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DEPARTMENT: Anatomy

COURSE: MAT 102

ASSIGNMENT

1. If $A = 5i - 7j - 6k$, $B = j + 4k$, $C = 9i - 4j + k$. Find $-8(A+B) \cdot (C-A)$
2. Find a unit vector tangent to the space curve $x = 3t$, $y = t^2$, $z = 4t^3$ at the point where $t = 1$
3. A particle moves along a curve, $x = 8t^2$, $y = t^2 - 4t$, $z = tt + 1$, where t is time. Find its acceleration
4. If $A = i + 2j - 4k$, $B = 2i - 3j + k$, $C = 4j - 3k$. Find $(A \times B) \times C$
5. Given $B = 45 \sin 3t i + 4e^{3t} j + 7t^3 k$, Find the integral of B with respect to t from 0 to 1

ANSWERS

$$-8(A+B) \cdot (C-A)$$

$$A = 5i - 7j - 6k, B = j + 4k, C = 9i - 4j + k$$

$$(A+B)$$

$$= (5i - 7j - 6k) + (j + 4k)$$

$$= 5i - 7j + j - 6k + 4k$$

$$-8(5i - 6j - 2k)$$

$$= -40i + 48j + 16k$$

$$(C-A)$$

$$C = 9i - 4j + k, A = 5i - 7j - 6k$$

$$(C-A)$$

$$= (9i - 4j + k) - (5i - 7j - 6k)$$

$$= 9i - 4j + k - 5i + 7j + 6k$$

$$= 9i - 5i - 4j + 7j + k + 6k$$

$$= 4i + 3j + 7k$$

$$\begin{aligned}
 &= 8(A+B) \cdot (C-A) \\
 &= (C-40i + 48j + 16k) \cdot (4i + 3j + 7k) \\
 &= -160 + 144 + 112 \\
 &= 128//
 \end{aligned}$$

4. $x=3t$, $y=t^2$, $z=4t^3$ at the point where $t=1$

$$\begin{aligned}
 r &= xi + yj + zk \\
 &= 3ti + t^2j + 4t^3k
 \end{aligned}$$

$$\frac{dr}{dt} (3ti + t^2j + 4t^3k) = 3i + 2tj + 12t^2k$$

where $t=1$

$$\begin{aligned}
 &= 3i + 2(1)j + 12(1)^2k \\
 &= 3i + 2j + 12k
 \end{aligned}$$

$$\begin{aligned}
 \left| \frac{dr}{dt} \right| &= \sqrt{3^2 + 2^2 + 12^2} \\
 &= \sqrt{9 + 4 + 144} \\
 &= \sqrt{157}
 \end{aligned}$$

$$\begin{aligned}
 T &= \frac{dr/dt}{|dr/dt|} \\
 &=
 \end{aligned}$$

4. $A = i + 2j - 4k$, $B = 2i - 3j + k$, $C = 4j - 3k$. Find $(A \times B) \times C$

$$(A \times B) \quad A = i + 2j - 4k, \quad B = 2i - 3j + k$$

$$\begin{array}{c}
 \begin{array}{|c|c|c|} \hline + & - & + \\ \hline i & j & k \\ \hline 1 & 2 & -4 \\ \hline 2 & -3 & 1 \\ \hline \end{array} \\
 = i \begin{array}{|c|c|} \hline 2 & -4 \\ \hline -3 & 1 \\ \hline \end{array} - j \begin{array}{|c|c|} \hline 1 & -4 \\ \hline 2 & 1 \\ \hline \end{array} + k \begin{array}{|c|c|} \hline 1 & 2 \\ \hline 2 & -3 \\ \hline \end{array} \\
 = 2 - 12 = -10i & = -(1 - (-8)) = -9j & = -3 - 4 = -7k
 \end{array}$$

$$= -10\hat{i} - 9\hat{j} - 7\hat{k} \text{ or } -(10\hat{i} + 9\hat{j} + 7\hat{k})$$

$$(A \times B) \times C \quad C = 4\hat{j} - 3\hat{k}$$

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 10 & -9 & -7 \\ 0 & 4 & -3 \end{vmatrix} = \hat{i} \begin{vmatrix} -9 & -7 \\ 4 & -3 \end{vmatrix} - \hat{j} \begin{vmatrix} 10 & -7 \\ 0 & -3 \end{vmatrix} + \hat{k} \begin{vmatrix} -10 & -9 \\ 0 & 4 \end{vmatrix}$$

$$= 27 - 28$$

$$= -\hat{i}$$

$$= -(-10 \times -3) - (0 \times -7) = -40 - 0$$

$$= -(30 - 0) = -30\hat{j} = -40\hat{k}$$

$$= -\hat{i} - 30\hat{j} - 40\hat{k} \text{ or } -(\hat{i} + 30\hat{j} + 40\hat{k}) \text{ // (ANS)}$$

3.

$$x = 8t^2, y = t^2 - 4t, z = t + 1$$

$$\mathbf{r} = x\hat{i} + y\hat{j} + z\hat{k}$$

$$= 8t^2\hat{i} + (t^2 - 4t)\hat{j} + (t + 1)\hat{k}$$

$$\frac{d\mathbf{r}}{dt} (8t^2\hat{i} + (t^2 - 4t)\hat{j} + (t + 1)\hat{k}) = 16t\hat{i} + (2t - 4)\hat{j} + \hat{k}$$

$$\text{Acceleration} = \frac{d^2\mathbf{r}}{dt^2} = 16\hat{i} + 2\hat{j} \text{ // (ANS)}$$

$$5. \int_R = \int_0^1 4 \sin 3t \hat{i} + \int_0^1 4e^{3t} \hat{j} + \int_0^1 7t^3 \hat{k}$$

$$= \hat{i} \left[-\frac{4}{3} \cos 3t \right]_0^1 + \hat{j} \left[\frac{4}{3} e^{3t} \right]_0^1 + \hat{k} \left[\frac{7t^4}{4} \right]_0^1$$

$$= \hat{i} \left(-\frac{4}{3} \cos(3 \times 1) - \left(-\frac{4}{3} \cos(3 \times 0) \right) \right) + \hat{j} \left(\left(\frac{4}{3} e^{3 \times 1} \right) - \left(\frac{4}{3} e^{3 \times 0} \right) \right) + \hat{k} \left(\frac{7}{4} \times 1^4 - \left(\frac{7}{4} \times 0^4 \right) \right)$$

$$= \hat{i} \left[-1.3316 - (-1.3333) \right] + \hat{j} \left[26.7807 - 1.3333 \right] + \hat{k} \left[1.75 \right]$$

$$\approx 0.0018\hat{i} + 25.4474\hat{j} + 1.75\hat{k}$$

≈

$$= 1.8 \times 10^{-3}\hat{i} + 25.45\hat{j} + 1.75\hat{k} \text{ // (ANS)}$$