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MATRIC NUMBER: 19/sci01/070

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1) If $A = 5i - 7j - 6k$, $B = j + 4k$, $C = 9i - 4j + k$, Find $-8(A+B)\cdot(C-A)$

Solution

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

$= 5i - 6j - 2k$

$-8(A+B) = -8(5i - 6j - 2k)$

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

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

$= 4i + 3j + 7k$

$-8(A+B)\cdot(C-A) = (-40i + 48j + 16k)\cdot(4i + 3j + 7k)$

$= -160i + 144j + 112k$

2) Find the unit vector tangent to the space curve $x = 3t$, $y = t^2$ and $z = 4t^3$ at the point where $t = 1$

Solution

$r = -3ti + t^2 j + 4t^3 k$

$\frac{dr}{dt} = -3i + 2tj + 12t^2 k$

at $t = 1$, $\frac{dr}{dt} = -3i + 2j + 12k$

$\left|\frac{dr}{dt}\right| = \sqrt{(-3)^2 + (2)^2 + (12)^2} = \sqrt{9 + 4 + 144} = \sqrt{157}$

$= 12.3$

Hence, $\vec{T} = \frac{-3i + 2j + 12k}{12.3}$

3. A particle moves along a curve, $x = 8t^2, y = t^2 - 4t, z = t+1$. Where t is time, Find its acceleration

Solution

Acceleration $= \frac{d^2r}{dt}$

To find the acceleration we must first find $= \frac{dr}{dt}$

$$r = xi + yj + zk$$
$$r = (8t^2) + (t^2 - 4t) + (t+1)$$
$$\frac{dr}{dt} = (16t) + (2t - 4) + 1$$
$$\frac{d^2r}{dt^2} = 16 + 2$$

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

Solution

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

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

$$i(2 - 12) - j(1 - (-8)) + k(-3 - 4)$$
$$i(-10) - j(9) + k(-7) = -10i - 9j - 7k$$

$$(\bar{A} \times \bar{B}) \times \bar{c} \begin{vmatrix} i & j & k \\ -10 & -9 & -7 \\ 0 & 4 & -3 \end{vmatrix}$$

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

$$i(27 - (-24)) - j(30 - 0) + k(-40 - 0)$$
$$i(55) - j(30) + k(-40) = 55i - 30j - 40k$$

5) Given $R = 4\sin 3t\, i + 4e^{3t} j + 7t^3 k$, find the integral of R with respect to t from 0 to 1

Solution

$$\int_0^1 R = \int_0^1 \left(4\sin 3t + 4e^{3t} + 7t^3\right) dt$$

$$= \int_0^1 4\sin 3t\, dt + \int_0^1 4e^{3t}\, dt + \int_0^1 7t^3\, dt$$

$$= \frac{-4\cos(3t)}{3}\Big|_0^1 + \frac{4e^{3t}}{3}\Big|_0^1 + \frac{7t^4}{4}\Big|_0^1$$

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

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

$$= \frac{-4\cos 3}{3} i + \frac{4e^3 - 4}{3} j + \frac{7}{4} k$$