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DEPT: ARCHITECTURE
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MAT 102

(1)(i) $\cos\theta = \dfrac{A \cdot C}{\|A\|\|C\|}$

$\theta = \cos^{-1}\left[\dfrac{A \cdot C}{\|A\|\|C\|}\right]$

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

$= 27 + (-28) + (-12)$

$A \cdot C = -13$

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

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

$\theta = \cos^{-1}\left[\dfrac{-13}{\sqrt{62}\sqrt{133}}\right]$

$\theta = 98.23^\circ$

∴ the angle between A and C is $98.23^\circ$

(i) $\theta = \cos^{-1}\left[\frac{B \cdot C}{\|B\| \|C\|}\right]$

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

$= 9 + (-12) + 42$

$= 39$

$\|B\| = \sqrt{(1)^2 + (3)^2 + (7)^2} = \sqrt{442}$

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

$\theta = \cos^{-1}\left[\frac{39}{\sqrt{442}\sqrt{133}}\right]$

$\theta = 80.74^\circ$

$\therefore$ the angle between B and C $= 80.74^\circ$ //

(ii) $(A + B + C) =$

$\langle 3, 7, -2 \rangle + \langle 1, 3, 7 \rangle + \langle 9, -4, 6 \rangle$

$\langle 4, 10, 5 \rangle + \langle 9, -4, 6 \rangle$

$\langle 13, 6, 11 \rangle$

① $\langle 0, 0, 0 \rangle$ → ② $\langle 13, 6, 11 \rangle$

$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$

$= \sqrt{(13-0)^2 + (6-0)^2 + (11-0)^2}$

$= \sqrt{(13)^2 + (6)^2 + (11)^2} = \sqrt{326}$

$U = 1/\sqrt{326}\,(13i + 6j + 11k)$

(1) (iii) $u = \frac{1}{\sqrt{326}}(13i + 6j + 11k)$

$u = \frac{13}{\sqrt{326}}i + \frac{6}{\sqrt{326}}j + \frac{11}{\sqrt{326}}k$

(2) $\vec{r} = 8t^2\hat{i} + (t^2 - 4t)\hat{j} + (6+1)k$

velocity vector $\vec{v} = d\vec{r}/dt$

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

now at time $t = 1$ sub the value to $t$ =

vector $\vec{v} = \frac{d\vec{r}}{dt} = 16(1)\hat{i} + (2(1)-4)\hat{j} + k$

$= 16\hat{i} - 2\hat{j} + k$

and for acceleration

$\vec{a} = \frac{d\vec{v}}{dt} = 16\hat{i} + (2-0)\hat{j} + 0$

$= |16\hat{i} + 2\hat{j}|$

$= 16\hat{i} + 2\hat{j}$

$$\begin{matrix} & + & - & + \end{matrix}$$

③ $A \times B = \begin{vmatrix} i & j & k \\ 4 & 2 & -4 \\ 8 & -2 & 1 \end{vmatrix}$

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

$\hat{i}(2-8) - \hat{j}(4+32) + k(-8-16)$

$-6\hat{i} - 36\hat{j} - 24k \rightarrow D$

$$\begin{matrix} & + & - & + \end{matrix}$$

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

$= \begin{vmatrix} -36 & -24 \\ 4 & -3 \end{vmatrix} \hat{i} - \begin{vmatrix} -6 & -24 \\ 1 & -3 \end{vmatrix} \hat{j} + \begin{vmatrix} 6 & -36 \\ 1 & 4 \end{vmatrix} k$

$(108+96)\hat{i} - (18+24)\hat{j} + (24+36)k$

$204\hat{i} - 42\hat{j} + 60k$ //