A + 7B - 8C
$-3(2i - j) + 7[3i + j - 4k] - 8[4i + 4j - 5k]$
$-6i + 3j + 21i + 7j - 28k - 32i - 32j + 40k$
$[-6i + 21i - 32i] + [3j + 7j - 32j] + [-28k + 40k]$
$-17i - 22j - 37k$

ii) R = 2A + 4B - C Find location vector
$R = 2[2i - j] + 4[3i + j - 4k] - 8[4j + 4j - 5k]$
$= 4i - 2j + 12i + 4j - 16k - 4i - 4j + 5k$
$= 12i + 0j - 19k$
$|R| = \sqrt{(12)^2 + (0)^2 - (19)^2}$
$|R| = \sqrt{144 + 36 - 361}$
$= \sqrt{2581} = 50.80$

$x = \cos\alpha = 12/50.80$
$\alpha = \cos^{-1}[12/5080]$
$\alpha = \cos^{-1}[0.2362]$
$\alpha = 1.55°$

$y = \cos\alpha = 6/50.80$
$\alpha = \cos^{-1}[6/50.80]$
$\alpha = \cos^{-1}[0.1181]$
$\alpha = 1.45°$

$z = \cos\alpha = 19/50.80$
$\alpha = \cos^{-1}[19/50.80]$
$\alpha = \cos^{-1}[0.7646]$
$\alpha = 0.27°$

iii) $A \times [B \times C]$

$$[B \times C] = \begin{vmatrix} 1 & -1 & 12 \\ 3 & 1 & -11 \\ 4 & 4 & -5 \end{vmatrix}$$

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

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

$= 59i + 29j + 8k$

$A \times [B \times C] = \begin{vmatrix} i & j & k \\ 2 & -1 & 0 \\ 59 & -29 & 8 \end{vmatrix}$

$= 1\begin{vmatrix} -1 & 0 \\ -29 & 8 \end{vmatrix} - j\begin{vmatrix} 2 & 0 \\ 59 & 8 \end{vmatrix} + k\begin{vmatrix} 2 & -1 \\ 59 & -29 \end{vmatrix}$

$= 8i - 16j + 97k$

$\therefore A \times [B \times C] = 8i - 16j + 97k$

$= -8i + 16j - 97k$

iv) $[3A \times B] \cdot [A \times 2B]$

$3A = 3[2, -1] = 6i - 3j$

$2B = 2[3i + j - 11k] = 6i + 2j - 22k$

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

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

$= 66i + 66j + 15k$

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

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

$= 22i + 44j + 10k$

$[3A \times B] \cdot [A \times 2B]$

$[66i + 66j + 15k] \cdot [22i + 44j + 10k]$

$= 1452i + 2904j + 150k$

4] A - 2B - C

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

$= -8i + j + 17k$

5a] Vectors are said to be perpendicular if and only if their scalar product is equal to zero

5] Vectors are said to be coplanar if their scalar triple product is zero