ρ Greek letter "Rho"

DENSITY PROBLEMS

1) A rock has a volume of 90 ml and a mass of 30g. Find the density.

TO FIND ρ: **MASS DIVIDED BY VOLUME**

$\rho = \frac{\text{mass}}{\text{volume}} = \frac{30\text{ g}}{90\text{ mL}} = 0.\overline{33}\text{ g/mL}$

2) What mass will 100 ml of zinc possess? ρ ZINC = 7.13 g/ml

TO FIND MASS: **MULTIPLY ρ BY VOLUME**

$\text{mass} = \rho \times V = \frac{7.13\text{ g}}{\text{mL}} \times 100\text{ mL} = 713\text{ g}$

3) Gold has a density of 19.3 g/ml. What volume will 386 g of gold occupy?

TO FIND VOLUME: **MASS DIVIDED BY ρ**

$V = \frac{m}{\rho} = \frac{386\text{ g}}{19.3\text{ g/mL}} = 20\text{ mL}$

4) A stone occupies 85 ml and has a mass of 25g. Will it float in water?

$\rho = \frac{m}{V} = \frac{25\text{ g}}{85\text{ mL}} = 0.294\text{ g/mL}$

The density of water is 1.00 g/mL

Since ρ WATER > ρ STONE

$1.00 > 0.294$

The stone floats in water (LAVA? PUMICE?)

5) A garbage bag full of CO_2 occupies 26 L and has a mass of 52g. Will it float in air?

$\rho = \frac{m}{V} = \frac{52\text{ g}}{26\text{ L}} = 2\text{ g/L}$

The density of air is 1.2 g/L

Since ρ AIR < ρ BAG

$1.2 < 2$

$CO_2(g)$ SINKS!

DENSITY REVIEW

$\rho = \frac{m}{V}$

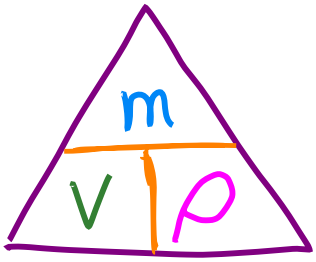
$m = \rho \times V$

$V = \frac{m}{\rho}$

Density $\frac{g}{mL}$ OR $\frac{g}{L}$

Mass g

Volume mL OR L (cm^3)



Sink/Float:

AT room Temp →

ρ WATER = 1.00 g/ml

ρ AIR = 1.2 g/L

] Densities to memorize

IN WATER:	ρ WATER > ρ OBJECT	OBJECT FLOATS
	ρ WATER < ρ OBJECT	OBJECT SINKS
IN AIR:	ρ AIR > ρ OBJECT	OBJECT FLOATS
	ρ AIR < ρ OBJECT	OBJECT SINKS

More Density Calculations!!

Name_____

Date_____ Per_____

Calculate the density of each substance. Then find the substance in the table in Think About It 7-6 on page 262 of BC Science 8.

1. A substance has a mass of 144 g and a volume of 600 cm^3. What substance is it?

$m = 144\,g$
$V = 600\,cm^3$

$\rho = \frac{m}{V} = \frac{144\,g}{600\,cm^3} = 0.24\,g/cm^3$

CORK

2. A substance has a mass of 6923 g and a volume of 880 cm^3. What substance is it?

$m = 6923\,g$
$V = 880\,cm^3$

$\rho = \frac{m}{V} = \frac{6923\,g}{880\,cm^3} = 7.867\,g/cm^3$

IRON

3. A substance has a mass of 725 g and a volume of 575 mL. What substance is it?

$m = 725\,g$
$V = 575\,mL$

$\rho = \frac{m}{V} = \frac{725\,g}{575\,mL} = 1.26\,g/mL$

Glycerol

4. A substance has a mass of 1220 g and a volume of 90 mL. What substance is it?

$m = 1220\,g$
$V = 90\,mL$

$\rho = \frac{m}{V} = \frac{1220\,g}{90\,mL} = 13.56\,g/mL$

Mercury

5. A substance has a mass of 1771 g and a volume of 820 cm^3. What substance is it?

$m = 1771\,g$
$V = 820\,cm^3$

$\rho = \frac{m}{V} = \frac{1771\,g}{820\,cm^3} = 2.16\,g/cm^3$

Salt

Name:
Date:
Block:

DENSITY: Practice problems

1. An unknown liquid has a density of 2000 g/L. Could this liquid be water? Explain.

2. A copper bracelet is placed in a graduated cylinder full of water. The water level rises from 15.6 mL to 28.0 mL. The mass of the bracelet is 101.7 g. Is the bracelet made of pure copper? How do you know? Explain.

3. You freeze 92 g of water, and it becomes a cube of ice.
   a. What is the mass of the ice cube? _____
   b. The cube's volume is 100 cm^3. What is its density?_____
   c. Will the ice cube float or sink in water?_____

4. A piece of magnesium has a volume of 20 cm^3 and a mass of 34 g. Calculate its density.

5. Find the mass of 55 cm^3 of lead if its density is 11.5 g/cm^3.

6. An object with a mass of 35 g is placed in a graduated cylinder containing water. If the water level rises from 22 mL to 31 mL, calculate the density of the object.

7. An aquarium has dimensions of 50 cm x 25 cm x 20 cm. Calculate :
   a. The volume of the aquarium in cm^3: _____. In litres: _____
   b. Calculate the mass of alcohol necessary to fill the aquarium : _____
      (density of alcohol = 0.79 g/cm^3)

HW → DENSITY **Assignment**

Answer these questions on a separate page in the correct scientific manner including:

a) Equation b) Substitution of values and c) Solution with units.

1. A block has a mass of 100 grams and measures ℓ = 10 cm, w = 10 cm, h = 2 cm. Find its volume and density.

$V = \ell \times w \times h$

$V = 10\text{cm} \times 10\text{cm} \times 2\text{cm} = 200\text{cm}^3$

$\rho = \frac{m}{V} = \frac{100\text{g}}{200\text{cm}^3} = 0.5\text{g/cm}^3$

2. A steel cube (iron) has a mass of 78.6 grams and a volume of 10 cm^3.

   a) Calculate the density of the iron cube.

$\rho = \frac{m}{V} = \frac{78.6\text{g}}{10\text{cm}^3} = 7.86\text{ g/cm}^3$

   b) What is the density of iron as given in your Table of Properties? page 262

7.87 g/cm^3

3. A cube has a mass of 89.5 grams and a volume of 10 cm^3.

   a) Calculate the density of the cube.

$\rho = \frac{m}{V} = \frac{89.5\text{g}}{10\text{cm}^3} = 8.95\text{g/cm}^3$

   b) Look in the Table of Properties to determine if the cube is aluminum, carbon, copper or gold.

GOOGLE or p.262

closest to Copper 8.92g/cm^3

4. Describe in your own words how to determine the density of a regularly shaped block.

measure the length, width and height. The volume is $\ell \times w \times h$ and the units are cm^3

5. A stone has a mass of 150 g and causes the water level in a graduated cylinder to rise from 50 mL to 75 mL when placed in it.

   a) Calculate the density of the stone.

   b) Will this stone float or sink in water? Give a reason.

6. A stone displaces 10 mL of water.

   c) What is the volume of the stone (use correct units)?

   d) If the stone has a density of 6 g/cm3, what is the mass of the stone?

see next page

7 A piece of volcanic pumice causes the water level in a cylinder to rise from 50 to 60 mL. If the pumice has a mass of 9 grams, what is the density of the pumice?

5. Since the water rose 25 mL $\begin{pmatrix}75\\-50\end{pmatrix}$

when the stone was dropped into it, then the volume of stone is 25 mL

This is called the VOLUME DISPLACEMENT METHOD

a) $\rho = \frac{m}{V} = \frac{150\,g}{25\,mL} = 6\,g/mL$

b) Since ρ of the stone > ρ of the water then the less dense substances rises to the top. In other words, the stone SINKS!

6 a) Stone displaces 10 mL of water

10 mL can also be written $10\,cm^3$

Volume of stone = $10\,cm^3$

b) $m = V \times \rho$

$= 10\,cm^3 \times \frac{6\,g}{cm^3} = 60\,g$

7. Volume displaced = $\begin{array}{r}60\\-50\\\hline 10\,mL\end{array}$

$\rho = \frac{m}{V} = \frac{9\,g}{10\,mL} = 0.9\,g/mL$

The volcanic pumice floats in water because it's Density is < ρ_{water} (1.00 g/mL)

Name: _____
Date: _____
Period: _____

EXERCISES: DENSITY

Part 1: Answer the following questions. Include a) equation b) substitution c) solution with units.

1- If a piece of wood occupies 75 cm^3 and has a mass of 50 g, what is its density? Will it float on water?

2- A plastic bag filled with gas has a mass of 125 g and a volume of 100 litres. What is its density? Will it float in air?

3- Zinc metal has a density of 7.14 g/cm^3 under normal conditions. If we have 65 cm^3 of zinc, what mass of the metal is present?

4- Gold metal at room conditions has a density of 19.3 g/ cm^3. What mass is contained in 65 cm^3 of gold?

5- Lead has a density of 11.4 g/ cm^3. What volume is occupied by 100 g of lead?

6- Chlorine has a density of 3.17 g/L. What space is occupied by 100 g of chlorine?

7- Ice floats in water. What does this tell us about the density of ice?

8- Helium balloons float in air. What does this tell us about the density of these balloons?

9- Mercury has a density of 13.6 g/mL and lead has a density of 11.4 g/ cm^3. Will lead float or sink in liquid mercury?

Part 2: Density calculations

a) 60 g; 20 mL: D =_____

b) 2 kg; 2000 mL: D =_____

c) 100 g; 75 mL: D =_____

d) 51 g; 30 mL: D =_____

Science 8
BLOCK: ____
DENSITY

Experiment

Name_____
Partner's name_____
Date_____

FINDING ρ of H_2O BY DIRECT MEASUREMENT

EACH PAIR OF STUDENTS NEEDS: 100 ml graduated cylinder
scientific balance

BALANCE # _____

Mass of empty graduated cylinder: _____ = A

Volume of water in graduated cylinder: _____ = V

Mass of graduated cylinder + water: _____ = B

CALCULATION: Mass of water in graduated cylinder = B — A = _____ = M

Density = $\frac{\text{mass}}{\text{volume}} = \frac{M}{V} = \frac{\text{g}}{\text{ml}} =$ _____ **g /mL**

Note: the density of water is 1.00 g /ml at 25°C (room temperature) and at standard pressure: 101.3 kPa

FINDING ρ of metals BY INDIRECT MEASUREMENT

EACH PAIR OF STUDENTS NEEDS: 100 ml graduated cylinder
scientific balance
1 piece of metal

SAMPLE #1: _____

Mass of metal: _____ = M

Initial Volume of water in graduated cylinder: _____ = A

Volume of metal + water: _____ = B (***"Water Displacement Method"***)

CALCULATION: Volume of metal = B — A= _____ = V

Density = $\frac{\text{mass}}{\text{volume}} = \frac{M}{V} = \frac{\text{g}}{\text{mL}} =$ _____ **g /mL**

DISCUSSION QUESTIONS:

1) Why was our first activity a DIRECT measurement of density?

2) Why was our second activity an INDIRECT measurement of density?

3) What types of matter can have their density determined directly?

4) When will indirect measurements of density ***not*** work?

1) The procedure we used to find the density of water was a DIRECT measurement because we did not need another substance or sample of matter to find the (volume) answer.

2) Our second Density procedure was INDIRECT because we used the *THE WATER DISPLACEMENT METHOD* to determine the volume of the metal.

3) Matter that can have its Density determined DIRECTLY:
   LIQUIDS

4) Matter that can NOT use the INDIRECT Density procedure:
   - GAS
   - LIQUIDS that completely mix with water
   - Matter that floats on water (that is less dense than water)
   - Matter that dissolves in water
   - Alkali metals (sodium, lithium) react dangerously with water
   - Matter that absorbs water

FINDING ρ of metals BY INDIRECT MEASUREMENT

SAMPLE #2: _____

Mass of metal: _____ = M

Initial Volume of water in graduated cylinder: _____ = A

Volume of metal + water: _____ = B

CALCULATION: Volume of metal = B — A= _____ = V

Density = $\frac{\text{mass}}{\text{volume}} = \frac{M}{V} = \frac{\text{\_\_\_\_\_ g}}{\text{mL}} =$ _____ **g /mL**

SAMPLE #3: _____

Mass of metal: _____ = M

Initial Volume of water in graduated cylinder: _____ = A

Volume of metal + water: _____ = B

CALCULATION: Volume of metal = B — A= _____ = V

Density = $\frac{\text{mass}}{\text{volume}} = \frac{M}{V} = \frac{\text{\_\_\_\_\_ g}}{\text{mL}} =$ _____ **g /mL**

SAMPLE #4: _____

Mass of metal: _____ = M

Initial Volume of water in graduated cylinder: _____ = A

Volume of metal + water: _____ = B

CALCULATION: Volume of metal = B — A= _____ = V

Density = $\frac{\text{mass}}{\text{volume}} = \frac{M}{V} = \frac{\text{\_\_\_\_\_ g}}{\text{mL}} =$ _____ **g /mL**