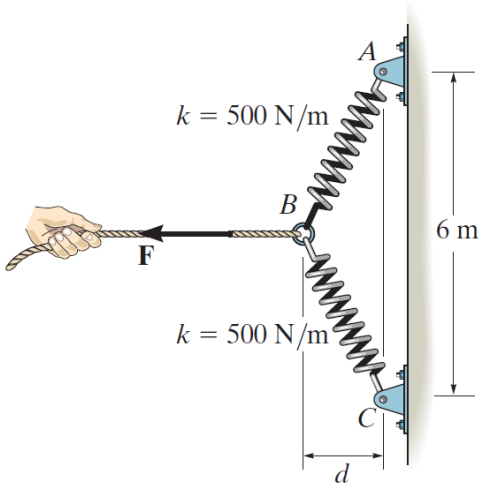
Problem 3-23

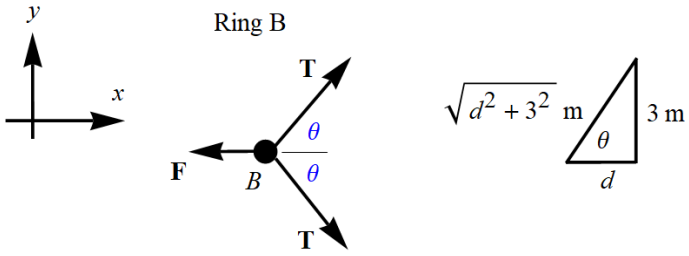
The springs BA and BC each have a stiffness of 500 N/m and an unstretched length of 3 m. Determine the displacement d of the cord from the wall when a force $F = 175$ N is applied to the cord.



Probs. 3–22/23

Solution

Draw a free-body diagram for the ring at B.



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

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

$$\sum F_y = 0: \qquad T\sin\theta - T\sin\theta = 0$$

The equation in the x-direction is relevant.

$$F = 2T\cos\theta = 2(k\Delta x)\cos\theta = 2\left[500\left(\sqrt{d^2+3^2}-3\right)\right]\cos\theta = 1000\left(\sqrt{d^2+3^2}-3\right)\frac{d}{\sqrt{d^2+3^2}}$$

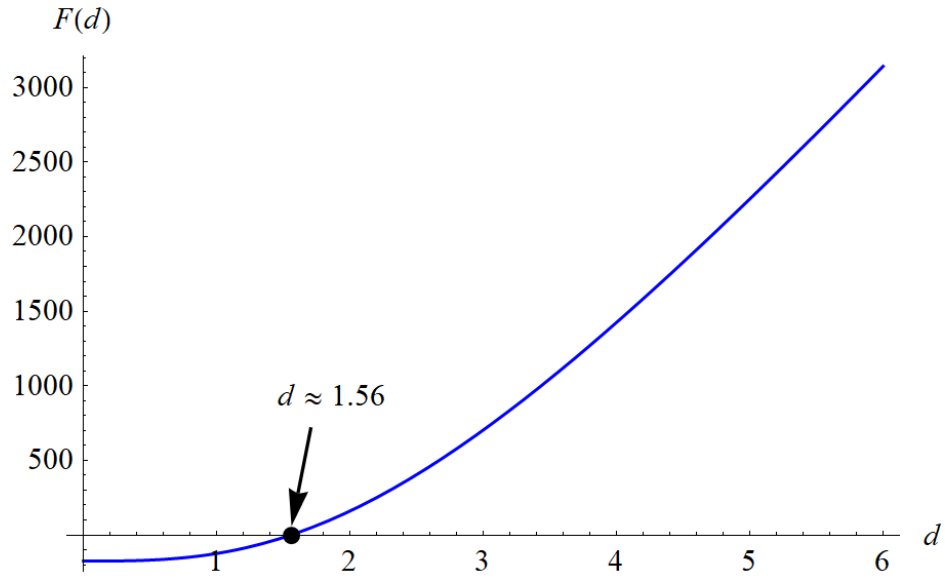
$$= 1000d\left(1-\frac{3}{\sqrt{d^2+3^2}}\right)$$

Set $F = 175$ N and solve the equation for d.

$$175 = 1000d\left(1 - \frac{3}{\sqrt{d^2 + 3^2}}\right)$$

$$1000d\left(1 - \frac{3}{\sqrt{d^2 + 3^2}}\right) - 175 = 0$$

Let the function on the left side be $F(d)$. Graph $F(d)$ versus d and find where the curve crosses the horizontal axis.



Therefore, $d \approx 1.56$ m.