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MAT 102

1. A Particle moves along a Curve $x = 7t^2$, $y = 6t^2 - 4t$, $z = t - 5$; where t is time, find its Velocity

The position vector; $r = xi + yj + zk$

$$\text{i.e } r = (7t^2)i + (6t^2 - 4t)j + (t - 5)k; \quad \text{velocity} = \frac{dr}{dt} = (14t)i + (12t - 4)j + k$$

2. If $A = i + 2j - 4k$, $B = 2i - 5j + 4k$, $C = i - 3k$; find $A \times (B \times C)$.

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

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

$$= 5i + 6j + 8k.$$

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

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

$$= 40i - 26j - 4k.$$

4) If $A = 7i + 2j + k$, $B = 2i + j + 4k$, $C = i + j + k$; find $(A + C) \cdot (B - A)$

$$\text{If } (A + C) = 7i + i + 2j + j - k + k = 8i + 3j$$

$$B - A = 2i - 7i + j - 2j + 4k - k = -5i - j + 3k.$$

$$(A + C) \cdot (B - A) = (8i + 3j) \cdot (-5i - j + 3k) = (8i \times -5i) + (3j \times -j) + (0 \times 3k) \\ = 40 - 3 = 37$$

5 Find a unit vector tangent to the space Curve $x = t$, $y = t^2$, $z = t^3$ at point where $t = 1$. $f(t) = (t)i + (t^2)j + (t^3)k$

Tangent Vector.

$$f'(t) = i + 2tj + 3t^2k.$$

$$f'(1) = i + 2(1)j + 3(1)^2k.$$

$$f'(1) = i + 2j + 3k.$$

$$\text{Unit tangent vector} = \frac{f'(1)}{|f'(1)|}$$

$$|f'(1)| = \sqrt{(1)^2 + 2(2)^2 + 3^2}$$

$$= \sqrt{1 + 4 + 9} = \sqrt{14}.$$

$$\text{unit tangent vector} = \frac{i + 2j + 3k}{\sqrt{14}}$$