Physics 301  
Winter Quarter 1990  
March 15, 1990  
George Williams

average 17 = 17.7

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FINAL EXAM

Name (print)  
Name (signed)

Discussion Instructor (circle one): Baselgia  
Morrill  
Reeve  
Stoops  
Zhang

Discussion Section #  

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

(a) A wheel with radius \( R = 0.370 \text{ m} \) is rolling without sliding. The velocity of the center of mass is 27.5 m/s. Find the angular velocity of the wheel.

\[
\omega = \frac{v}{R} = \frac{27.5 \text{ m/s}}{0.370 \text{ m}} = 74.5 \text{ rad/s}
\]

(b) A wheel on an axle has an angular acceleration of \(-2.10 \text{ rad/s}^2\), and an initial angular velocity of 17.5 rad/s. How many revolutions does it undergo in 5.0 s?

\[
\theta = \alpha t^2 + \omega_0 t = (-2.10 \text{ rad/s}^2)(5.0 \text{ s})^2 + 17.5 \text{ rad/s}(5.0 \text{ s}) = 9.75 \text{ rad}
\]

(c) Two spheres touch each other. Each has a mass of 5.00 kg, and a radius of 4.25 cm. Calculate the moment of inertia for rotation about an axis through the point of contact and tangent to the two spheres, as shown.

\[
I = \frac{2}{5} M R^2 = \frac{2}{5} (5.00 \text{ kg})(0.0425 \text{ m})^2 = 2.53 \times 10^{-2} \text{ kg m}^2
\]

(d) A rotating wheel with initial angular velocity of 175 rad/s coasts to a stop in 115 s. What is its TOTAL angular displacement during this time?

\[
\theta = \omega_0 t = 175 \text{ rad/s}(115 \text{ s}) = 20187.5 \text{ rad}
\]

(e) Calculate the TOTAL kinetic energy of a bowling ball that is rolling without sliding. The ball weighs 16.0 pounds, its radius is 4.00 inches and the translational velocity of its center-of-mass is 35.0 ft/s.

\[
KE = \frac{1}{2} I \omega^2 = \frac{1}{2} (4.26 \text{ slug ft}^2)(3.78 \text{ ft/s})^2 = 132.7 \text{ J}
\]

(f) An object weighing 19.6 N on earth is given a velocity on the moon of 25.0 m/s. Calculate its kinetic energy on the moon.

\[
KE = \frac{1}{2} m v^2 = \frac{1}{2} (19.6 \text{ N})(25.0 \text{ m/s})^2 = \frac{4900}{2} \text{ J}
\]