Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Period:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Chemistry Unit 9 – Scientific Measurement**

|  |  |  |  |
| --- | --- | --- | --- |
| Objective | Learning Opportunities | Suggested Due Date | Date Completed |
| 9.1 Know how to write numbers and do calculations in scientific notation | * Read p. 62 – 71 and use the Math Handbook p. 69, 3 and 4, p. 70, 5 and 6, p. 71, 7 and 8, 9-10 pg. 72
* Podcast 2.1 Scientific Notation
* Scientific Notation Practice
 | 02/08 |  |
| 9.2 Describe and apply accuracy, precision, and error | * Podcast 2.2 Accuracy, Precision, and Error
* Shooting Baskets Demo
* 78-80 pg. 97
* Accuracy, Precision, and Percent Error Practice Problems
 | 02/11 |  |
| 9.3 Know how measurements’ uncertainties and significant figures apply to calculations | * Podcast 2.3 Sig-Figs
* Sig-Fig Lab
* More Scientific Measurement Practice Problems
* Significant Figures Practice Problems
 | 02/13 |  |
| 9.4 Know the components for the metric system and how to convert from one metric prefix to another | * Podcast 2.4 Metric Mania
* 18-24 pg. 79
* Mega Metric Mania
* Volume of a Tennis Ball
 | 02/15 |  |
| 9.5 Be able to perform dimensional analysis using T-tables | * Podcast 2.7 T-Tables
* 38-45 pg. 87
* T-table Review and Practice
* Unit Conversions
 | 02/21 |  |

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Per: \_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Scientific Notation Practice**

*Convert the following numbers to Standard Scientific Notation.*

1. 0.0023 \_\_\_\_\_\_\_\_\_\_\_\_\_ 5) 1374000000 \_\_\_\_\_\_\_\_\_\_\_\_\_
2. 471000 \_\_\_\_\_\_\_\_\_\_\_\_\_ 6) 2515000 \_\_\_\_\_\_\_\_\_\_\_\_\_
3. 0.0124 \_\_\_\_\_\_\_\_\_\_\_\_\_ 7) 0.0000010032 \_\_\_\_\_\_\_\_\_\_\_\_\_
4. 0.000000000004 \_\_\_\_\_\_\_\_\_\_\_\_\_ 8) 201400000000000 \_\_\_\_\_\_\_\_\_\_\_\_\_

*Convert the following from Standard Scientific Notation to numerical form.*

1. 1.37 x 107 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 12) 4.320 x 106 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. 2.01 x 10-4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 13) 3.002 x 10-7 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. 7.90 x 10-13 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 14) 4.98 x 101 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*Complete the following calculations.* **DO NOT** *use a calculator.* **SHOW ALL YOUR WORK!!**

1. 4.35x10-7 + 1.002x10-8 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. 7.002x105 + 1.3x103 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. 2.9 x 106 • 1.2x10-3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. 9.3 x10-13 ÷ 3.1x104 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. 1.002x102 – 7.10x103 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. 8.00 x107 • 1.11x10-5 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
7. 4.21 x1012 ÷ 1.00 x10-4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
8. 3.0 x1032 – 4.51 x1029 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Accuracy and Precision/Percent Error Practice Problems**

*For each of the following situations* ***FIND THE PERCENT ERROR*** *involved. Be careful in determining the true vs. observed value.* **SHOW ALL YOUR WORK!!!**

1. Samantha S. Sloppiness measured the volume of her soda before she drank it for her midmorning snack. She measured the volume of the 12 oz. bottle to be 14 oz.
2. Clyde Clumsy was directed to weigh a 500 g mass on the balance. After diligently goofing off for ten minutes, he quickly weighed the object and reported 458 g.
3. Willomina Witty was assigned to determine the density of a sample of nickel metal. When she finished, she reported the density of nickel as 5.59 g/ml. However, Miraculous knew the density of nickel was 6.44 g/ml.

**Uncertainty in Measurements Lab**

*Complete the following with a partner. Go to each station and perform the measurements and answer the questions.* Include units for each measurement!

**Station #1 – Temperature (⁰C)**

1. Using the **digital** thermometer, record the room temperature (in Celsius…ALWAYS!) \_\_\_\_\_\_\_\_\_
	* What is the uncertainty digit in your measurement?
2. Using the **glass** thermometer, record the temperature of the water in the beaker. \_\_\_\_\_\_\_\_\_\_\_\_
	* How many certain digits are in your measurement?

**Station #2 – Mass (g)**

1. Using the **digital scale**, record the mass of object #1 (in grams…ALWAYS) \_\_\_\_\_\_\_\_\_\_\_\_
	* What is the uncertainty digit in your measurement?
2. Using the **three-beam balance**, record the mass of object #2. \_\_\_\_\_\_\_\_\_\_\_\_\_
	* How many certain digits are in your measurement?

**Station #3 – Volume (mL)**

1. Record the volume of water in the **beaker** (as accurately as your instrument will allow).
2. Record the volume of water in the **100 mL graduated cylinder**. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Record the volume of water in the **10 mL graduated cylinder**. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Which of the three instruments you used to record volume will allow you to have the most accurate measurement? Explain why.

**Station #4 – Length (cm)**

1. With the **ruler**, measure the dimensions of an index card. (length and width) Calculate the AREA of the index card.
2. With the **meter stick**, measure the dimensions of the chemistry textbook. (length, width, and depth) Calculate the VOLUME of the textbook.

**Station #5 - Time**

1. Using the **stop watch**, determine how accurately you can record time (ie, minutes, seconds, tenth of a second, etc). Explain why.
2. Using the classroom **clock**, determine how accurately you can record time. Explain why.

**Additional Questions (review your notes if you’re not sure)**

1. Why is it important to include the right number of digits in a measurement?
2. What determines the uncertainty of a measurement?

**More Scientific Measurement**

Practice Problems

*Each answer must have the correct number of significant figures. Scientific notation only needs to be used in your answer if the number of significant figures limits your answer.* **YOU MUST SHOW ALL YOUR WORK TO GET ANY CREDIT FOR THE QUESTION!**

1. $0.027 ×3.20$ = \_\_\_\_\_\_\_\_\_\_\_\_
2. $7.60 ÷2.0$ = \_\_\_\_\_\_\_\_\_\_\_\_
3. $10.01+4.70+0.37$ = \_\_\_\_\_\_\_\_\_\_\_\_
4. $0.364 ÷0.0200$ = \_\_\_\_\_\_\_\_\_\_\_\_
5. $2.10 ×0.60$ = \_\_\_\_\_\_\_\_\_\_\_\_
6. $1.003+0.725+2.510$ = \_\_\_\_\_\_\_\_\_\_\_\_
7. $9.63-0.15$ = \_\_\_\_\_\_\_\_\_\_\_\_
8. $\left(4.702 ×3.41\right)÷4.6$ = \_\_\_\_\_\_\_\_\_\_\_\_
9. $\left(6.72×10^{3}\right)×\left(3.6×10^{2}\right)$ = \_\_\_\_\_\_\_\_\_\_\_
10. $\frac{\left(4.01×10^{2}\right)×(3.6×10^{3})}{1.01×10^{-1}}$ =\_\_\_\_\_\_\_\_\_\_\_\_
11. $2.0×10^{-2}+ 4.29×10^{-3}$ = \_\_\_\_\_\_\_\_\_\_\_\_
12. $9.70×10^{4}+ 1.03×10^{6}$ = \_\_\_\_\_\_\_\_\_\_\_\_
13. $\frac{3.00×10^{3}}{6.1×10^{2}}$ = \_\_\_\_\_\_\_\_\_\_\_\_
14. $\frac{7.60 ×3.20}{10.9}$ = \_\_\_\_\_\_\_\_\_\_\_\_
15. $\left(3.3×10^{6}\right)×(4.23×10^{-2}$) = \_\_\_\_\_\_\_\_\_\_

Word Problem: A student estimated the distance from her house to the Denver mint as 350 miles. She set her odometer trip meter to zero when she left home and the actual distance was 362.79 miles. Calculate the error and the percent error for this problem. (Be organized and show your work)

**Significant Figures Practice Problems**

*Write the correct number of significant figures for each:*

1. .023 \_\_\_\_\_ 6. 6.00 x 106 \_\_\_\_\_
2. 4000 \_\_\_\_\_ 7. 0.0808 \_\_\_\_\_
3. 1.200 x 10-7 \_\_\_\_\_ 8. 0.0000100 \_\_\_\_\_
4. 100 \_\_\_\_\_ 9. 1.500 \_\_\_\_\_

 5. 300.10 \_\_\_\_\_ 10. 2343.0 \_\_\_\_\_

*State the number of significant digits that must be reported in the answers for the following calculations.*

1. .1 × 2.4 \_\_\_\_\_ 7. 30 - 0.5 \_\_\_\_\_
2. 7.80 + 5.5 \_\_\_\_\_ 8. 0.845 ÷ 0.015 \_\_\_\_\_
3. 13.04 - 0.56 \_\_\_\_\_ 9. 6.004 × 4.00 \_\_\_\_\_
4. 20 ÷ 7.36 \_\_\_\_\_ 10. 2.0 + 3.0 + 0.020 \_\_\_\_\_
5. 24.3 + 0.41 \_\_\_\_\_ 11. 1400 ÷ 20.6 \_\_\_\_\_
6. 0.019 × 8.15 \_\_\_\_\_ 12. 30.03 - 2.110 - 0.145 \_\_\_\_\_

*Complete the following calculations and give the answer to the proper number of significant digits.* **SHOW ALL YOUR WORK!!!**

1. 2.36 + 1.7 + 3.284 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ 3. 1.89 × 2.03 × 3.277 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. 15.8 – 3.02 – 2.937 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ 4. 8.2 ÷3.74 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_

# Mega Metric Mania

**Basic Unit**

**Notes**

*To convert to a smaller unit, move decimal point to the right or multiply.*

*To convert to a larger unit, move decimal point to the left or multiply.*

**Different Types of Basic Units:**

**Temperature: Other Useful Conversion Information:**

* + K = 1 inch = \_\_\_\_\_\_\_\_\_\_\_\_\_ cm 1 mile = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ km
	+ ˚C = 1 lb. = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ g 1 oz = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ g
	+ Absolute zero – 1 gallon = \_\_\_\_\_\_\_\_\_\_\_\_ L 1 oz = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ mL

 1 mL = \_\_\_\_\_\_\_\_\_\_\_\_\_ cm3 1 hour = \_\_\_\_\_\_\_\_ min = \_\_\_\_\_\_\_\_ sec

* + ˚F =
	+ ˚C =

**Try these conversions, using the ladder method.**

1000 milligrams = \_\_\_\_\_\_\_ grams 1 liter = \_\_\_\_\_\_\_ milliliters 783 dekagrams = \_\_\_\_\_\_\_\_\_ megagrams

0.736 centiliters = \_\_\_\_\_\_\_\_ nanoliters 14 kilometers = \_\_\_\_\_\_\_ meters 890,036 picometers = \_\_\_\_\_\_\_\_\_ meters

109 grams = \_\_\_\_\_\_\_ kilograms 250 meters = \_\_\_\_\_\_\_ kilometers 5.6 gigawatts = \_\_\_\_\_\_\_\_ watts

**Come up with your own pneumatic device to help you remember the order of the SI prefixes:**

G M K H D B D C M N P

**Mega Metric Mania**

# Conversion Challenge

**Write the correct abbreviation for each metric unit.**

1) \_\_\_\_\_ Kilogram 2) \_\_\_\_\_ Milliliter 3) \_\_\_\_\_ Kilometer

4) \_\_\_\_\_ Meter 5) \_\_\_\_\_ Millimeter 6) \_\_\_\_\_ Centimeter

7) \_\_\_\_\_ Gram 8) \_\_\_\_\_ Liter 9) \_\_\_\_\_ Milligram

10) \_\_\_\_\_ Picogram 11) \_\_\_\_\_ Megameter 12) \_\_\_\_\_ Microliter

13) \_\_\_\_\_ Gigagram 14) \_\_\_\_\_ Nanogram 13) \_\_\_\_\_ Decimeter

**Try these conversions, using the ladder method.**

1) 2000 milligrams = \_\_\_\_\_\_\_ grams 2) 104 kilometers = \_\_\_\_\_\_\_ meters

3) 480 centimeters = \_\_\_\_\_ meters 4) 5.6 kilograms = \_\_\_\_\_ grams

5) 8 millimeters = \_\_\_\_\_ centimeters 6) 5 liters = \_\_\_\_\_\_\_ milliliters

7) 46 hectograms = \_\_\_\_\_\_\_\_Gigagrams 8) 12400 picoliters = \_\_\_\_\_\_\_\_ dekaliters

9) 45 millimeters = \_\_\_\_\_\_\_\_ nanometer 10) 67 megagrams = \_\_\_\_\_\_\_\_\_ grams

*Now do the conversions using the abbreviations.*

11) 198 g = \_\_\_\_\_\_\_ kg 12) 75 mL = \_\_\_\_\_\_\_ L 13) 50 cm = \_\_\_\_\_\_\_ m

14) 5.6 m = \_\_\_\_\_\_\_ cm 15) 16 cm = \_\_\_\_\_\_\_ mm 16) 2500 m = \_\_\_\_\_\_\_ km

17) 65 g = \_\_\_\_\_\_\_ mg 18) 6.3 cm = \_\_\_\_\_\_\_ mm 19) 120 mg = \_\_\_\_\_\_\_ g

20) 3487 µL = \_\_\_\_\_\_ L 21) 0.086 Gg = \_\_\_\_\_\_\_ cg 22) 9800 ρm = \_\_\_\_\_\_\_ nm

23) 9123 hg = \_\_\_\_\_\_ Mg 24) 0.0034 daL = \_\_\_\_\_\_\_mL 25) 8731 dm = \_\_\_\_\_\_\_ km

**Some “Other Conversion” Problems.**

26) 68˚C = \_\_\_\_\_\_\_\_\_\_ K 27) 376 K = \_\_\_\_\_\_\_\_\_\_˚C 28) 0˚C = \_\_\_\_\_\_\_\_\_\_\_K

 29) 0 K = \_\_\_\_\_\_\_\_\_\_˚C 30) 100˚C = \_\_\_\_\_\_\_\_\_\_ K 31) 80˚F = \_\_\_\_\_\_\_\_\_\_\_˚C

 32) 4.3 mL = \_\_\_\_\_\_\_\_ cm3 33) 3 hours = \_\_\_\_\_\_\_\_ sec 34) 10 inches = \_\_\_\_\_\_\_\_ cm

**Now some word problems… (bum, bum, bummmmm)**

35) How many liters are in 246 centiliters? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 36) How many millimeters are in 0.237 meters? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

38) An Olympic distance triathlon consists of a 1.5 kilometer swim, 40 kilometer bike

ride, and a 10 kilometer run. How many km does an athlete cover over the course of an entire triathlon? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ How many meters? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

39) How many seconds are in one awesome Chemistry class period (92 minutes)? \_\_\_\_\_\_\_\_\_\_

40) The altitude of Mt. Everest is 8,850 meters. How tall is Mt. Everest in feet? (1 mile = 5280 ft)

**Volume of a Tennis Ball Mini-Lab**

**Purpose:** How can significant figures be used to determine the volume of a tennis ball?

**Hypothesis:**

**Materials:**

**Procedure:**

1. Obtain the necessary materials.
2. Determine the Circumference of your tennis ball. (Remember: Circumference = 2πr)
3. Using your value for circumference, which has been read to the proper degree of accuracy with the meter stick, calculate a value for the radius of your tennis ball.
4. Using the value obtained for the radius, calculate the Volume of your tennis ball. (Remember: Volume of a Sphere = (4/3)πr3)
5. Using the Actual value for the volume of the tennis ball, calculate a value for Error.
6. Using your value for error, calculate a Percent Error.

**Data and Data Analysis: (SHOW ALL CALCULATIONS)**

 Circumference of the tennis ball: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cm

Radius of the tennis ball: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cm

Volume of the tennis ball: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cm3

Volume of the tennis ball: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ m3

Error: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cm3

Percent Error: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ %

**Questions:**

1. What types of Error contributed to your experiment?
2. How many significant figures should your value of Volume have? How do you know this?

**Error Analysis:**

1. If the string used to measure the tennis ball was stretched during the measurement of the circumference, how would this error influence the calculation of the tennis ball volume (too high or too low)?
2. Suppose that one student used a regulation tennis ball, while their lab partner used a dog-toy tennis ball. Describe the potential error in this situation.
3. One of the newer tennis balls had a fuzzier surface than the older, more worn tennis ball. What kind of error occurs when two students use these two different tennis balls in their measurements and how does it influence the calculation of the volume?

Unit Conversions

# Convert 20.33 cm to m

|  |  |  |  |
| --- | --- | --- | --- |
| 20.33 cm | 1 m | = 20.33 \*1 m | = 20.33 x 10-2 m |
|  | 102 cm |  102 |  |

1. Convert 12.06 L to cL

|  |  |  |  |
| --- | --- | --- | --- |
| 12.06 L | 102 cL | = 12.06 \*102  cL | = 1,206 cL |
|  | 1 L |  1 L |  |

1. Convert 32.27 kg to g

|  |  |  |  |
| --- | --- | --- | --- |
| 32.27 kg | 103 g | = 32.27 \*103  g | =  |
|  | 1 kg |  1 kg |  |

1. Convert 13.09 m to cm

|  |  |  |  |
| --- | --- | --- | --- |
| 13.09 m | 102 cm | = 13.09 \*102  cm | =  |
|  | 1 m |  1 m |  |

1. Convert 3.47 mm to m

|  |  |  |  |
| --- | --- | --- | --- |
| 3.47 mm | 1 m | =  |  |
|  | 103 mm |   |  |

1. Convert 33.81 kg to g

|  |  |  |  |
| --- | --- | --- | --- |
| 33.81 kg | 103 g | =  |  |
|  | 1 kg |   |  |

1. Convert 9.92 kL to L

|  |  |  |  |
| --- | --- | --- | --- |
| 9.92 kL |  | =  |  |
|  |  kL |   |  |

1. Convert 2.61 g to mg

|  |  |  |  |
| --- | --- | --- | --- |
| 2.61 g |  | =  |  |
|  |  g |   |  |

1. Convert 24.37 g to mg
2. Convert 28.77 L to cL
3. Convert 22.04 mL to L
4. Convert 9.42 L to mL
5. Convert 20.03 cm3 to mL
6. Convert 23.28 L to mL
7. Convert 9.72 mL to L
8. Convert 1.47 kg /m3 to g/cm3

|  |  |  |  |
| --- | --- | --- | --- |
| 1.47 kg | 103 g | 1 m3 | = |
| 1 m3 | 1kg |  (100 cm)3 |  |

1. Convert 7.18 mL/min to cL/sec

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 7.18 mL |  L |  cL | 1 min |  = |
| 1 min |  |  L |  \_\_\_\_\_\_ sec |  |

1. Convert 33.21 cg to mg
2. Convert 30.62 mg to cg
3. Convert 16.43 mg to cg

**T-Table Review and Practice**

1. Write the given number and unit.
2. Set up a conversion factor (fraction used to convert one unit to another).
	1. Place the given unit as denominator of conversion factor.
	2. Place desired unit as numerator.
	3. Place a “1” in front of the larger unit.
	4. Determine the number of smaller units needed to make “1” of the larger unit.
	5. Go to base units first (meter, Liter, gram).
3. Cancel units. Solve the problem. A vertical line means multiply (x), whereas a horizontal line means divide, ($÷$).

Example 1: 55 mm = \_\_\_\_\_ m Example 2: 88 km = \_\_\_\_\_m

$\frac{55 mm}{}|\frac{1 m}{1000 m}=0.055 m$ $\frac{88 km}{}|\frac{1000 m}{1 km}=88,000 m$

Example 3: 7000 cm = \_\_\_\_\_ hm Example 4: 8 daL = \_\_\_\_\_ dL

$\frac{7000 cm}{}\left|\frac{1 m}{100 cm}\right|\frac{1 hm}{100 hm}=0.7 hm$ $\frac{8 daL}{}\left|\frac{10 L}{1 daL}\right|\frac{10 dL}{1 L}=800 dL$

1. Convert 3 cm to km
2. Convert 8 hL to nL
3. Convert 9 mL to ML
4. Convert 1 kg to dg
5. \*\* Special Challenge: Convert 6cg/daL to g/mL

**Density Mini-Lab**

*Read section 3.4 (pages 89-93) in your textbook on density and answer the following questions* **BEFORE** *starting the lab.*

**Connecting to Your World**

1. What determines whether and object floats or sinks in water?
2. What is the ratio for water at 4⁰C?

**Determining Density**

1. Which is heavier, a pound of lead or a pound of feathers? Make sure you give the correct answer and EXPLAIN WHY!
2. Define density.
3. What is the equation (yellow box) for density?
4. Density can be measured in g/mL AND g/cm3. Explain how this can be (*hint: Mega Metric Mania Chart*)
5. *Key Point* What determines the density of a substance?
6. Is density a physical or chemical property (the answer is not in this section of the book…look back at your notes from last section)?

**Density and Temperature**

1. How does a change in temperature affect most objects density?
2. How is water different from most substances in regard to density? What should ice do?

**Density Mini-Lab Procedure**

1. Measure the MASS of each cube using the scale. Record in your data table accurately. Include units and the appropriate number of significant figures
2. Measure the volume of each density cube.
	1. Fill the water displacement container to the top of the spout (just so a little water runs out). Let it sit until no more water comes out.
	2. Place a graduated cylinder under the spout (somebody will have to be holding it at an angle).
	3. Put the cube into the container and catch the water with the graduated cylinder.
	4. Measure the volume of the cube by recording the volume of the water that was displaced. Watch those uncertainty values. Make sure you have enough digits!
	5. Record in your data table accurately. Include units.
3. Calculate the density for each cube.
	1. Show your calculations IN YOUR DATA TABLE (plug the numbers into the equation).
	2. Double check you have the correct number of significant figures.
	3. Record density for each cube in your data table. Include units.
4. Get the actual density value for each metal and CALCULATE YOUR PERCENT ERROR.
	1. Show your calculations (plug the numbers into the equation).
	2. Double check you have the correct number of significant figures.

|  |
| --- |
| **DATA TABLE** |
| **Mass** | **Volume** | **Work** | **Density** | **Identity of Metal** | **Actual Value** | **Percent Error** |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

**Practice Problems**

*Solve the following problems in the space provided.* **SHOW YOUR WORK!**

1. A rock has a mass of 127 g and displaces 32.1 mL of water. What is the density of the rock?
2. A 1.00-L sample of carbon tetrachloride has a mass of 1.58 kg. What is the density of this substance in g/cm3?
3. A bar of silver has a mass of 68.0g and a volume of 6.48 cm3. What is the density of silver?