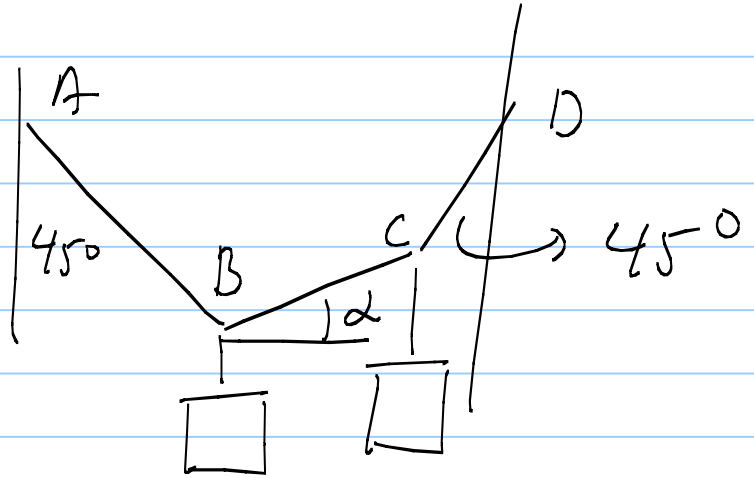
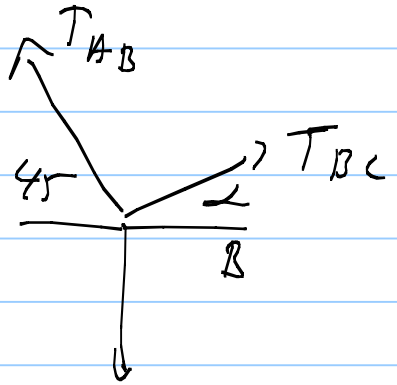
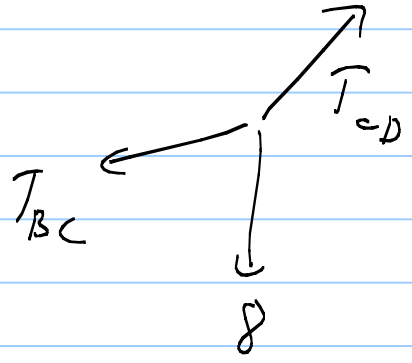
EGR 180 6/3/10

Note Title 6/3/2010

3-13)







(B)

$$\sum F_x = -T_{AB}\cos(45) + T_{BC}\cos(\alpha) = 0$$

$$\sum F_y = T_{AB}\sin(45) + T_{BC}\sin(\alpha) - 10 = 0$$

$$T_{BC} = T_{AB} \frac{\cos(45)}{\cos(\alpha)} = \frac{10\cos(45)}{\sin(45+\alpha)}$$

$$T_{AB}\sin(45) + T_{AB}\frac{\cos(45)}{\cos(\alpha)}\sin(\alpha) = 10$$

$$T_{AB}\frac{\sin(45+\alpha)}{\cos(\alpha)} = 10$$

$$T_{AB} = \frac{10\cos(\alpha)}{\sin(45+\alpha)}$$

(c)

$$\Sigma F_x = -T_{BC}\cos(\alpha) + T_{CD}\cos(45) = 0$$

$$\Sigma F_y = -T_{BC}\sin(\alpha) + T_{CD}\sin(45) - 8 = 0$$

$$T_{CD} = + T_{BC} \frac{\cos(\alpha)}{\cos(45)} = \frac{10\cos(\alpha)}{\sin(45+\alpha)}$$

$$\frac{10\cos(\alpha)}{\sin(45+\alpha)} \sin(45) - \frac{10\cos(45)}{\sin(45+\alpha)} \sin(\alpha) = 8$$

$$\frac{10\left(\sin(45)\cos(\alpha) - \cos(45)\sin(\alpha)\right)}{\sin(45+\alpha)} = 8$$

$$\frac{10\sin(45-\alpha)}{\sin(45+\alpha)} = 8$$

$$\sin(\theta) = \cos(90-\theta)$$

$$\sin(45-\alpha) = \cos(45+\alpha)$$

$$10\cot(45+\alpha) = 8$$

$$\frac{5}{4} = \tan(45 + \alpha) \quad \Rightarrow \boxed{\alpha = \tan^{-1}\left(\tfrac{5}{4}\right) - 45}$$

$\alpha = 6.3^\circ$

$T_{AB} = 12.7 \text{ lbs}$

$T_{BC} = 9.1 \text{ lbs}$

$T_{CD} = 12.7 \text{ lbs}$

1. Given 2 or more forces compute the resultant, 2D or 3D

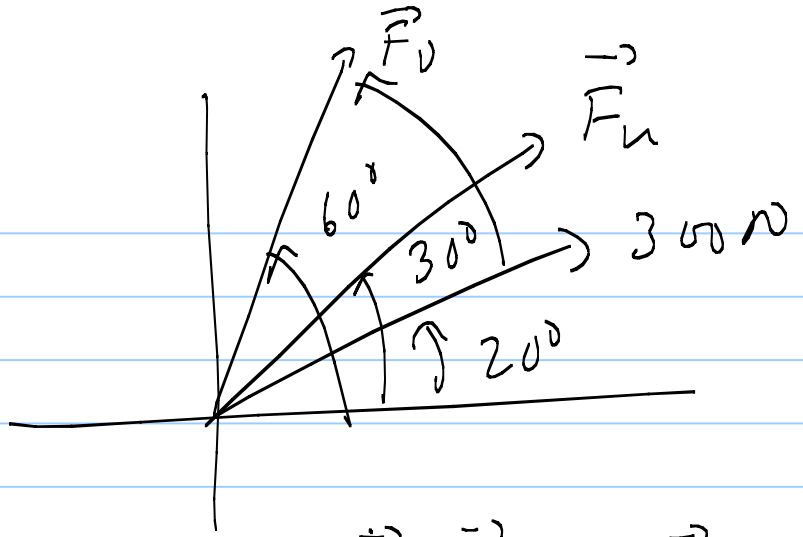
2. Give a force and two directions $\longrightarrow$ components

in those directions (2D)

3. Problem is construct the free body diagram

4. Solve a system in equilibrium

Given a force of 300 N acting at an angle of 20° with respect to the X axis, compute the components 30° and 60° with respect to the X axis.

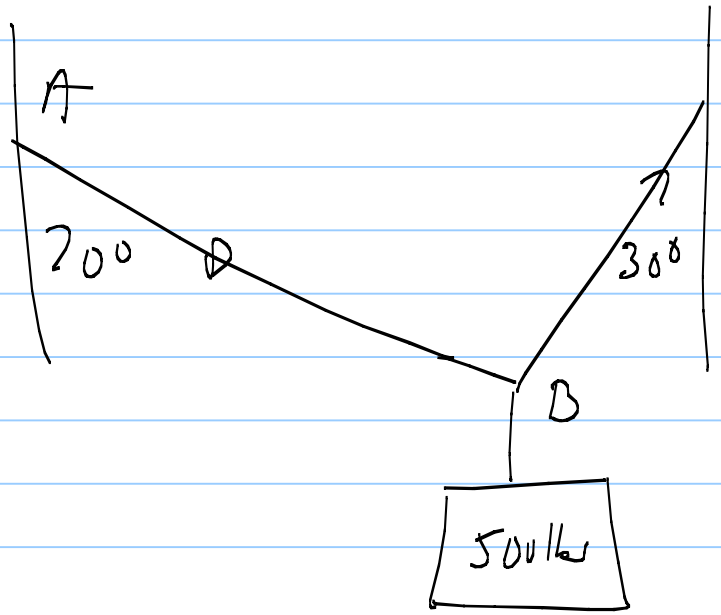


$$F_u = \vec{F} \cdot \hat{u} = 300 \cos(10)$$

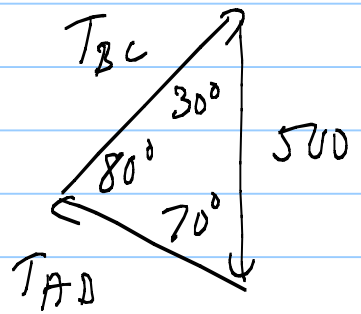
$$F_v = \vec{F} \cdot \hat{v} = 300 \cos(40)$$

$$= 300 \cdot 1 \cdot \cos(40)$$

$$\vec{u} \cdot \vec{v} = |\vec{u}|\,|\vec{v}| \cos(\theta)$$



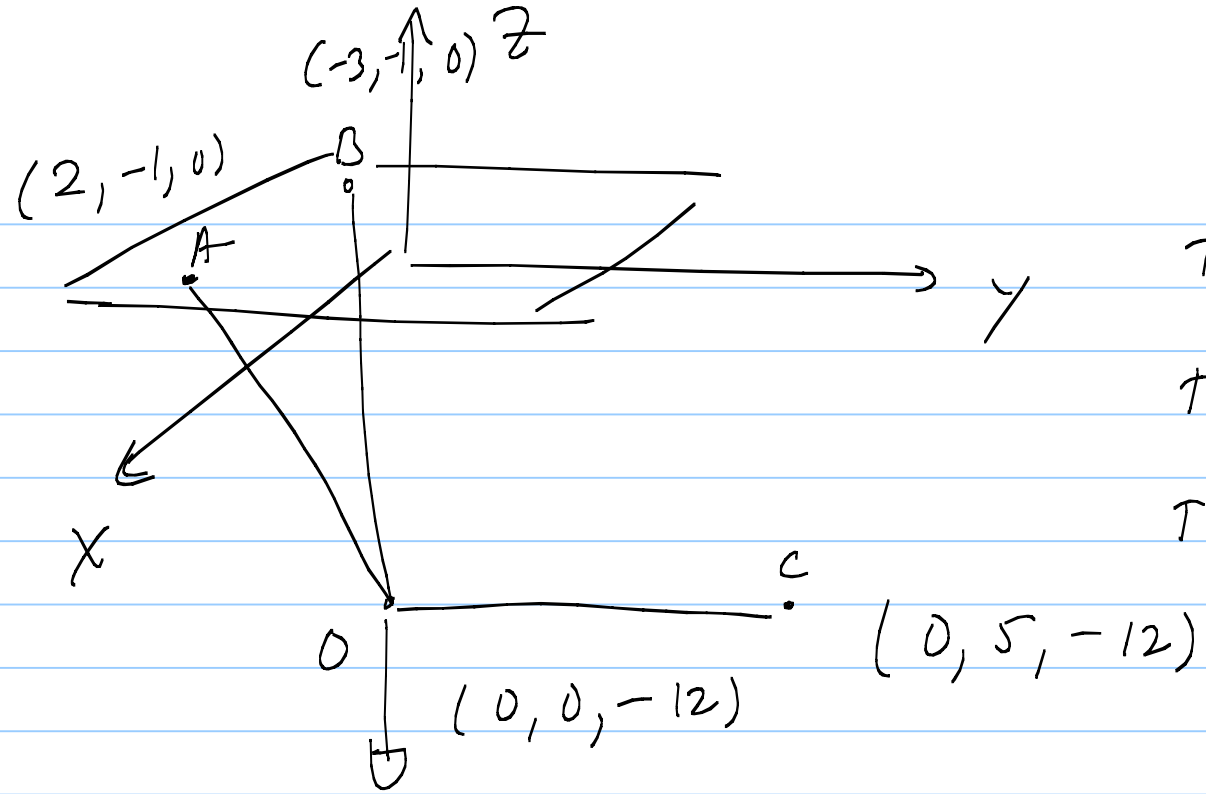
Find tension in AB & BC.



$$\frac{T_{BC}}{\sin(70)} = \frac{500}{\sin(80)} = \frac{T_{AB}}{\sin(30)}$$

$$T_{BC} = 500\,\frac{\sin(70)}{\sin(80)} = 477 \text{ lbs}$$

$$T_{AB} = 500\,\frac{\sin(30)}{\sin(80)} = 254 \text{ lbs}$$



T_A

T_B

T_C

$\vec{u}_A = 2\hat{i} - \hat{j} + 12\hat{k}$

$\vec{u}_B = -3\hat{i} - \hat{j} + 12\hat{k}$

$\vec{u}_C = \hat{j}$

$\vec{T}_A = R_A(2\hat{i} - \hat{j} + 12\hat{k})$

$\vec{T}_B = R_B(-3\hat{i} - \hat{j} + 12\hat{k})$

$\vec{T}_C = T_C\hat{j}$

$$\sum F_x = 2R_A - 3R_B = 0 \Rightarrow R_A = \tfrac{3}{2} R_B = 60$$

$$\sum F_y = -R_A - R_B + T_C = 0$$

$$\sum F_z = 12R_A + 12R_B - 1200 = 0$$

$$T_C = R_B + \tfrac{3}{2} R_B = \tfrac{5}{2} R_B = 100$$

$$18 R_B + 12 R_B = 1200$$

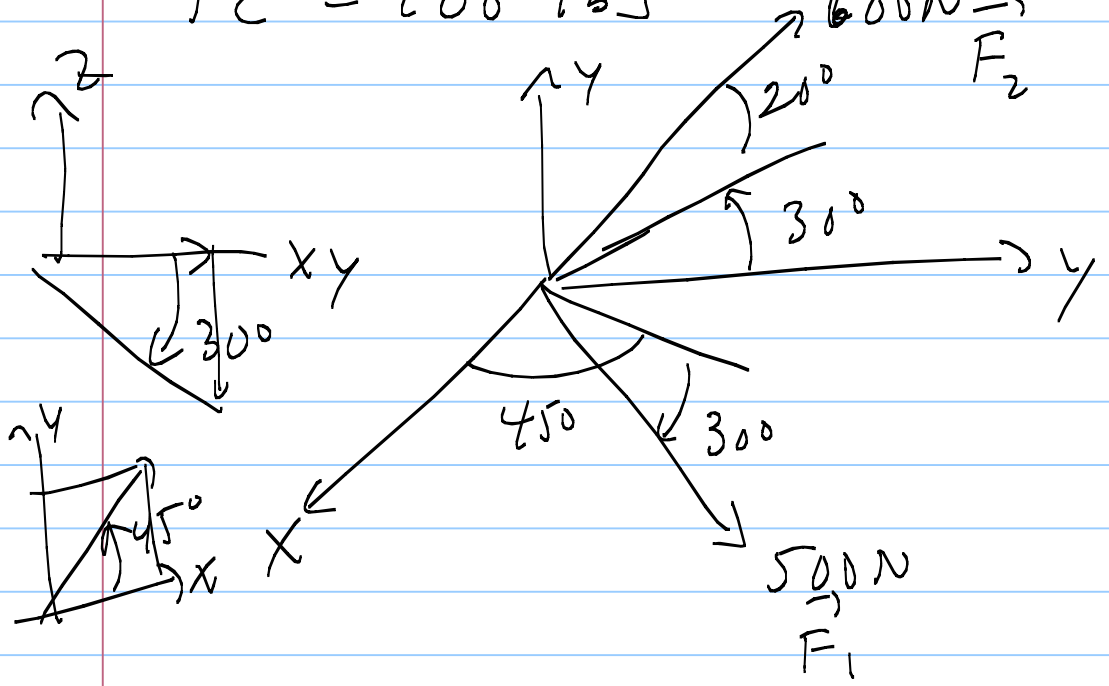
$$30 R_B = 1200$$

$$R_B = 40$$

$$T_A = R_A \left[4 + 1 + 144\right]^{1/2} = 60\sqrt{149} = 732 \text{ lbs}$$

$$T_B = R_B \left[9 + 1 + 144\right]^{1/2} = 40\sqrt{154} = 496 \text{ lbs}$$

$$T_C = 100 \text{ lbs}$$



$$\vec{F}_1 = 500\cos(30)\cos(45)\,\hat{i} + 500\cos(30)\sin(45)\,\hat{j} - 500\sin(30)\,\hat{k}$$

$$\vec{F}_2 = -600\cos(20)\sin(30)\,\hat{i} + 600\cos(20)\cos(30)\,\hat{j} + 600\sin(20)$$

$$\vec{R} = \vec{F}_1 + \vec{F}_2 = 306\,\hat{i} + 794\,\hat{j} - 228\,\hat{k}$$