Density Worksheet
Physical Science
D=m/V

Densities of Common Substances @ 20°C				
Substance	**Density (g/cm³)**		**Substance**	**Density (g/cm³)**
Oxygen	0.00133		Aluminum	2.70
Hydrogen	0.000084		Iron	7.87
Ethanol	0.785		Copper	8.96
Benzene	0.880		Silver	10.5
Water	1.000		Lead	11.34
Magnesium	1.74		Mercury	13.6
Salt (sodium chloride)	2.16		Gold	19.32

1. The ratio of an object's mass to its volume is called the *density* of the object.

2. A kilogram of lead occupies a much smaller volume than a kilogram of water, because lead has a much higher *density*.

3. For the masses and volumes indicated, calculate the **density** in grams per cubic centimeters.

   a. mass = 453 g; volume = 225 cm3 → $\rho = \frac{m}{V} = \frac{453\,g}{225\,cm^3} = 2.01\,g/cm^3$

   b. mass = 5.0 g; volume = 10.0 cm3 → $\rho = \frac{5.0\,g}{10.0\,cm^3} = 0.50\,g/cm^3$

   c. mass = 26.1 g; volume = 2.0 mL → $\rho = 26.1\,g/2.0\,mL = 13\,g/mL$

4. If 89.2 mL of a liquid has a mass of 75.2 g, calculate the liquid's density.

$$\frac{75.2\,g}{89.2\,mL} = 0.843\,g/mL$$

5. A cube of metal weighs 1450 g and displaces 542 mL of water when immersed. Calculate the density of the metal.

$$\frac{1450\,g}{542\,mL} = 2.68\,g/mL$$

6. Calculate the volume of 50.0 g of each of the following substances: $\rho = \frac{m}{V}$

a. sodium chloride $\rho = 2.16\ g/cm^3$ $V = \frac{50.0\ g}{2.16\ g/cm^3}$ $V = \frac{m}{\rho}$ $= 23.1\ cm^3$

b. mercury $\rho = 13.6\ g/cm^3$ $V = \frac{50.0\ g}{13.6\ g/cm^3}$ $= 3.68\ cm^3$

c. benzene $\rho = 0.880\ g/cm^3$ $V = \frac{50.0\ g}{0.880\ g/cm^3} = 56.8\ cm^3$

d. silver $\rho = 10.5\ g/cm^3$ $V = \frac{50.0\ g}{10.5\ g/cm^3} = 4.76\ cm^3$

7. Calculate the mass of 50.0cm^3 of each of the following substances:

a. gold $m = \rho V = (19.32\ g/cm^3)(50.0\ cm^3) = 966\ g$

b. iron $m = \rho V = (7.87\ g/cm^3)(50.0\ cm^3) = 394\ g$

c. lead $m = \rho V = (11.34\ g/cm^3)(50.0\ cm^3) = 567\ g$

d. aluminum $m = \rho V = (2.70\ g/cm^3)(50.0\ cm^3) = 135\ g$

8. A cubic block of one of the substances listed on the chart has a side length of 5.0 cm and a mass of 224 grams. Which material is it?

$V = L \times W \times H = 5.0 \times 5.0 \times 5.0 = 125$ or $130\ cm^3$ (two sig figs)

$\rho = \frac{m}{V} = \frac{224\ g}{130\ cm^3} = 1.72\ g/cm^3$ (very close to Magnesium)

9. Archemedes was commissioned to determine if the crown given to the king was pure gold or not. If the crown had a mass of 882 grams and displaced 50.0 mL of water, was the crown pure gold? Show the calculation.

$\rho = \frac{m}{V} = \frac{882\ g}{50.0\ mL} = 17.6\ g/mL$ No, not dense enough!

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8. $F_g = 315\ N$

F_B in water $= 315 - 265 = 50\ N$

F_B in oil $= 315 - 269 = 46\ N$

a. $\frac{\rho_o}{\rho_f} = \frac{F_g}{F_B}$ (ρ_f and F_B for water)

$\frac{\rho_o}{1.00 \times 10^3} = \frac{315}{50}$ $\quad 50\rho_o = 3.15 \times 10^5$

$\boxed{\rho_o = 6300\ kg/m^3}$

b. $\frac{\rho_o}{\rho_f} = \frac{F_g}{F_B}$ (ρ_f and F_B for oil)

$\frac{6300}{\rho_f} = \frac{315}{46}$ $\quad 315\rho_f = 290{,}000$

$\boxed{\rho_f = 920\ kg/m^3}$

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9. $F_g = 300.0\ N$

$F_B = 300.0 - 200.0 = 100.0\ N$

$$\frac{\rho_o}{\rho_f} = \frac{F_g}{F_B}$$

$$\frac{\rho_o}{0.70 \times 10^3} = \frac{300.0}{100.0}$$

$$100.0\,\rho_o = 210000$$

$$\boxed{\rho_o = 2100\ kg/m^3}$$

p. 324 (G and H Blocks)

2. For air mattress to float

$$F_g = F_B$$

$$m_o g = m_f g$$

$$m_o = \rho_f V_f$$

$$m_o = (1.00 \times 10^3)(2.00 \times 0.500 \times 0.100)$$

$$m_o = 100\ kg \qquad 100 - 2.8 = \boxed{97.2\ kg}$$

↑ mass of mattress

Name Key Period _____

Density Worksheet

In order to receive full credit, you must show ALL work and circle your final answer.

1. 100 grams of a liquid completely fill a 200 mL bottle. What is the density of the liquid?

$$\rho = \frac{m}{V} = \frac{100\ g}{200\ mL} = \boxed{0.5\ g/mL}$$

2. A solution has a density of 1.50 g/mL. How many grams are needed to obtain 10.0 mL of solution?

$$\rho = \frac{m}{V} \qquad 1.50 = \frac{m}{10.0}$$

$$\boxed{m = 15.0\ g}$$

3. If a block of copper measures 2.00 cm x 4.00 cm x 5.00 cm and weighs 356 grams, what is its density?

$$V = 2.00 \times 4.00 * 5.00 = 40.0\ cm^3$$

$$\rho = \frac{m}{V} = \frac{356\ g}{40\ cm^3} = \boxed{8.90\ g/cm^3}$$

4. The density of mercury is 13.6 g/mL.

   a. what is the mass of 8.20 mL of mercury?

$$m = \rho V = \frac{13.6\ g}{mL} \times \frac{8.20\ mL}{1} = \boxed{112\ g}$$

   b. what volume would 120 grams of mercury occupy?

$$\rho = \frac{m}{V} \qquad 13.6 = \frac{120}{V} \qquad 13.6V = 120$$

$$\boxed{V = 8.8\ mL}$$

5. A piece of silver has a mass of 2800 grams and occupies a volume of 266 cm^3. What is the density of silver?

$$\rho = \frac{m}{V} = \frac{2800\ g}{266\ cm^3} = \boxed{11\ g/cm^3}$$

6. A bottle has a capacity of 1.2 liters. If the density of ether is 0.74 g/mL, what mass of ether can the bottle hold?

$\frac{1.2\ L}{1} \times \frac{1000\ mL}{1\ L} = 1200\ mL$ $m = \rho V$

$= (0.74)(1200) = \boxed{890\ g}$

7. A student pipets 5.00 mL of ethanol into a flask weighing 15.25 grams. She finds that the mass of the flask *plus* ethanol = 19.17 grams. Calculate the density of ethyl alcohol.

$19.17 - 15.25 = 3.92$ grams (mass of ethyl alcohol)

$\rho = \frac{m}{V} = \frac{3.92\ g}{5.00\ mL} = \boxed{0.784\ g/mL}$

8. Peanut oil has a density of 0.92 g/mL. If a recipe calls for ¼ cup of peanut oil, what mass of peanut oil is required? (Hint: 1 cup = 237 mL).

$V = \frac{0.25\ cup}{1} \times \frac{237\ mL}{1\ cup} = 59.3\ mL$ $m = \rho V = (0.92)(59.3)$

$= \boxed{55\ g}$

9. A chemist needs 2.00 g of a liquid compound, which has a density of 0.718 g/mL. If the compound costs $5.67 **per mL**, how much will a 2.0 gram sample cost?

$\rho = \frac{m}{V}$ $0.718 = \frac{2.00}{V}$ $V = 2.79\ mL$

$0.718V = 2.00$

$\frac{\$5.67}{mL} \times \frac{2.79\ mL}{1} = \boxed{\$15.82}$

10. Suppose you find a chunk of what *appears* to be gold in the sand at the beach. Devise a simple experiment to determine whether or not you've struck it rich. Please list all lab equipment required and list the **specific** steps you would take.

1. Find the ~~mass~~ mass in g on the balance.
2. Submerge the sample in a beaker of water and see how much the water level rises. This will give the volume of the sample.
3. Divide mass by volume; compare to density of gold ($19\ g/cm^3$)

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