Name: _____ Date: _____

# "Gears and Speed – Constant Distance" Worksheet

| Condition | Number Of Teeth On Gear On Motor | Number Of Teeth On Gear On Rear Axle | Gear Ratio (Rear Axle To Motor) | Distance Tankbot Traveled (cm) | Length Of Time The Robot Moves (sec) [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. Answer the following questions:
   a. Will your robot run for exactly two meters if you follow the preceding instructions? Why or why not?

   b. The number displayed on the RCX indicates the amount of time to go what distance?

   c. When you calculate the speed for this condition, should you use the distance the robot eventually traveled, or should you use 200 cm?

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. Distance the robot ran in this condition

3. Calculate the average speed for each trial in this condition, and fill out the appropriate column 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 complete revolution?

   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 distance traveled, and calculate the gear ratio for this condition.

7. Calculate the average speed for each trial in this condition and add the data to your worksheet.

8. Calculate the overall average speed by averaging the speeds from each of the three individual trials and add the data to your worksheet.

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 behaviors?

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 distance traveled, and calculate the gear ratio for this condition.

14. Calculate the average speed for each trial in this condition and add the data to your worksheet.

15. Calculate the overall average speed by averaging the speeds from each of the three individual trails and add the data to your worksheet.

16. 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?

**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:
    a. Write a fraction comparing the speed in Condition 3 to the speed in Condition 2.

    b. Convert your answer to a decimal number.

c. Round the decimal to the nearest whole number.

20. Answer the following conditions:
    a. 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 two robots?

    c. How are speed and gear ratio related, based on this comparison?

21. Answer the following conditions:
    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.”