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1. $r = xi + yj + zk$

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

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

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

$$2. (P \times Q) = \begin{vmatrix} \overset{+}{i} & \overset{-}{j} & \overset{+}{k} \\ 1 & -9 & -4 \\ 8 & -3 & 6 \end{vmatrix}$$

$$R_{11} = +i(-54 - (-12)) = -66i$$

$$R_{12} = -j(6 - (-32)) = -38j$$

$$R_{13} = +k(-3 - (-72)) = 69k$$

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

$$R_{11} = +i(16 - (27)) = -11i$$

$$R_{12} = -j(-4 - (-3)) = j$$

$$R_{13} = +k(-9 - (-4)) = -5k$$

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

$$= 726 - 38 - 345$$

$$= \underline{\underline{343}}$$

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

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

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

$$= 5i \left[\frac{1}{7} \sin 7t \right] - 2j \left[\frac{1}{3} e^{3t} \right] - 4k \left[\frac{t^4}{4} \right] + C$$

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