Name: OFOR CHUKWUEBUKA EMMANUEL
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Course: MAT 102

1 $A = 3i + 7j - 2k$, $B = i + 3j + 7k$, $C = 9i - 4j + 6k$

(i) A and C angle between them

$$\cos\theta = \frac{\bar{A} \cdot \bar{C}}{|A||C|}$$

$$\bar{A} \cdot \bar{C} = (3i + 7j - 2k) \cdot (9i - 4j + 6k)$$
$$= 27 - 28 - 12$$
$$\bar{A} \cdot C = 13$$
$$|A| = \sqrt{3^2 + 7^2 + (-2)^2} = \sqrt{62}$$
$$|C| = \sqrt{9^2 + -(4)^2 + 6^2} = \sqrt{133}$$

$$\cos\theta = \frac{-13}{\sqrt{62} \times \sqrt{133}} = \frac{-13}{90.8} = -0.1432$$
$$\theta = \cos^{-1} - 0.1482$$
$$\theta = 98.23$$

i B and C

$$\bar{B} \cdot \bar{C} = (i + 3j + 7k) \cdot (9i - 4j + 6k)$$
$$= 9 - 12 + 42$$
$$= 39$$
$$|B| = \sqrt{1^2 + 3^2 + 7^2} = \sqrt{59}$$
$$|C| = \sqrt{9^2 + (-4)^2 + 6^2} = \sqrt{133}$$

$$\cos\theta = \frac{39}{\sqrt{59} \times \sqrt{133}} = \frac{39}{88.54} = 0.4403$$

$\theta = \cos^{-1} 0.4403$

$\theta = 63.87^\circ$

iii. unit vector in direction of vector $(A+B+C)$

$A+B+C = (3i+7j-2k)+(i+3j+7k)+(9i-4j+6k)$

$A+B+C = 13i + 6j + 11k$

$e_{A+B+C} = \dfrac{A+B+C}{|A+B+C|}$

$|A+B+C| = \sqrt{13^2+6^2+11^2} = \sqrt{326} = 18.06$

$e(A+B+C) = \dfrac{13i+6j+11k}{18.06}$

$= \dfrac{13}{18.06}i + \dfrac{6}{18.06}j + \dfrac{11}{18.06}k$

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

where t = time

Find the modulus of acceleration at $t = 1$

Solution

$$\vec{F} = xi + yj + zK$$

$$\vec{r} = -8t^2 i + (t^2 - 4t)j + (t+1)K$$

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

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

Unit vector of a:

$$e_a = \frac{a}{|a|}$$

$$|a| = \sqrt{(-16)^2 + 2^2} = \sqrt{260} = 16.1245 \triangleq 16.1$$

$$e_a = \frac{-16i + 2j}{16.1} = \frac{16}{16.1}\,i + \frac{2}{16.1}\,j \;//$$

3 $A=4i+2j-4K$, $B=8i-2j+K$, $C=i+4j+3K$.
Find $(A\times B)\times C$

Solution

$$A\times B=\begin{vmatrix} i & j & K \\ 4 & 2 & -4 \\ 8 & -2 & 1 \end{vmatrix}=i\begin{vmatrix} 2 & -4 \\ -2 & 1 \end{vmatrix}-j\begin{vmatrix} 4 & -4 \\ 8 & 1 \end{vmatrix}+K\begin{vmatrix} 4 & 2 \\ 8 & -2 \end{vmatrix}$$

$$=i(2-8)-j[4-(32)]+K(-8-16)$$

$$=6i-36j-24K.$$

$$(A\times B)\times C=\begin{vmatrix} i & j & K \\ -6 & -36 & -24 \\ 1 & 4 & -3 \end{vmatrix}=i\begin{vmatrix} -36 & -24 \\ 4 & -3 \end{vmatrix}-j\begin{vmatrix} -6 & -24 \\ 1 & -3 \end{vmatrix}$$

$$=i(108+96)-j(18+24)+K(-24+36)$$

$$=204i-42j+12K\ //$$