# 8.3 Velocity

## Time Velocity Graph

Velocity (ft/sec)

Time (sec)

Velocity =

Speed =

| Conversions |
| --- |
| 1 in = 2.54 cm |
| 1 ft = 12 in |
| 1 yd = 3 ft |
| 1 mile = 5280 ft |

## DIMENSIONAL ANALYSIS

3 miles = _____ inches

45km/h = _____ m/sec

7 revolutions every 3 min = _____ radians per sec

**Horse makes 3 revolutions every minute.**
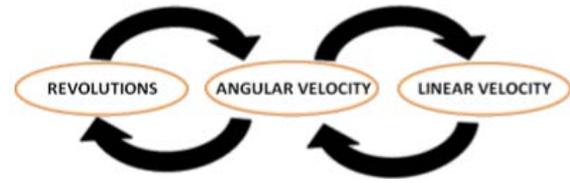
θ

15 m

A

B
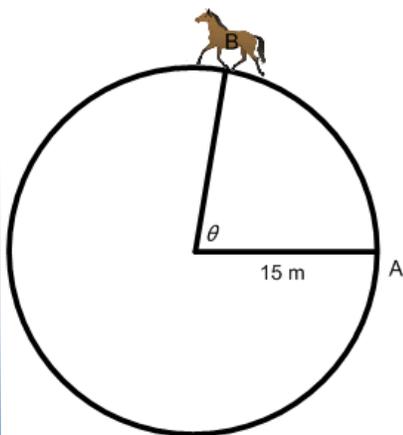
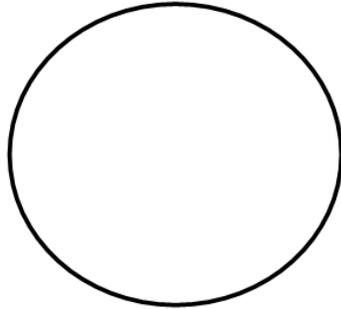## Angular Velocity

## Linear Velocity

9 revolutions per minute

radius = 3 feet

5 revolutions every minute          What is your linear velocity in mph?

A point on the rim of a wheel with a diameter of 2 yards has a linear speed of 100 feet per second.  Find the angular speed (in radians per second) and the number of revolution in a minute.

A bike has a front wheel with a diameter of 40 centimeters and a back wheel of a diameter of 60 centimeters.  Through what angle in radians does the front wheel turn if the back wheel turns through 15 radians?

A bicycle tire with a circumference of 87 inches has an angular speed of 20 radians per second.  What is the linear speed in mph?

## SUMMARY:

Now, summarize your notes here!

**Perform each conversion.**

| | | |
|---|---|---|
| 1. 45 yards = _____ inches | 2. 1.5 km = _____ cm | 3. 28 m/sec = _____ km/hr |
| 4. 30 rev/min = _____ rad/min | 5. 120 rev/hr = _____ rev/min | 6. 30 mi/hr = _____ ft/sec |

**A windmill for generating electricity has a blade that is 30 feet long. Depending on the wind, it rotates at various velocities. In each case, find the angular velocity in rad/sec for the tip of the blade.**

| | | |
|---|---|---|
| 7. 500 rev/sec | 8. 11,000 rev/hr | 9. 50,000 rev/day |

**A common speed for an electric motor is 3450 revolutions per minute. Saw blades of various diameters can be attached. Determine the linear velocity in mi/hr for a point on the edge of a blade given the diameter.**

| | | |
|---|---|---|
| 10. 6 in | 11. 1.2 feet | 12. 1 yard |

**13. A circular blade with a 12-inch diameter spins at a rate of 1800 rpm (revolutions per minute).**

a. What is the blade's angular velocity in radians per minute?

b. Find the linear velocity (in inches per minute) of one of the teeth on the edge of the blade.

c. Convert the linear velocity into feet per second.

**14. Vinyl record albums are 11 inches in diameter and spin at a rate of 33 rpm.**

a. What is a record's angular velocity in radians per minute?

b. How fast (in inches per minute) would a record move under a needle placed on the records edge?

c. Convert this linear velocity to feet per second.

**15. With his arms fully extended, a baseball player swings a bat. Using his shoulder as the center of rotation, the bat moves through 120° in only 0.2 seconds.**

a. What is the angular velocity of the batter's swing in radians per second?

b. As he swings the bat, the player hits a baseball. Suppose the ball leaves the bat at a distance of 40 inches from the player's shoulder. How fast (in miles per hour) would the ball be moving?

c. During a second time at bat, the player hits another ball, which leaves the bat a distance of 43 inches from the player's shoulder. How fast (in miles per hour) would this ball be moving?

| **Skillz Review** Simplify the following. | | | |
|---|---|---|---|
| 1. $\dfrac{\frac{1}{2}}{\frac{5}{4}}$ | 2. $\dfrac{\frac{1}{4}}{\frac{\sqrt{2}}{2}}$ | 3. $\dfrac{5}{\left(\frac{\sqrt{3}}{2}\right)}$ | 4. $\dfrac{\left(\frac{\sqrt{3}}{2}\right)}{\sqrt{2}}$ |

1. **The blades of a ceiling fan are 26 inches long, but the fan's entire diameter in 70 inches. It spins at a rate of 100 rpm.**

   a. What is the linear velocity of a point on the outer edge of the blade?

   b. What is the linear velocity of a point on the inner edge of the blade?

   70 in

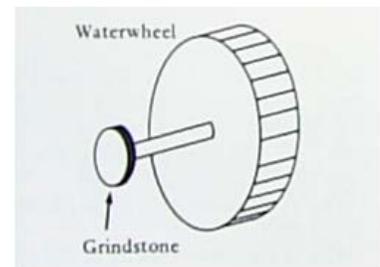   c. What is the linear velocity of a point at the center of the fan?

   d. Do point A and point B have the same angular velocity OR the same linear velocity?
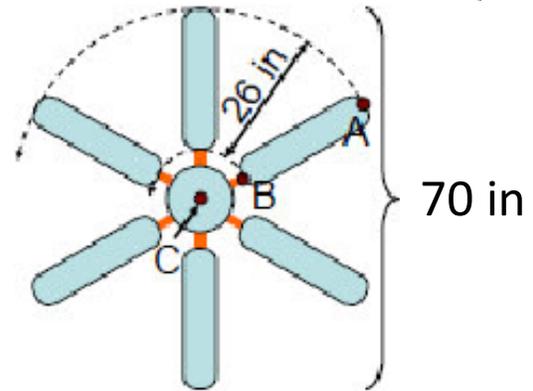
2. **A waterwheel of diameter 12 feet turns at .3 radians per second.**

   a. What is the linear velocity of the rim?

   b. The wheel is connected by an axel to a grindstone of diameter 3 feet. What is the linear velocity of a point on the rim of the grindstone?

   Waterwheel

   Grindstone

   c. Do a point on the waterwheel and a point on the grindstone have the same angular velocity OR the same linear velocity?

3. **The rear wheels of a tractor are 4 feet in diameter and turn at 20 rpm.**

   a. How fast is the tractor going in feet per second?

   b. The front wheels have a diameter of only 1.8 feet. What is the linear velocity of a point on their tire treads?

   c. What is the angular velocity of the front wheels in rpm?

   d. Do a point on the rear wheel and a point on the front wheel have the same angular velocity OR the same linear velocity?
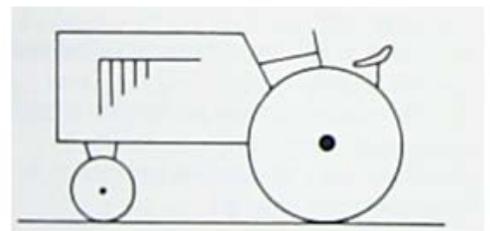
4. **Mr. Kelly lets his Spanish rescue dog Tasker outside. You are "tasked" with describing Tasker's velocity over time given the graph below.**

velocity
(m/min)
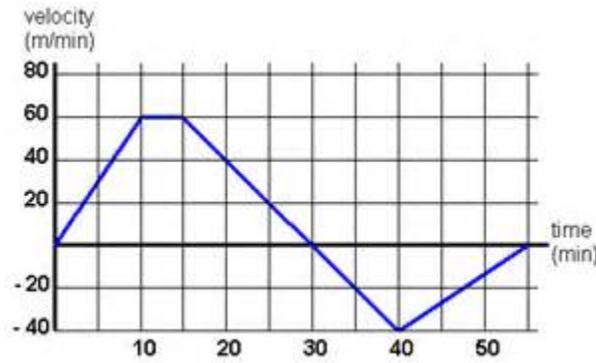
| Time | Description of what Tasker is doing |
|---|---|
| 0-10 min | |
| 10-15 min | |
| 15-30 min | |
| 30 min | |
| 30-40 min | |
| 40-55 min | |

**"Chew" on this, the area under the line represents the total distance travelled. Use your mad Geometry skills to find out how far Tasker travelled over the 55 minutes. If you get it right, Mr. Kelly may give you a treat.**

5. **Mr. Kelly throws a dog toy straight up in the air for his Spanish rescue dog Tasker. The position graph below shows the height of the dog toy over time. You are "tasked" with drawing the velocity of the dog toy over time given the position graph.**

**POSITION GRAPH**

HEIGHT (ft)

TIME (sec)

**VELOCITY GRAPH**

VELOCITY (ft/sec)

TIME (sec)