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 19/ENUGOS1047
 Mechatronics

(1) $\mathbf{r} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$

$\mathbf{r} = 7t^2\mathbf{i} + (6t^2 - 4t)\mathbf{j} + (t - 5)\mathbf{k}$

Velocity = $\frac{d\mathbf{r}}{dt} = 14t\mathbf{i} + (12t - 4)\mathbf{j} + \mathbf{k}$

(2) $\mathbf{A} = \mathbf{i} + 2\mathbf{j} - 4\mathbf{k}$, $\mathbf{B} = 2\mathbf{i} - 3\mathbf{j} + \mathbf{k}$, $\mathbf{C} = 4\mathbf{j} - 3\mathbf{k}$

$\mathbf{A} \times (\mathbf{B} \times \mathbf{C})$

$\mathbf{B} \times \mathbf{C} = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ 2 & -3 & 1 \\ 0 & 4 & -3 \end{vmatrix}$

$= \mathbf{i}(9 - 4) - \mathbf{j}(-6 - 0) + \mathbf{k}(8)$

$5\mathbf{i} + 6\mathbf{j} + 8\mathbf{k}$

$= \mathbf{i} \begin{vmatrix} -3 & 1 \\ 4 & -3 \end{vmatrix} - \mathbf{j} \begin{vmatrix} 2 & 1 \\ 0 & -3 \end{vmatrix} + \mathbf{k} \begin{vmatrix} 2 & -3 \\ 0 & 4 \end{vmatrix}$

$5\mathbf{i} + 6\mathbf{j} + 8\mathbf{k}$

$5\mathbf{i} + 6\mathbf{j} + 8\mathbf{k}$

$\mathbf{A} \times (\mathbf{B} \times \mathbf{C})$

$\begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ 1 & 2 & -4 \\ 5 & 6 & 8 \end{vmatrix}$

$= \mathbf{i}(16 + 24) - \mathbf{j}(8 + 20) + \mathbf{k}(6 - 10)$

$40\mathbf{i} - 28\mathbf{j} - 4\mathbf{k}$

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3) $\mathbf{R} = 4\sin 3t\mathbf{i} + 4e^{3t}\mathbf{j} + 7t^3\mathbf{k}$

$4e^{3t}\mathbf{j} + 4e^{3t}\mathbf{j} + 7t^3\mathbf{k}$

$-11\cos 3t\mathbf{i} + 11e^{3t}\mathbf{j} + 7t^4\mathbf{k}$

$\frac{3}{3} \quad \frac{3}{3} \quad \frac{4}{4}$

$$4) A = 7i + 2j - k$$

$$B = 2i + j + 4k$$

$$C = i + j + k$$

$$(A+C) \cdot (B-A)$$

$$A+C = (7i + 2j - k) + (i + j + k) = (8i + 3j)$$

$$B-A = (2i + j + 4k) - (7i + 2j - k) = (-5i - j + 5k)$$

$$(A+C) \cdot (B-A) = (8i + 3j) \cdot (-5i - j + 5k)$$

$$= -40 - 3 - 0$$

$$= -43$$

$$5) r = ti + t^2j + t^3k$$

$$t = 1$$

$$\frac{dr}{dt} = i + 2tj + 3t^2k$$

$$dt$$

$$\text{at } t = 1 \frac{dr}{dt} = i + 2j + 3k$$

$$\left| \frac{dr}{dt} \right| = \sqrt{1^2 + 2^2 + 3^2} = \sqrt{14} = 3.74 \text{ units}$$

$$T = \frac{dr/dt}{|dr/dt|}$$

$$T = i + 2j + 3k$$

$$3.74$$