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19/ENG 05/058

MAT 102

Mechatronics Engineering

$$x = t^2, \quad y = -5t^2 + t, \quad z = t + 7$$

$$r = (t^2)i + (-5t^2 + t)j + (t + 7)k$$

$$\frac{dr}{dt} = (2t)i + (-10t + 1)j + (1)k$$

$$\frac{d^2r}{dt^2} = \text{acceleration} = (2)i + (-10)j = 2i - 10j$$

$$P = i - 9j - 4k, \quad Q = 8i - 3j + 6k, \quad R = i - 4j - 3k$$

Find $(P \times Q) \cdot (R \times P)$

$$(P \times Q) = \begin{vmatrix} i & j & k \\ 1 & -9 & -4 \\ 8 & -3 & 6 \end{vmatrix}$$

$$= i \begin{vmatrix} -9 & -4 \\ -3 & 6 \end{vmatrix} - j \begin{vmatrix} 1 & -4 \\ 8 & 6 \end{vmatrix} + k \begin{vmatrix} 1 & -9 \\ 8 & -3 \end{vmatrix}$$

$$= i(-54 - (+12)) - j(6 - (-32)) + k(-3 - (-72))$$

$$= i(-66) - j(38) + k(69)$$

$$= -66i - 38j + 69k$$

$$(R \times P) = \begin{vmatrix} i & j & k \\ 1 & -4 & -3 \\ 1 & -9 & -4 \end{vmatrix}$$

$$= i \begin{vmatrix} -4 & -3 \\ -9 & -4 \end{vmatrix} - j \begin{vmatrix} 1 & -3 \\ 1 & -4 \end{vmatrix} + k \begin{vmatrix} 1 & -4 \\ 1 & -9 \end{vmatrix}$$

$$= i[16 - (+27)] - j[-4 - (-3)] + k[-9 - (-4)]$$

$$= i(-11) + j + k(-5)$$

$$= -11i + j - 5k$$

$$(P \times Q) \cdot (R \times P) = (-66i - 38j + 69k) \cdot (-11i + j - 5k)$$

$$= 726i - 38j - 345k$$