Torque and angular acceleration essay sample

1. A child is pushing a merry-go-round. The angle through the merry-go-round has turned varies with time according to θ(t) = γt + βt3, where γ = 0. 400 rad/s and β = 0. 0120 rad/s3. a. Calculate the angular acceleration as a function of time.

b. What is the initial value of the angular velocity?

c. Calculate the instantaneous value of the angular velocity at t = 5. 00 s and the average angular velocity for the time interval t = 0 to t = 5. 00 s.

2. At t = 0 the current to a dc electric motor is reversed, resulting in an angular displacement of the motor shaft given by to θ(t) = (250 rad/s)t – (20. 0 rad/s2)t2 – (1. 50 rad/s3)t3. a. At what time is the angular velocity of the motor shaft zero?

b. Calculate the angular acceleration at the instant that the motor shaft has zero angular velocity.

c. How many revolutions does the motor shaft turn through between the time when the current is reversed and the instant when the angular velocity is zero?

d. How fast was the motor shaft rotating at t = 0, when the current was reversed?

e. Calculate the average angular velocity for the time period from t = 0 to the time calculated in part a.

3. A wheel is rotating about an axis that is in the z direction. The angular velocity is – 6. 00 rad/s at t = 0, increases linearly with time, and is +8. 00

m/s at t = 7. 00 s. We have taken counterclockwise rotation to be positive. a. Is the angular acceleration during this time interval positive or negative?

b. During what time interval is the speed of the wheel increasing? Decreasing?

c. What is the angular displacement of the wheel at t = 7. 00s?

4. A turntable rotates with a constant 2. 25 rad/s2 angular acceleration. After 4. 00 s it has rotated through an angle of 60. 0 rad. What was the angular velocity of the wheel at the beginning of the 4. 00-s interval?

5. At t = 0 a grinding wheel has an angular velocity of 24. 0 rad/s. It has a constant angular acceleration of 30. 0 rad/s2 until a circuit breaker trips at t = 2. 00 s. From then on, it turns through 432 rad as it coasts to a stop at constant angular acceleration. a. Through what total angle did the wheel turn between t = 0 and the time it stopped?

b. At what time did it stop?

c. What was its acceleration as it slowed down?

6. An electric turntable 0. 750 m in diameter is rotating about a fixed axis with an initial angular velocity of 0. 250 rev/s and a constant angular acceleration of 0. 900 rev/s2. a. Compute the angular velocity of the turntable after 0. 200s.

b. Through how many revolutions has the turntable spun in this time interval?

c. What is the tangential speed of a point on the rim of the turntable at t = 0. 200s?

d. What is the magnitude of the resultant acceleration of a point on the rim at t = 0. 200s?

7. According to the shop manual, when drilling a 12. 7 mm diameter hole in wood, plastic or aluminum, a drill should have a speed of 1250 rev/min. For a 12. 7 mm diameter drill bit turning at a constant 1250 rev/min, find: a. the maximum linear speed of any part of the bit

b. the maximum radial acceleration of any part of the bit

8. A uniform bar has two small balls glued to its ends. The bar is 2. 00 m long and has mass 4. 00 kg, while the balls each have a mass of 0. 500 kg and can be treated as point masses. Find the moment of inertia of this combination about each of the following axes: a. an axis perpendicular to the bar through its center

b. an axis perpendicular to the bar through one of the balls

c. an axis parallel to the bar through both balls

d. an axis parallel to the bar and 0. 500 m from it.

9. A twirler’s baton is made of a slender metal cylinder of mass M and length L. Each end has a rubber cap of mass m, and you can accurately treat each cap as a particle in this problem. Find the total moment of inertia of the baton about the usual twirling axis (perpendicular to the baton through its center)

10. Calculate the moment of inertia of the following uniform objects about the axes indicated. A thin 2. 50 kg rod of length 75. 0 cm, about an axis perpendicular to it and passing through i. one end

ii. its center

iii. about an axis parallel to the rod and passing through it

11. 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. Calculate the net torque about this axis due to the three forces F1 = 18 N, F2= 26N, and F3= 14N.

12. The flywheel of an engine has moment of inertia 2. 50 kg m2 about its rotation axis. What constant torque is required to bring it up to an angular speed of 400 rev/min in 8 s, starting from rest?

13. A uniform 255 N rod that is 2m long carries a 225 N weight at its right end and an unknown weight W toward the left end. When W is placed 50 cm from the left end of the rod, the system just balances horizontally when the fulcrum is located 75 cm form the right end. a. Find W.

b. If W is now moved 25 cm to the right, how far and in what direction must the fulcrum be moved to restore the balance?

14. A 1. 5 kg grinding wheel is in the form of a solid cylinder of radius 0. 100 m. (a) What constant torque will bring it from rest to an angular speed of 1200 rev/min in 2. 5 s? (b) Through what angle has it turned during that

time? (c) Calculate the work done by the torque. (d) What is the grinding wheel’s kinetic energy when it is rotating at 1200 rev/min?

15. A 50 kg grindstone is a solid disk 0. 520 m in diameter. You press an ax down on the rim with a normal force of 160 N. The coefficient of kinetic friction between the blade and the stone is 0. 60 and there is a constant friction torque of 6. 50 N-m between the axle of the stone and its bearings. (a) How much force must be applied tangentially at the end of a crank handle 0. 500 m long to bring the stone from rest to 120 rev/min in 9. 00 s?

(b) After the grindstone attains an angular speed of 120 rev/min, what tangential force at the end of the handle is needed to maintain a constant angular speed of 120 rev/min?

(c) How much time does it take the grindstone to come from 120 rev/min to rest if it is acted on by the axle friction alone?