

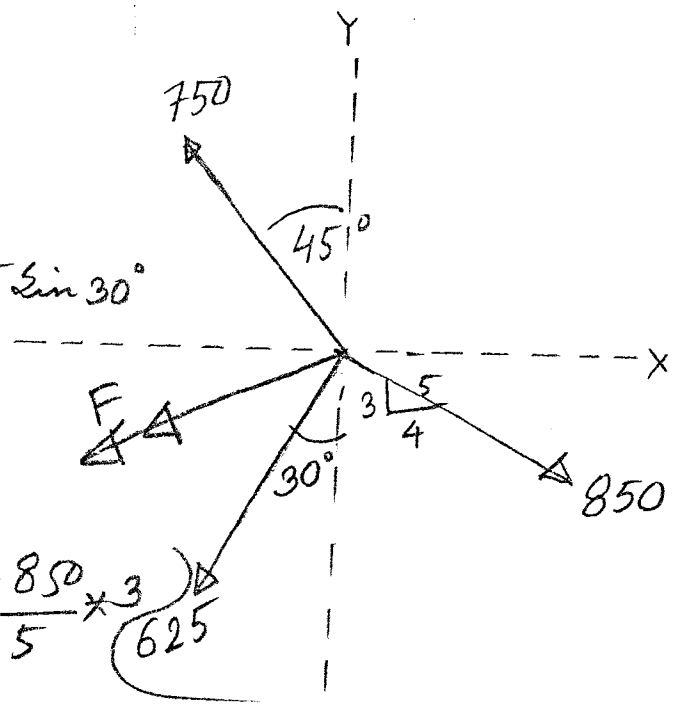
CE - 201, H.W # 02 Page-01

2.36/2.52/2.62/2.69/2.90/2.99

2-36

$$\begin{aligned} \sum F_x &= \frac{850}{5} \times 4 - 750 \sin 45 - 625 \sin 30 \\ &= -162.8 \text{ N} \end{aligned}$$

$$\begin{aligned} \sum F_y &= 750 \cos 45 - 625 \cos 30 - \frac{850}{5} \times 3 \\ &= -520.9 \end{aligned}$$



$$\begin{aligned} F &= \sqrt{(\sum F_x)^2 + (\sum F_y)^2} \\ &= \sqrt{(-162.8)^2 + (-520.9)^2} \end{aligned}$$

$$\theta = \tan^{-1} \left( \frac{\sum F_y}{\sum F_x} \right) = \tan^{-1} \left( \frac{-520.9}{-162.8} \right) = 72.6$$

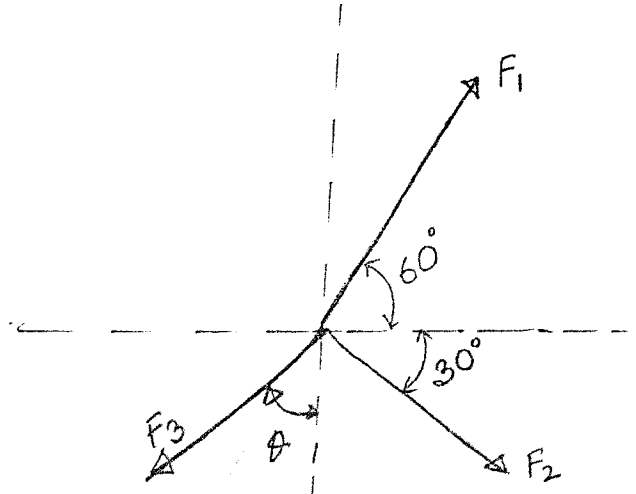
From X-axis, angle  $\theta = (180 + 72.6) = 252.64^\circ$

2-52

As  $F_R = 0 \therefore \sum F_x = 0; \sum F_y = 0$

$$\begin{aligned} \sum F_x = 0 &\Rightarrow F_1 \cos 60^\circ + F_2 \cos 30^\circ - F_3 \sin \theta = 0 \\ &\Rightarrow F_1 \times \frac{1}{2} + \left(\frac{2}{3}\right) \left(\frac{\sqrt{3}}{3}\right) F_1 - F_3 \sin \theta = 0 \\ &\Rightarrow \frac{F_1}{2} + \frac{1}{\sqrt{3}} F_1 - F_3 \sin \theta = 0 \\ &\Rightarrow 1.077 F_1 = F_3 \sin \theta \quad \text{--- (I)} \end{aligned}$$

$$\begin{aligned} \sum F_y = 0; & F_1 \sin 60^\circ - F_3 \cos \theta - F_2 \sin 30^\circ = 0 \\ &\Rightarrow F_1 \times \frac{\sqrt{3}}{2} - F_3 \cos \theta - \left(\frac{2}{3} F_1\right) \times \frac{1}{2} = 0 \\ &\Rightarrow 0.532 F_1 = F_3 \cos \theta \quad \text{--- (II)} \end{aligned}$$



$$\text{(I) } \div \text{(II)} \Rightarrow \tan \theta = 2.024, \theta = 63.7^\circ \quad | \quad F_3 = 1.2$$

$$\begin{aligned} \vec{F}_1 &= 55 \cos 60^\circ \hat{i} + 55 \cos 30^\circ \hat{j} - 55 \sin 60^\circ \hat{k} \\ &= 27.5 \hat{i} + 47.63 \hat{j} - 27.5 \hat{k} \end{aligned}$$

$$\begin{aligned} \vec{F}_2 &= 0 \hat{i} - \frac{75}{25} * 24 \hat{j} + \frac{75}{25} * 7 \hat{k} \\ &= -72 \hat{j} + 21 \hat{k} \end{aligned}$$

$$\begin{aligned} \vec{F} &= (27.5 + 0) \hat{i} + (47.63 - 72) \hat{j} + (-27.5 + 21) \hat{k} \\ &= 27.5 \hat{i} - 24.37 \hat{j} - 6.5 \hat{k} \end{aligned}$$

$$\begin{aligned} |\vec{F}| &= \sqrt{(27.5)^2 + (-24.37)^2 + (-6.5)^2} \\ &= \underline{37.31} \end{aligned}$$

$$\vec{F} = \frac{27.5}{37.31} \hat{i} - \frac{24.37}{37.31} \hat{j} - \frac{6.5}{37.31} \hat{k}$$

$$= \frac{27.5}{37.31} = 74^\circ = \underline{42.85}$$

$$= -\frac{24.37}{37.31} \Rightarrow \beta = \underline{130.78}$$

$$= -\frac{6.5}{37.31} \Rightarrow \gamma = \underline{100^\circ}$$

2-69

$$\begin{aligned}\cos \gamma &= \sqrt{1 - \cos^2 \alpha - \cos^2 \beta} \\ &= \sqrt{1 - \cos^2 60 - \cos^2 45} \\ &= \sqrt{1 - \left(\frac{1}{2}\right)^2 - (0.7071)^2} \\ &= 0.5\end{aligned}$$

$$\therefore \gamma = 60$$

$$\begin{aligned}\text{Magnitude of } x \text{ component of } F &= 80 \cos 60^\circ = \underline{40 \text{ lb}} \\ \text{" } y \text{ " " " " } &= 80 \cos 45 = \underline{56.57 \text{ lb}} \\ \text{" } z \text{ " " " " } &= 8 \cos 60 = \underline{40 \text{ lb}}\end{aligned}$$

2-90

$$\begin{aligned}\vec{r}_{AB} &= (0-2)\hat{j} + (0-4)\hat{k} \\ &= (-2\hat{j} - 4\hat{k})\end{aligned}$$

$$|\vec{r}_{AB}| = \sqrt{(-2)^2 + (-4)^2} = \sqrt{20} =$$

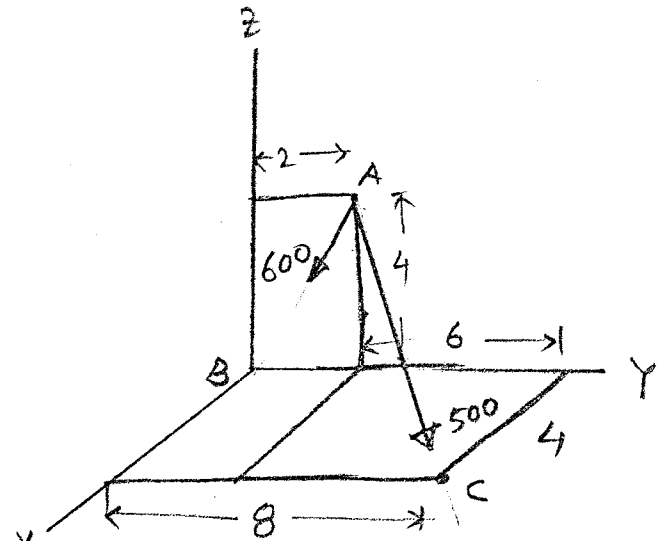
$$\begin{aligned}\therefore F_{AB} &= 600 \text{ N} \left( \frac{-2\hat{j}}{\sqrt{20}} - \frac{4\hat{k}}{\sqrt{20}} \right) \\ &= -268.3\hat{j} - 536.6\hat{k}\end{aligned}$$

$$\begin{aligned}\vec{r}_{AC} &= (4-0)\hat{i} + (8-2)\hat{j} + (0-4)\hat{k} \\ &= 4\hat{i} + 6\hat{j} - 4\hat{k}\end{aligned}$$

$$|\vec{r}_{AC}| = \sqrt{(4)^2 + (6)^2 + (-4)^2} = 8.24$$

$$F_{AC} = 500 \left\{ \frac{4\hat{i}}{8.24} + \frac{6\hat{j}}{8.24} - \frac{4\hat{k}}{8.24} \right\} = 242.7\hat{i} + 364\hat{j} - 242\hat{k}$$

$$\begin{aligned}\therefore \vec{F} &= (0 + 242.7)\hat{i} + (-268.3 + 364)\hat{j} + (-536.6 - 242.7)\hat{k} \\ &= 242.7\hat{i} + 95.7\hat{j} - 779.3\hat{k}\end{aligned}$$



$$|\vec{F}| = \sqrt{242.7^2 + 95.7^2 + (-779.3)^2}$$

$$= \underline{\underline{821.8}}$$

$$\therefore \alpha = \cos^{-1} \left( \frac{242.7}{821.8} \right) = \underline{\underline{72.82^\circ}}$$

$$\beta = \cos^{-1} \left( \frac{95.7}{821.8} \right) = \underline{\underline{83.31^\circ}}$$

$$\gamma = \cos^{-1} \left( \frac{-779}{821.8} \right) = \underline{\underline{161.42^\circ}}$$

2-99

$$\vec{F} = \{-120\hat{i} - 90\hat{j} - 80\hat{k}\} \text{ lb}$$

$$|\vec{F}| = 170 \text{ lb}$$

$$\vec{u}_F = \left\{ -\frac{120}{170}\hat{i} - \frac{90}{170}\hat{j} - \frac{80}{170}\hat{k} \right\} \text{ lb}$$

$$\cos \alpha = \frac{-120}{170} = \frac{x}{34} \Rightarrow \underline{\underline{x = |-24| = 24}}$$

$$\cos \beta = \frac{-90}{170} = \frac{y}{34} \Rightarrow y = |-18| = \underline{\underline{18}}$$

$$\cos \gamma = \frac{-80}{170} = \frac{z}{34} \Rightarrow z = |-16| = \underline{\underline{16}}$$

$$\therefore \begin{array}{l} x = 24 \\ y = 18 \\ z = 16 \end{array} \Bigg| \text{ Ans:}$$