From Ch. 10

A wheel is initially spinning at 1 rad/s and has a constant angular acceleration of -0.01 rad/s^2. How many revolutions does the wheel make between $t = 0$ and the moment it comes to rest? Answer: nearly 8 revolutions.

What is the magnitude of the net torque on an empty box on a table, if it is being pushed horizontally at its top, with force , has height h and width ℓ, and mass m? Answer: $\tau = hF - mg\ell/2$.

What is the rotational inertia around the center of mass, of a cross-shaped arrangement of two wires of negligible mass, and length $2d$, that have masses m at the ends of the vertical wire and masses $2m$ at the ends of the horizontal wire?

Show by direct integration that the rotational inertia of a uniform rod of length L and mass M about an axis through its center of mass is $I = (ML^2)/12$. Use the parallel axis theorem to find the rotational inertia about an axis through one end of the rod.

A mass m can slide without friction on a horizontal tabletop. A string of negligible mass runs over a pulley of mass M that is a uniform cylinder, and down to a hanging mass m. Use the 2nd Law for torques to find the acceleration of the system if the hanging mass is released. Answer: $a = (g/2)/[1 + (M/(4m))]$.

A hollow ball of mass M and radius R is rolling on a level surface at constant velocity. Show that 60% of its kinetic energy is carried by the center of mass, and 40% is due to rotation around its center of mass as it rolls without slipping.

A spool like the one shown in class has inner radius r and outer radius R. A string is wrapped tightly around the inner cylinder and does not slip. If the string is pulled horizontally with a constant force $\mathbf{T}$, and the spool rolls across a level table without slipping, show that if its rotational inertia around the center of mass is $I_{\text{cm}} = \kappa M R^2$, with M its total mass, then $a_{\text{cm}} = T(1 + (r/R))/[(\kappa + 1)M]$.

A uniform rod is held vertically. The rod has mass M and length L. If the rod is allowed to topple over from rest onto the floor, and the spot where the rod touches the floor remains fixed due to static friction, show that at the instant before the rod hits the table, the speed of the center of mass of the rod is $(1/2)\sqrt{3gL}$.