

# **Engineering GatorTRAX**

## **Mechanical Engineering Module**

### **Beginner Level**

*Designed in accordance with Tau Beta Pi MindSET standards*

*By American Society of Mechanical Engineers, University of*

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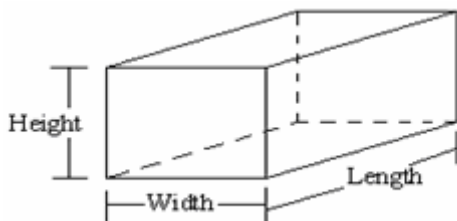


Well, we can use this equation to figure it out

$$(\text{Length}) \times (\text{Width}) \times (\text{Height}) \div (\text{A Candy's Volume})$$

The first part of the equation that multiplies the length times the width times the height is called the Rectangular prism's volume. Volume is defined as the amount of three dimensional space that an object takes up. It can be measured and predicted as well. Objects that look bigger have larger volumes and vice versa.

Now, you are going to try to solve these equations, but you will need to know about how to measure the length, width, and height of a rectangular prism. Here is a drawing to help you understand.



You will be using a ruler to measure these values, so go ahead and try it out. Write down what you get and get as much help as you can.

Length	Width	Height

**POWERS**

This operation is simple and easy once the concept is understood. The power number (number in top right corner) signifies the number of times that the radius must be multiplied by itself. Try to fill out this table to help you learn.

Operation Name	Configuration	What to do	Answer
Radius Cubed	$R^3$	Radius x Radius x Radius	
Radius Squared	$R^2$	Radius x Radius	
Three Squared	$3^2$	3 x 3	9
Four Cubed	$4^3$		
Twelve Squared	$12^2$		
Nine to the fourth	$9^4$		
	$4^5$		

Now that you have these measurements, setup the equation.

(Length) x (Width) x (Height) ÷ (A Candy's Volume)

\_\_\_\_\_ x \_\_\_\_\_ x \_\_\_\_\_ ÷ \_\_\_\_\_

Now, does it matter what order we do these operations? Should you divide first? What do you think?

If you are ever confused about what operation to do first, just say PEMDAS!

PEMDAS stands for Parenthesis Exponents Multiplication Division Addition Subtraction.

That is the order that you should always follow. Another rule is that you need work from left to right. For example, if I had  $4 \div 2 \div 2$ , I would just take 4 and divide by 2, then I would divide by two again. I would not want to take 2 and divide by two, then divide by four. Both would give you different answers.

Here is a table. Try to complete it. Ask questions if you are confused.

Equation to solve	Order of Operations	Answer
$4 \div 2 \div 2 + 4$	4 divided by 2 divided by 2 add 4	5
$9 + 9 + 8 \div 4$	8 Divided by 4 Plus 9 Plus 9	20
$7 - 5 - 5 + 9$		
$(2 + 4) \times 3$		
$3 \times 3 + 2 \times 2$		
$1 - 6 \div (4 + 2)$		
$9 \times 2 \div 6$		
$2 + 9^2 \times 2$		

Now solve for the number of candies!

$$(\text{Length}) \times (\text{Width}) \times (\text{Height}) \div (\text{A Candy's Volume})$$

$$\underline{\hspace{2cm}} \times \underline{\hspace{2cm}} \times \underline{\hspace{2cm}} \div \underline{\hspace{2cm}} =$$

Now with this number, you have an idea of what is in the rectangular prism. Now you know a little more, so add what you think is in the other shapes and give a prediction.

$$\# \text{ of candies in rectangular prism} + \# \text{ in other shapes} =$$

$$\underline{\hspace{2cm}} + \underline{\hspace{2cm}} =$$

### **PERCENT ERROR**

Percent error is something that might show the effectiveness of using mathematical methods to solve everyday problems. It is defined as the difference between an exact value and a predicted one. The equation for it is such follows. Try to figure out your error.

With  $V_{\text{predicted}}$  as the value you came up with when you first predicted, and  $V_{\text{actual}}$  as the true value

$$\text{Percent error} = \frac{V_{\text{predicted}} - V_{\text{actual}}}{V_{\text{actual}}} \times 100\% = \frac{\underline{\hspace{2cm}} - \underline{\hspace{2cm}}}{\underline{\hspace{2cm}}} \times 100\%$$

If your value came out to a negative value in your calculator, do not worry. It is because your predicted value was less than the actual value. Simply make your percentage positive.

Now that you have a hold on this, get the percent error for the value you predicted using the concept of volumes.

$$\text{Percent error} = \frac{V_{\text{predicted}} - V_{\text{actual}}}{V_{\text{actual}}} \times 100\% = \frac{\quad - \quad}{\quad} \times 100\%$$

For which did you have less error?

## **PENNY LAUNCHER**

It is now time to apply the concept of percent error to something that is just as fun.

Penny Launchers!

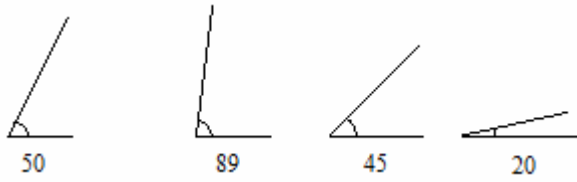
The setup is simple. You can only use rubber bands, popsicle sticks, and tape. The rules and regulations are just as simple:

- Size restriction: 12 x 12 x 12
- Must activate by the release of a string

So the competition this time will stress both accuracy and precision. You and your group will be looking to create a launcher that will make pennies land in the right position, consistently.

## **LAUNCH ANGLE**

Your penny launcher can be set to shoot in many angles, but which would be the best for getting the furthest horizontally? If you were given a penny launcher that had only one speed setting, what would be the best angle to choose? Why?



Pick one, write down, and discuss with others why you think this angle will get you the furthest.