Boaiye Oluwatunmi Ifedamola
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Biotechnology
MAT102

1a If $\vec{M} \cdot \vec{N} = 0$ ∴ They are perpendicular vectors

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

$4p - 18 + 3 = 0$

$4p - 15 = 0$

$4p = 15$

$p = 15/4$

b If $M(N \times O) = 0$ it is ~~par~~ parallel (coplanar)

$$M \cdot (N \times O) = \begin{vmatrix} p & -6 & -3 \\ 4 & 3 & -1 \\ 1 & -3 & 2 \end{vmatrix}$$

$0 = p(6-3) + 6(8-(-1)) - 3(-12-3)$

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

$3p + 54 + 45 = 0$

$3p = 99$

$p = 33$

2a direction cosine of $10i + 3j + 8k$

$a_x = 10 \quad a_y = 3 \quad a_z = 8$

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

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

$= \sqrt{173}$

$= 13.2$

The direction cosines are $\cos\alpha = 10/13.2$

$\cos\beta = 3/13.2$

$\cos\gamma = 8/13.2$

Unit vector, $e_v = \frac{\bar{v}}{|v|}$

$$e_v = \frac{10i + 3j + 8k}{13.2}$$

3 $\int_1^0 (F \times v)\, du$

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

$= i(u^2(u-2)) - j(3u(u-2) - (u+2)(2u)) + k(3u(-3u) - (2u)(u^2))$

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

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

$= [(u^3 + u^2 + 6u)i - (-u^2 - 10u)j + (-9u^2 - 2u^3)k]_0^1$

$= -[(1^3 + 1^2 + 6(1))i + (-1^2 + 10(1))j + (-9(1)^2 - 2(1)^3)k]$

$= [(1+1+6)i + (-1+10)j + (-9-2)k]$

$= 0 - [8i + 9j - 11k]$

$= -8i - 9j + 11k$