Collins Engineering Physics Questions – C1E

QUESTIONS

10. A flywheel is mounted on a horizontal axle of diameter 0.1 m. A constant force of 100N is applied tangentially to the axle (Figure 11). If the moment of inertia of the whole system (flywheel and axle) is 8.0 kgm^2, determine
    a. the angular acceleration of the flywheel
    b. the number of revolutions the flywheel makes in 30 s (assume the flywheel starts from rest).

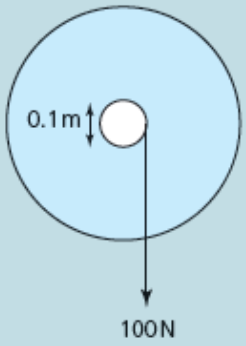

Figure 11

11. A park roundabout has been left rotating at 30rpm. A passer-by slows it down and stops it by applying a tangential braking force of 200N. The moment of inertia of the roundabout is 500kgm^2 and its radius is 2.0m. Calculate
    a. the initial angular velocity
    b. the braking torque being applied
    c. the angular deceleration of the roundabout
    d. the time taken to stop and how many revolutions this will take.

12. In a hammer throw (Figure 12), the athlete spins around six times in roughly 5s. The release velocity is 30ms^{-1}, the mass of the hammer is 7.00kg, and the length of the wire is 1.3m. Assume the length of the athlete's arm is 0.7m. In practice, the hammer's velocity is built up in stages, but here assume a constant angular acceleration.

Figure 12 *The hammer thrower builds up the angular velocity by spinning several times*

    a. Calculate the moment of inertia of the hammer on the end of the wire.
    b. Calculate the average angular acceleration.
    c. Calculate the average torque being applied by the athlete.
    d. Are we justified in ignoring the mass of the athlete's arm in the above calculation? A typical human arm has a mass of 9kg. Assume that a reasonable estimate for the moment of inertia of an arm can be gauged by $\frac{1}{3}mL^2$, where L is the length. Calculate the moment of inertia of the athlete's arm and compare it to the value obtained in part a. Comment.

QUESTIONS

15. A solid steel cylindrical rotor is being tested. The rotor has a mass of 272kg and a radius of 38.0cm. During the test, the rotor reaches an angular speed of 14000revmin^{-1} before breaking.
    a. Calculate the angular velocity when this happens.
    b. How much energy had the rotor stored? What happened to this energy when the rotor broke?

16. a. Assuming the Earth to be a sphere with moment of inertia $\frac{2}{5}MR^2$, where M is the mass of the Earth (6.0×10^{24}kg) and R is the radius of the Earth (6.4×10^{6}m), calculate the moment of inertia of the Earth.
    b. What is its rotational kinetic energy?