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QUESTIONS AND ANSWERS

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

Solution

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

$$-8(A+B) = -8[(5i - 7j - 6k) + (j + 4k)]$$
$$= -8[5i + (-7j + j] + (-6k + 4k)]$$
$$= -8[5i - 6j - 2k]$$
$$= -40i + 48j + 16k$$

$$(C - A) = [(9i - 4j + k] - [5i - 7j - 6k]]$$
$$= [[9i - 5i] + [-4j - (-7j]] + [k - (-6k)]]$$
$$= 4i + 3j + 7k$$

$$-8(A+B) \cdot (C-A) = (-40i + 48j + 16k) \cdot (4i + 3j + 7k)$$
$$= (-40 \times 4 + 48 \times 3 + 16 \times 7)$$
$$= -160 + 144 + 112 = -160 + 256 = 96$$

$$\therefore -8(A+B) \cdot [C - A] = 96$$

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

Solution

Given $x = -3t$, $y = t^2$, $z = 4t^3$, the unit vector at $t = 1$

$\therefore$ let $r = -3ti + t^2 j + 4t^3 k$; $\frac{dr}{dt} = -3i + 2tj + 12t^2 k$

at $t = 1$, $\frac{dr}{dt} = -3i + 2j + 12k$, $\left|\frac{dr}{du}\right|_{t=1} = \sqrt{(-3)^2 + 2^2 + 12^2} = \sqrt{157} = 12.5$

Hence the Tangent $T = \frac{-3i + 2j + 12k}{12.5}$

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

Solution.

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

let $r = -8t^2 i + (t^2 - 4t) j + (t + 1) k$.

Since t = time

Velocity ie. $\frac{dr}{dt} = -16t\, i + (2t - 4) j + k$

$\therefore$ Acceleration $= \frac{d^2 r}{dt^2} = -16 i + 2 j$

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

Solution

$A = i + 2j - 4k$, $B = 2i - 3j + k$, $C = 4j - 3k$.

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

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

$$= i[2 - 12] - j(1 + 8) + k(-3 - 4)$$

$$= i(-10) - j(9) + k(-7)$$

$$= -10i - 9j - 7k$$

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

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

$$= i(27 + 28) - j(30) + k(-40)$$

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$\therefore (A \times B) \times C = 55i - 30j - 40k$ //

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

$R = 4\sin 3t\, i + 4e^{3t} j + 7t^3 k$

Integral of $R = 4 \times \left(-\frac{1}{3}\cos 3t\right) i + 4\left(\frac{1}{3}e^{3t}\right) j + \frac{7t^4}{5} k$

from 0, Integral of $R = 4 \times \left(-\frac{1}{3}\cos 0\right) i + 4\left(\frac{1}{3}e^0\right) j + 0k$

$t = 0,\ \int R = 4 \times \left(-\frac{1}{3} \times 1\right) i + 4\left(\frac{1}{3}\right) j$

$= -\frac{4}{3} i + \frac{4}{3} j$

from 1, Integral of $R = 4\left(-\frac{1}{3}\cos 1\right) i + 4\left(\frac{1}{3}e^1\right) j + \frac{7}{5} k$

$t = 1,\ \int R = 4\left(-\frac{1}{3}\cos 1\right) i + 4\left(\frac{1}{3}e^1\right) j + \frac{7}{5} k$