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MAT 102

1(a) M and N are perpendicular to each other when their dot product = 0 that is

$\vec{M} \cdot \vec{N} = 0$

$M = Pi - 6j - 3k$, $N = 4i + 3j - k$

$\vec{M} \cdot \vec{N} = (Pi - 6j - 3k) \cdot (4i + 3j - k)$ $i \cdot i, j \cdot j, k \cdot k = 1$

$= 4p - 18 + 3 = 0$

$4p = 18 - 3$

$4p = 15$

$p = 15/4$

b) M, N and O are coplanar if their vector triple product = 0 that is $(M \times N) \cdot O = 0$

$$M \times N = \begin{vmatrix} \hat{i} & \hat{j} & k \\ p & -6 & -3 \\ 4 & 3 & -1 \end{vmatrix}$$

$$\begin{vmatrix} -6 & 3 \\ 3 & -1 \end{vmatrix} i - \begin{vmatrix} p & -3 \\ 4 & -1 \end{vmatrix} j + \begin{vmatrix} p & -6 \\ 4 & 3 \end{vmatrix} k$$

P.T.O

1b) $(6-9)i - (-p+12)j + (3p+24)k$

let this be $= \vec{u}$

recall $(M \times N) \cdot 0 = 0$

$M \times N = \vec{u}$ so $u \cdot 0$

$u \cdot 0 = -3i - (3p+36)j + (6p+48)k = 0$

2 sum of the vectors

$= (3i + 2j + 5k) + (2i - j + 6k)$

$= 5i + j + 11k \quad + 5i + 2j - 3k$

$= 10i + 3j + 8k \rightarrow \vec{A}$

direction cosines $\cos\alpha = l$

$\cos\beta = m$

$\cos\gamma = n$

unit vector, $u = \cancel{10i + 3j + 8k} = \dfrac{A}{\|A\|}$

$\cancel{= \langle 10, 3, 8 \rangle}$

$\vec{A} = \langle 10, 3, 8 \rangle$

$\|A\| = \sqrt{10^2 + 3^2 + 8^2} = \sqrt{100 + 9 + 64} = \sqrt{173}$

$= \dfrac{\langle 10, 3, 8 \rangle}{\sqrt{173}} = \left\langle \dfrac{10}{\sqrt{173}}, \dfrac{3}{\sqrt{173}}, \dfrac{8}{\sqrt{173}} \right\rangle$