

Density, Mass and Volume

Name: _____

Date: _____

Hour: _____

Information: Density

Object	Mass of Object (g)	Volume of Object (mL)	Density of Object (g/mL)
1	21.50	18.40	1.168
2	12.6	14.7	0.857
3	41.90	31.60	1.326
4	32.90	12.85	2.560
5	59.5	61.7	0.964
6	0.594	0.574	1.035
7	17.23	21.67	0.7951

Critical Thinking Questions

1. Consider the data for objects 1, 2 and 3. Which of the following equations correctly show the relationship(s) between mass (M), volume (V) and density (D)? There may be more than one answer.

A) $D = \frac{V}{M}$

B) $M = \frac{V}{D}$

C) $D = \frac{M}{V}$

D) $V = \frac{D}{M}$

E) $V = \frac{M}{D}$

F) $V = DM$

G) $M = DV$

H) $D = MV$

2. For objects 4, 5, 6 and 7 there are blanks in the table. Using your answers to question 1, fill in the blanks.

See the table above.

3. What are the units for density if the mass of an object was measured in kilograms and the volume in liters?

kg/L

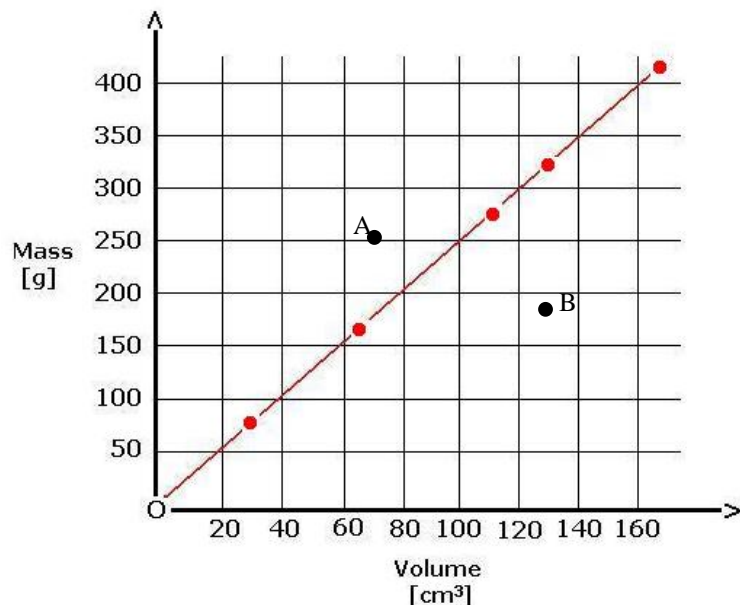
4. In your own words, define "density".

Density: the amount of mass an object has per unit volume. Density includes the idea of how much mass something has in comparison to its size.

5. Calculate the density of an object that has a mass of 45.0 kg and a volume of 20.0 L. Include units.

$$D = \frac{m}{V} = \frac{45.0\text{kg}}{20.0\text{L}} = 2.25 \text{ kg/L}$$

6. Use the following graph of mass vs volume to answer the following questions.



a) Calculate the density of the substance.

Pick 2 points on the line and get the slope. For example, (100, 250) and (160, 400)

$$\frac{400 - 250}{160 - 100} = 2.5 \text{ g/cm}^3$$

b) When students were obtaining data to plot on the graph, they used a graduated cylinder and water displacement to find the volume. Notice data point “A” that isn’t located on the line of best fit. What error(s) might the students have made when they collected data for point “A”?

Perhaps when they dropped the object into the graduated cylinder some water splashed out, making the volume less than it should have been.

c) Notice data point “B” that isn’t located on the line of best fit. What experimental error(s) might the students have made when they collected data for point “B”?

The mass is too low, or the volume is too large. Perhaps they misread the scale.

d) True or False: Whenever mass is plotted vs volume, the resulting line must pass through the origin at (0,0).

True—if there’s no mass, there’s also no volume. Matter is anything that has mass and takes up space.

e) From the graph, estimate the volume of 125g of the material.

Approximately 50 cm³

7. A certain substance has a density of 3.44 g/cm³. Find the mass of a block of the substance with the dimensions 5cm x 10cm x 2 cm.

$$V = 5 \times 10 \times 2 = 100 \text{ cm}^3; \quad m = D \times V = 3.44 \times 100 = 344 \text{ g} = 300 \text{ g (with significant figures)}$$

8. Sara drank 45 grams of Pepsi. How many mL of Pepsi did she drink if the density is 1.29 g/mL?

$$V = m \div D = 45 \div 1.29 = 34.88 \text{ mL} = 35 \text{ mL}$$

9. The cup is a volume widely used by cooks in the U.S. One cup is equivalent to 237 cm³. One cup of olive oil has a mass of 216 g; what is the density of olive oil?

$$D = m \div V = 216 \div 237 = 0.911 \text{ g/cm}^3$$

Use the following information for questions 10-12: Gold has a density of 19.3 g/cm^3 . A certain cube of gold measures 4.23 cm on each edge.

10. What is the volume of the cube?

$$V = 4.23 \times 4.23 \times 4.23 = 75.687 \text{ cm}^3 = 75.7 \text{ cm}^3$$

11. What is its mass?

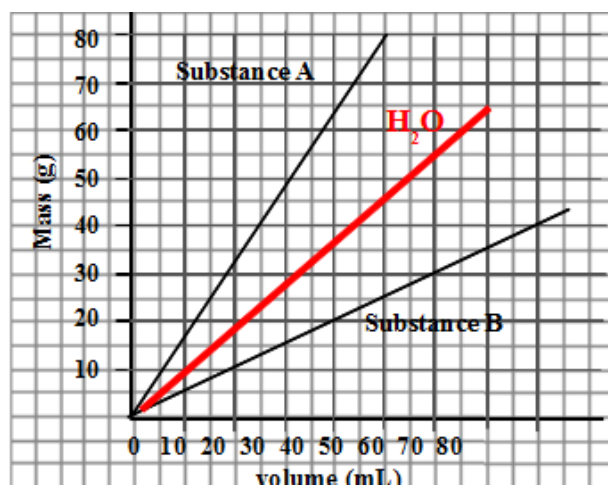
$$m = D \times V = 19.3 \times 75.7 = 1461.01 = 1460 \text{ g}$$

12. A standard backpack is approximately $30 \text{ cm} \times 30 \text{ cm} \times 40 \text{ cm}$. Suppose you find a hoard of pure gold while treasure hunting in the wilderness. How much mass would your backpack hold if you filled it with the gold? An average student has a mass of 70 kg . How do these values compare?

$$V = 30 \times 30 \times 40 = 36,000 \text{ cm}^3; m = D \times V = 19.3 \times 36,000 = 694,800 = 700,000 \text{ g} \rightarrow 700 \text{ kg}$$

The gold has ten times the mass of the student.

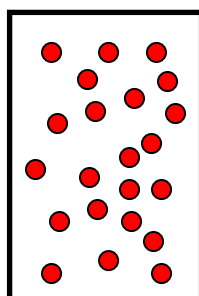
13. Consider the following graph. Which substance—A or B—will float in water? Why?



B will float in water since its slope is less steep. The steeper the slope, the higher the density.

14. Given the above graph, draw particle diagrams for Substances A and B.

Substance A



Substance B More particles per volume for substance A

