3) $F = 3ui + u^2 j + (u+z)k$

$v = 2ui - 3uj + (u-z)k$

$$(F \times v) = \begin{vmatrix} 3u & u^2 & (u+2) \\ 2u & -3u & (u-2) \end{vmatrix}$$

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

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

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

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

$$\int (F \times v) = \int i\left[u^3 + u^2 + 6u\right] - \int j\left[u^2 - 10u\right] + \int k\left[-2u^3 - 9u^2\right]$$

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

$$= \left[\frac{u^4}{4} + \frac{u^3}{3} + \frac{\cancel{6}^{3}u^2}{\cancel{2}_{1}}\right] - j\left[\frac{u^3}{3} - \frac{\cancel{10}^{5}u^2}{\cancel{2}_{1}}\right] + k\left[-\frac{\cancel{2}^{1}u^4}{\cancel{4}_{2}} - \frac{\cancel{9}^{3}u^3}{\cancel{3}_{1}}\right] + c$$

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

$$\int_0^1 (F \times v) = i\left[\frac{(1)^4}{4} + \frac{(1)^3}{3} + 3(1)^2\right] - j\left[\frac{(1)^3}{3} - 5(1)^2\right] + k\left[\frac{(-1)^4}{2} - 3(1)^3\right] + c - (0 + c)$$

$$= i\left[\frac{1}{4} + \frac{1}{3} + 3\right] - j\left[\frac{1}{3} - 5\right] + k\left[\frac{-1}{2} - 3\right] + \cancel{c} - \cancel{c}$$

$$= i\left[\frac{43}{12}\right] - j\left[\frac{-14}{3}\right] + k\left[\frac{-7}{2}\right]$$

$$\therefore \int_0^1 (F \times v) = \frac{43}{12}i + \frac{14}{3}j - \frac{7}{2}k$$

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

$n = 4\hat{i} + 3\hat{j} - k$

$O = \hat{i} - 3\hat{j} + 2k$

M and N are perpendicular to each other

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

$= 4p - 18 + 3$

$= 4p - 15$

Since they are perpendicular

$4p - 15 = 0$

$4p = 15$

$p = 15/4$

b) $\bar{m} \cdot |\bar{n} \times \bar{o}|$

$$|\bar{n} \times \bar{o}| = \begin{vmatrix} 4 & 3 & -1 \\ 1 & -3 & 2 \end{vmatrix}$$

$= i(6 - (3)) - j(8 - (-1)) + k(-12 - (-3))$

$|\bar{n} \times \bar{o}| = 3i - 8j - 13k$

$m \cdot |\bar{n} \times \bar{o}|$

$= pi - 6j - 3k \cdot (3i - 8j - 13k)$

$= 3p - 48 + 45$

$3p - 48 + 45 = 0$

$3p = 3$

$p = 1$

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

$\overline{V} = 10i + 3\hat{j} + 8k$

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

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

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

$= \sqrt{173} = 13.19$

i) The direction cosines are

$\cos\alpha = \dfrac{a_x}{|v|} = \dfrac{10}{13.19} = 0.758$

$\cos\beta = \dfrac{a_y}{|v|} = \dfrac{3}{13.19} = 0.228$

$\cos\gamma = \dfrac{a_z}{|v|} = \dfrac{8}{13.19} = 0.608$

ii) Unit Vector

$e_v = \dfrac{V}{|V|} = \dfrac{10i + 3j + 7k}{13.19}$