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matric No: 19/SCI01/079

1 $m = pi - 6j - 3k$

$n = 4i + 3j - k$

$o = i - 3j + 2k$

a) m & n are perpendicular to each other

$m \cdot n = (pi - 6j - 3k) \cdot (4i + 3j - k)$

$= 4p - 18 + 3$

$= 4p - 15$

Since the y are perpendicular

$4p - 15 = 0$

$\frac{4p}{4} = \frac{15}{4}$ $p = \frac{15}{4}$

b) m, n & o are coplanar

$m \cdot (n \times o) = \begin{vmatrix} p & -6 & -3 \\ 4 & 3 & -1 \\ 1 & -3 & 2 \end{vmatrix}$

$= p \begin{vmatrix} 3 & -1 \\ -3 & 2 \end{vmatrix} + 6 \begin{vmatrix} 4 & -1 \\ 1 & 2 \end{vmatrix} - 3 \begin{vmatrix} 4 & 3 \\ 1 & -3 \end{vmatrix}$

$= p(6-3) + 6(8+1) - 3(-12-3)$

$= 3p + 6(9) - 3(-15) = 0$

$= 3p + 54 + 45 = 0$

$= 3p + 99 = 0$

$\frac{3p}{3} = \frac{-99}{3}$ $p = -33$

2. $\bar{v} = (3i + 2j + 5k) + (2i - j + 6k) + (5i + 2j - 3k)$

$\bar{v} = 10i + 3j + 8k$

$a_x = 10,\ a_y = 3$ and $a_z = 8$

$|v| = \sqrt{10^2 + 3^2 + 8^2}$

$= \sqrt{100 + 9 + 64}$

$= \sqrt{173} = 13.15$

i The directions cosines are

$\cos\alpha = \frac{a_x}{|v|} = \frac{10}{13.15} = 0.761$

$\cos\beta = \frac{a_y}{|v|} = \frac{3}{13.15} = 0.228$

$\cos\gamma = \frac{a_z}{|v|} = \frac{8}{13.15} = 0.608$

ii Unit vector

$e_v = \frac{v}{|v|} = \frac{10i + 3j + 7k}{13.15}$

3. $E = 3ui + u^2 j + (u+2)k$

$x = 2ui - 3uj + (u-a)k$

$$(f \times v) = \begin{vmatrix} i & j & k \\ 3u & u^2 & (u+2) \\ 2u & -3u & (u-2) \end{vmatrix}$$

$$= i\begin{vmatrix} u^2 & (u+2) \\ -3u & (u-2) \end{vmatrix} - j\begin{vmatrix} 3u & (u+2) \\ 2u & (u-2) \end{vmatrix} + k\begin{vmatrix} 3u & u^2 \\ 2u & -3u \end{vmatrix}$$

$= i\,[u^2(u-2) - [-3u(u+2)] - j\,[3u(u-2)] - 2u(u+2)]$
$+ k\,[-9u^2 - 2u]$

$= i\,[u^3 - 2u^2 - [-3u^2 + 6u]] - j\,[3u^2 - 6u - 2u^2 - 4u] + k[$
$-2u^2 - 9u^2]$

$= i\,[u^3 - 2u^2 + 3u^2 + 6u] - j\,[u^2 - 10u] + k\,[-2u^3 - 9u^2]$

$= i\,[u^3 + u^2 + 6u] - j\,[u^2 - 10u] + k\,[-2u^3 - 9u^2]$

$\int_0^1 (f \times v) = \int i\,[u^3 + u^2 + 6u] - [j\,(u^2 - 10u] + k\,[-2u^2 +$
$3u^2]$

$= i\int u^3 + u^2 + 6u - j\int u^2 - 10u + k\int -2u^3 - 9u^2$

$= \left[\frac{u^2}{4} + \frac{u^3}{3} + \frac{6u^2}{2}\right] - j\left[\frac{u^3}{3} - \frac{10u^2}{2}\right] + k\left[\frac{-2u}{4} - \frac{9u^3}{3}\right]$

$= \left[\frac{u^6}{4} + u^3/3 + 3u^2\right] - j\left[u^3/3 - 5u^2\right] + k\left[-u^4/2 - 3u^3\right] + c$

$\int_0^1 (f \times v) = 1\left[\frac{(1)^6}{4} + \frac{(1)^3}{3} + 3(1)^2\right] - j\left[\frac{(1)^3}{3} - 5(1)^2\right] + k\left[\frac{-u^4}{2}$
$3u^3\right] + c$

$\int_0^1 (f \times v) = 1\left[\frac{(1)^6}{4} + \frac{(1)^3}{3} + 3(1)^2\right] - j\left[\frac{(1)^3}{3} - 5(1)^2\right] + k\left[-\right.$
$\left.-3(1)^3\right]k$

$\therefore \int (f \times v) = i\left[\frac{1}{4} + \frac{1}{3} + 3\right] - j\left[\frac{1}{3} - 5\right] + k\left[\frac{-1}{2} - 3\right] + 4 - c$

$\therefore \int (f \times v) = i\left[43/12\right] - j\left[-14/3\right] + k\left[-7/2\right]$

$\therefore \int (f \times v) = 43/12\, i + 14/3\, j - 7/2\, k.$