

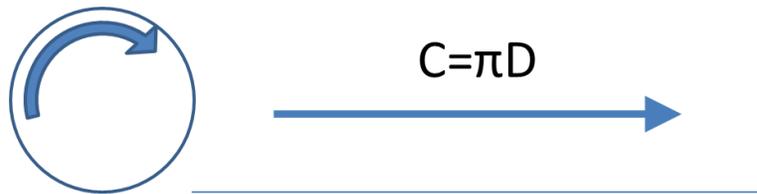
Data Collection Worksheet **Answer Key**

1. What is the height, length and width of your elevator box? How is the string attached?

Example answer: The elevator box's height is 4 inches, length is 4 inches and width is 2 inches. The string is attached with masking tape from the top of the elevator box.

2. Dimensions and Calculations:

A: What is the diameter of your wheel? What is the circumference? How many degrees are needed to raise the elevator box up one floor (six inches)? How many rotations is this?



$$\begin{aligned}
 \text{one floor} &= \frac{6 \text{ inches}}{1} \times \frac{360 \text{ degrees}}{\text{Circumference}} = ? \text{ degrees} \\
 &= \frac{? \text{ degrees}}{1} \times \frac{1 \text{ rotation}}{360 \text{ degrees}} = ? \text{ rotations}
 \end{aligned}$$

Dimensions	Value
diameter (in)	1.19 in
circumference (in)	3.73 in
degrees	579 degrees
rotations	1.6 rotations

B. Using a calculator, fill out the table below with the predicted and measured rotations.

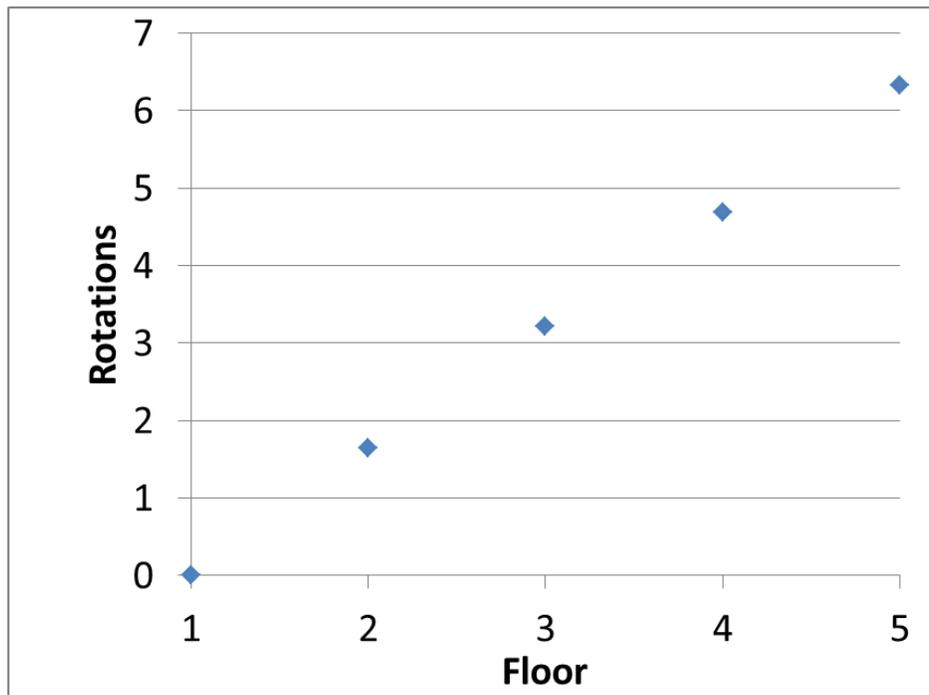
Floor	Predicted Height (in)	Degrees to Get to Floor	Rotations to Get to Floor
1	0	0	0
2	6	579	1.61
3	12	1158	3.22
4	18	1737	4.83
5	24	2316	6.43

Name: _____ Date: _____

3. Build an elevator box from the supplied materials and attach it to the elevator cable.
4. Build the elevator motor according to the instructions handout or follow along with the teacher.
5. Turn on the rotary encoder tool on the EV3.
6. Measure the height of the floor and number of degrees and rotations it takes to reach that floor. Record these values in the table below.

Floor	Actual Height (in)	Actual Degrees to Get to Floor	Actual Rotations	Percent Difference
1	0	0	0	0
2	6	591	1.64	1.8 %
3	12	1154	3.21	0.3 %
4	18	1687	4.69	3.0 %
5	24	2279	6.33	1.6 %

7. Graph your results in the chart below.



8. Did all your passengers reach the top floor safely with the motor program?

Yes, a model elevator box that is designed well can easily enclose and lift the weight of 41 cents.

Name: _____ Date: _____

9. Estimate the degrees to get to the next floor. Turn on the elevator.c program on the LEGO EV3. To the nearest 30 degrees, use the gray buttons to enter in the predicted degree to get to the next floor. Calculate your predicted height. Press the elevator button. Measure the actual height and record the percent difference.

Floor	Predicted Degrees to Get to Floor	Predicted Height (in)	Actual Height (in)	Percent Difference
6	2955	30	32	6.3%

10. After measuring the top height again using the elevator.c program, what is the percent difference in this trial? What do you think about the percent difference? Is it acceptable for public use?

The difference is 6.3%. If a building had 100 floors and a person pressed the button for the 100th floor, the elevator would be off by 6 floors!

11. What is the control device used to control elevators and escalators? How are they used by engineers to ensure public safety?

Rotary encoders are used to control elevators and escalators. Engineers make sure that the motors in the devices are calibrated using the measurements of the encoders so that people arrive at the correct destinations.

12. In your own words, define the term *calibration*. How does it relate to rotary encoders and the activity you did today?

Calibration is the process of standardizing or precisely adjusting a measure or tool. The elevator was calibrated so that the passengers are delivered at the correct destinations.