Chapter 06, Problem 051
An airplane is flying in a horizontal circle at a speed of 500 km/h. If its wings are tilted at angle $\theta = 30^\circ$ to the horizontal, what is the radius of the circle in which the plane is flying?

\[ F_c = \tan 34^\circ \frac{mg}{\cos \theta} \]
\[ r = \frac{mg}{F_c} \]
\[ \tan 30^\circ g = 130.56 \]
\[ r = 1865 \text{ m} \]

Chapter 09, Problem 068
Block 1 of mass $m_1$ slides from rest along a frictionless ramp from height $h = 3.0 \text{ m}$ and then collides with stationary block 2, $m_2 = 4m_1$. After the collision, block 2 slides into a region where the coefficient of kinetic friction $\mu_k$ is 0.40 and comes to a stop in distance $d$ within that region.

\[ m_1v_{top} + \frac{1}{2}mv_{top}^2 = m_1v_{bot} + \frac{1}{2}mv_{bot}^2 \]
\[ v_{bot} = 7.75 \text{ m/s} \]

Inelastic
Now it collides
\[ m_1v + m_2v = (m_1+m_2)v_{1,2} \]
\[ m_1v + 0 = (m + 4m)v_{1,2} \]
\[ v_{1,2} = 1.55 \text{ m/s} \]

Energy, post collision, is reduced by friction through a distance
\[ \frac{1}{2}m_{1,2}v_{1,2}^2 - F_f \cdot d = \frac{1}{2}mv_{bot}^2 \]
\[ \frac{1}{2}5m 1.55^2 - 0.4(5)m g \cdot d = 0 \]
\[ 6 - 20d = 0 \]
\[ d_{inelas} = 0.30 \text{ m} \]

Chapter 09, Problem 058
Block 2 (mass 2.00 kg) is at rest on a frictionless surface and touching the end of an unstretched spring of spring constant 4 N/cm. The other end of the spring is fixed to a wall. Block 1 (mass 3.00 kg), with an initial speed of speed $v_1 = 8.00 \text{ m/s}$ travels 4 meters on a dirty surface with an effective coefficient of friction of 0.2, then collides with block 2 (clean and frictionless at that point), and the two blocks stick together.

\[ \text{Initial energy is reduced by friction through a distance} \]
\[ \frac{1}{2}m_{1,2}v^2 - F_f \cdot d = \frac{1}{2}mv_{f}^2 \]
\[ \frac{1}{2}5m 6.92^2 - 0.2(5)m g \cdot d = 0 \]
\[ 20 - 16d = 0 \]
\[ d_{elas} = 1.2 \text{ m} \]
A pulley, with a rotational inertia of 2.00 × 10^{-3} \text{ kg} \cdot \text{m}^2 about its axle and a radius of 10.0 cm, is acted on by a force applied tangentially at its rim. The force magnitude varies in time as \( F = t + 0.90t^2 \), \text{SI} units. The pulley is initially at rest. At \( t = 4.00 \) s what is its angular speed?

\[
τ = I \alpha \\
rF \, dt = \int \frac{I}{r} \, d\omega \\
\int t \, dt + 0.9 \int t^2 \, dt = \left( \frac{I}{r} \right) \Delta \omega \\
\frac{1}{2} t^2 + 0.9/3 \, t^3 = (2 \times 10^{-3} / 0.1) \Delta \omega \\
\Delta \omega = 1360 \text{ rad/sec}
\]