

1) a)  $M \cdot N = 0$

$$P \times 4 - 6 \times 3 - 3 \times -1 = 0$$

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

$$4P - 15 = 0$$

$$4P = 15$$

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

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

$$\begin{vmatrix} P & -6 & -3 \\ 4 & 3 & -1 \\ 1 & -3 & -2 \end{vmatrix} = 0$$

$$P \begin{vmatrix} 3 & -1 \\ -3 & 2 \end{vmatrix} + 6 \begin{vmatrix} 4 & -1 \\ 1 & 2 \end{vmatrix} - 3 \begin{vmatrix} 4 & 3 \\ 1 & -3 \end{vmatrix} = 0$$

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

$$9P + 54 + 45 = 0$$

$$9P = -99$$

$$P = -11$$

$$2) \text{ Sym} = 3\mathbf{i} + 2\mathbf{j} + 5\mathbf{k} + 2\mathbf{j} - \mathbf{j} + 2\mathbf{j} + 5\mathbf{k} + 6\mathbf{k} - 3\mathbf{k}$$

$$= 3\mathbf{i} + 3\mathbf{j} + 8\mathbf{k}$$

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

$$q_x = 10, q_y = 3, q_z = 8$$

$$|c| = \sqrt{(10)^2 + (3)^2 + (8)^2}$$

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

$$|c| = \sqrt{173}$$

$$|c| = 13.15$$

$$\cos \alpha = \frac{10}{13.15} = 0.7609 = \cancel{0.228}$$

$$\cos \beta = \frac{3}{13.15} = 0.2281$$

$$\cos \gamma = \frac{8}{13.15} = 0.6084$$

$$\hat{c} = \frac{10\mathbf{i} + 3\mathbf{j} + 8\mathbf{k}}{\sqrt{173}}$$

$$3) \int (F \times U) \, dV$$

i	j	k
$3u$	$u^2$	$u+2$
$2u$	$-3u$	$u-2$

$$i \begin{vmatrix} u^2 \cdot u+2 \\ -3u \cdot u-2 \end{vmatrix} - j \begin{vmatrix} 3u \cdot u+2 \\ 2u \cdot u-2 \end{vmatrix} + k \begin{vmatrix} 3u \cdot u^2 \\ 2u \cdot -3u \end{vmatrix}$$

$$i(u^3 - 2u^2 + 3u^2 + 6u) - j(3u^2 - 6u - 2u^2 - 4u) + k(-9u^2 - 2u^3)$$

$$(u^3 + u^2 + 6u)i + (-u^2 + 10u)j + (-9u^2 - 2u^3)k$$

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

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

$$+ \left[ -3u^2 - \frac{2u^4}{4} \right]_0^1 k + C$$

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

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