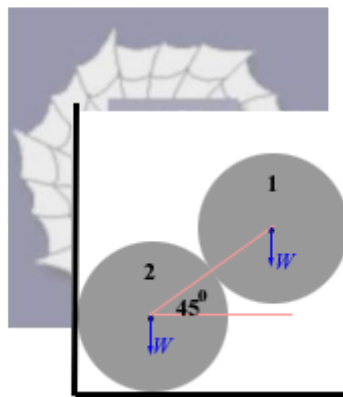


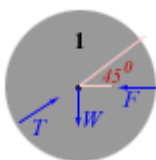
43.

**Problem 13.20P (HRW)**

*Two identical, uniform, frictionless spheres, each of weight  $W$ , rest in a rigid rectangular container. We have to find in terms of  $W$ , the forces acting on the spheres due to (a) the container surfaces and (b) one another, if the line of centres of the spheres makes an angle of  $45^\circ$  with the horizontal.*



**Solution:**



We will first draw the free-body diagram of the ball 1. In this diagram  $F$  is the force on the ball exerted by the wall, and  $T$  is the force exerted by the ball 2 on the ball 1. As the spheres are frictionless, force  $T$  will be along their line of contact, which is at an angle of  $45^\circ$  with the horizontal.

As the ball is in equilibrium, the vector sum of forces has to be zero. Adding the vertical component of forces, we get

$$T \cos 45^\circ = W,$$

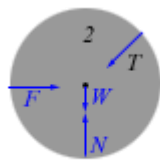
or,

$$T = \sqrt{2}W.$$

Adding the horizontal component of forces acting on ball 1, we get

$$F = T \cos 45^\circ = T/\sqrt{2} = W.$$

We will consider next the free-body diagram of ball 2. It is as shown on the line diagram.



$N$  is the force exerted by the base of the box on the ball 2.  $F$  is the force exerted by the side on the ball and  $T$  is the force

exerted by the ball 1 on ball 2. Applying the conditions of static equilibrium, we get the following two equations:

$$N = W + \frac{1}{\sqrt{2}}T = W + W = 2W,$$

and

$$F = \frac{1}{\sqrt{2}}T = W.$$