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Assignment

1. A particle moves along a curve, $x = t^2$, $y = -5t^2 + t$, $z = t + 7$, where t is time. Find its acceleration.

Solution

The Position Vector $r = xi + yj + zk$

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

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

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

2. If $P = i - 9j - 4k$, $Q = 8i - 3j + 6k$, $R = i - 4j - 3k$. Find $(P \times Q) \cdot (R \times P)$

Solution

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

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

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

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

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

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

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

$$= -11i + 1j - 5k$$

$$(P \times Q) \cdot (R \times P) = (-66i - 38j + 69k) \cdot (-11i + 1j - 5k)$$

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

3. Given $F = 5\cos 7t\, i - 2e^{3t} j - 4t^3 k$, find the integral of F with respect to t

Solution

$$\int F\, dt = \int (5\cos 7t\, i - 2e^{3t} j - 4t^3 k)\, dt$$

$$= \frac{1}{35}\sin 7t\, i - \frac{1}{6}e^{3t} j - \frac{4t^4}{4} k$$

$$= \frac{1}{35}\sin 7t\, i - \frac{1}{6}e^{3t} j - t^4 k$$