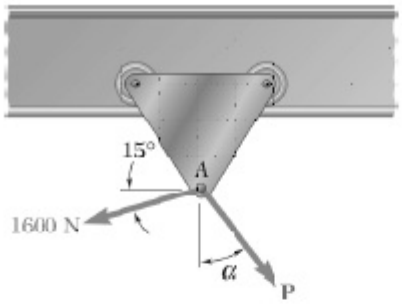
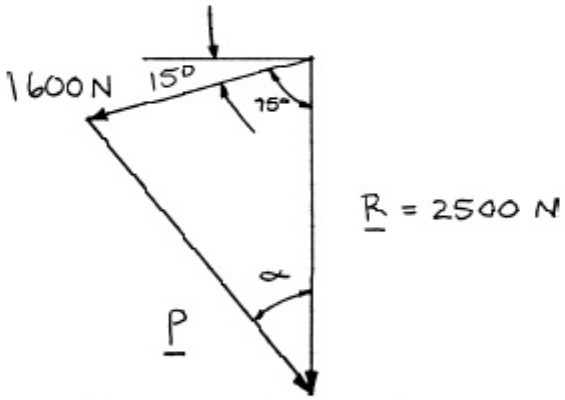


PROBLEM 2.7

A trolley that moves along a horizontal beam is acted upon by two forces as shown. Determine by trigonometry the magnitude and direction of the force **P** so that the resultant is a vertical force of 2500 N.

SOLUTION



Using the law of cosines:

$$P^2 = (1600\text{ N})^2 + (2500\text{ N})^2 - 2(1600\text{ N})(2500\text{ N})\cos 75°$$

$$P = 2596\text{ N}$$

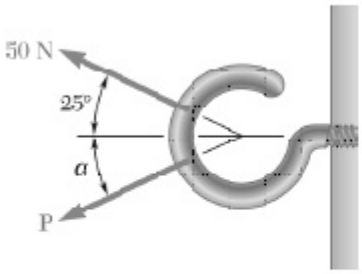
Using the law of sines:

$$\frac{\sin\alpha}{1600\text{ N}} = \frac{\sin 75°}{2596\text{ N}}$$

$$\alpha = 36.5°$$

P is directed $90° - 36.5°$ or $53.5°$ below the horizontal.

P = 2600 N ↘ 53.5° ◀

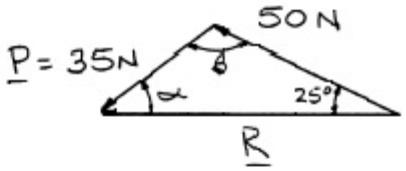


PROBLEM 2.10

Two forces are applied as shown to a hook support. Knowing that the magnitude of **P** is 35 N, determine by trigonometry (*a*) the required angle α if the resultant **R** of the two forces applied to the support is to be horizontal, (*b*) the corresponding magnitude of **R**.

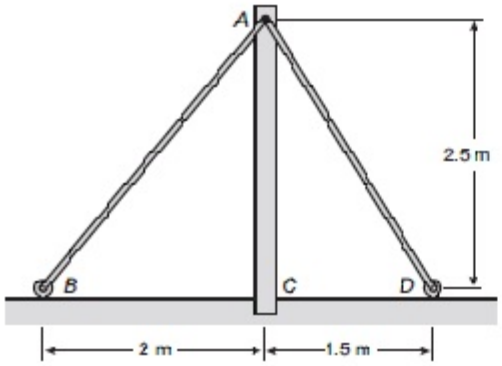
SOLUTION

Using the triangle rule and law of sines:



(*a*)
$$\frac{\sin\alpha}{50\text{ N}} = \frac{\sin 25^\circ}{35\text{ N}}$$
$$\sin\alpha = 0.60374$$
$$\alpha = 37.138^\circ$$
$$\alpha = 37.1^\circ \blacktriangleleft$$

(*b*)
$$\alpha + \beta + 25^\circ = 180^\circ$$
$$\beta = 180^\circ - 25^\circ - 37.138^\circ$$
$$= 117.862^\circ$$
$$\frac{R}{\sin 117.862^\circ} = \frac{35\text{ N}}{\sin 25^\circ}$$
$$R = 73.2\text{ N} \blacktriangleleft$$

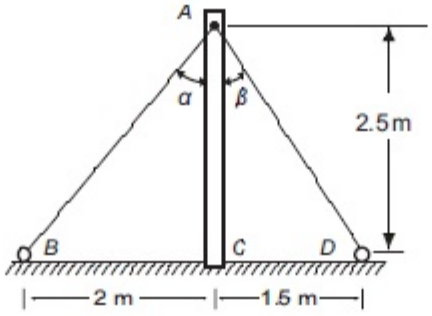


PROBLEM 2.15

Solve Problem 2.2 by trigonometry.

PROBLEM 2.2 The cable stays *AB* and *AD* help support pole *AC*. Knowing that the tension is 600 N in *AB* and 200 N in *AD*, determine graphically the magnitude and direction of the resultant of the forces exerted by the stays at *A* using (*a*) the parallelogram law, (*b*) the triangle rule.

SOLUTION

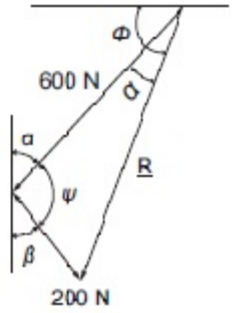


$$\tan\alpha = \frac{2}{2.5}$$

$$\alpha = 38.66°$$

$$\tan\beta = \frac{1.5}{2.5}$$

$$\beta = 30.96°$$



Using the triangle rule: $\alpha + \beta + \psi = 180°$

$$38.66° + 30.96° + \psi = 180°$$

$$\psi = 110.38°$$

Using the law of cosines: $R^2 = (600\text{ N})^2 + (200\text{ N})^2 - 2(600\text{ N})(200\text{ N})\cos 110.38°$

$$R = 695.4\text{ N}$$

Using the law of sines: $\dfrac{\sin\gamma}{200\text{ N}} = \dfrac{\sin 110.38°}{695.4\text{ N}}$

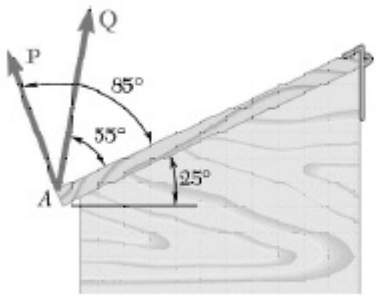
$$\gamma = 15.64°$$

$$\phi = (90° - \alpha) + \gamma$$

$$\phi = (90° - 38.66°) + 15.64°$$

$$\phi = 66.98°$$

R = 695.4 N ∠ 67.0° ◀



PROBLEM 2.20

Two forces **P** and **Q** are applied to the lid of a storage bin as shown. Knowing that $P = 60$ N and $Q = 48$ N, determine by trigonometry the magnitude and direction of the resultant of the two forces.

SOLUTION

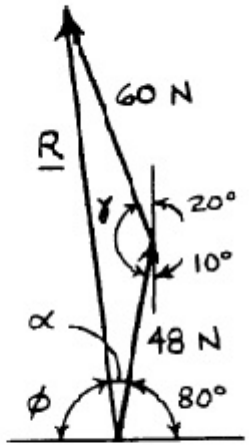
Using the force triangle and the laws of cosines and sines:

We have
$$\gamma = 180° - (20° + 10°)$$
$$= 150°$$

Then
$$R^2 = (60\text{ N})^2 + (48\text{ N})^2 - 2(60\text{ N})(48\text{ N})\cos 150°$$
$$R = 104.366\text{ N}$$

and
$$\frac{60\text{ N}}{\sin\alpha} = \frac{104.366\text{ N}}{\sin 150°}$$
$$\sin\alpha = 0.28745$$
$$\alpha = 16.7054°$$

Hence:
$$\phi = 180° - \alpha - 180°$$
$$= 180° - 16.7054° - 80°$$
$$= 83.295°$$



R = 104.4 N ↘ 83.3° ◀