Spring-2018 Phys101
Assignment 10
Check MateringPhysics for other problems
Due date: 27 April 2018.

Discussion questions

1-Can a single force applied to a body change both its translational and rotational motion? Explain.

2-A bullet spins on its axis as it emerges from a rifle. Explain how this prevents the bullet from tumbling and keeps the streamlined end pointed forward.

3-Two identical flywheels are mounted on a horizontal axis that is free to rotate as shown in the figure below. The two wheels rotate in the same direction (clockwise when looking from the right) with the same speed. Will the horizontal axis precess? If yes, in which direction. Will your answer change if they were rotating in opposite directions? Explain all your answers.

4-A gyroscope takes 3.8 **sec** to precess 1.0 revolution about a vertical axis. Two minutes later, it takes only 1.9 **sec** to precess 1.0 revolution. No one has touched the gyroscope. Explain.

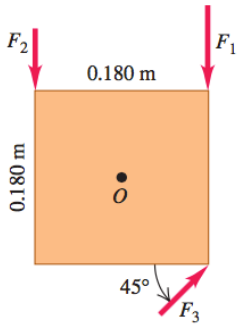
Hint: consider friction in the rotating wheel.

5-If you stop a spinning raw egg for the shortest possible instant and then release it, the egg will start spinning again. If you do the same to a hard-boiled egg, it will remain stopped. Try it. Explain it.

6-A ball is thrown in such a way that it does not spin about its own axis. Does this mean that the angular momentum is zero about an arbitrary origin? Explain.

Problems

7- A square metal plate 0.180 m on each side is pivoted about an axis through point *O* at its center and perpendicular to the plate (See the figure below). Calculate the net torque about this axis due to the three forces shown in the figure if the magnitudes of the forces are F_1 =18.0 N, F_2 =26.0 N, and F_3 =14.0 N.The plate and all forces are in the plane of the page.

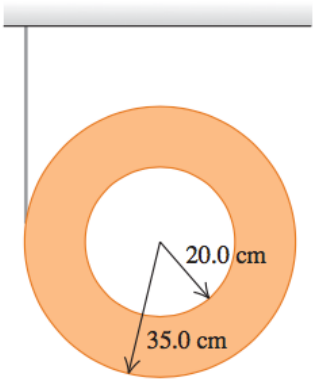


8- A thin, light string is wrapped around the outer rim of a uniform hollow cylinder of mass 4.75 kg having inner and outer radii as shown below. The cylinder is then released from rest.

(a) How far must the cylinder fall before its center is moving at 6.66 m/s?

(b) If you just dropped this cylinder without any string, how fast would its center be moving when it had fallen the distance in part (a)?

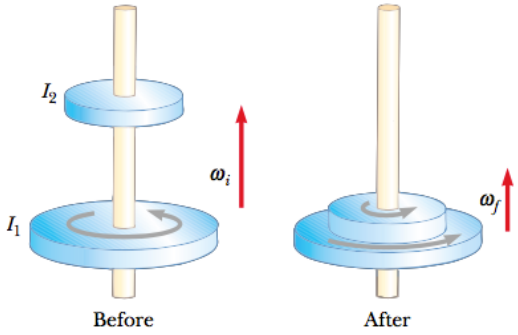
(c) Why do you get two different answers when the cylinder falls the same distance in both cases?



9-A cylinder with a moment of inertia of I_1 rotates about a vertical, frictionless axle with angular velocity w_i. A second cylinder that has a moment of inertia of I_2 and initially is not rotating drops onto the first cylinder. Because of friction between the surfaces, the two eventually reach the same angular speed w_f.

(a) Calculate w_f.

(b) Show that the kinetic energy of the system decreases in this interaction and calculate the ratio of the final rotational energy to the initial rotational energy.



10- The top in the figure below has a moment of inertia of 4.00×10^{4} kg m^2 and is initiallyat rest. It is free to rotate about a stationary axis *AA'* .A string wrapped around a peg along the axis of the top is pulled in such a manner as to maintain a constant tension of 5.57 N in the string. If the string does not slip while wound around the peg, what is the angular speed of the top after 80.0 cm of string has been pulled off the peg? *Hint:* Consider the work that is done.