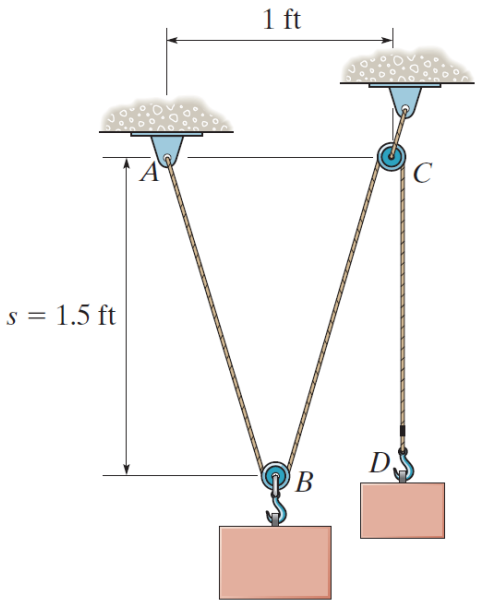
Problem 3-42

A "scale" is constructed with a 4-ft-long cord and the 10-lb block D. The cord is fixed to a pin at A and passes over two *small* pulleys. Determine the weight of the suspended block B if the system is in equilibrium when $s = 1.5$ ft.



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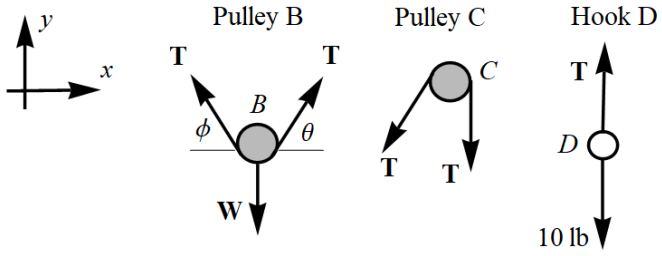
Solution

Draw free-body diagrams for the two pulleys and the hook. The pulleys are assumed to be frictionless, so the tension is the same everywhere in the cord.



In order for the system to be in equilibrium, the sum of the forces in each direction must be zero.

$$\sum F_x = 0: \qquad T\cos\theta - T\cos\phi = 0 \qquad 0 = 0$$

$$\sum F_y = 0: \qquad T\sin\theta + T\sin\phi - W = 0 \qquad T - 10 = 0$$

This first equation in the middle implies that $\theta = \phi$. Also, since $T = 10$, the second equation becomes

$$2(10)\sin\theta - W = 0 \quad \rightarrow \quad W = 20\sin\theta \text{ lb} = 20\,\frac{1.5 \text{ ft}}{h} \text{ lb}.$$