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1a. M & N are perpendicular

$M \cdot N = 0$

$(Pi - 6j - 3k) \cdot (4i + 3j - k) = 0$

$4P - 18 + 3 = 0$
$4P - 15 = 0$
$P = 15/4$

b. M, N and O are coplanar

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

$N \times O = \begin{vmatrix} i & j & k \\ 4 & 3 & -1 \\ 1 & -3 & 2 \end{vmatrix}$

$R_{1} = +i(6 - (-3 \times -1)) = +i(6 - (3)) = 3i$
$R_{2} = -j(8 - (-1 \times 1)) = -j(8 + 1) = -9j$
$R_{3} = +k(-12 - (3 \times 1)) = +k(-12 - (3)) = -15k$

$\therefore M \cdot (N \times O) = 0$

$M(3i - 9j - 15k = 0$

$(Pi - 6j - 3k) \cdot (3i - 9j - 15k) = 0$

$3P + 54 + 45 = 0$
$3P + 99 = 0$
$P = -99/3$ $P = 33$

2. The sum of vectors

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

$3i + 2i + 5i + 2j - j + 2j + 5k + 6k - 3k$

$\underline{10i + 3j + 8k}$

i. Direction cosines

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

$= \sqrt{173}$

$\cos\alpha = \frac{10}{\sqrt{173}} = \underline{0.7601}$

$\cos\beta = \frac{3}{\sqrt{173}} = \underline{0.2281}$

~~cos~~

$\cos\gamma = \frac{8}{\sqrt{173}} = \underline{0.6082}$

ii. Unit vector of the sum

is $= \frac{10i + 3j + 8k}{\sqrt{173}}$

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

$R_{11} = +i((u^2(u-2)) - (-3u(u+2)))$
$= +i(u^3 - 2u^2 - (-3u^2 - 6u))$
$= +i(u^3 - 2u^2 + 3u^2 + 6u)$
$= +i(u^3 + u^2 + 6u)$

$R_{12} = -j(3u(u-2) - (2u(u+2)))$
$= -j(3u^2 - 6u - (2u^2 + 4u))$
$= -j(3u^2 - 2u^2 - 6u - 4u)$
$= -j(u^2 - 10u)$

$R_{13} = +k(3u(-3u) - (2u(u^2)))$
$= +k(-9u^2 - (2u^3))$
$= k(-9u^2 - 2u^3)$

$\therefore \int_0^1 (u^3 + u^2 + 6u)i + (-u^2 + 10u)j + (-9u^2 - 2u^3)k$

$= \left[\frac{u^4}{4} + \frac{u^3}{3} + \frac{6u^2}{2}\right]_0^1 i + \left[\frac{-u^3}{3} + \frac{10u^2}{2}\right]_0^1 j + \left[\frac{-9u^3}{3} - \frac{2u^4}{4}\right]_0^1 k$

$= \left[\frac{u^4}{4} + \frac{u^3}{3} + 3u^2\right]_0^1 i + \left[\frac{-u^3}{3} + 5u^2\right]_0^1 j + \left[-3u^3 - \frac{u^4}{2}\right]_0^1 k$

$$\left[\frac{1^4}{4} + \frac{1^3}{3} + 3(1)^2\right] i + \left[-\frac{1^3}{3} + 5(1)^2\right] j + \left[-3(1)^3 - \frac{1^4}{2}\right] k$$

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

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