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MAT 102

1. If $A = 4i + j - 2k$, $B = 3i - 2j + k$ and $C = i - 2k$. Find:

(a) $(A - 2B) \times C$

(b) $A \times (2C \times 3B)$

Solution

(a) $A = 4i + j - 2k$

$2B = 6i - 4j + 2k$

$A - 2B = -2i + 5j - 4k$

$C = i + 0j - 2k$

$$(A-2B) \times C = \begin{vmatrix} i & j & k \\ -2 & 5 & -4 \\ 1 & 0 & -2 \end{vmatrix}$$

$$= i\begin{vmatrix} 5 & -4 \\ 0 & -2 \end{vmatrix} - j\begin{vmatrix} -2 & -4 \\ 1 & -2 \end{vmatrix} + k\begin{vmatrix} -2 & 5 \\ 1 & 0 \end{vmatrix}$$

$= i(-10 - 0) - j(4 - (-4)) + k(0 - 5)$

$= -10i - 8j - 5k$

(b) $2C = 2i + 0j - 4k$

$3B = 9i - 6j + 3k$

$$2C \times 3B = \begin{vmatrix} i & j & k \\ 2 & 0 & -4 \\ 9 & -6 & 3 \end{vmatrix}$$

$$= i\begin{vmatrix} 0 & -4 \\ -6 & 3 \end{vmatrix} - j\begin{vmatrix} 2 & -4 \\ 9 & 3 \end{vmatrix} + k\begin{vmatrix} 2 & 0 \\ 9 & -6 \end{vmatrix}$$

$= i(0 - 24) - j(6 - (-36)) + k(-12 - 0)$

$= -24i - 42j - 12k$

$$A \times (2C \times 3B) = \begin{vmatrix} i & j & k \\ 4 & 1 & -2 \\ -24 & -42 & -12 \end{vmatrix}$$

$$= i\begin{vmatrix} 1 & -2 \\ -42 & -12 \end{vmatrix} - j\begin{vmatrix} 4 & -2 \\ -24 & -12 \end{vmatrix} + k\begin{vmatrix} 4 & 1 \\ -24 & -42 \end{vmatrix}$$

$= i(-12 - 84) - j(-48 - 48) + k(-168 - 24)$

$= -96i + 96j - 192k$

d:

2. $A = Pi - 6j - 3k$, $B = 4i + 3j - k$ and $C = i - 3j + 2k$. Find the value of P for which A, B and C are co-planar.

Solution

$A = Pi - 6j - 3k$

$B = 4i + 3j - k$

$C = i - 3j + 2k$

$$\begin{vmatrix} P & -6 & -3 \\ 4 & 3 & -1 \\ 1 & -3 & 2 \end{vmatrix}$$

$$0 = +P\begin{vmatrix} 3 & -1 \\ -3 & 2 \end{vmatrix} - (-6)\begin{vmatrix} 4 & -1 \\ 1 & 2 \end{vmatrix} - 3\begin{vmatrix} 4 & -1 \\ 1 & 2 \end{vmatrix}$$

$0 = P(6-3) + 6(8-(-1)) - 3(8-(-1))$

$0 = 3P + 54 - 27$

$0 = 3P + 27$

$\frac{3P}{3} = \frac{27}{3}$

$\therefore P = 9$