Worksheet6.5 - *Torque, Rotational Inertia, Angular Momentum and Kinetic Energy*

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1. When a torque of magnitude 32.0 N·m is applied to a certain wheel, it acquires an angular acceleration of 25.0 rad/s². What is the moment of inertia of the wheel?
2. A flywheel (disk) initially spinning at 1850 rpm counterclockwise is brought to rest in 3.00 minutes.
   1. What is the wheel’s average angular acceleration?
   2. What is the ***angular displacement*** of the flywheel during this acceleration?
   3. If the flywheel has a mass of 155 kg and a radius of 0.650 m, what torque was required to accelerate it?
3. A heavy flywheel rotating *counterclockwise* about its middle at an original speed of 157.1 rad/s is slowing down because of friction in its bearings.
   1. If its acceleration is constant at 1.785 rad/s², find its ***angular velocity*** at the end of 1.00 minute.
   2. The flywheel is 5.50 m in diameter and has a mass of 985 kg. If the flywheel resembles a uniform disk, find the torque applied by friction.
4. A uniform solid sphere has a mass of 1.765 kg and a radius of 0.854 m.
   1. Find the torque required to bring the sphere from rest to an angular velocity of 317 rad/s, *clockwise*, in 15.5 s.
   2. What magnitude force applied tangentially at the equator would provide the needed torque?
5. A piece of machinery with a moment of inertia of 2.5 kg∙m² rotates with a constant ***angular speed*** of 4.0 rad/s. A bolt loosens, causing a part of it to shift outward from the rotation axis, increasing the moment of inertia by 1.0 kg∙m². What would the new ***angular speed*** of the machinery be?
6. A small particle of mass 0.20 kg is being whirled in a horizontal circle at the end of a 2.0 m long string at a constant speed of 1.0 m/s. Determine its ***angular momentum*** about its axis of rotation.
7. A bowling ball has a mass of 5.5 kg and a radius of 12.0 cm. It is released so that it rolls down the alley at a rate of 12 rev/s. Find the magnitude of its ***angular momentum***.
8. a. What is the ***angular momentum*** of a 2.8 kg uniform cylindrical grinding wheel of radius 18 cm when rotating at 1500 rpm? b. How much torque is required to stop it in 6.0 s?
9. Calculate the moment of inertia of a wheel that has a rotational kinetic energy of 24,400 J when it is rotating at 62.8 rad/s.
10. A man stands on a rotating platform that has an angular speed of 6.28 rad/s; his arms are outstretched and he holds a weight in each hand. With his hands in this position the total moment of inertia of the man, the weights, and the platform is 6.00 kg·m². If by moving the weights the man decreases the total moment of inertia to 2.00 kg·m².
    1. What is the resulting ***angular speed*** of the platform?
    2. By how much is the kinetic energy increased?’

Answers:

1. 1.28 kg·m²
2. a. 1.08 rad/s² b. 17,400 rad c. 35.4 N⋅m
3. a. 50.0 rad/s b. 6650 N·m,
4. a. 10.5 N·m, in b. 12.3 N
5. 2.9 rad/s Remember Momentum (***even angular!***) is Conserved
6. 0.40 kg·m²/s
7. 2.4 kg·m²/s
8. a. 7,1 kg·m²/s b. 1.2 N
9. 12.4 kg·m²
10. a. 18.8 rad/s b. 235 J