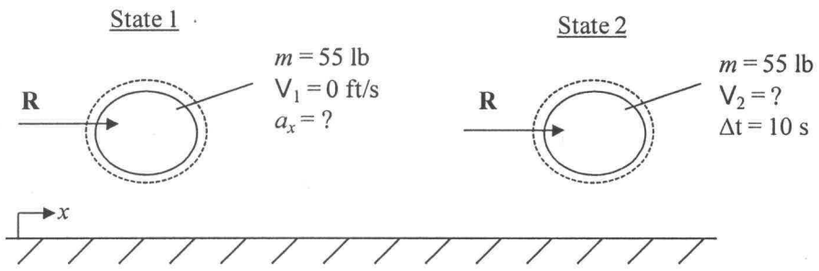
PROBLEM 2.19

Known: Object initially at rest, experiences a constant horizontal acceleration due to the action of a resultant force.

Find: Determine the constant horizontal acceleration in ft/s^2.

Schematic and Given Data:



Engineering Model:
(1) The object is a closed system.
(2) The object is initially at rest.
(3) Motion is horizontal. The system experiences no change in potential energy.
(4) Horizontal acceleration is constant.

Analysis:
Applying Eq. 2.6

$$\int_{s_1}^{s_2}(R)ds = \frac{1}{2}m\left(V_2^2 - V_1^2\right)$$

Using assumption 2, the work of the resultant force is given by

$$Work = \frac{1}{2}m\left(V_2^2\right)$$

Rearranging and substituting known values, the final velocity is

$$V_2 = \sqrt{\frac{2(\text{Work})}{m}} = \sqrt{\frac{2(10\text{Btu})}{55\text{lb}}\left|\frac{778\text{ft}\cdot\text{lbf}}{1\text{Btu}}\right|\left|\frac{32.2\text{lb}\cdot\frac{\text{ft}}{\text{s}^2}}{1\text{lbf}}\right|} = 95.44\frac{\text{ft}}{\text{s}}$$

Acceleration can be determined

$$a = \frac{V_2 - V_1}{\Delta t} = \frac{95.44\frac{\text{ft}}{\text{s}} - 0}{10\text{ s}} = 9.54\frac{\text{ft}}{\text{s}^2}$$