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1 $A = 5i - 7j - 6k$, $B = j + 4k$, $C = 9i - 4j + k$

$-8(A+B)$

$A+B = (5i - 7j - 6k) + (j + 4k)$
$= (5i - 6j - 2k)$

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

$-8(A+B) = -40i + 48j + 16k$

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

$(C-A) = (4i + 3j + 7k)$

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

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

$= -160 + 144 + 112$
$= -160 + 256$
$= 96$

$-8(A+B) \cdot (C-A) = 96.$

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2 Unit vector tangent to the space curve $x = -3t, y = t^2, z = 4t^3$ at the point where $t = 1$

Solution

$r = xi + yj + zk$

$r = -3t\,i + t^2 j + 4t^3 k$

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

at $t = 1$ $\quad \frac{dr}{dt} = -3i + 2(1)j + 12(1)^2 k$

$= -3i + 2j + 12k$

$\left|\frac{dr}{dt}\right|_{t=1} = \sqrt{(-3)^2 + (2)^2 + (12)^2}$

$= \sqrt{9 + 4 + 144}$

$= \sqrt{157} = 12.529$

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

Hence, $T = \frac{-3i + 2j + 12k}{12.529}$.

3 $x = -8t^2, y = t^2 - 4t, z = t + 1$

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

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

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

Velocity

$$\frac{d^2r}{dt^2} = -16i + 2j + 0$$

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

$\therefore$ Acceleration $= -16i + 2j$

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

$A \times (B \times C)$

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

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

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

$(B \times C) = 5i + 6j + 8k$

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

$i[16-(-24)] - j[8-(-20)] + k(6-10)$

$i(16+24) - j(8+20) + k(6-10)$

$i(40) - j(28) + k(\cancel{6}-4)$

$i(40) - j(28) - k(4)$

$= 40i - 28j - 4k$

$A \times (B \times C) = 40i - 28j - 4k$

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5 $R = (4\sin 3t)i + (4e^{3t})j + (7t^3)k$

~~$\int R\,dt = \int [(4\sin 3t$~~

$$\int R\,dt = \int_0^1 \left[(4\sin 3t)i + (4e^{3t})j + (7t^3)k\right] dt$$

$$= \int_0^1 (4\sin 3t)i\,dt + (4e^{3t})j\,dt + (7t^3)k\,dt$$

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

$$= i\left(\frac{4}{3}\cos 3t\right)\Big|_0^1 + j\left(\frac{4}{3}e^{3t}\right)\Big|_0^1 + k\left(\frac{7t^4}{4}\right)\Big|_0^1$$

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

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

$$i[4/3 \times 0.9986] + j[4/3 \times 20.0855] + k[1.75]$$

$$i(1.3315) + j(26.7807) + k(1.75)$$

$$1.3315\,i + 26.7807\,j + 1.75\,k.$$