

“Gears and Speed – Constant Time” Worksheet

Condition	Number of Teeth on Gear on Motor	Number of Teeth on Gear on Wheel Axle	Gear Ratio between Motor Axle and Wheel Axle	Length of Time the Robot Moves (sec)	Distance Tankbot Traveled (cm) [3 Trials]	Average Speed for Each Trial (cm/sec)	Overall Average Speed for Condition (cm/sec)
1					1.	1.	
					2.	2.	
					3.	3.	
2					1.	1.	
					2.	2.	
					3.	3.	
3					1.	1.	
					2.	2.	
					3.	3.	

Condition 1:

1. The back of the starting line is where the front of your robot was at the beginning of the run. At the end of the run, you measured to the front of the robot again. Why is it important to always measure to and from the same point on the robot?

2. Fill in the following values in your data table.
 - a. Number of teeth on the "motor" gear for this condition.

 - b. Number of teeth on the "wheel" gear for this condition

 - c. Gear ratio for this condition

 - d. Number of seconds the robot runs for this condition

3. Calculate the average speed for each trial in this condition, and fill out the appropriate cells in the data table.

4. Calculate the overall average speed by averaging the speeds from each of the three individual trials. Fill out the appropriate cell in the data table.
5. Answer the following questions:
 - a. How many times does the gear on the motor have to turn for the wheel to make one full rotation?
 - b. How is this number related to the gear ratio for this condition?

Condition 2:

6. Fill in the number of teeth for each gear and the length of time, and calculate the gear ratio for this condition.
7. Calculate the average speed for each trial in this condition.
8. Calculate the overall average speed by averaging the speeds from each of the three individual.
9. Answer the following questions:
 - a. How many times does the gear on the motor have to turn for the wheel to make one full rotation?
 - b. How is this number related to the gear ratio for this condition?

Condition 3:

10. What happened? What change did we make to the robot that caused this change in behavior?
11. What would happen if we added a second idler gear between the 40-tooth gear and the 24-tooth gear?
12. What happens when you reverse the polarity on a motor? How does this help with our problem?

13. Fill in the number of teeth for each gear and the length of time, and calculate the gear ratio for this condition.
14. Calculate the average speed for each trial in this condition.
15. Calculate the overall average speed by averaging the speeds from each of the three individual trials.
16. Answer the following questions:
- How many times does the gear on the motor have to turn for the wheel to make one full rotation?
 - How is this number related to the gear ratio for this condition?

Analysis and Conclusions:

17. In which experimental condition did your robot move fastest?
18. In which experimental condition did your robot move slowest?
19. Answer the following questions:
- Write a fraction comparing the speed in Condition 3 to the speed in condition 2.
 - Convert your answer to a decimal number.
 - Round the decimal to the nearest whole number.
20. Answer the following questions:
- What is the ratio of speeds between the robot in Condition 1 and the robot in Condition 2?

- b. What is the ratio of gear ratios between the 2 robots?
- c. How are speed and gear ratio related, based on this comparison?

21. Answer the following questions:

- a. Predict the speed of the robot in Condition 3 based on its gear ratio and the speed you measured for Condition 1.
- b. Compare this value to the actual measured speed. How accurate was this prediction?

22. Did the presence of an idler gear affect your robot's speed?

23. Suppose you have a robot with a 40-tooth gear on the motor, and an 8-tooth gear on the wheel.

- a. What would its gear ratio be?
- b. What would its average speed be?
- c. Would either of these values change if you added an idler gear? Would anything else change?

24. Explain how gear ratio affects the speed of the robot.

25. Describe a method for calculating the speed of the robot.

26. Did your result support or refute the hypothesis? Explain.

Hypothesis: "As the gear ratio between the motor and the wheel increases, speed will decrease proportionally."