# HW_9_Fixed_Axis_Rotation_Ch_10

## Problems: 31, 35, 37, 39, 44, 45, 47, 49, 55, 57, 67, 71, 75, 81, 83, 92, 93, Total = 17

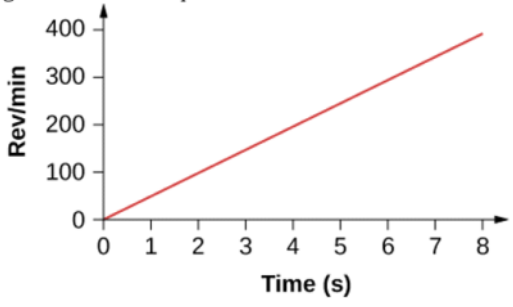
**31.** A particle moves 3.0 m along a circle of radius 1.5 m. (a) Through what angle does it rotate? (b) If the particle makes this trip in 1.0 s at a constant speed, what is its angular velocity? (c) What is its acceleration?

**35.** On takeoff, the propellers on a UAV (unmanned aerial vehicle) increase their angular velocity from rest at a rate of $\omega = (25.0t)$ rad/s for 3.0 s. (a) What is the instantaneous angular velocity of the propellers at $t = 2.0$ s ? (b) What is the angular acceleration?

**37.** A wheel has a constant angular acceleration of $5.0\,\text{rad/s}^2$. Starting from rest, it turns through 300 rad. (a) What is its final angular velocity? (b) How much time elapses while it turns through the 300 radians?

**39.** The angular velocity of a rotating rigid body increases from 500 to 1500 rev/min in 120 s. (a) What is the angular acceleration of the body? (b) Through what angle does it turn in this 120 s?

**44.** The angular velocity vs. time for a fan on a hovercraft is shown below. (a) What is the angle through which the fan blades rotate in the first 8 seconds? (b) Verify your result using the kinematic equations.




**45.** A rod of length 20 cm has two beads attached to its ends. The rod with beads starts rotating from rest. If the beads are to have a tangential speed of 20 m/s in 7 s, what is the angular acceleration of the rod to achieve this?

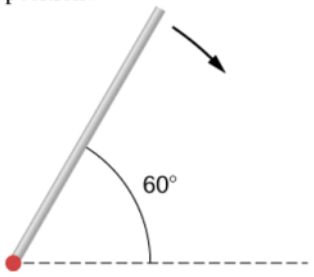
**47.** A man stands on a merry-go-round that is rotating at 2.5 rad/s. If the coefficient of static friction between the man's shoes and the merry-go-round is $\mu_S = 0.5$, how far from the axis of rotation can he stand without sliding?

**49.** A wind turbine is rotating counterclockwise at 0.5 rev/s and slows to a stop in 10 s. Its blades are 20 m in length. (a) What is the angular acceleration of the turbine? (b) What is the centripetal acceleration of the tip of the blades at $t = 0$ s? (c) What is the magnitude and direction of the total linear acceleration of the tip of the blades at $t = 0$ s?

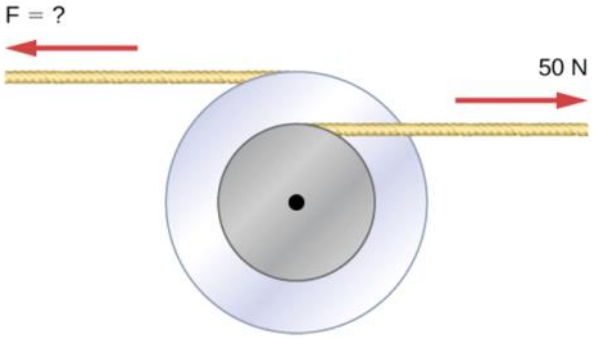
**55.** (a) Calculate the rotational kinetic energy of Earth on its axis. (b) What is the rotational kinetic energy of Earth in its orbit around the Sun?

**57.** A baseball pitcher throws the ball in a motion where there is rotation of the forearm about the elbow joint as well as other movements. If the linear velocity of the ball relative to the elbow joint is 20.0 m/s at a distance of 0.480 m from the joint and the moment of inertia of the forearm is $0.500\,\text{kg-m}^2$, what is the rotational kinetic energy of the forearm?

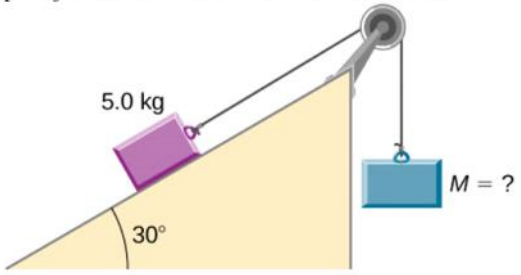
**67.** A uniform rod of mass 1.0 kg and length 2.0 m is free to rotate about one end (see the following figure). If the rod is released from rest at an angle of $60°$ with respect to the horizontal, what is the speed of the tip of the rod as it passes the horizontal position?



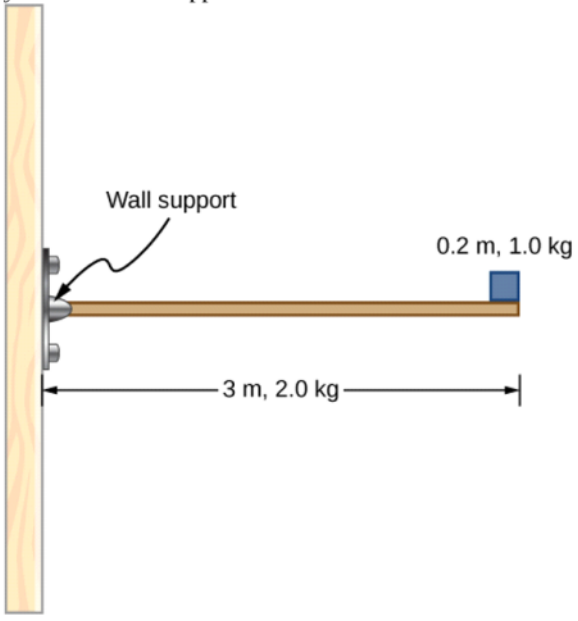
**71.** Two flywheels of negligible mass and different radii are bonded together and rotate about a common axis (see below). The smaller flywheel of radius 30 cm has a cord that has a pulling force of 50 N on it. What pulling force needs to be applied to the cord connecting the larger flywheel of radius 50 cm such that the combination does not rotate?




**75.** What hanging mass must be placed on the cord to keep the pulley from rotating (see the following figure)? The mass on the frictionless plane is 5.0 kg. The inner radius of the pulley is 20 cm and the outer radius is 30 cm.




**81.** A horizontal beam of length 3 m and mass 2.0 kg has a mass of 1.0 kg and width 0.2 m sitting at the end of the beam (see the following figure). What is the torque of the system about the support at the wall?




**83.** What is the torque about the origin of the force $(5.0\,\hat{\mathbf{i}} - 2.0\,\hat{\mathbf{j}} + 1.0\,\hat{\mathbf{k}})\,\text{N}$ if it is applied at the point whose position is: $\vec{\mathbf{r}} = \left(-2.0\,\hat{\mathbf{i}} + 4.0\,\hat{\mathbf{j}}\right)\text{m}$?

**92.** A pulley of moment of inertia $2.0\,\text{kg-m}^2$ is mounted on a wall as shown in the following figure. Light strings are wrapped around two circumferences of the pulley and weights are attached. What are (a) the angular acceleration of the pulley and (b) the linear acceleration of the weights? Assume the following data: $r_1 = 50\,\text{cm}$, $r_2 = 20\,\text{cm}$, $m_1 = 1.0\,\text{kg}$, $m_2 = 2.0\,\text{kg}$

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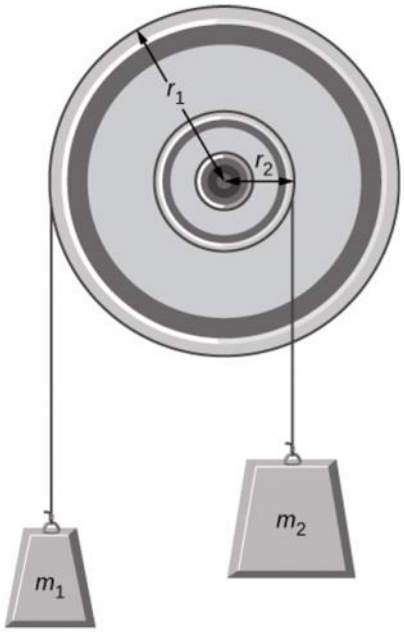


**93.** A block of mass 3 kg slides down an inclined plane at an angle of $45°$ with a massless tether attached to a pulley with mass 1 kg and radius 0.5 m at the top of the incline (see the following figure). The pulley can be approximated as a disk. The coefficient of kinetic friction on the plane is 0.4. What is the acceleration of the block?