

Mechanics Engineering

1) $S = x + y + z$

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

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

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

$\frac{d^2S}{dt^2} = 2i - 10j$

acceleration = $2i - 10j$

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

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

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

$= -68i - 38j + 69k$

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

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

$= -11i + j - 5k$

19 / ENG051010

$$\begin{aligned} (P \times Q) \cdot (R \times V) &= (-68i - 38j + 169k) \cdot (-11i + j - 5k) \\ &= 748 - 38 - 345 \\ &= 365 \end{aligned}$$

3

$$\begin{aligned} 3) \quad F &= 5 \cos 7t i - 2 e^{3t} j - 4t^3 k \\ \int F dt &= \int (5 \cos 7t i - 2 e^{3t} j - 4t^3 k) \\ &= \left[\frac{5}{7} \sin 7t i - \frac{2 e^{3t}}{3} j - \frac{4t^4}{4} k \right] + C \\ &= \frac{5}{7} \sin 7t i - \frac{2}{3} e^{3t} j - t^4 k + C \end{aligned}$$

where C is constant

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