Rotation Problems

Fun With Fiziks

July 6, 2022

Practice Problems

1. A deep-sea fisherman hooks a big fish that swims away from the boat pulling the fishing line from his fishing reel. The whole system is initially at rest and the fishing line unwinds from the reel at a radius of 4.50 cm from its axis of rotation. The reel is given an angular acceleration of 110 rad/s^2 for 2.00 s.

   (a) What is the final angular velocity of the reel?

   (b) At what speed is fishing line leaving the reel after 2.00 s elapses?

   (c) How many revolutions does the reel make?

   (d) How many meters of fishing line come off the reel in this time?

2. A person decides to use a microwave oven to reheat some lunch. In the process, a fly accidentally flies into the microwave and lands on the outer edge of the rotating plate and remains there. If the plate has a radius of 0.15 m and rotates at 6.0 rpm, calculate the total distance traveled by the fly during a 2.0-min cooking period. (Ignore the start-up and slow-down times.)

3. A particle moves in a circle 1.50 m in radius. Through what angle in radians does it rotate if it moves through an arc length of 2.50 m? What is this angle in degrees?

4. A grinding wheel, initially at rest, is rotated with constant angular acceleration $\alpha = 5.0$ rad/s^2 for 8.0 s. The wheel is then brought to rest, with uniform negative acceleration, in 10 rev. Determine the negative angular acceleration required and the time needed to bring the wheel to rest.

5. A centrifuge in a medical laboratory is rotating at an angular speed of 3600 rev/min. When switched off, it rotates 50.0 times before coming to rest. Find the constant angular deceleration of the centrifuge.

6. An airliner arrives at the terminal, and the engines are shut off. The rotor of one of the engines has an initial clockwise angular velocity of 2000 rad/s. The engine's rotation slows with an angular acceleration of

magnitude 80.0 rad/s^2. (a) Determine the angular velocity after 10.0 s. (b) How long does it take the rotor to come to rest?

7. A race car travels in a circular track of radius 200 m. If the car moves with a constant speed of 80 m/s, find (a) its angular velocity and (b) its tangential acceleration.

8. The race car of Problem 5 increases its speed at a constant linear acceleration from 80 m/s to 95 m/s in 10 s. (a) Find the constant angular acceleration and (b) the angle the car moves through in this time.

9. A tire 0.500 m in radius rotates at a constant rate of 200 revolutions per minute. Find the speed and acceleration of a small stone lodged in the tread of the tire (on its outer edge).