

4th Assignment due October 21st (class, no later than noon) - distributed October 9th

Please note your name clearly on your solutions, number the pages and write notes along the way, so that it is easy to follow your thought process.

The points for every single number are stated below.

- 1.) In San Francisco a very simple technique is used to turn around a cable car when it reaches the end of its route. The car rolls onto a turntable, which can rotate about a vertical axis through its center. Then, two people push perpendicularly on the car, one at each end. The turntable is rotate one-half of a revolution to turn the car around. If the length of the car is 9.20 m and each person pushes with a 185 N force, what is the magnitude of the net torque applied to the car? (Make a drawing of the situation, add all variable in there) (3 points)
- 2.) The angular speed of the rotor in a centrifuge increases from 420 rad/s to 1420 rad/s in a time of 5.00 s.
 - (a) Obtain the angle through which the rotor turns.
 - (b) What is the magnitude of the angular acceleration? (4 points)
- 3.) The earth and moon are separated by a center-to-center distance of 3.85×10^8 m. The mass of the earth is 5.98×10^{24} kg and that of the moon is 7.35×10^{22} kg. How far does the center of mass lie from the center of the earth? (2 points)
- 4.) A mine car, whose mass is 440 kg, rolls at a speed of 0.50 m/s on a horizontal track. A 150 kg chunk of nickel ore has a speed of 0.80 m/s when it leaves the chute (tilted upwards from the horizontal by 25°). Determine the velocity of the car/nickel system after the nickel has come to rest in the car. Start by making a drawing showing all relevant parameters. (3 points)
- 5.) Calculate the kinetic energy that the earth has because of
 - a) its rotation about its own axis and
 - b) its motion around the sun.Assume that the earth is a uniform sphere and that the path around the sun is circular. For comparison, the total energy used in the United States in one year is about 9.3×10^{19} Joule. (4 points)
- 6.) A cylindrical shaped space station is rotation about the axis of the cylinder to create artificial gravity. The radius of the cylinder is 82.5 m. The moment of inertia of the station with out people is 3.00×10^9 kg m². Suppose 500 people, with an average mass of 70.0 kg each, live on this station. As they move radially from the outer surface of the cylinder toward the axis, the angular speed of the station changes. What is the maximum possible percentage change in the station's angular speed due to the radial movement of the people? (3 points)

- 7.) A uniform board is leaning against a smooth vertical wall. The board is at an angle Θ above the horizontal ground. The coefficient of static friction between the ground and the lower end of the board is 0.650. Find the smallest value for the angle Θ , such that the lower end of the board does not slide along the ground. (3 points)
- 8.) A thin uniform rod is initially positioned in the vertical direction, with its lower end attached to a frictionless axis that is mounted on the floor. The rod has a length of 2.00 m and is allowed to fall, starting from rest. Find the tangential speed of the free end of the rod, just before the rod hits the floor after rotating through 90° . (3 points)
- 9.) A cup of coffee is sitting on a table in an airplane that is flying at a constant altitude and a constant velocity. The coefficient of static friction between the cup and the table is 0.30. Suddenly, the plane accelerates, its altitude remaining constant. What is the maximum acceleration that the plane can have without the cup sliding backward on the table? (3 points)
- 10.) Suppose you are riding a stationary exercise bicycle, and the electronic meter indicates that the wheel is rotating at 9.1 rad/s. The wheel has a radius of 0.45 m. If you ride the bike for 35 min, how far would you have gone if the bike could move? (2 points)