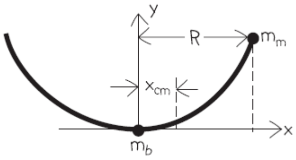
38. When the mouse starts at the rim, the center of mass of the mouse-bowl system has x component:

$$x_{cm} = (m_b x_b + m_m x_m)/(m_b + m_m) = m_m R/(m_b + m_m)$$

since initially $x_b = 0$, and $x_m = R$. Because there is no external horizontal force (no friction), x_{cm} remains constant as the mouse climbs. When it reaches the center of the bowl, both have x coordinates equal to x_{cm}, which is, therefore, the distance moved by the bowl across the counter, given as $\frac{1}{5}R$. Thus, $x_{cm} = \frac{1}{5}R = m_m R(m_b + m_m)$, or $m_m = \frac{1}{4}m_b$.



80. **INTERPRET** Find the center of mass of the solar system. Since most of the mass of the solar system is contained by the Sun, Jupiter, and Saturn, use only these three objects. We will find the distance of the Sun from the center of mass.

DEVELOP We will assume that the three are in line with each other, with both planets on one side of the center of mass. This is not generally the case, but it will give us the maximum amount of solar wobble. The center of mass is located at $r_{cm} = \frac{1}{M}\sum m_i r_i$. The mass of Jupiter is $m_{Jupiter} = 1.90 \times 10^{27}$ kg and its orbital radius is $r_{Jupiter} = 7.78 \times 10^{11}$ m. The mass of Saturn is $m_{Saturn} = 5.68 \times 10^{26}$ kg and its orbital radius is $r_{Saturn} = 1.43 \times 10^{12}$ m. The mass of the Sun is 1.99×10^{30} kg. All distances are measured from the Sun, and M is the total mass of the three.

EVALUATE $r_{cm} = \frac{1}{M}[m_{Sun}\cancel{r_{Sun}} + m_{Jupiter}r_{Jupiter} + m_{Saturn}r_{Saturn}] = 1.15 \times 10^9$ m.

ASSESS This distance is a little less than twice the radius of the Sun.