Name: ______________________ Date: __________ Skill and Practice

6C Circular Motion

Read:

You have learned several important terms used to describe circular motion:

- **Rotate** means to spin around an internal axis. Example: Earth makes one complete rotation every 24 hours.
- **Revolve** means to travel in a circle around an external axis. Example: Earth makes one complete revolution around the sun each year.
- **Angular speed** describes how fast something rotates. Degrees per minute and rotations per minute (rpm) are two common units of angular speed.

$$\text{Angular speed} = \frac{\text{rotations or degrees}}{\text{time}}$$

- The **radius** is the distance from the axis of rotation to any point on the outside of the circle.
- **Circumference** describes the distance traveled during one revolution.

Circumference = $2\pi r$, where r is the radius of the circle.

- **Linear speed** describes how fast a revolving object travels. Linear speed is often given in meters per second.

Linear speed (v) = $\frac{2\pi r}{t}$ where r is the radius and t is the time for one revolution.

Example:

1. A merry-go-round makes 18 rotations in 3 minutes. What is its angular speed in rpm?

$$\text{Angular speed} = \frac{18 \text{ rotations}}{3 \text{ minutes}} = 6 \text{ rpm}$$

2. A coin rolls across the floor at an angular speed of 4 rotations per second. What is its speed in degrees per second? Hint: One full rotation equals 360 degrees.

$$\text{Angular speed} = \frac{4 \times 360°}{1 \text{ second}} = 1440°/\text{second}$$

3. A child sits two meters from the center of a merry-go-round. How far does she travel during one revolution?

$$\text{Circumference} = 2\pi(2 \text{ meters}) = 12.6 \text{ meters}$$

4. If the merry-go-round makes one revolution in 10 seconds, what is the child's linear speed?

$$\text{Linear speed} = \frac{2\pi(2 \text{ meters})}{10 \text{ seconds}} = 1.3 \text{ m/s}$$

Practice:

1. A compact disc is spinning with an angular speed of 3.3 rotations per second.
   a. What is its angular speed in degrees per second?

   b. What is its angular speed in rotations per minute (rpm)?

2. A compact disc has a radius of 6 centimeters.
   a. What is its circumference in meters?

   b. If the cd rotates 4 times per second, what is the linear speed of a point on the outer edge of the cd? Give your answer in meters per second.

   c. What is the linear speed of a point 3 centimeters from the center of the cd? (Assume the angular speed has not changed).

3. **Challenge!** When a computer reads a cd-rom, the "read-head" must read the data at a constant linear velocity. That means the same amount of information must pass by the "read-head" each second no matter what part of the cd is being read. The cd spins at different angular speeds to keep the linear speed the same. If the "read-head" moves from reading data at the inner edge of the cd to read data at the outer edge, will the cd need to spin faster or slower to maintain a constant linear velocity?

4. Rolling is a combination of linear and rotating motion. When a wheel makes one full rotation, it moves forward a distance equal to the wheel's circumference.
   a. A child's first bicycle has 12-inch tires. These tires have a 6-inch radius. How far does the bicycle move forward each time the wheel makes one complete rotation? Give your answer in meters.
   (1 inch = 0.022 meters)

   b. A woman's ten-speed bicycle has 27-inch tires (13.5-inch radius). How far does this bicycle move forward each time the wheel makes one complete rotation? Give your answer in meters.

c. How many times does the child's bicycle tire have to rotate for the bicycle to travel 1 kilometer?

d. How many times does the woman's bicycle tire have to rotate for the bicycle to travel 1 kilometer?