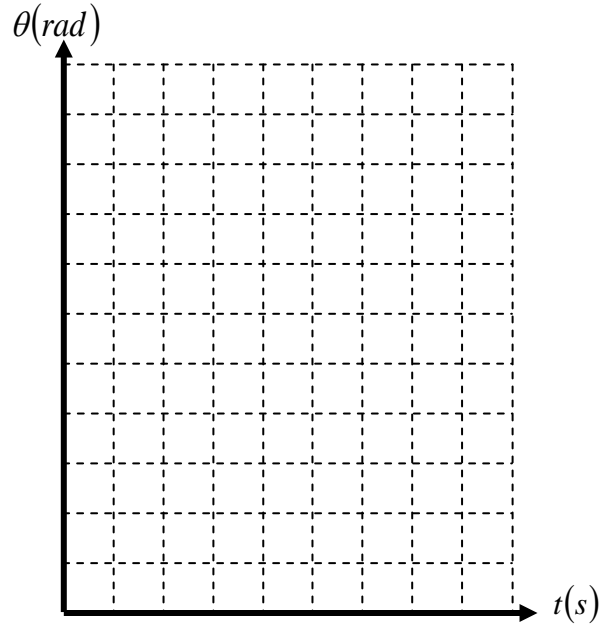


Rotation: Worksheet 1

Constant Angular Velocity

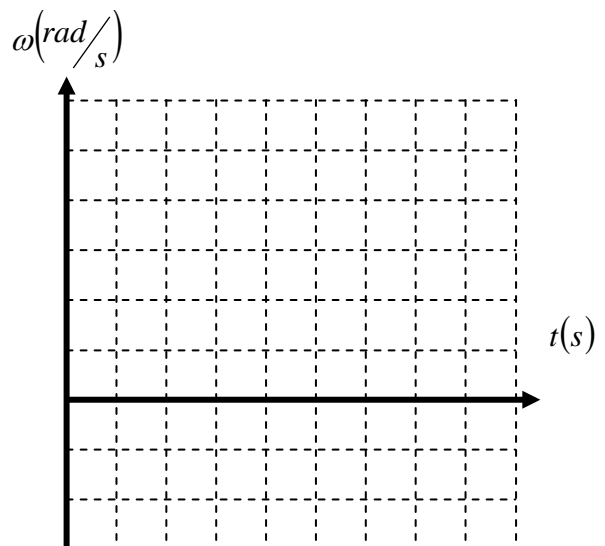
1. The wheel of an automobile is spun so that its *angular position vs. time* is given in the data table below.
- a. Plot the following data for the automobile wheel.

$t(s)$	$\theta(rad)$
1.0	1.53
2.0	2.15
3.0	2.55
4.0	3.10
5.0	3.55
6.0	4.18
7.0	4.74
8.0	5.25



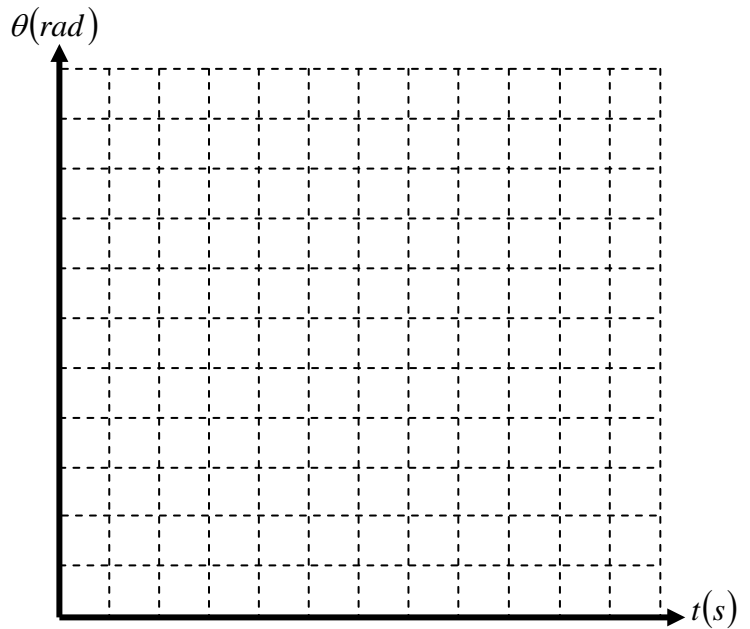
- b. Draw a line of best fit and use this line to write an equation for this rotation.
- c. Determine the angular displacement in 12.5 s for this wheel.
- d. How long will it take the wheel to have an angular displacement of 5.00 rad?

- e. Graph the *angular velocity* as a function of *time* and then use the graph to determine the angular displacement from $t = 1.5 s$ to $t = 4.25 s$.



2. The wheel of a truck is spun so that its *angular position vs. time* is given in the data table below.
- a. Plot the following data for the truck wheel.

$t(s)$	$\theta(rad)$
0	0
1.5	4.71
3.0	9.42
4.5	14.14
6.0	18.85
7.5	18.85
9.0	12.57
10.5	6.29
12.0	0



- b. In your own words, describe the motion of this truck wheel from $t = 0\text{ s}$ until $t = 12\text{ s}$. Be sure to include the direction of rotation.

- c. Calculate the total angular displacement of the truck wheel.

- d. What is the average angular velocity of the truck wheel? What does this mean?

3. A pottery wheel has a radius of 20 cm and an angular velocity of 150 rpm (revolutions per minute).

- a. Convert this angular velocity to $\frac{rad}{s}$.

- b. What is the linear velocity of a point on the outside of the wheel?

4. A drill bit has an angular velocity of 1767 rad/s .
- Convert this to rev/min .
 - How many revolutions will the drill bit make in a half hour of continuous use?
5. A rotating, circular ride at a local park is 12 m in diameter and rotates with a constant angular velocity of 1.5 rad/s . Three sisters sit on this ride, Mary 2.0 m from the center, Goh 4.0 m from the center, and Wround (The W is silent!) 6.0 m from the center. All three children strangely have exactly the same mass; 42 kg (**Don't Panic!**).
- Draw a force diagram for each child.
 - What is the angular velocity of each child?
 - What is the linear speed of each child?
 - What is the centripetal acceleration of each child?
 - What is the force of static friction acting on each child?

6. A ball of radius 0.25 m rolls at a constant velocity without slipping. It takes the ball $10.\text{ s}$ to travel 5.0 m .

- a. What is the velocity of the center of mass of the ball? b. What is the linear velocity of a point on the outside of the ball?

- c. What is the angular velocity of the ball? d. What is the linear velocity of a point half way from the center?

- e. Suppose you made a mark on the outside of the ball. How far would that mark move in the $10.\text{ s}$? f. Through what angular displacement does the ball rotate in the $10.\text{ s}$? g. How long does it take the ball to fully rotate once?