Thursday, May 31, 2012
2:31 PM

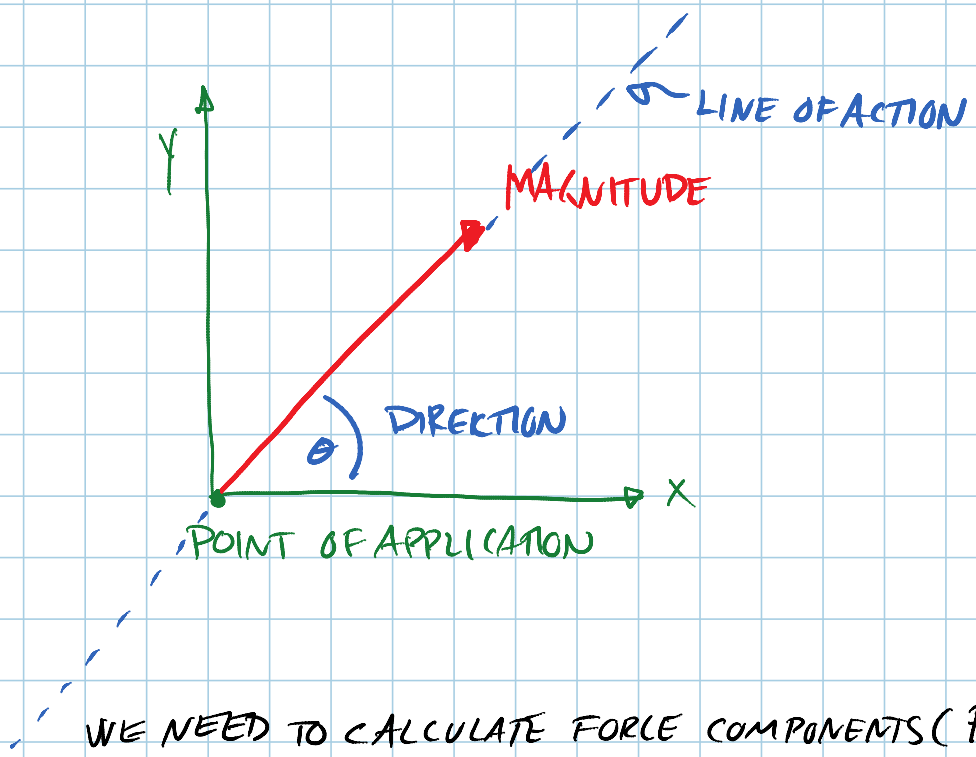
2D CONCURRENT FORCE SYSTEMS

FORCE: MAGNITUDE (lb_f = pound force, kip = 1000 lb)

(N = Newton, kN = 1000 N)

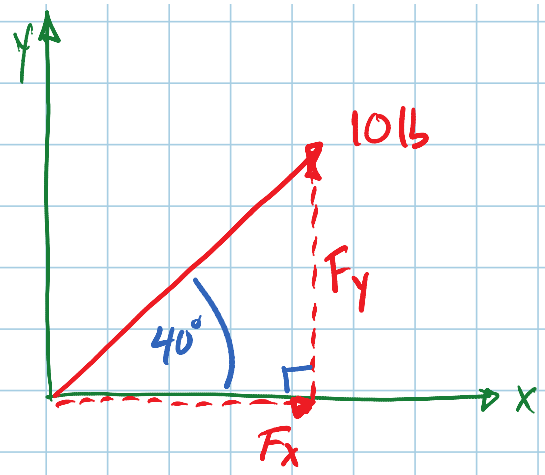
DIRECTION (degrees from horizontal) — OPTIONAL

POINT OF APPLICATION (ORIGIN)



WE NEED TO CALCULATE FORCE COMPONENTS (F_x, F_y, F_z)

GIVEN:



$$\sin\theta = \frac{opp}{hyp} \qquad \tan\theta = \frac{opp}{adj}$$

$$\cos\theta = \frac{adj}{hyp}$$

FIND:

FIND THE X AND Y COMPONENTS OF THE 101b FORCE.

SOLUTION:

USING THE DEFINITION OF COSINE:

$$\cos\theta = \frac{adj}{hyp}$$

$$\cos 40^\circ = \frac{F_x}{101b}$$

SOLVE FOR FX:

$$F_x = (\cos 40^\circ) \cdot 101b$$

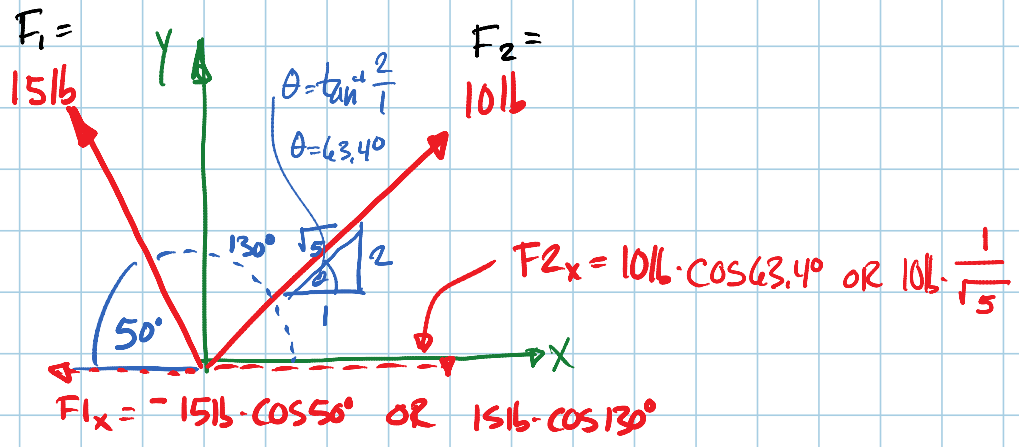
THEREFORE $\therefore$ $F_x = 7.66\ lb$

$$\sin\theta = \frac{F_y}{101b}$$

SOLVE FOR F_y:

$F_y = 10\text{lb} \cdot \sin 40^\circ \quad \therefore F_y = 6.431\text{lb}$

WE NEED TO ADD FORCES TOGETHER

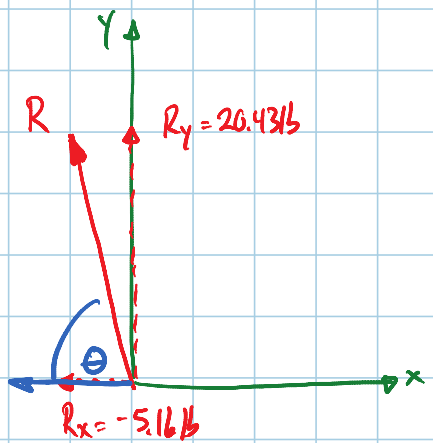


SIGMA (SUMMATION)

$$\sum F_x = F_{1x} + F_{2x} = -15\text{lb} \cdot \cos 50^\circ + 10\text{lb} \cdot \cos 63.4^\circ = -5.16\text{lb}$$
$$(-9.641\text{lb}) \quad + (4.481\text{lb})$$

(THE SUMMATION OF FORCES IN THE X-DIRECTION)

$$\sum F_y = F_{1y} + F_{2y} = 15\text{lb} \cdot \sin 50^\circ + 10\text{lb} \cdot \sin 63.4^\circ = +20.43\text{lb}$$
$$(11.49\text{lb}) \quad + \quad (8.94\text{lb})$$



$$R = \sqrt{R_x^2 + R_y^2}$$

$$R = \sqrt{(-5.16\text{lb})^2 + (20.43\text{lb})^2}$$

$$R = 21.07\text{lb}$$

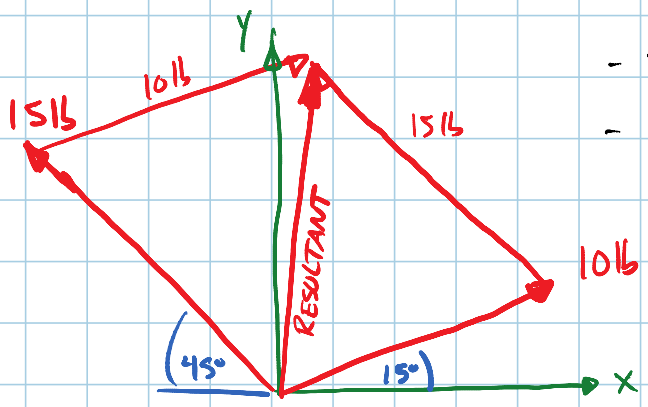
$$\theta = \tan^{-1} \frac{R_y}{R_x}$$

$$= \tan^{-1}\frac{20.43\text{lb}}{-5.16\text{lb}}$$

$$\theta = 75.8°$$

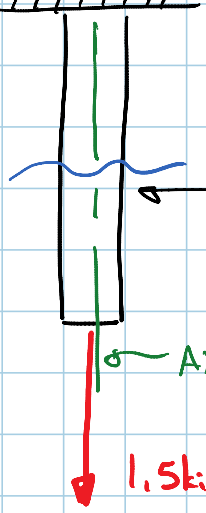
CONCURRENT FORCE SYSTEM:

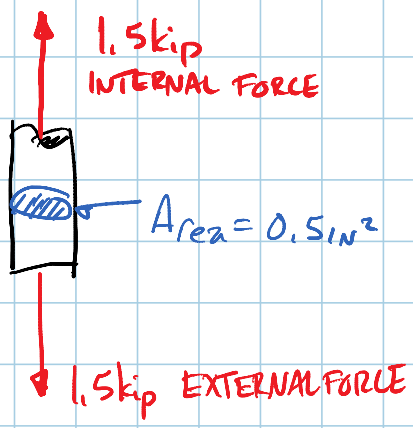
- ALL LINES OF ACTION FOR THE FORCES IN THE YOUR SYSTEM MEET AT A SINGLE POINT.
- NO ROTATION



- PARALLAGRAM METHOD
- HEAD-TO-TAIL

IMMOVABLE OBJECT / OUTSIDE OF SYSTEM





STRESS = INTENSITY OF INTERNAL FORCES

$$\text{STRESS} = \frac{\text{INTERNAL FORCE}}{\text{AREA}} = \frac{1500\,\text{lb}}{0.5\,\text{in}^2} = 3000\,\frac{\text{lb}}{\text{in}^2} = 3000\,\text{psi}$$

THERE EXISTS 3000 PSI (3 KSI) OF AXIAL STRESS IN THE BAR.