$$\hat{T} = \frac{r'}{|r'|} = \frac{1}{\sqrt{1+4t^2+9t^4}}\langle 1, 2t, 3t^2 \rangle$$

From $t = 1$

$$\hat{T} = \frac{1}{\sqrt{1+4(1)^2+9(1)^4}}\langle 1, 2(1), 3(1)^2 \rangle$$

$$= \frac{1}{\sqrt{1+4+9}}\langle 1, 2, 3 \rangle$$

$$= \frac{1}{\sqrt{14}}\langle 1, 2, 3 \rangle = \left(\frac{1}{\sqrt{14}}, \frac{2}{\sqrt{14}}, \frac{3}{\sqrt{14}}\right) = \left(\frac{1\sqrt{14}}{14}, \frac{\sqrt{14}}{7}, \frac{3\sqrt{14}}{14}\right)$$

$A \times (B \times C) = [(8 \times 2) - (-4 \times 6)]i - [(8 \times 1) - (-4 \times 5)]j + [(2 \times 5) - (6 \times 1)]k$

$= [16 + 24]i - [8 + 20]j + [10 - 6]k$

$= 40i - 28j + 4k$

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

$\Rightarrow \int R = \left(\int 4 \times \int \sin 3t\right) i + \left(\int 4 \times \int e^{3t}\right) j + \left(\int 7t^3\right) k$

$\Rightarrow \int R = \left(4t \times (\cos 3t)\right) i + \left(4t \times \frac{1}{3} e^{3t}\right) j + \left(7t^4\right) k$

$\therefore \int R = \left(-4t \cos 3t + c\right) i + \left(4t \frac{e^{3t}}{3} + c\right) j + \left(\frac{7t^4}{4} + c\right) k$

4) If $A = 2i + 2j - k$, $B = 2i + j + 4k$, $C = i + j + k$

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

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

$= 3i + 3j$

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

$= -j + 5k$

$\therefore (A + C) \cdot (B - A) = (3 \times 0) i + (3 \times (-1)) j + (0 \times 5) k$

$= -3j$

5) Find a unit vector tangent to the space curve $x = t$, $y = t^2$, $z = t^3$ at point where $t = 1$.

$x = t, \quad y = t^2, \quad z = t^3 \qquad t = 1$

Let $r = (t, t^2, t^3)$

$r' = \frac{dr}{dt} = (1, 2t, 3t^2)$

$|r'| = \sqrt{(1)^2 + (2t)^2 + (3t^2)^2} = \sqrt{1 + 4t^2 + 9t^4}$

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1) $x = 2t^2$, $y = 6t^2 - 4t$, $z = t - 5$

$V_x = \frac{dx}{dt} = 2t^2$

$\Rightarrow 2 \times 2t$

$= 14t$

$V_y = \frac{dy}{dt} = 6t^2 - 4t$

$= (6 \times 2t) - (4 \times 1)$

$= 12t - 4$

$V_z = t - 5$

$= 1 - 0$

$= 1$

$\therefore$ Velocity $= V_x + V_y + V_z$

$= 14t + 12t - 4 + 1$.

$= 26t - 3$

2) $A = i + 2j - 4k$, $B = 2i - 3j + k$, $C = 4j - 3k$

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

$(B \times C) = [(-3 \times -3) - (4 \times 1)]i - [(-3 \times 2) - (0 \times 1)]j + [(4 \times 2) - (-3 \times 0)]k$

$= 19 - 4i - 1 - 6 - 0j + 18 - 0k$

$= 5i + 6j + 8k$

$$A \times (B \times C) = \begin{vmatrix} i & j & k \\ 1 & 2 & -4 \\ 5 & 6 & 8 \end{vmatrix}$$