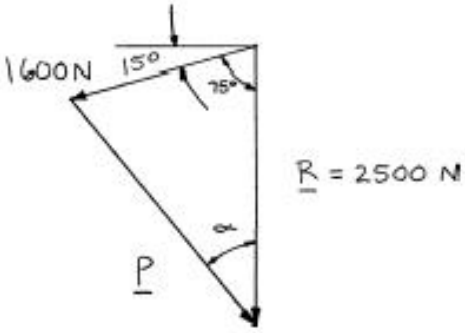


PROBLEM 2.7

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:

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

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

Using the law of sines:

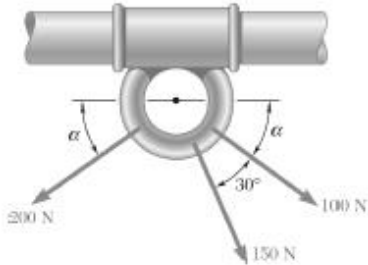
$$\frac{\sin \alpha}{1600 \text{ N}} = \frac{\sin 75^\circ}{2596 \text{ N}}$$

$$\alpha = 36.5^\circ$$

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

P = 2600 N \searrow 53.5° ◀

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PROBLEM 2.35

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

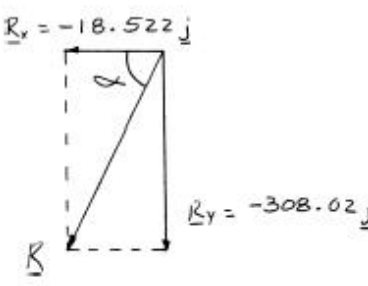
SOLUTION

100-N Force: $F_x = +(100 \text{ N}) \cos 35^\circ = +81.915 \text{ N}$
 $F_y = -(100 \text{ N}) \sin 35^\circ = -57.358 \text{ N}$

150-N Force: $F_x = +(150 \text{ N}) \cos 65^\circ = +63.393 \text{ N}$
 $F_y = -(150 \text{ N}) \sin 65^\circ = -135.946 \text{ N}$

200-N Force: $F_x = -(200 \text{ N}) \cos 35^\circ = -163.830 \text{ N}$
 $F_y = -(200 \text{ N}) \sin 35^\circ = -114.715 \text{ N}$

Force	x Comp. (N)	y Comp. (N)
100 N	+81.915	-57.358
150 N	+63.393	-135.946
200 N	-163.830	-114.715
	$R_x = -18.522$	$R_y = -308.02$



$R_x = -18.522 \underline{j}$

$R_y = -308.02 \underline{j}$

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

$$= (-18.522 \text{ N})\mathbf{i} + (-308.02 \text{ N})\mathbf{j}$$

$$\tan \alpha = \frac{R_y}{R_x}$$

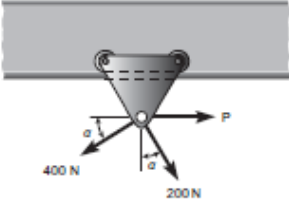
$$= \frac{308.02}{18.522}$$

$$\alpha = 86.559^\circ$$

$$R = \frac{308.02 \text{ N}}{\sin 86.559}$$

$\mathbf{R} = 309 \text{ N} \nearrow 86.6^\circ \blacktriangleleft$

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PROBLEM 2.41

A hoist trolley is subjected to the three forces shown. Knowing that $\alpha = 40^\circ$, determine (a) the required magnitude of the force **P** if the resultant of the three forces is to be vertical, (b) the corresponding magnitude of the resultant.

SOLUTION

$$R_x = \overset{+}{\rightarrow} \Sigma F_x = P + (200 \text{ N}) \sin 40^\circ - (400 \text{ N}) \cos 40^\circ$$

$$R_x = P - 177.860 \text{ N} \tag{1}$$

$$R_y = \overset{+}{\downarrow} \Sigma F_y = (200 \text{ N}) \cos 40^\circ + (400 \text{ N}) \sin 40^\circ$$

$$R_y = 410.32 \text{ N} \tag{2}$$

(a) For **R** to be vertical, we must have $R_x = 0$.

Set $R_x = 0$ in Eq. (1)

$$0 = P - 177.860 \text{ N}$$

$$P = 177.860 \text{ N} \qquad P = 177.9 \text{ N} \blacktriangleleft$$

(b) Since **R** is to be vertical:

$$R = R_y = 410 \text{ N} \qquad R = 410 \text{ N} \blacktriangleleft$$

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