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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.

solution

$\vec{r} = xi + yj + zk$

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

$\frac{d\vec{r}}{dt}$ = velocity = v

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

velocity $= (14t)i + (12t-4)j + k$

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

solution

$A \times (B \times C)$

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

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

$5i + 6j + 8k$

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

$$A \times (B \times C) = [16 - (-24)]i - [8 - (-20)]j + [6 - 10]k$$

$40i - 28j - 4k$

3 Given

$R = 4\sin 3t\,i + 4e^{3t}j + 7t^3k$, find the integral of R with respect to t

Solution

$$\int R\,dt = \int\left[(4\sin 3t)i + (4e^{3t})j + (7t^3)k\right]dt$$

$$\int(4\sin 3t)i\,dt + \int(4e^{3t})j\,dt + \int(7t^3)k\,dt$$

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

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

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

Solution

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

$$\left[(7i + 2j - k) + (i + j + k)\right]\cdot\left[(2i + j + 4k) - (7i + 2j - k)\right]$$

$$\left[8i + 3j + 0k\right]\cdot\left[-5i - j + 5k\right]$$

$$(A+C)\cdot(B-A) = \left[8i + 3j + 0k\right]\cdot\left[-5i - j + 5k\right]$$

$$-40 - 3 + 0$$

$$(A+C)\cdot(B-A) = -43$$

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

Solution

$$\vec{r} = xi + yj + zk$$

$$\vec{r} = ti + t^2j + t^3k$$

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

$$\frac{d\vec{r}}{dt} = i + 2tj + 3t^2k \quad \text{Where } t = 1$$

$$\left.\frac{d\vec{r}}{dt}\right|_{t=1} = i + 2j + 3k$$

$$\left|\frac{dr}{dt}\right|_{t=1} = \sqrt{1^2 + 2^2 + 3^2} = \sqrt{1+4+9} = \sqrt{14}$$

$$= 3.74$$

Hence, $T = \dfrac{\frac{dr}{dt}}{\left|\frac{dr}{dt}\right|} = T = \dfrac{i + 2j + 3k}{3.74}$

$$\cancel{T = \frac{i + 2j + 3k}{3.74}} \qquad \cancel{T = \frac{i + 2tj + 3t^2k}{3.74}}$$