FINAL EXAM

Name (print) __________________________  Name (signed) __________________________

Discussion Instructor (circle): Chakhbazian Condella DiCarlo Gundlach Paul Romer Wei

Discussion Section # ______

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

(a) Four cylinders are touching each in the arrangement shown. Calculate the moment of inertia for rotation about the axis A, at the exact center, and perpendicular to the paper. Take the mass of each cylinder as M, and the radius of each as R.

\[
I_A = 2I_0 + 2M R^2 + 2MR^2 = 4MR^2
\]

\[
\Gamma = 4I_A = 10MR^2
\]

(b) A wheel is accelerated from rest at an angular acceleration of \(3.75 \text{ rad/s}^2\). Calculate the total angular displacement after 8.90 s.

\[
\theta = \frac{\omega t^2}{2} = \frac{1}{2} \times 3.75 \times 8.9^2 = 148.5 \text{ rad}
\]

(c) For the wheel in (b), calculate the magnitude of the angular velocity when the total angular displacement is 18.0 rad.

\[
\Omega = \frac{\omega t}{2} = \sqrt{2 \times 18} \approx 11.6 \text{ rad/s}
\]

(d) A car is traveling at 60 mi/hr. If the wheels have a radius of 15 inches, what is the magnitude of their angular velocity in rad/s?

\[
\omega = \frac{v}{r} = \frac{60 \text{ mi/hr}}{15 \text{ in}} = \frac{60 \times 5280 \times 12}{15 \times 3600} = 704.4 \text{ rad/s}
\]

(e) A bowling ball has a weight of 16.0 pounds. If it is rolling without sliding and the radius is 4.00 inches, calculate the rotational kinetic energy if its translational speed is 30.0 ft/s.

\[
E = \frac{1}{2} I \omega^2 = \frac{1}{2} M R^2 \Omega^2 = \frac{M v^2}{2} = \frac{16 \times 30^2}{2 \times 12} = 88.4 \text{ ft-lb}
\]

(f) Calculate magnitude of the angular momentum of a baseball of mass 0.145 kg if it rotates at 1600 RPM (revolutions per minute). Assume a uniform mass distribution. Take the radius as 4.00 cm.

\[
\mathbf{L} = I \omega = \frac{1}{2} M R^2 \omega = \frac{2}{3} \times 0.145 \times 0.04 \times 0.04 \times 1600 \approx 135 \text{ N-m}^2 \text{s}^{-1}
\]