NAME: **HONORS CHEMISTRY**

SECTION: Pairs/Check: Density Problems

1. The older partner does the even problems. The younger partner does the odd problems. Take turns solving the problems. As you work, explain how you are doing the problem while your partner listens. Follow the rules for significant figures in all calculations. Include appropriate units with your answers.
2. After each problem, discuss the answer with your partner. If both partners agree on the answer, the solver initials the answer. If an agreement can’t be reached, both partners raise their hands to get the teacher’s attention.
3. Complete the self-evaluation. Turn in the sheet when you have finished.

**Level 1**

**Densities of some common materials**

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| --- | --- |
| Copper | 8.92 g/cm3 |
| Ethanol | 0.789 g/cm3 |
| Mercury | 13.6 g/cm3 |
| Gold | 19.31 g/cm3 |
| Silver | 10.5 g/cm3 |
| Nickel | 8.90 g/cm3 |

1. A student measures a block of aluminum and measures its volume as 15.5 mL and has a mass of 40.0 g.
2. What is the experimental density of aluminum?

b) The accepted density of aluminum is 2.70 g/mL. Calculate the students’ percent error.

1. A student determines that a 23.04 gram metal sample occupies a volume of 2.241 mL.
2. Identify the metal. Justify your answer with a calculation.

b) Using the accepted value for the density of the metal, calculate the percent error.

1. What is the mass of the ethanol that exactly fills a 200.0 mL container?
2. What volume of nickel metal will have a mass of precisely 2500.0 g?

**Level 2**

1. 28.5 g of iron shot is added to a graduated cylinder containing 45.5 mL of water. The water level rises to the 49.1 mL mark. From this information, calculate the experimental density of iron.
2. A cylindrical glass tube of length 27.75 cm and the radius 2.00 cm is filled with argon gas. The empty tube has a mass of 188.250 g and the tube filled with argon has a mass of 188.870 g. Use the data to calculate the density of argon gas. (Volume of a cylinder = πr2h)
3. 57.0 kg of copper is drawn into a wire with a diameter of 9.50 mm. What is the length of wire in meters? (Hint: What is the formula for the volume of a cylinder?)
4. An ice cube with a volume of 45.0 mL and a density of 0.900 g/cm3 floats in a liquid with a density of 1.36 g/mL. What volume of the cube is submerged in the liquid?

**Challenge Problems**

1. A graduated cylinder is filled to the 40.00 mL mark with mineral oil. The masses of the cylinder before and after the addition of mineral oil are 124.966 g and 159.446 g. In a separate experiment, a metal ball bearing of mass 18.713 g is placed in the cylinder and the cylinder is again filled to the 40.00 mL mark with the mineral oil. The combined mass of the ball bearing and mineral oil is 50.952 g. Calculate the density of the ball bearing.
2. A calibrated flask was filled to the 25.00 mark with ethyl alcohol. By massing the flask before and after adding the alcohol, it was determined that the flask contained 19.7325 g of alcohol. In a second experiment, 25.9880 g of metal beads were added to the flask, and the flask was again filled to the 25.00 ml mark with ethyl alcohol. The total mass of the metal plus alcohol in the flask was determined to be 38.5644 g. What is the density of the metal in g/mL?

The purpose of this assignment was to: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| Did I: | Circle the appropriate response: |
| Clearly identify the errors? | Always Sometimes Rarely |
| Listen while my partner explained? | Always Sometimes Rarely |
| Give my partner positive support? | Always Sometimes Rarely |
| Stay on task during the assignment? | Always Sometimes Rarely |
| Use encouraging and polite words? | Always Sometimes Rarely |
| Record my work on the paper? | Always Sometimes Rarely |
| Demonstrate an understanding of the material? | Yes No |

Comments:

Answer key, do not copy

1. 2.58 g/ml; 4.4% error (2 sig figs!)
2. Silver…10.28 g/mL; 2% error (1 sig fig)
3. 158 g
4. 281 g
5. 7.9 g/ml
6. 1.78 x 10-3 g/mL
7. 57000 g, r = .475 cm, V of cylinder = 6390 cm3; h = 90.2 m
8. determine the mass of the cube: (45.0 mL) (0.900 g/cm3) = 40.5 g

The cube will float when 40.5 g of liquid is displaced. We need to know what volume of the liquid weighs 40.5 g.

volume of liquid: (40.5 g) ÷ (1.36 g/mL) = 29.8 mL

This means that 29.8 mL of the cube is submerged

9. a) Determine the density of the mineral oil:

159.446 g minus 124.966 g = 34.480 g

34.480 g / 40.00 mL = 0.8620 g/mL

b) Determine the volume of the ball bearing:

50.952 g minus 18.713 = 32.239 g (this is the mass of mineral oil)

32.239 g divided by 0.8620 g/mL = 37.40 mL (this is the volume of mineral oil)

40.00 mL - 37.40 mL = 2.60 mL

c) The density of the ball bearing is 7.20 g/mL. This came from 18.713 g divided by 2.60 mL.

10. a) Determine density of alcohol:

19.7325 g / 25.00 mL = 0.7893 g/mL

b) Determine volume of metal beads:

38.5644 g - 25.9880 g = 12.5764 g (this is the mass of alcohol)

12.5764 g / 0.7893 g/mL = 15.9336 mL (this is the volume of alcohol)

25.00 mL - 15.9336 mL = 9.07 mL (this is the volume of the metal beads)

c) Density of the metal:

25.9880 g / 9.07 mL = 2.87 g/mL