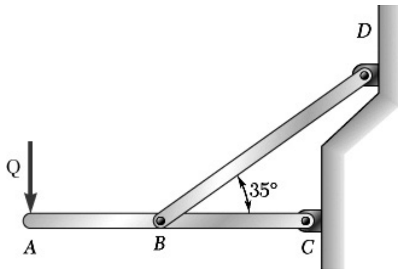
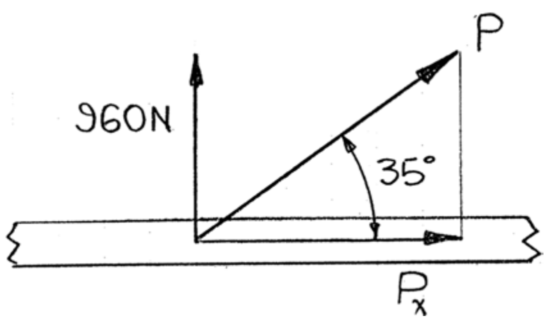
PROBLEM 2.26



Member *BD* exerts on member *ABC* a force **P** directed along line *BD*. Knowing that **P** must have a 960-N vertical component, determine (*a*) the magnitude of the force **P**, (*b*) its horizontal component.

SOLUTION



(*a*)

$$P = \frac{P_y}{\sin 35°}$$

$$= \frac{960 \text{ N}}{\sin 35°}$$

or $P = 1674$ N ◀

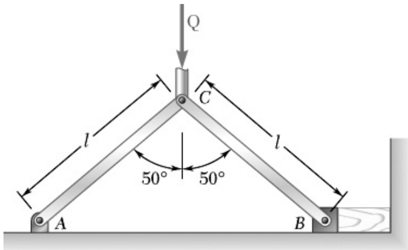
(*b*)

$$P_x = \frac{P_y}{\tan 35°}$$

$$= \frac{960 \text{ N}}{\tan 35°}$$

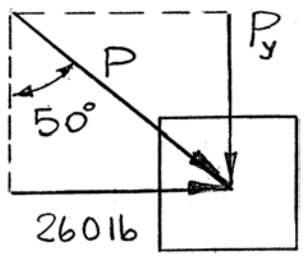
or $P_x = 1371$ N ◀

PROBLEM 2.27



Member *CB* of the vise shown exerts on block *B* a force **P** directed along line *CB*. Knowing that **P** must have a 260-lb horizontal component, determine (*a*) the magnitude of the force **P**, (*b*) its vertical component.

SOLUTION



We note:

CB exerts force **P** on *B* along *CB*, and the horizontal component of **P** is $P_x = 260$ lb.

Then:

(*a*)

$$P_x = P \sin 50°$$

$$P = \frac{P_x}{\sin 50°}$$

$$= \frac{260 \text{ lb}}{\sin 50°}$$

$$= 339.4 \text{ lb}$$

$P = 339$ lb ◀

(*b*)

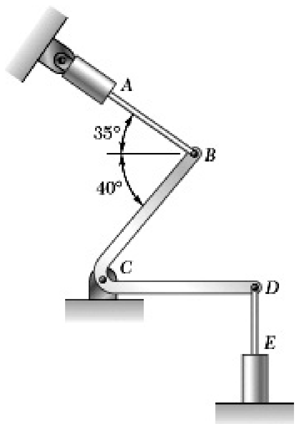
$$P_x = P_y \tan 50°$$

$$P_y = \frac{P_x}{\tan 50°}$$

$$= \frac{260 \text{ lb}}{\tan 50°}$$

$$= 218.2 \text{ lb}$$

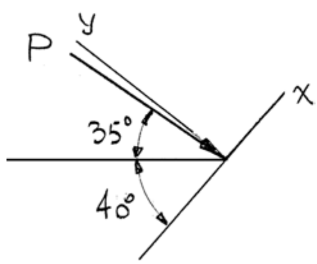
$\mathbf{P}_y = 218$ lb ↓ ◀

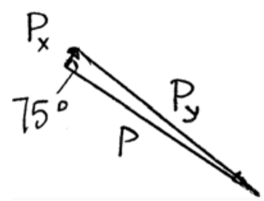


PROBLEM 2.28

Activator rod *AB* exerts on crank *BCD* a force **P** directed along line *AB*. Knowing that **P** must have a 25-lb component perpendicular to arm *BC* of the crank, determine (*a*) the magnitude of the force **P**, (*b*) its component along line *BC*.

SOLUTION





Using the *x* and *y* axes shown.

(*a*) $P_y = 25\text{ lb}$

Then: $P = \dfrac{P_y}{\sin 75°}$

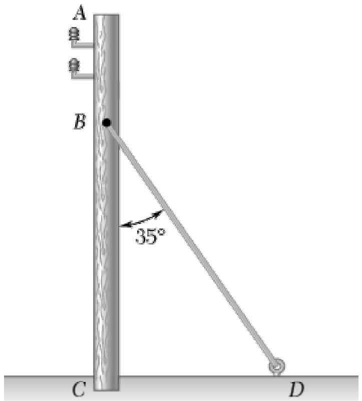
$= \dfrac{25\text{ lb}}{\sin 75°}$

or $P = 25.9\text{ lb}$ ◀

(*b*) $P_x = \dfrac{P_y}{\tan 75°}$

$= \dfrac{25\text{ lb}}{\tan 75°}$

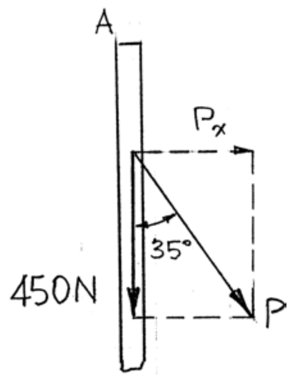
or $P_x = 6.70\text{ lb}$ ◀



PROBLEM 2.29

The guy wire *BD* exerts on the telephone pole *AC* a force **P** directed along *BD*. Knowing that **P** has a 450-N component along line *AC*, determine (*a*) the magnitude of the force **P**, (*b*) its component in a direction perpendicular to *AC*.

SOLUTION



Note that the force exerted by *BD* on the pole is directed along *BD*, and the component of *P* along *AC* is 450 N.

Then:

(*a*)

$$P = \frac{450\text{ N}}{\cos 35°} = 549.3\text{ N}$$

$$P = 549\text{ N} \blacktriangleleft$$

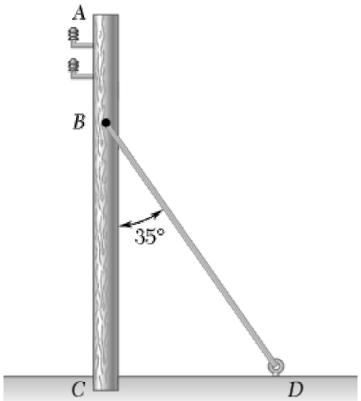
(*b*)

$$P_x = (450\text{ N})\tan 35°$$

$$= 315.1\text{ N}$$

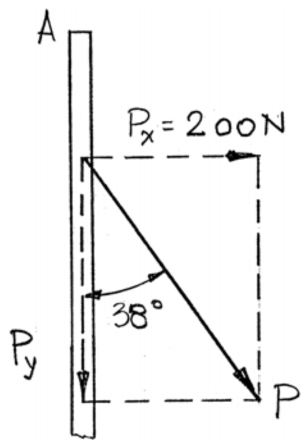
$$P_x = 315\text{ N} \blacktriangleleft$$

PROBLEM 2.30



The guy wire *BD* exerts on the telephone pole *AC* a force **P** directed along *BD*. Knowing that **P** has a 200-N perpendicular to the pole *AC*, determine (*a*) the magnitude of the force **P**, (*b*) its component along line *AC*.

SOLUTION



(*a*)

$$P = \frac{P_x}{\sin 38°}$$

$$= \frac{200 \text{ N}}{\sin 38°}$$

$$= 324.8 \text{ N}$$

or $P = 325$ N ◀

(*b*)

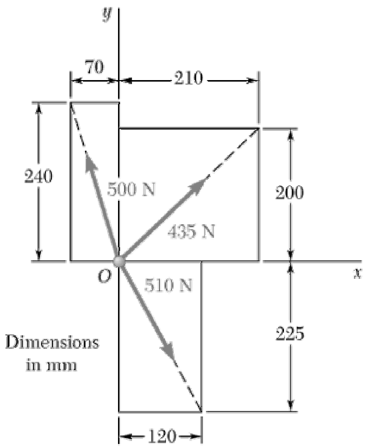
$$P_y = \frac{P_x}{\tan 38°}$$

$$= \frac{200 \text{ N}}{\tan 38°}$$

$$= 255.98 \text{ N}$$

or $P_y = 256$ N ◀

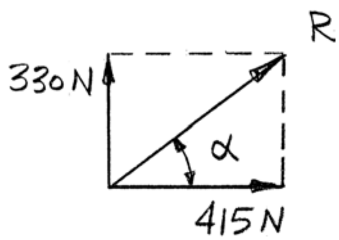
PROBLEM 2.31



Determine the resultant of the three forces of Problem 2.24.

Problem 2.24: Determine the *x* and *y* components of each of the forces shown.

SOLUTION



From Problem 2.24:

$$\mathbf{F}_{500} = -(140\text{ N})\mathbf{i} + (480\text{ N})\mathbf{j}$$

$$\mathbf{F}_{425} = (315\text{ N})\mathbf{i} + (300\text{ N})\mathbf{j}$$

$$\mathbf{F}_{510} = (240\text{ N})\mathbf{i} - (450\text{ N})\mathbf{j}$$

$$\mathbf{R} = \Sigma\mathbf{F} = (415\text{ N})\mathbf{i} + (330\text{ N})\mathbf{j}$$

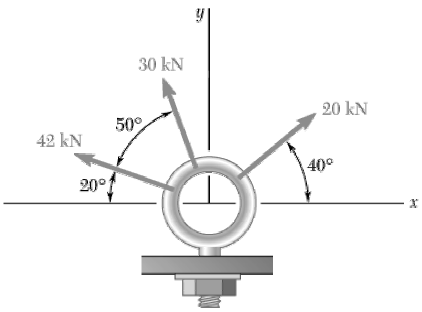
Then:

$$\alpha = \tan^{-1}\frac{330}{415} = 38.5°$$

$$R = \sqrt{(415\text{ N})^2 + (330\text{ N})^2} = 530.2\text{ N}$$

Thus: $\mathbf{R} = 530\text{ N} \measuredangle 38.5°$ ◀

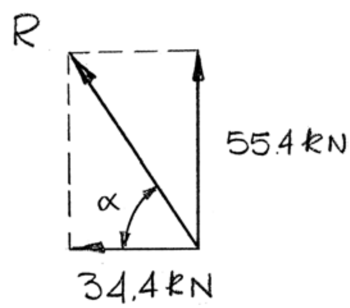
PROBLEM 2.32



Determine the resultant of the three forces of Problem 2.21.

Problem 2.21: Determine the *x* and *y* components of each of the forces shown.

SOLUTION



From Problem 2.21:

$$\mathbf{F}_{20} = (15.32\text{ kN})\mathbf{i} + (12.86\text{ kN})\mathbf{j}$$

$$\mathbf{F}_{30} = -(10.26\text{ kN})\mathbf{i} + (28.2\text{ kN})\mathbf{j}$$

$$\mathbf{F}_{42} = -(39.5\text{ kN})\mathbf{i} + (14.36\text{ kN})\mathbf{j}$$

$$\mathbf{R} = \Sigma\mathbf{F} = -(34.44\text{ kN})\mathbf{i} + (55.42\text{ kN})\mathbf{j}$$

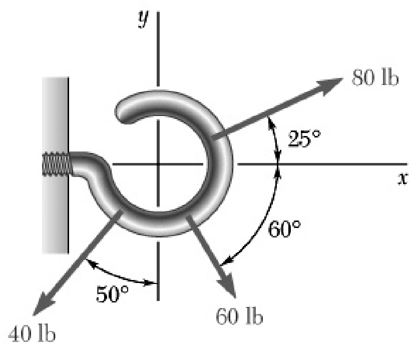
Then:

$$\alpha = \tan^{-1}\frac{55.42}{-34.44} = 58.1°$$

$$R = \sqrt{(55.42\text{ kN})^2 + (-34.44\text{ N})^2} = 65.2\text{ kN}$$

$R = 65.2$ kN ⦣58.2° ◀

PROBLEM 2.33



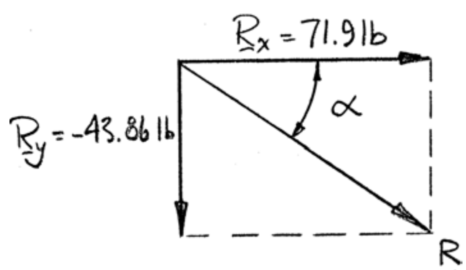
Determine the resultant of the three forces of Problem 2.22.

Problem 2.22: Determine the x and y components of each of the forces shown.

SOLUTION

The components of the forces were determined in 2.23.

Force	x comp. (lb)	y comp. (lb)
40 lb	–30.6	–25.7
60 lb	30	–51.96
80 lb	72.5	33.8
	$R_x = 71.9$	$R_y = -43.86$



$$\mathbf{R} = R_x\mathbf{i} + R_y\mathbf{j}$$

$$= (71.9 \text{ lb})\mathbf{i} - (43.86 \text{ lb})\mathbf{j}$$

$$\tan\alpha = \frac{43.86}{71.9}$$

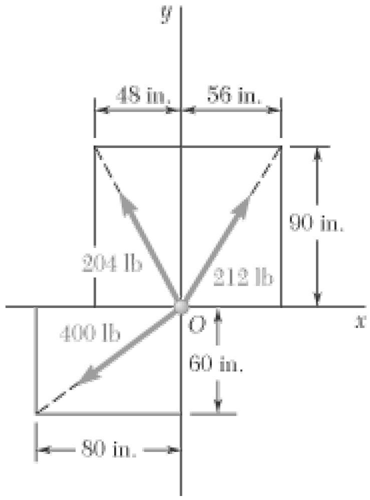
$$\alpha = 31.38°$$

$$R = \sqrt{(71.9 \text{ lb})^2 + (-43.86 \text{ lb})^2}$$

$$= 84.23 \text{ lb}$$

$\mathbf{R} = 84.2$ lb ⦪ 31.4° ◀

PROBLEM 2.34



Determine the resultant of the three forces of Problem 2.23.

Problem 2.23: Determine the x and y components of each of the forces shown.

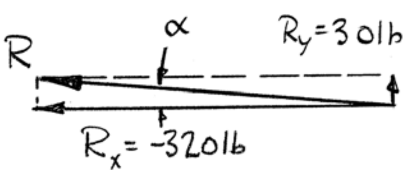
SOLUTION

The components of the forces were determined in Problem 2.23.

$$\mathbf{F}_{204} = -(48.0 \text{ lb})\mathbf{i} + (90.0 \text{ lb})\mathbf{j}$$

$$\mathbf{F}_{212} = (112.0 \text{ lb})\mathbf{i} + (180.0 \text{ lb})\mathbf{j}$$

$$\mathbf{F}_{400} = -(320 \text{ lb})\mathbf{i} - (240 \text{ lb})\mathbf{j}$$



Thus

$$\mathbf{R} = \mathbf{R}_x + \mathbf{R}_y$$

$$\mathbf{R} = -(256 \text{ lb})\mathbf{i} + (30.0 \text{ lb})\mathbf{j}$$

Now:

$$\tan\alpha = \frac{30.0}{256}$$

$$\alpha = \tan^{-1}\frac{30.0}{256} = 6.68°$$

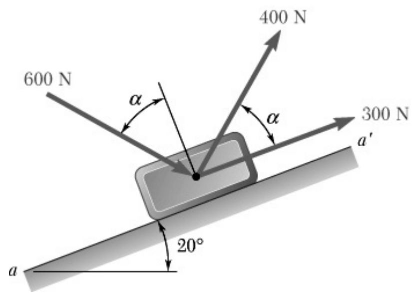
and

$$R = \sqrt{(-256 \text{ lb})^2 + (30.0 \text{ lb})^2}$$

$$= 257.75 \text{ lb}$$

$\mathbf{R} = 258 \text{ lb}$ ⦪ $6.68°$ ◀

PROBLEM 2.35



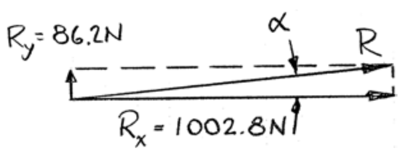
Knowing that $\alpha = 35°$, determine the resultant of the three forces shown.

SOLUTION

300-N Force:

$$F_x = (300\text{ N})\cos 20° = 281.9\text{ N}$$

$$F_y = (300\text{ N})\sin 20° = 102.6\text{ N}$$



400-N Force:

$$F_x = (400\text{ N})\cos 55° = 229.4\text{ N}$$

$$F_y = (400\text{ N})\sin 55° = 327.7\text{ N}$$

600-N Force:

$$F_x = (600\text{ N})\cos 35° = 491.5\text{ N}$$

$$F_y = -(600\text{ N})\sin 35° = -344.1\text{ N}$$

and

$$R_x = \Sigma F_x = 1002.8\text{ N}$$

$$R_y = \Sigma F_y = 86.2\text{ N}$$

$$R = \sqrt{(1002.8\text{ N})^2 + (86.2\text{ N})^2} = 1006.5\text{ N}$$

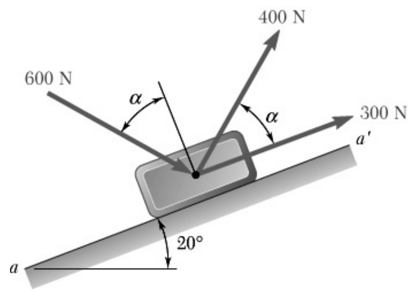
Further:

$$\tan\alpha = \frac{86.2}{1002.8}$$

$$\alpha = \tan^{-1}\frac{86.2}{1002.8} = 4.91°$$

$$\mathbf{R} = 1007\text{ N} \measuredangle 4.91° \blacktriangleleft$$

PROBLEM 2.36



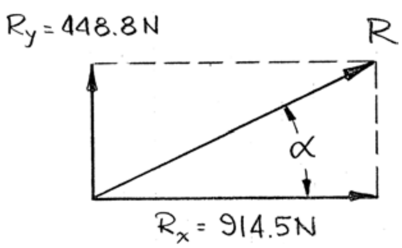
Knowing that $\alpha = 65°$, determine the resultant of the three forces shown.

SOLUTION

300-N Force:

$$F_x = (300\text{ N})\cos 20° = 281.9\text{ N}$$

$$F_y = (300\text{ N})\sin 20° = 102.6\text{ N}$$



400-N Force:

$$F_x = (400\text{ N})\cos 85° = 34.9\text{ N}$$

$$F_y = (400\text{ N})\sin 85° = 398.5\text{ N}$$

600-N Force:

$$F_x = (600\text{ N})\cos 5° = 597.7\text{ N}$$

$$F_y = -(600\text{ N})\sin 5° = -52.3\text{ N}$$

and

$$R_x = \Sigma F_x = 914.5\text{ N}$$

$$R_y = \Sigma F_y = 448.8\text{ N}$$

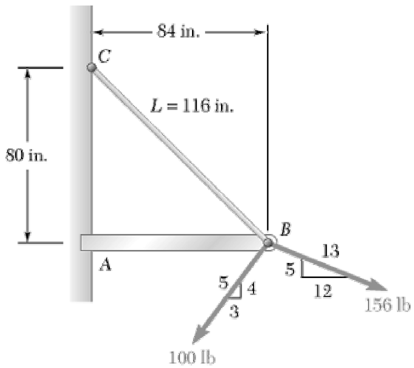
$$R = \sqrt{(914.5\text{ N})^2 + (448.8\text{ N})^2} = 1018.7\text{ N}$$

Further:

$$\tan\alpha = \frac{448.8}{914.5}$$

$$\alpha = \tan^{-1}\frac{448.8}{914.5} = 26.1°$$

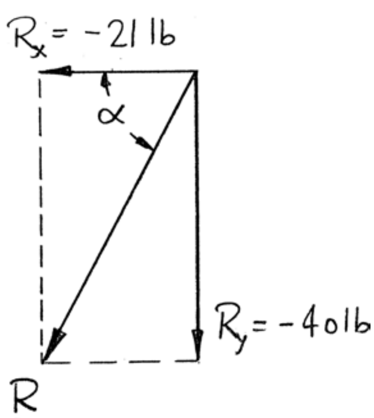
R = 1019 N ⦣ 26.1° ◀



PROBLEM 2.37

Knowing that the tension in cable *BC* is 145 lb, determine the resultant of the three forces exerted at point *B* of beam *AB*.

SOLUTION



Cable BC Force:

$$F_x = -(145\text{ lb})\frac{84}{116} = -105\text{ lb}$$

$$F_y = (145\text{ lb})\frac{80}{116} = 100\text{ lb}$$

100-lb Force:

$$F_x = -(100\text{ lb})\frac{3}{5} = -60\text{ lb}$$

$$F_y = -(100\text{ lb})\frac{4}{5} = -80\text{ lb}$$

156-lb Force:

$$F_x = (156\text{ lb})\frac{12}{13} = 144\text{ lb}$$

$$F_y = -(156\text{ lb})\frac{5}{13} = -60\text{ lb}$$

and

$$R_x = \Sigma F_x = -21\text{ lb}, \qquad R_y = \Sigma F_y = -40\text{ lb}$$

$$R = \sqrt{(-21\text{ lb})^2 + (-40\text{ lb})^2} = 45.177\text{ lb}$$

Further:

$$\tan\alpha = \frac{40}{21}$$

$$\alpha = \tan^{-1}\frac{40}{21} = 62.3°$$

Thus: $\mathbf{R} = 45.2\text{ lb} \measuredangle 62.3°$ ◀