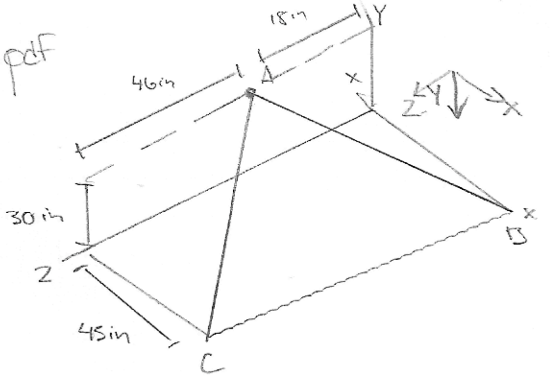
EGR 209 | HW # 3 | Danny Ricciotti

Problem: #1 on pdf



$T_{AB} = 285 lb$

$T_{AC} = 426 lb$

Find: a) components of force excerted at A
b) ~~magnitude of resultant~~ direction of resultant

Solution:

$|\overline{AC}| = \sqrt{30^2 + 45^2 + 46^2}$
$= 71$ in.

$|\overline{AB}| = \sqrt{30^2 + 45^2 + 18^2}$
$= 57$ in.

$\vec{T}_{AC} = \frac{45}{71}(426)\vec{i} + \frac{30}{71}(426)\vec{j} + \frac{46}{71}\vec{k}$

$\vec{T}_{AB} = \frac{45}{57}(285)\vec{i} + \frac{30}{57}(285)\vec{j} - \frac{18}{57}(285)\vec{k}$

$\vec{r}_A = \vec{T}_{AB} + \vec{T}_{AC} = \begin{matrix} 270\vec{i} & + 180\vec{j} & + 276\vec{k} \\ + 225\vec{i} & + 150\vec{j} & + -90\vec{k} \end{matrix} =$

a) $\boxed{\vec{r}_A = 495\vec{i} + 330\vec{j} + 186\vec{k} \; [N]}$

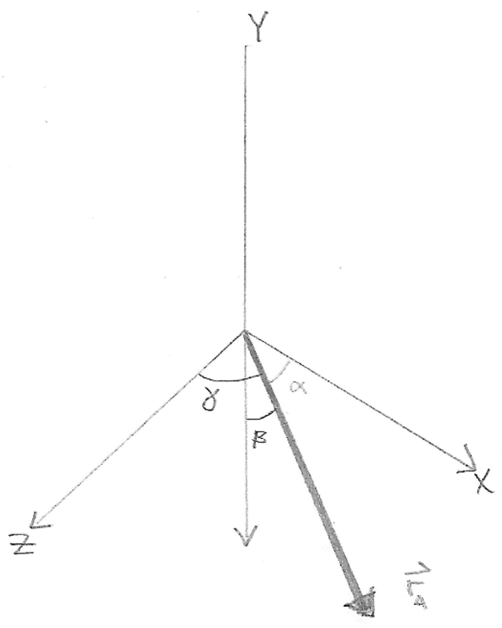
b)

$r_a = \sqrt{495^2 + 330^2 + 186^2} = 623 N$

$\alpha = \cos^{-1}\left(\frac{495}{623}\right) = 37.4°$

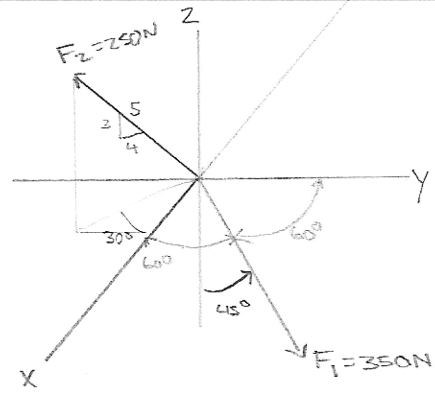
$\beta = \cos^{-1}\left(\frac{330}{623}\right) = 58°$

$\gamma = \cos^{-1}\left(\frac{186}{623}\right) = 72.6°$

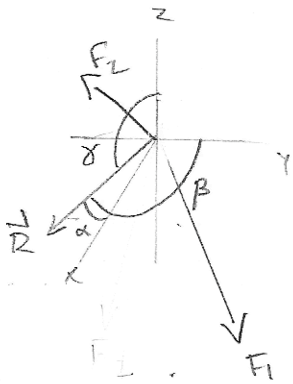


* Y-axis defined differently than in solution posted in pdf

Problem: 2.68 in book



Find: a) magnitude & coordinate direction angles of resultant
b) sketch resultant



$$\vec{F_2} = \frac{4}{5}(250)\vec{i} - \cos(60)(250)\vec{j} + \frac{3}{5}(250)\vec{k}$$

$$\vec{F_1} = \cos(60)\,350\vec{i} + \cos(60)(350)\vec{j} - \cos(45)(350)\vec{k}$$

$$\vec{r} = \begin{pmatrix} \frac{4}{5}(250) \\ + \cos 60 \cdot 350 \end{pmatrix}\vec{i} + \begin{pmatrix} -\cos 60 \cdot 250 \\ + \cos 60 \cdot 350 \end{pmatrix}\vec{j} + \begin{pmatrix} \frac{3}{5}\,250 \\ - \cos 45 \cdot 350 \end{pmatrix}\vec{k}$$

$$\vec{r} = 375\vec{i} + 50\vec{j} - 97.5\vec{k} \quad [N]$$

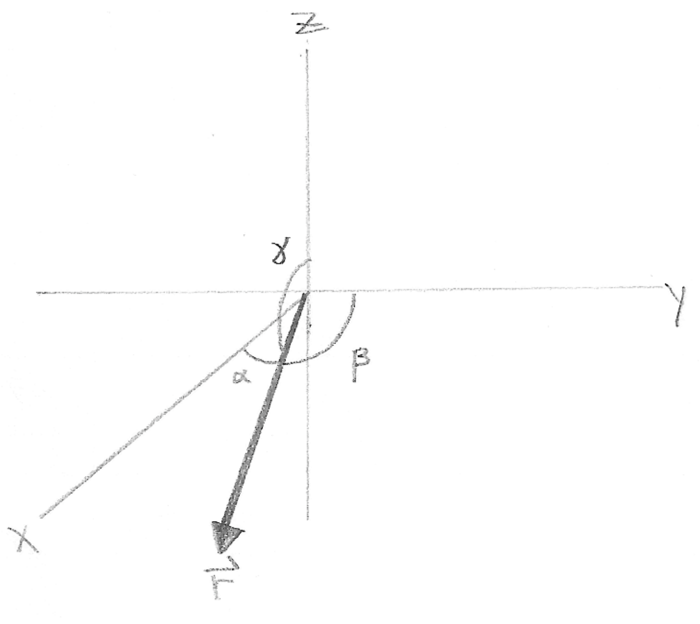
$$r = \sqrt{375^2 + 50^2 + 97.5^2}$$

$$\boxed{r = 390.7\ N}$$

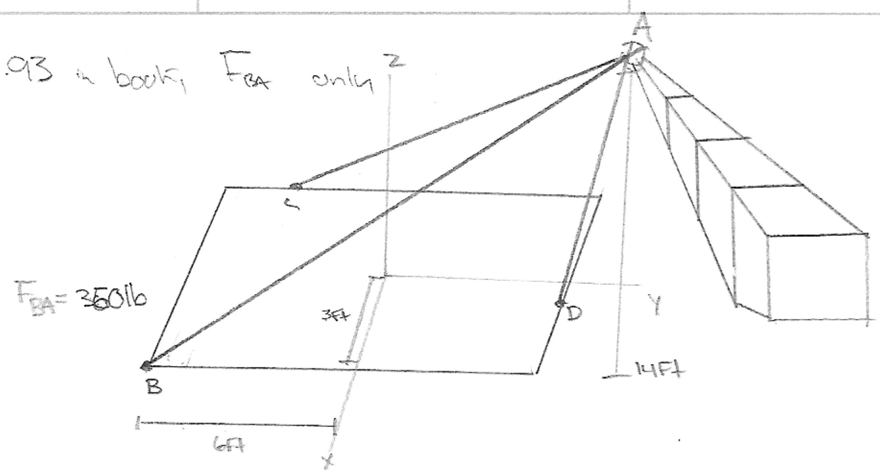
a)

$$\boxed{\begin{aligned} \alpha &= \cos^{-1}\left(\frac{375}{390}\right) = 16.28^\circ \\ \beta &= \cos^{-1}\left(\frac{50}{390}\right) = 82.64^\circ \\ \gamma &= \cos^{-1}\left(\frac{-97}{390}\right) = 104^\circ \end{aligned}}$$

b)

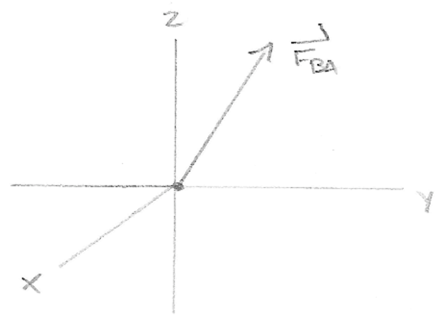


Problem : #2.93 in book, F_{BA} only



Find : Express F_{BA} as a vector

Solution :



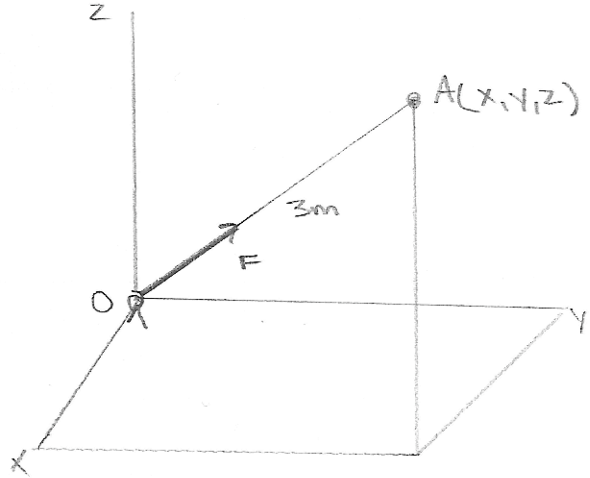
$$BA = \sqrt{3^2 + 6^2 + 14^2} = \sqrt{241}$$
$$= 15.5 \text{ ft}$$

$$\vec{F_{BA}} = \frac{-3}{\sqrt{241}} \cdot 350 \vec{i} + \frac{-6}{\sqrt{241}} \cdot 350 \vec{j} + \frac{-14}{\sqrt{241}} \cdot 350 \vec{k}$$

$$\boxed{\vec{F_{BA}} = -67.7 \vec{i} + -135.2 \vec{j} - 315.6 \vec{k} \quad [\text{lb}]}$$

$$\boxed{\vec{F_{BA}} = -664.1 \vec{i} - 1326.3 \vec{j} - 3096 \vec{k} \quad [N]}$$

Problem: 2-99 in book



$F_{OA} = 40\vec{i} + 60\vec{j} + 70\vec{k}$

Find: The values of (X,Y,Z) such that the rope is 3m.

Solution:

$$x^2 + y^2 + z^2 = (3)^2 \quad [m]$$

$$F = \sqrt{40^2 + 60^2 + 70^2} = 10\sqrt{101}$$

isolate vector components and compute individually

$$40 = \cos\alpha \cdot F$$
$$40 = \frac{x}{3} \cdot F$$

$$x = \frac{40 \cdot 3}{F} = 1.19m$$

$$60 = \cos\beta \cdot F$$
$$60 = \frac{y}{3} \cdot F$$

$$y = \frac{60 \cdot 3}{F} = 1.79m$$

$$z = \frac{70 \cdot 3}{F} = 2.09m$$

$$\boxed{(x,y,z) = (1.19, 1.79, 2.09)\ [m]}$$