Name: KEY

Date:

Section C D F

The Masters School
Mr. Alex Rawson
Physics

Rotational Motion I

1. A girl sits on a merry go round at a distance of 1.5 m from the center. If the girl moves through an arc length of 2.5 m, through what angular displacement does she move?

$$\Delta\theta = \frac{\Delta s}{r} = \frac{2.5}{1.5} = 1.67 \text{ radians}$$

b. What measurement is this in degrees?

$$\frac{1.67 \text{ rad}}{1} \times \frac{180^\circ}{\pi \text{ rad}} = 95.68^\circ$$

2. A passenger cart on a ferris wheel moves through a distance of 12 m before it stops to drop off passengers. If the passenger carts are all 35 m from the axis of rotation of the Ferris wheel, what angular displacement does each cart move through during this part of the ride?

$$\Delta\theta = \frac{\Delta s}{r} = \frac{12 \text{ m}}{35 \text{ m}} = .343 \text{ rad}$$

b. What measurement is this in degrees?

$$\frac{.343 \text{ rad}}{1} \times \frac{180^\circ}{\pi \text{ rad}} = 19.64^\circ$$

3. A car tire rotates counterclockwise 3.5 times during a time interval of .75 seconds. What is the angular speed of the tire?

$$(3.5)(\text{revolutions}) = 3.5(2\pi \text{ rad}) = 7\pi \text{ rad}$$

$$\omega_{avg} = \frac{\Delta\theta}{\Delta t} = \frac{7\pi \text{ rad}}{.75} = 29.32 \text{ rad/s}$$

b. Calculate the angular speed in revolutions per minute.

$$\frac{29.32 \text{ rad}}{\text{s}} \times \frac{1 \text{ rev}}{2\pi \text{ rad}} \times \frac{60 \text{ s}}{1 \text{ min}} = 280 \text{ rev/min}$$

4. A girl ties a toy airplane to the end of a string and swings it around her head. What is the plane's angular speed if that plane moves through an angular displacement of 3.3 rad during 1.5 s?

$$\omega = \frac{\Delta\theta}{\Delta t} = \frac{3.3 \text{ rad}}{1.5 \text{ s}} = 2.2 \text{ rad/s}$$

5. A figure skater begins spinning counterclockwise at an angular speed of 4.0π rad/s. During a 3.0s interval, she slowly pulls her arms inward and finally spins at 8.0π rad/s. What is her average angular acceleration during this time interval?

$$\alpha_{avg} = \frac{\Delta\omega}{\Delta t} = \frac{\omega_f - \omega_i}{\Delta t} = \frac{(8\pi \text{ rad/s}) - (4\pi \text{ rad/s})}{3 \text{ sec.}} = \frac{4\pi \text{ rad/s}}{3}$$

$$\boxed{\alpha_{avg} = 4.19 \text{ rad/s}^2}$$

6. While pitching, a softball pitcher swings the ball with an angular speed of 10.5 rad/s. If the pitchers arm is .66 m long, what is the tangential speed of the ball just before the pitcher releases it?

$\omega = 10.5$ rad/s
$r = .66$ m

$V_t = r\omega$
$= (.66)(10.5)$
$\boxed{V_t = 6.93 \text{ m/s}}$

7. An athlete spins in a circle before letting go of a discus. If the athlete spins at an angular speed of 12.3 rad/s and holds at the discus at a distance of .75 m from the center of the torso, what is the discus's linear speed (tangential speed) when the athlete releases it?

$\omega = 12.3$ rad/s
$r = .75$ m

$V_t = r\omega$
$= (.75)(12.3)$
$\boxed{V_t = 9.225 \text{ m/s}}$

8. A young boy swings a yo-yo horizontally above his head at an angular acceleration of .35 rad/s^2. If the yoyo string is .5 m long, what is the tangential acceleration of the yoyo at the end of the string?

$\alpha = .35$ rad/s^2
$r = .5$ m

$a_t = r\alpha$
$a_t = (.5)(.35)$
$\boxed{a_t = .175 \text{ m/s}^2}$