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DEPARTMENT: MECHATRONICS.

MATRIC NO: 19/ENG08/1001.

Assignment

1. $x = 2t^2$ $y = 6t^2 - 4t$ $z = t - 8$.

ii. $v = (2t^2)i + (6t^2 - 4t)j + (t-8)k$

a. velocity $= \frac{dv}{dt}$

$\frac{dv}{dt} = [4t]i + [12t - 4]j + k.$

$= [4t]i + [12t - 4]j + k.$

2. $\bar{A} = i + 2j - 4k$ $\quad \bar{B} = 2i - 3j + k$ $\quad \bar{C} = 4j - 3k$

Find $\bar{A} \times (\bar{B} \times \bar{C})$

Solution

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

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

$i(9-4) - j(-6-0) + k(8-0)$

$i(5) - j(-6) + k(8)$

$5i + 6j + 8k$.

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

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

$i(16 - (-24)) - j(8 - (-20)) + k(6 - 10$

$i(16 + 24) - j(8 + 20) + k(-4)$

$i(40) - j(28) - 4k$

$40i - 28j - 4k$.

3i. $\vec{r} = 4\sin 2t\,\vec{i} + 4e^{3t}\,\vec{j} + 7t^3\vec{k}$.

$\frac{d\vec{r}}{dt} = 8\cos 2t\,\vec{i} + 12e^{3t}\,\vec{j} + 21t^2\vec{k}$.

4. A = 2i + 2j - k B = 2i + j + k C = i + j + c.

A + C = [2i + 2j - k] + [i + j + k]

= [2i + i] + [2j + j] + [-k + k] = 3i + 3j

B - A = [2i + j + k] - [2i + 2j - k].

= [2i - 2i] + [j - 2j] + [k - (-k)]

= -j + 2k.

(A + C) · (B - A)

= (3i + 3j) · (-j + 2k).

= 0 - 3 + 0 = -3.

5. Find the unit tangent vector at the point $t = 1$.

$\mathbf{r}(t) = t\mathbf{i} + t^2\mathbf{j} + t^3\mathbf{k}$

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

$\frac{d\mathbf{r}}{dt} = \mathbf{i} + 2t\mathbf{j} + 3t^2\mathbf{k}$

At $t = 1$, $\frac{d\mathbf{r}}{dt} = \mathbf{i} + 2\mathbf{j} + 3\mathbf{k}$

$\left|\frac{d\mathbf{r}}{dt}\right|_{t=1} = \sqrt{1^2 + 2^2 + 3^2} = \sqrt{14} = 3.74$

Hence, $\mathbf{T} = \frac{\mathbf{i} + 2\mathbf{j} + 3\mathbf{k}}{3.74}$