Current Draw

Lesson Procedure

Overview

In this lesson, you will observe the relationship between work and current by driving your modified Vex Squarebot up incremental inclines and recording the current drawn. For a review of work and current, look at "Overview / Guides / Note to the Student."

This document is the companion to "Lesson / Videos / Current Draw: Lesson Procedures" video. If you have access to this video, it is recommended that you watch the video before attempting the Lesson Procedure. In addition, if you have not already done so, open and follow "Lesson / Videos / Current Draw: Lesson Setup." If you are unable to watch this video, use the "Lesson / Printable PDF / Current Draw: Lesson Setup" PDF. For more information about using a multimeter, refer to "Background / Resources / Multimeter Guide," which contains two instructional videos and a PowerPoint presentation.

You Will be Able to:

1. Observe how work done affects current
2. Measure current using a multimeter
3. Graph and interpret your results
4. Collect data from your experiments and use multiple trials
5. Apply scientific process

Materials Needed:

- Vex Squarebot with modified battery and attached multimeter
- Radio control transmitter
- Board or plywood (8 ft. by 12 in.)
- White foam board (8 ft. by 4 ft.) or other board suitable for drawing
- Protractor
- Stopwatch
- Books, boxes or similar objects
- Current Worksheet in either PDF or Excel format; found in Background / Resources / Current Worksheet" PDF or xls.

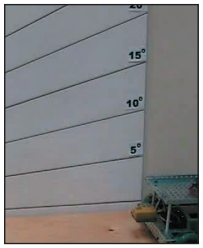

Figure 1

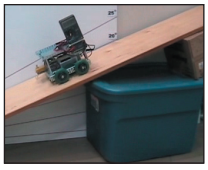
Figure 2

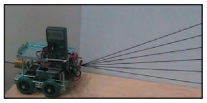
Figure 3

Procedure

1. First, you will need to create a way to increment the inclines. You will need an 8' by 4' sheet that you can mark. We used white foam board. Draw angle increments 0, 5, 10, 15, 20 and 25 degrees using your protractor, as shown in Figure 1.
2. You will also need a 8' by 1' board to drive Squarebot on. Align the board with the bottom line on your white foam board at 0 degrees. Note that when driving Squarebot at 5, 10, 15, 20 and 25 degrees, you will need books, boxes or other objects to raise the end of your board up to match the line drawn on the white foam board, as in Figure 2.
3. Since your first trial will be at 0 degrees, you can leave the board resting on the floor. Set your robot at the end of the board, as in Figure 3. Turn on your radio control transmitter and your modified Squarebot. Turn on the multimeter and configure it to read DC current.

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Current Draw *continued*

Lesson Procedure

4. Remember to begin this experiment with a fresh battery. In addition, whenever you drive the robot, make sure to drive at maximum speed (push the joysticks all the way forward).
5. Drive the robot across the board while observing the multimeter readings. Use a stopwatch to time how long the robot takes to reach the end of the board. Ideally, one person should drive the robot, another should observe the multimeter, and another should time the robot.
6. Expect the current readings to vary slightly in these trials. Do your best to estimate the average reading for the robot over the course of a trial. For example, the multimeter may begin with readings of 0.68 briefly, then vary between 0.64 and 0.65 for the rest of the trial. Therefore, you might conclude that 0.65 is the best average reading over the course of the trial.

   The worksheet for this lesson can be found in "Background / Resources / Current Worksheet." Enter this average reading into your Current Worksheet in the Current Table under Trial 1 for a theta of 0 degrees. Record the time in the Time Table under Trial 1 for a theta of 0 degrees.

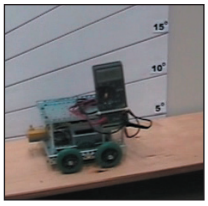

Figure 7

7. Now, prop the board up so that its angle is as close as possible to the 5 degree line you drew on your foam board, as in Figure 7. Repeat steps 5 and 6 for a theta of 5 degrees, making sure to record the current reading and time on the Current Worksheet.
8. Follow the procedure as in step 7 for 10, 15, 20 and 25 degrees.
9. Repeat the experiment steps 3 through 8 twice more and record your values in the Trial 2 and Trial 3 columns in your Current Worksheet.
10. Take the average of the current on Trial 1, 2 and 3 for each theta and record this in the Average Current column of the Current Table. Follow the formula below to find the average of each row.

$$\text{Average} = \frac{\text{Trial 1 current} * \text{Trial 2 current} * \text{Trial 3 current}}{3}$$

11. Repeat step 10 for the Time Table columns of trials 1, 2 and 3.
12. Plot Theta vs. Average Current. Refer to the Current Worksheet for a similar graph, and templates for your graph. Theta should be on the x-axis, while Average Current is on the y-axis.
13. Repeat step 12 for Theta vs. Time.


Figure 14

14. Now that you have your current readings and know how they change as theta increases, you must find out how work changes with a varying theta. For a refresher on work, refer to "Overview / Guides / Note to the Student." The formula at left shows that we need current, voltage and time.

    You know that your Vex robot is supplied by a 7.2 V battery (Figure 14), which means voltage is 7.2 V. Transfer the average current and time values from the Current Table and Time Table into the appropriate columns in the Work Table. Multiply the average current, time and the voltage above for each theta, and record them in the Work Table.

$Work_2 = V \times I \times t$

15. Plot Theta vs. Work as in step 12.
16. You have three graphs of work, current and time. How do these relate? What is the relationship between work and current in this lab? Current and time? Work and time?

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