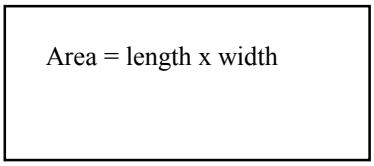
# Chemistry CP

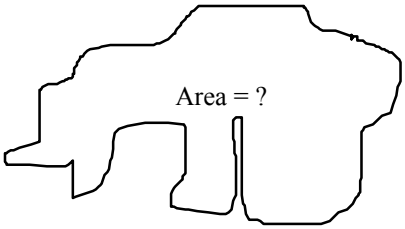
Name:

Lab: Using Mass to Find Area

Section:

It is straightforward to determine the area of a regular geometric shape—such as a rectangle, triangle, hexagon, or circle. For example, to calculate the area of a rectangular piece of cardboard, you measure the length and width of the cardboard and calculate their product. However, finding the area of an irregular object like the one pictured to the right below is much more difficult.




Based on your past experience, you might be tempted to subdivided the irregular object into several smaller squares, calculate the area of each, and then add them up. As you might imagine, this method involves a fair amount of error, depending on the size of the squares you divide each shape into. In this lab, we will try a new approach. We will determine the dimensions and mass of the rectangular pieces, then make a careful graph of mass vs. area for each rectangle. Then we will draw a "best fit" line through these four data points. This will allow us to find the area of any irregularly shaped piece by determining its mass and then reading the graph to find the corresponding area.

By the way, what assumption have we made in this process? We have assumed that the thickness of all the pieces is the same, which means that the mass will be directly proportional to area. Two quantities are said to be directly proportional if a graph of one as a function of the other produces a straight line with a positive slope.

## Preparations

**Problem**

How can we determine the area of an irregularly shaped object?

**Objectives**

- Using metric rulers and laboratory balances to precisely measure objects
- Applying rules of significant figures in measurements
- Representing data in graphical form
- Using data to interpolate and extrapolate values

**Materials**

set of 4 rectangular pieces
irregularly shaped piece of same material
metric ruler
balance
graph paper

**Roles** Record the names—make sure this is included in your lab report, too!

- Project Manager _____
  Reads directions, keeps track of time, keeps group on task
- Quality Control Manager _____
  Approves data table, checks data quality, checks calculations
- Materials Manager _____
  Gets and returns materials, supervises sharing of materials

## Procedure

1. Design and create appropriate data tables in your laboratory notebook.
2. Using the balance, determine the mass of each piece to the correct number of significant figures.
3. Using the ruler, determine the dimensions of the rectangular pieces to the correct number of significant figures.
4. Calculate the area of the rectangular pieces, using the formula A = l * w, to the correct number of significant figures. Because area is the product of two lengths, which both have units of cm, area has units of $cm^2$.
5. Using a full sheet of graph paper, create a graph of mass vs. area for the rectangular pieces. Place mass on the y-axis and area on the x-axis.
6. Use a straightedge to draw a "best-fit line" connecting the points. The line on your graph should go through the origin in this graph (this won't always be true for every graph).
7. Use the graph to determine the area of the irregularly shaped piece.

**Analyze and Apply**

Answer these questions in complete sentences!

1. How many significant figures are in your measurement of the length of the rectangular pieces? The width? Explain why this number of significant figures is correct.
2. How many significant figures are in your calculated areas for the rectangular pieces? Explain how you arrived at your answer.
3. What is the purpose of the estimated digit when reporting measurements? Why is that digit uncertain?
4. Calculate the slope of your best fit line. The units of your slope will be $g/cm^2$—can you explain why?
5. Use the slope you calculated to determine the mass of 2 $cm^2$ of cardboard.
6. Consider the situation in which the mass of the irregularly shaped piece was considerably larger than the masses of any of the rectangular pieces. Could you still determine the area of the irregular piece? Explain.
7. In this particular graph, your best-fit line should go through the origin. In your own words, explain what this means physically.

Don't forget to write an appropriate conclusion for this lab!