

Possibly Useful Information: $g = 9.80\text{m/s}^2$

Problem 1 (2 points each)

Junior stands at the center of a large rotating turntable in a playground. The turntable rotates without friction. When Junior walks from the center to the rim of the turntable, describe the changes in the total kinetic energy, the total angular momentum and the angular velocity. Answer +, - or 0.

_____ [i] ΔK _____ [ii] ΔL _____ [iii] $\Delta \omega$

Problem 2 A 3kg mass is at (3m,-4m), a 5kg mass is at (0,4m) and a 2kg mass is at (-2m,0). What is the moment of inertia for rotations about the y-axis? (6 points)

Problem 3 (7 points each)

(a) A 200 g glider moves at 0.3 m/s on an air track toward a 300 g glider moving in the opposite direction at 0.1 m/s. If the collision is elastic then what are both final velocities?

(b) Before being hit by a bat, a 0.15kg baseball has a velocity of $\langle -40, 0 \rangle$ m/s. It leaves the bat with velocity $\langle 45, 25 \rangle$ m/s. If the bat is in contact with the ball for 0.05s then what is the average force of the bat on the ball?

Problem 4 (7 points each)

(a) What fraction of a rolling tennis ball's total kinetic energy goes into its rotational motion. Assume it to be a uniform thin-shelled hollow sphere.

(b) What is the angular momentum about the origin of a 5 kg particle at (2m, -3m, 0) moving at 4 m/s in the z-direction?

Problem 5 A 5 kg uniform disk with a 40 cm radius swings without friction about a nail through a point 10 cm from the rim. It is released from rest from a position with its center above the nail.

(a) What is its angular velocity when the center is directly below the nail?

(b) What is its angular acceleration when the center is level with the nail?

Problem 6 Someone holds a horizontal meter stick of weight w with his thumb pushing down at the 5 cm line and his fingers pushing up at the 10 cm line. What are the applied forces of the thumb and of the fingers? (8 points)

Problem 7 A 2 kg turntable with a 0.6 m radius is a uniform disk rotating about its center. It accelerates from rest with a constant angular acceleration of 0.3 rad/s^2 . (8 points each)

(a) How many times does the turntable rotate when accelerating to 35 rev/min?

(b) After 2.5 s what are the linear speed and the magnitude of the acceleration of a point on the rim?

(c) What is the magnitude of the net torque acting on the turntable at $t = 2.5 \text{ s}$?