Practice Questions for Rotational Kinematics Work on Next Page

When you are not working on the lab (only half the class at a time will be in the lab area), work on these practice problems in addition to your WebAssign. Check your answers with Ms. Fowler during class today (a Key will be posted, too, later tonight). Please show your work clearly!

1. A rope goes over a circular pulley with a radius of 6.50 cm. If the pulley makes exactly 4 revolutions without the rope slipping, what length of rope passes over the pulley?

$d = 163\ cm$

2. A ball with a radius of 15.0 cm rolls on a level surface. The translational speed of the center of mass is 0.250 $m \cdot s^{-1}$. What is the angular speed about the center of mass if the ball rolls without slipping?

$\omega = 3.33\ rad \cdot s^{-1}$

3. A bocce ball with a diameter of 6.00 cm rolls without slipping on a level lawn. It has an initial angular speed of 2.35 $rad \cdot s^{-1}$ and comes to rest after 2.50 m Assuming uniform acceleration (deceleration), determine the following:
   a. The magnitude of its angular deceleration

$\alpha = -0.0330\ rad \cdot s^{-2}$

   b. The magnitude of the linear deceleration of the center of mass

$= 9.94 \times 10^{-4}\ m \cdot s^{-2}$

4. Sammi rolls a ball on a level floor to Mick, who is sitting 4.50 m away.
   a. If the ball makes 15.0 revolutions while it rolls without slipping, what is the ball's diameter?

$0.0955\ m$

   b. Danielle timed how long it took the ball to travel the 4.50 m and found that time to be 3.85 s.
      i. What is the translational speed of the center of mass?

$V_{cm} = 1.17\ m \cdot s^{-1}$

      ii. What is the tangential speed of a point on the top of the ball as it rolls?

$V_{top} = 2.34\ m \cdot s^{-1}$

Practice Questions for rotational Kinematics

(1) $r = 6.50\ cm$ $\quad C = 2\pi r$

$= 2\pi(6.50\ cm)$

Total # Rev = 4

Total dist. $= 4 \cdot C$

Rope length = ?

$= 8\pi(6.50\ cm)$

$= 163.4 \approx \boxed{163\ cm}$

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(2) $r = 15.0\ cm = 0.150\ m$

$V_{cm} = 0.250\ m \cdot s^{-1}$

$V_{Top} = 2 \cdot V_{cm} = 0.500\ m \cdot s^{-1}$

$V_{Top} = \omega r \longrightarrow \omega = \frac{V_{Top}}{r} = \frac{0.500\ m \cdot s^{-1}}{0.150\ m} = 3.33\ rad \cdot s^{-1}$

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(3) $d = 6.00\ cm \rightarrow r = 0.0300\ m$

$C = \pi \cdot d = \pi(.0600\ m) = 0.188\ m$

$s = 2.50\ m$

Total # rot $= \frac{\text{Total distance}}{\text{Circumference}} = \frac{2.50\ m}{0.188\ m} = 13.3$ rotations

$(13.3\ rot)\left(\frac{2\pi}{1\ rot}\right) = 83.6\ rad = \theta$

3 (continued)

a) $\omega^2 = \omega_0^2 + 2\alpha\theta$

$0 = (2.35)^2 + 2\alpha(83.6)$

$\frac{-(2.35)^2}{2(83.6)} = \alpha$

$-0.0330 = \alpha$ rad·s^{-2}

b) (alternate way)

$a = \alpha \cdot r$

$a = (-0.0330)(0.0300\ m)$

$= -0.00099\ m \cdot s^{-2}$

$= -9.9 \times 10^{-4}\ m \cdot s^{-2}$

(u)

b) $V = \omega r$

$V = (2.35\ rad \cdot s^{-1})(0.0300\ m)$

$u = 0.0705\ m \cdot s^{-1}$

$u = 0.0705\ m \cdot s^{-1}$

$V = \emptyset$

$a = ?$

$s = 2.50\ m$

$V^2 = u^2 + 2as$

$0^2 = (0.0705)^2 + 2a(2.50)$

$-0.00994 = a$

$a = 9.94 \times 10^{-4}\ m \cdot s^{-2}$

4) $s = 4.50\ m$

#rev = 15.0

$s = (\#rev)(Circ.)$

$4.50 = (15.0)(\pi \cdot d)$

a) $0.0955\ m = d$

b) $s = 4.50\ m$, $t = 3.85\ s$

$V = \frac{s}{t} = \frac{4.50}{3.85} = 1.17\ m \cdot s^{-1}$

c) $V_{cm} = 1.17\ m \cdot s^{-1}$

$V_{Tip} = 2 \times V_{cm} = 2(1.17) = 2.34\ m \cdot s^{-1}$