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Mechatronics Engineering

$$1 \quad x = t^2 \quad y = -5t^2 + t \quad z = t + 7$$

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

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

$$a = \frac{dv}{dt} = \underline{2i - 10j}$$

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

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

$$\begin{aligned} (P \times Q) &= \begin{vmatrix} i & j & k \\ 1 & -9 & -4 \\ 8 & -3 & 6 \end{vmatrix} = (-54 - 12)i - (6 + 32)j + (-3 - 72)k \\ &= -66i + 38j + 69k \end{aligned}$$

$$\begin{aligned} (R \times P) &= \begin{vmatrix} i & j & k \\ 1 & -4 & -3 \\ 1 & -9 & -4 \end{vmatrix} = (16 - 27)i - (-4 + 3)j + (9 + 4)k \\ &= -11i + j - 5k \end{aligned}$$

$$(P \times Q) \cdot (R \times P) = 726 + 38 - 345 = \underline{419}$$

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

$$\int F = \int i + \int j + \int k$$

$$\int i = \frac{5}{7} \sin 7t \quad \int j = \int \frac{2}{3} e^{3t} \quad \int k = t^4$$

$$\int F = \underline{\left(\frac{5}{7} \sin 7t \right) i - \left(\frac{2}{3} e^{3t} \right) j - (t^4) k}$$