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Matric: 19/ENG05/056

Dept: Mechatronics.

1 $A = 3i + 7j - 2k$, $B = i + 3j + 7k$, $C = 9i - 4j + 6k$
(1) A and C angle between them

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

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

$$\bar{A} \cdot \bar{C} = 13$$

$$|A| = \sqrt{3^2 + 7^2 + (-2)^2} = \sqrt{62}$$

$$|C| = \sqrt{9^2 + (-4)^2 + 6^2} = \sqrt{133}$$

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

$$\theta = \cos^{-1} -0.1482$$

$$\theta = 98.23$$

i B and C

$$\bar{B} \cdot \bar{C} = (i + 3j + 7k) \cdot (9i - 4j + 6k)$$
$$= 9 - 12 + 42$$

$$= 39$$

$$|B| = \sqrt{1^2 + 3^2 + 7^2} = \sqrt{59}$$

$$|C| = \sqrt{9^2 + (-4)^2 + 6^2} = \sqrt{133}$$

$$\cos \theta = \frac{39}{\sqrt{59} \times \sqrt{133}} = \frac{39}{88.58} = 0.4403$$

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

$$\theta = 63.87^\circ$$

iii - unit vector in direction of vector $(A+B+C)$
 $A+B+C = (3i+7j-2k) + (i+3j+7k) + (9i-4j+6k)$

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

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

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

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

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

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

Where $t = \text{time}$

Find the modulus of acceleration at $t = 1$

Solution

$$\vec{r} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$$

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

$$v = \frac{d\vec{r}}{dt} = -16t\mathbf{i} + (2t - 4)\mathbf{j} + \mathbf{k}$$

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

Unit vector of a :

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

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

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

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

SOLUTION

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

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

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

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

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

$$= 204i - 42j + 12k //$$