SIXTH MIDTERM

REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!
Use the conversion constants and data given on the front page.

(a) A truck with wheels 48.0 inches in diameter is traveling at 60.0 mi/hour. Calculate the angular velocity of its wheels assuming they are not slipping.

\[ \omega = \frac{\sqrt{R}}{2} \]

\[ = \frac{\sqrt{60.0 \text{ mi/hr} \cdot \frac{1 \text{ hr}}{3600 \text{ sec}}}}{114 \text{ in}} \]

\[ \approx 4.4 \text{ rad/sec} \]

(b) Two uniform solid spheres of mass \( M \) and radius \( R \) are touching. Determine the moment of inertia of this system for rotation about an axis through point A and perpendicular to the paper.

\[ I = I_{cm} + Mn^2 \]

\[ I_{tot} = I_{Si} + I_{Sc} = (\frac{2}{5} MR^2 + M R^2) + (\frac{2}{5} MR^2 + M (3R)^2) = \frac{5}{5} M R^2 
\]

\[ = 10.8 M R^2 \]

(c) The angular frequency of an oscillator is 375.0 rad/sec. Find its period.

\[ T = \frac{2\pi}{\omega} = \frac{2\pi}{375.0 \text{ rad/sec}} \approx 0.0168 \text{ s} \]

\[ (1.68 \times 10^{-2} \text{ s}) \]

(d) Calculate the total kinetic energy, Joules, of a 16.1 pound bowling ball rolling without slipping and at a speed of 40.0 ft/s. \( m = 16.1 \text{ lbs}, R = 32.2 \text{ ft/} \text{s}^2 \)

\[ KE = \frac{1}{2} mv^2 + \frac{1}{2} I\omega^2 = \frac{1}{2} (2) (40.0 \text{ ft/s})^2 + \frac{1}{2} (\frac{2}{5} m R^2)(\omega)^2 = 7.0 \text{ J} \]

\[ \approx 3 \times 10 \left(\frac{16.1 \text{ lbs}}{32.2 \text{ ft/} \text{s}^2}\right)^2 \times (40.0 \text{ ft/s})^2 = 560 \text{ lbs ft} \]

\[ = 7.59 \text{ J} \]

(e) A pendulum clock keeps good time on earth. It is taken to the moon, and started at 12:00 noon in Salt Lake City. When it is 1:00 p.m. in Salt Lake City, what time does this clock read?

\[ T = \sqrt{\frac{l}{g}} \]

\[ \frac{T}{\text{sec}} = \sqrt{\frac{g_{\text{sec}}}{g_m}} = 2.42 \]

After 1 hour on earth, the pendulum has completed \( \frac{1}{2} \) of a period: \( \frac{1}{2} \times 1 \text{ hour} = 24.8 \text{ mn} \). So the clock on the moon reads 12:24:48 (0.8 of 1 mn = 48 sec).