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MAT 102 MR OKUNLOLA

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

solution

$\vec{r} = xi + yJ + zK$

velocity $= \frac{d\vec{r}}{dt}$ $\quad \vec{r} = t^2 i + (-5t^2+t)J + (t+7)K$

$\frac{d\vec{r}}{dt} = 2ti + (-10t+1)J + 1K$

Acceleration $= \frac{d^2\vec{r}}{dt^2}$

$\frac{d^2\vec{r}}{dt^2} = 2i - 10J$

$\therefore$ Acceleration $= 2i - 10J$

If $P = i - 9J - 4K$, $Q = 8i - 3J + 6K$, $R = i - 4J - 3K$, find $(P \times Q) \cdot (R \times P)$

Solution

$$P \times Q = \begin{vmatrix} i & J & K \\ 1 & -9 & -4 \\ 8 & -3 & 6 \end{vmatrix}$$

$P \times Q = [(-9 \times 6) - (-4 \times -3)]i - [(1 \times 6) - (-4 \times 8)]J + [(1 \times -3) - (-9 \times 8)]$

$(-54 - 12)i - (6 + 32)J + (-3 + 72)K$

$-66i - 38J + 69K$

$$R \times P = \begin{vmatrix} i & J & K \\ 1 & -4 & -3 \\ 1 & -9 & -4 \end{vmatrix}$$

$R \times P = [(-4 \times -4) - (-3 \times -9)]i - [(1 \times -4) - (-3 \times 1)]J + [(1 \times -9) - (-4 \times 1)]K$

$(16 - 27)i - (-4 + 3)J + (-9 + 4)K$

$-11i + J - 5K$

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

$P \times Q = -66i - 38j + 69k$

$R \times P = -11i + 3j - 5k$

$(-66 - 38j + 69k)(-11i + 3j - 5k)$

$(P \times Q) \cdot (R \times P) = 726 - 38 - 345$

$(P \times Q) \cdot (R \times P) = 343$

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

solution

$$\int f = \int 5\cos 7ti - 2e^{3t}j - 4t^3k \, dt$$

$$5 \times \frac{1}{7} \sin 7ti - 2 \times \frac{1}{3} e^{3t}j - \frac{4t^{3+1}}{3+1} k$$

$$\frac{5}{7} \sin 7ti - \frac{2}{3} e^{3t}j - \frac{4t^4}{4} k + C$$

$$\frac{5}{7} \sin 7ti - \frac{2}{3} e^{3t}j - t^4 k + C$$