Name:

Period:

LAB 11.2 - DENSITY EQUATIONS

BACKGROUND

We have learned that density is the relationship between mass and volume, specifically, the amount of mass per unit volume (g/cm^3 or g/mL). Density is calculated by dividing the mass of an object or liquid by the volume of that object or liquid, so if we know the mass and volume of something we can calculate its density.

So mass, volume, and density are all related in the equation

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

PROBLEM

1. What is the density matrix and how do we use it?

2. What are the density equations and how do we use them?

3. How can we determine the mass or volume of an object/liquid if we know the density of the object/liquid?

MATERIALS

- Calculator
- Pencil

PROCEDURE

1. Fill in the density matrix below.

Figure 11.2-1: Density Matrix

Mass Δ↑	Δ↑ Δ0 Δ↓	Δ↑	Δ↑
Mass Δ0	Δ↓	Δ0	Δ↑
Mass Δ↓	Δ↓	Δ↓	Δ↑ Δ0 Δ↓
	Volume Δ↑	Volume Δ0	Volume Δ↓

Δ↑ - increase Δ0 - no change Δ↓ - decrease

2. Answer the questions below using the density matrix.

a. When the mass of an object increases and the volume of that object stays the same, what happens to the density?

$\Delta\uparrow$

b. An empty box with a fixed volume gets partially filled with sand. What happens to the overall density of the box?

$\Delta\uparrow$

c. When the volume of an object increases and the mass of that object stays the same, what happens to the density?

$\Delta\downarrow$

d. A floating ball of Styrofoam is compressed into a smaller shape. What happens to the ball's density?

$\Delta\uparrow$

e. When the mass of an object decreases but the volume stays the same, what happens to the density of the object?

$\Delta\downarrow$

f. A ball of clay is shaped into a hollow ball without removing any of the clay itself. What happens to the density of the clay ball?

$\Delta\downarrow$

g. A balloon is filled with air. Its mass goes up by a little, but its volume goes up by a lot more. What happens to the density of the balloon?

$\Delta\downarrow$

3. Use the density equations to calculate mass.

a. If the mass of a sample of liquid A is 10g and the volume of that sample is 5mL, what is the density of the liquid?

$10g \div 5ml = 2\ g/mL$

b. Since you know the density of liquid A, what is the mass of 10mL of liquid A?

$2g/mL \times 10mL = 20\ g$

c. The volume of a sample of mineral B is $6cm^3$. The mass of that sample is 27g. What is the density of the mineral?

$27g \div 6cm^3 = 4.5\ g/cm^3$

d. What is the mass of 16cm^3 of the mineral?

$4.5g/cm^3 \times 16cm^3 = 72\ g$

e. A sample of liquid C has a mass of 12g and a volume of 16mL. What is the mass of 23mL of liquid C?

$12g \div 16mL = 0.75g/mL$
$0.75g/mL \times 23mL =$ **17.25 g**

f. Mineral D has a volume of 39cm^3 and a mass of 49g. What is the mass of 30cm^3 of the mineral?

$49g \div 39cm^3 = 1.26g/cm^3$
$1.26g/cm^3 \times 30cm^3 =$ **37.7g**

4. Use the density equations to calculate the volume.

a. The mass and volume of an object E are 21g & 35cm^3. What is the density of the object?

$21g \div 35cm^3 = 0.6g/cm^3$

b. What would the volume of object E be if its mass was only 15g?

$15g \div .6g/cm^3 = 25cm^3$

c. 25mL of liquid F has a mass of 18g. Calculate the density.

$18g \div 25mL = 0.72g/mL$

d. What is the volume of 45g of liquid F?

$45g \div 0.72g/mL = 62.5mL$

e. A sample of liquid G has a volume of 13mL but has a mass of 72g. What is the volume of a sample of liquid G that has a mass of 120g?

72g ÷ 13mL = 5.54g/mL
120g ÷ 5.54g/mL = **21.66mL**

f. If liquid G is saturated with hydrogen atoms (H) it becomes liquid G(H) and its density increases to 7.5 g/mL. Its volume does not change, however. What is the mass of 21.66mL of liquid G(H)?

21.66mL x 7.5g/mL = 162.45g

Figure 11.2-2: Density Equations

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

If you know:	In order to calculate:	You must:	Equation:
Mass & Volume	Density	÷	D = M ÷ V
Mass & Density	Volume	÷	V = M ÷ D
Volume & Density	Mass	X	M = V x D