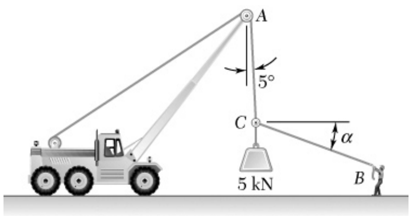
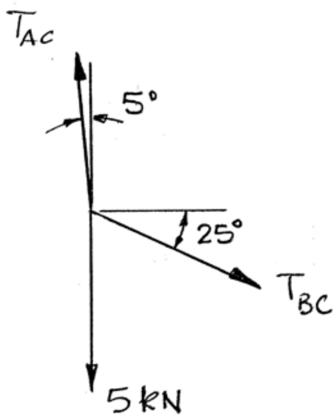


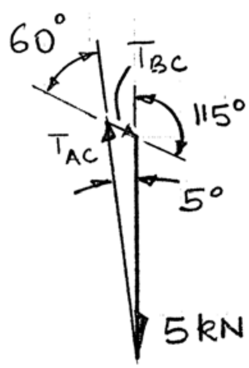
PROBLEM 2.44

Knowing that $\alpha = 25°$, determine the tension (*a*) in cable *AC*, (*b*) in rope *BC*.

SOLUTION

Free-Body Diagram **Force Triangle**





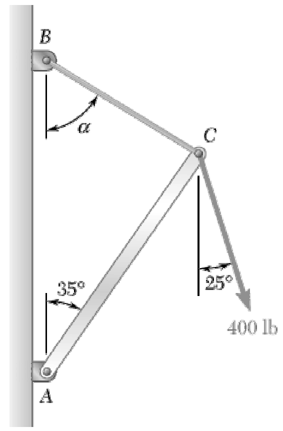
Law of Sines:

$$\frac{T_{AC}}{\sin 115°} = \frac{T_{BC}}{\sin 5°} = \frac{5 \text{ kN}}{\sin 60°}$$

(*a*) $$T_{AC} = \frac{5 \text{ kN}}{\sin 60°}\sin 115° = 5.23 \text{ kN}$$ $T_{AC} = 5.23$ kN ◀

(*b*) $$T_{BC} = \frac{5 \text{ kN}}{\sin 60°}\sin 5° = 0.503 \text{ kN}$$ $T_{BC} = 0.503$ kN ◀

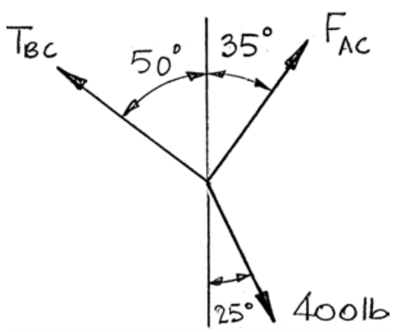
PROBLEM 2.45



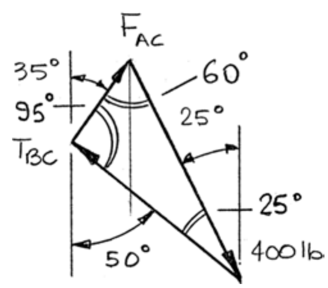
Knowing that $\alpha = 50°$ and that boom *AC* exerts on pin *C* a force directed long line *AC*, determine (*a*) the magnitude of that force, (*b*) the tension in cable *BC*.

SOLUTION

Free-Body Diagram



Force Triangle



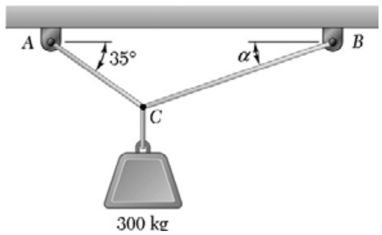
Law of Sines:

$$\frac{F_{AC}}{\sin 25°} = \frac{T_{BC}}{\sin 60°} = \frac{400 \text{ lb}}{\sin 95°}$$

(*a*) $$F_{AC} = \frac{400 \text{ lb}}{\sin 95°}\sin 25° = 169.69 \text{ lb}$$ $F_{AC} = 169.7$ lb ◀

(*b*) $$T_{BC} = \frac{400}{\sin 95°}\sin 60° = 347.73 \text{ lb}$$ $T_{BC} = 348$ lb ◀

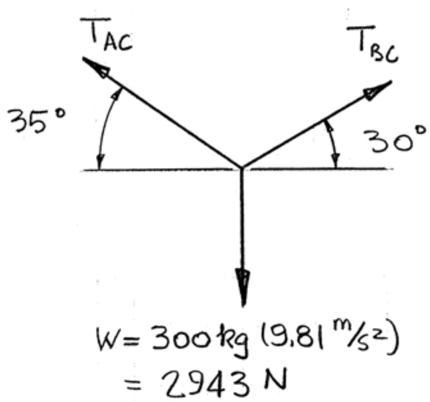
PROBLEM 2.46



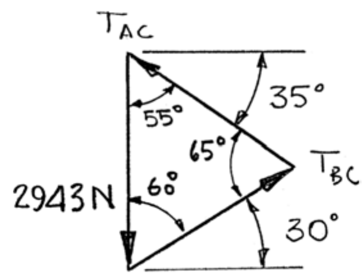
Two cables are tied together at *C* and are loaded as shown. Knowing that $\alpha = 30°$, determine the tension (*a*) in cable *AC*, (*b*) in cable *BC*.

SOLUTION

Free-Body Diagram



Force Triangle



Law of Sines:

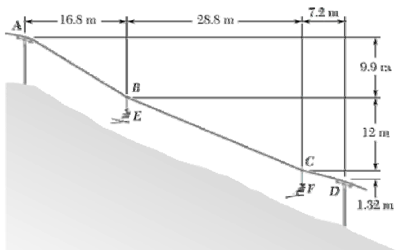
$$\frac{T_{AC}}{\sin 60°} = \frac{T_{BC}}{\sin 55°} = \frac{2943 \text{ N}}{\sin 65°}$$

(*a*) $$T_{AC} = \frac{2943 \text{ N}}{\sin 65°} \sin 60° = 2812.19 \text{ N}$$

$T_{AC} = 2.81 \text{ kN}$ ◀

(*b*) $$T_{BC} = \frac{2943 \text{ N}}{\sin 65°} \sin 55° = 2659.98 \text{ N}$$

$T_{BC} = 2.66 \text{ kN}$ ◀

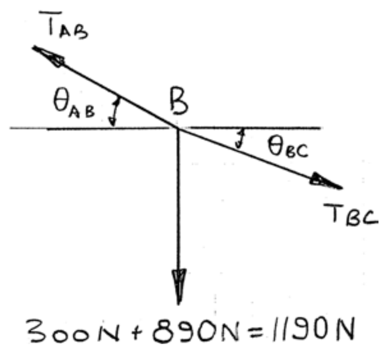


PROBLEM 2.47

A chairlift has been stopped in the position shown. Knowing that each chair weighs 300 N and that the skier in chair *E* weighs 890 N, determine that weight of the skier in chair *F*.

SOLUTION

Free-Body Diagram Point B

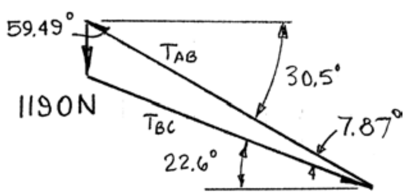


In the free-body diagram of point *B*, the geometry gives:

$$\theta_{AB} = \tan^{-1}\frac{9.9}{16.8} = 30.51°$$

$$\theta_{BC} = \tan^{-1}\frac{12}{28.8} = 22.61°$$

Force Triangle

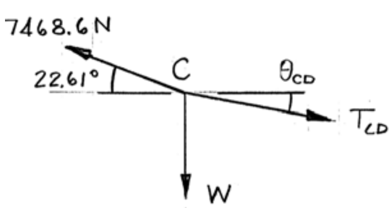


Thus, in the force triangle, by the Law of Sines:

$$\frac{T_{BC}}{\sin 59.49°} = \frac{1190 \text{ N}}{\sin 7.87°}$$

$$T_{BC} = 7468.6 \text{ N}$$

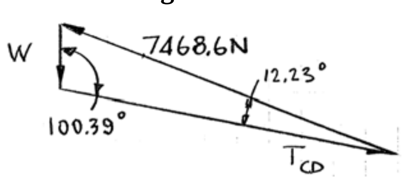
Free-Body Diagram Point C



In the free-body diagram of point *C* (with *W* the sum of weights of chair and skier) the geometry gives:

$$\theta_{CD} = \tan^{-1}\frac{1.32}{7.2} = 10.39°$$

Force Triangle



Hence, in the force triangle, by the Law of Sines:

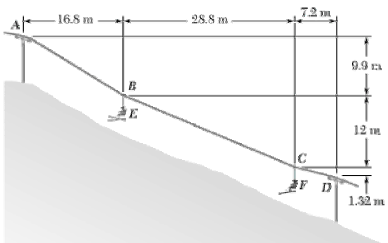
$$\frac{W}{\sin 12.23°} = \frac{7468.6 \text{ N}}{\sin 100.39°}$$

$$W = 1608.5 \text{ N}$$

Finally, the skier weight $= 1608.5 \text{ N} - 300 \text{ N} = 1308.5 \text{ N}$

skier weight $= 1309$ N ◀

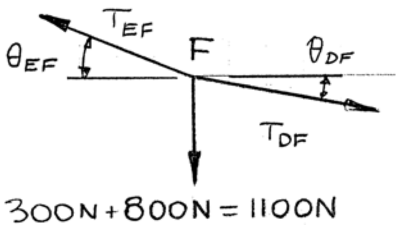
PROBLEM 2.48



A chairlift has been stopped in the position shown. Knowing that each chair weighs 300 N and that the skier in chair *F* weighs 800 N, determine the weight of the skier in chair *E*.

SOLUTION

Free-Body Diagram Point F



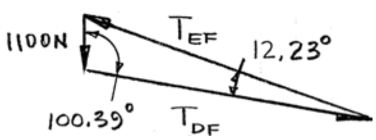
In the free-body diagram of point *F*, the geometry gives:

$$\theta_{EF} = \tan^{-1}\frac{12}{28.8} = 22.62°$$

$$\theta_{DF} = \tan^{-1}\frac{1.32}{7.2} = 10.39°$$

Thus, in the force triangle, by the Law of Sines:

Force Triangle

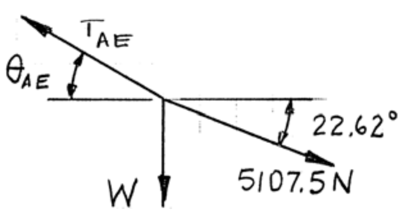


$$\frac{T_{EF}}{\sin 100.39°} = \frac{1100 \text{ N}}{\sin 12.23°}$$

$$T_{BC} = 5107.5 \text{ N}$$

In the free-body diagram of point *E* (with *W* the sum of weights of chair and skier) the geometry gives:

Free-Body Diagram Point E



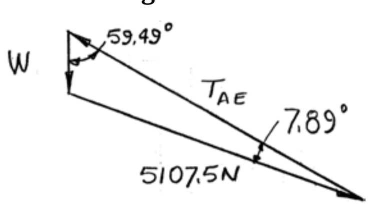
$$\theta_{AE} = \tan^{-1}\frac{9.9}{16.8} = 30.51°$$

Hence, in the force triangle, by the Law of Sines:

$$\frac{W}{\sin 7.89°} = \frac{5107.5 \text{ N}}{\sin 59.49°}$$

$$W = 813.8 \text{ N}$$

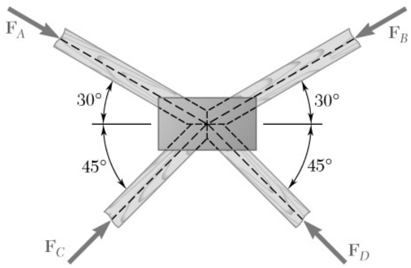
Force Triangle



Finally, the skier weight $= 813.8 \text{ N} - 300 \text{ N} = 513.8 \text{ N}$

skier weight $= 514$ N ◀

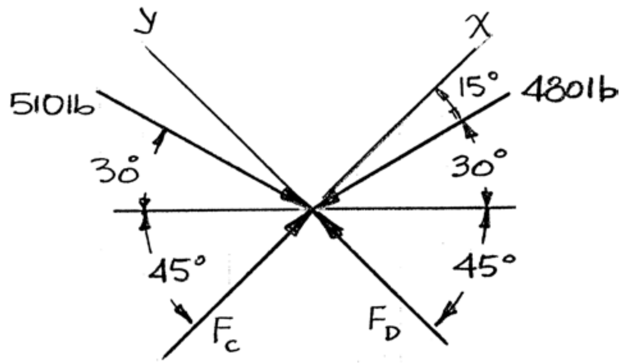
PROBLEM 2.49



Four wooden members are joined with metal plate connectors and are in equilibrium under the action of the four fences shown. Knowing that $F_A = 510$ lb and $F_B = 480$ lb, determine the magnitudes of the other two forces.

SOLUTION

Free-Body Diagram



Resolving the forces into *x* and *y* components:

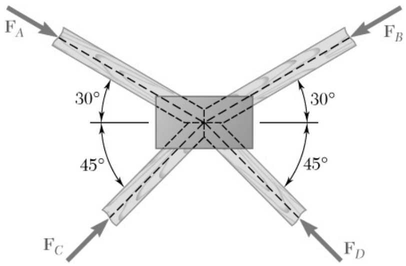
$$\Sigma F_x = 0: \quad F_C + (510 \text{ lb})\sin 15° - (480 \text{ lb})\cos 15° = 0$$

or $F_C = 332$ lb ◀

$$\Sigma F_y = 0: \quad F_D - (510 \text{ lb})\cos 15° + (480 \text{ lb})\sin 15° = 0$$

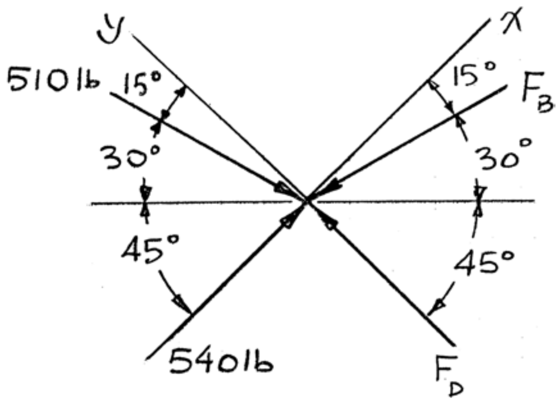
or $F_D = 368$ lb ◀

PROBLEM 2.50



Four wooden members are joined with metal plate connectors and are in equilibrium under the action of the four fences shown. Knowing that $F_A = 420$ lb and $F_C = 540$ lb, determine the magnitudes of the other two forces.

SOLUTION



Resolving the forces into *x* and *y* components:

$$\Sigma F_x = 0: \quad -F_B \cos 15° + (540 \text{ lb}) + (420 \text{ lb})\cos 15° = 0 \qquad \text{or} \qquad F_B = 671.6 \text{ lb}$$

$F_B = 672$ lb ◀

$$\Sigma F_y = 0: \quad F_D - (420 \text{ lb})\cos 15° + (671.6 \text{ lb})\sin 15° = 0$$

or $F_D = 232$ lb ◀