

You will need

graph paper



A MYSTERY LIQUID

Reg, Bea, and Gabe were doing an experiment in science class. They had an unknown liquid whose volume they measured in a graduated cylinder. A graduated cylinder is a tall, narrow container that is used for measuring liquid volume accurately. They used a cylinder that weighed 50 grams and measured volume in milliliters. They used a balance to find the weight of the liquid to the nearest gram.

Reg's Data

Volume	Weight
10 ml	16 g
20 ml	32 g
50 ml	80 g
80 ml	128 g

- Plot Reg's data, with *weight* on the vertical axis and *volume* on the horizontal axis.
- Does it make sense to connect the points on your graph? Explain.
- Find an equation relating weight to volume.
- Estimate the weight of of:
 - 60 ml of liquid;
 - 1 ml of liquid.
- If you add 30 ml to the volume, how much are you adding to the weight? See if you get the same answer in two different cases.

- If you double the volume, do you double the weight?

Bea's Data

Weight	Volume
16 g	10 ml
32 g	20 ml
48 g	30 ml
64 g	40 ml

- Plot Bea's data with *volume* on the vertical axis and *weight* on the horizontal axis.
- Connect the points on your graph with a line and write an equation for the line.
- Estimate the volume of:
 - 100 g of liquid;
 - 1 g of liquid.
- Compare Bea's graph with Reg's graph. Explain the similarities and differences.

We say that Reg graphed weight versus volume, while Bea graphed volume versus weight.

- If you add 10 ml to the volume, how much are you adding to the weight? See if you get the same answer in three different cases. Is the answer consistent with what you found in Reg's data?

Definition: *Density* equals weight per unit of volume. This means that to find the density of the mystery liquid, you would find the weight of 1 ml of the liquid. (Actually, scientists use *mass* rather than *weight*, but we will use weight which is equivalent for our purposes.)

12. Find the density of the mystery liquid, using three different pairs of weight/volume values from Reg's and Bea's data. Do all your answers agree? Explain.
13. In problems 4b and 9b, you have found the weight in grams of one ml of liquid, and the volume in ml of one gram. Multiply the two numbers. Explain the result.

THE MYSTERY GROWS

Gabe's Data:

Volume	Weight
10 ml	66 g
20 ml	82 g
40 ml	114 g
60 ml	146 g

14. Draw a pair of axes and label the vertical axis *weight* and the horizontal axis *volume*. Plot Gabe's data.
15. If you double the volume, does the weight double? Check this in two cases.
16. If you add 20 ml, how much weight are you adding? Is this consistent with what you learned from Reg's and Bea's data?
17. According to Gabe's graph, what is the weight of 0 ml of the liquid? Does this make sense?
18. What might be the real meaning of the y-intercept on Gabe's graph? Did Gabe make a mistake? Explain.
19. Find the density of the mystery liquid by dividing weight by volume for three different pairs of values from Gabe's data. Do all your answers agree? Explain.
20.  Write an equation that expresses weight as a function of volume for Gabe's data.

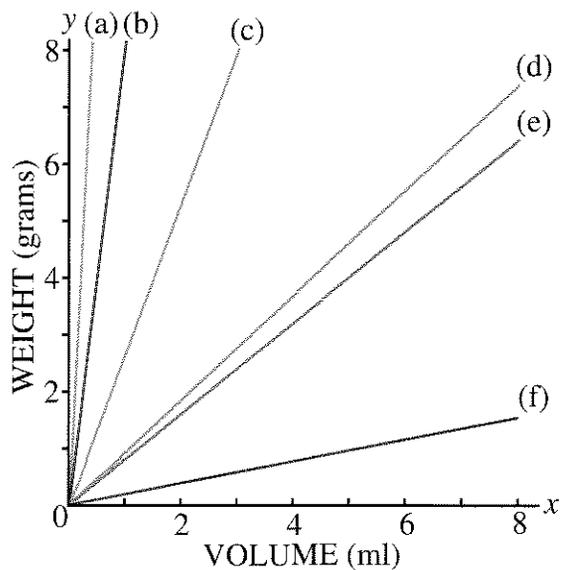
DIRECT VARIATION

Definition: If the relationship between two variables x and y can be expressed in the form $y = mx$, we call this a *direct variation*, or say that y *varies directly with* x .

21. Which of Reg's, Bea's, and Gabe's data are an example of a direct variation? Explain.
22. Compare Gabe's graph to Reg's. How are they the same and how are they different?
23.  There are number patterns in all the data.
- What pattern is there in all of Reg's, Bea's, and Gabe's data?
 - What patterns are true only of Reg's and Bea's data?
24. **Summary** What do you know about direct variation? Be sure to discuss equation, graph, and number patterns. You may get ideas from this lesson and Lesson 5.

OTHER SUBSTANCES

25. The graph shows the relationship between weight and volume for some familiar substances. The substances are aluminum, cork, gold, ice, iron, and oak. Which substance do you think is represented by each line? Explain why you think so.



26. Using the graph, estimate the densities of the substances in problem 25.

27. Project

- Look up the densities of those substances in a science book, almanac, or other reference book. How close were your estimates?
- Based on your research, what do you think the mystery liquid is? Could it be water? Explain.