AP Physics C
HW Set 2
Rotational Kinematics

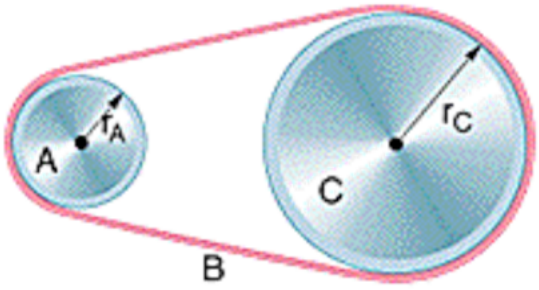
1. **The angular position of a point on a rotating wheel is given by $\theta = 3 + 3t^2 + 8t^3$, where θ is in radians and t is in seconds.**
   a. **At t = 0, what is the point's angular position?**
   b. **At t = 0, what is the point's angular velocity?**
   c. **What is the point's angular velocity at t = 4 [s]?**
   d. **Calculate the point's angular acceleration at t = 2.0 [s].**
   e. **Is the angular acceleration constant?**

2. **The acceleration of an oscillating object is $a(t) = 2\cos(2t)$ [m/s^2]. What is the change in the velocity of the object from time 4 [s] to 8 [s]?**

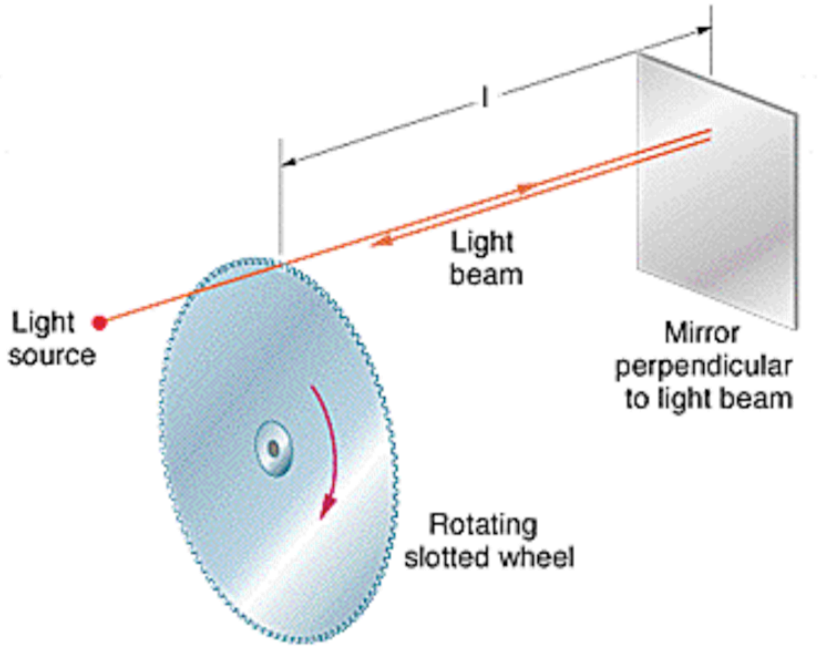
3. **Starting from rest, a disk rotates about its central axis with constant angular acceleration. In 6.0 [s], it rotates 25 [rad].**
   a. **What was the angular acceleration during this time?**
   b. **What was the average angular velocity?**
   c. **What is the instantaneous angular velocity of the disk at the end of the 6.0 [s]?**
   d. **Assuming that the acceleration does not change, through what additional angle will the disk turn during the next 12.0 [s]?**

4. **A drum rotates around its central axis at an angular velocity of 11.20 [rad/s]. Assume that the drum then slows at a constant rate of 4.60 [rad/s^2].**
   a. **How much time is required for it to come to rest?**
   b. **Through what angle does it rotate as it comes to rest?**

5. **In the figure below, wheel A of radius r_A = 13 [cm] is coupled by belt B to wheel C of radius r_C = 20 [cm]. The angular speed of wheel A is increased from rest at a constant rate of 1.6 [rad/s^2]. Find the time needed for wheel C to reach an angular speed of 120 rev/min, assuming the belt does not slip.**



6. **An early method of measuring the speed of light makes use of a rotating slotted wheel. A beam of light passes through one of the slots at the outside edge of the wheel, travels to a distant mirror, and returns to the wheel just in time to pass through the next slot in the wheel. One such slotted wheel has a radius of 5.0 [cm] and 850 slots at its edge. Measurements taken when the mirror was l = 500 [m] from the wheel indicated a speed of light of 3.0 × 10^5 [km/s].**



a. **What was the (constant) angular speed of the wheel?**
b. **What was the linear speed of a point on the edge of the wheel?**

7. **A toy car of mass 6 [kg], moving in a straight path, experiences a net force given by the function F = -3t [N]. At time t = 0, the car has a velocity of 4 [m/s] in the positive direction and is located at +8 [m] from the origin. At what time will the car come to rest?**

8. **AP 2006 #2 (Linearizing Graphs)**

9. **AP 2008 #1 (Writing Differential Equations)**

1a. 3 [rad]
1b. 0 [rad/s]
1c. 408 [rad/s]
1d. 102 [rad/s^2]
1e. No, since the second derivative of $\theta(t)$ is $\alpha(t) = 48t$ and is time dependent.

2. -1.277 [m/s^2]

3a. 1.39 [rad/s^2]
3b. 4.17 [rad/s]
3c. 8.33 [rad/s]
3d. 200 [rad]

4a. 2.43 [s]
4b. 13.6 [rad]

5. 12.1 [s]

6a. 2220 [rad/s]
6b. 111 [m/s]

7. 4 [s]

8a. Will discuss in class
8b. Will discuss in class
8c. Will discuss in class
8d. 1.7×10^3 [N/m^2]
8e. 0.57 [J]
8f. 1.5 [m/s]

9a. Will discuss in class
9b. Will discuss in class
9c. $v_T = Mg\sin\theta/b$