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If $A = 2i - j$, $B = 3i + j - 11k$ and $C = 4i + 4j - 5k$ find the following

1 $-3A + 7B - 3C$

2 If $R = 2A + 3B - C$, find the direction cosine of R

$A \times (B \times C)$

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

$A - 2B - C$

Define perpendicular and coplanar vectors

Solution

1 $-3(2i - j)$ $-3A = -6i + 3j$

$7B = 21i + 7j - 77k$

$3C = 32i + 32j - 40k$

$(-6i + 3j) + (21i + 7j - 77k)$

$= (15i + 10j - 77k) - (32i + 32j - 40k)$

$= -17i - 22j - 117k$

2 If $R = 2A + 4B - C$

$2A = 4i - 2j$

$4B = 12i + 4j - 44k$

$C = 4i + 4j - 5k$

$$t = 12i - 2j - 48k$$

$$|t| = \sqrt{(12)^2 + (-2)^2 + (-48)^2}$$

$$= \sqrt{144 + 4 + 2304}$$

$$= \sqrt{2452}$$

$$= 50.48$$

$\therefore$ direction cosines =

$$\frac{12}{50.48} = 0.237$$

$$\frac{-2}{50.48} = -0.037$$

$$\frac{-48}{50.48} = -0.77$$

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

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

$i(-15 - (-44)) - j(-15 - (-44)) + k(12 - 16$

$29i - 29j + 8k$

$\vec{A} = 2\hat{i} - 3\hat{j}$

$\vec{B} = 6\hat{i} + 2\hat{j} - 22\hat{k}$

4 $3\vec{A} \times \vec{B} = \begin{vmatrix} i & j & k \\ 6 & -3 & 0 \\ 3 & 1 & -22 \end{vmatrix}$

$i(+60 - 0) \quad -j(-132 - 0) \quad k(6 - (-9))$

$66\hat{i} + 132\hat{j} + 27\hat{k}$

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

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

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

8 $(3\vec{A} \times \vec{B}) \cdot (2\vec{A} \times 2\vec{B}) = (66\hat{i} + 132\hat{j} + 27\hat{k}) \cdot (22\hat{i} + 44\hat{j} + 10\hat{k})$

$= 1452\hat{i} + 5808\hat{j} + 270\hat{k}$

5 $\vec{A} - 2\vec{B} - \vec{C} = -8\hat{i} - 7\hat{j} - 17\hat{k}$

$2\hat{i} \quad -\hat{j}$

$6\hat{i} \quad +2\hat{j} \quad -22\hat{k}$

$4\hat{j} \quad +4\hat{j} \quad +5\hat{k}$

2. Vectors are said to be perpendicular if the dot product is equal to zero

" Vectors are said to be coplanar if their triple product is equal to zero