Chemistry – Chapter 2 Study Guide/Practice Problems

What to Know From Your NOTES (stuff other than calculations)

Review notes from the packet:

- ***Steps of the scientific method- what they are and why they are important***
- ***Difference between law, theory, and hypothesis***
- ***Difference between accuracy and precision***
- ***Be able to calculate % error***
- ***Difference between mass and weight***
- ***Qualitative vs. quantitative***
- ***Density***
- ***SI (metric) units (including common derived units), what they measure, and prefixes***
- ***Rounding rules!***
- ***Study any quizzes that you took and related assignments.***

CALCULATIONS AND RELATED CONCEPTS

Section 2.2 – Dimensional Analysis

The information below is the summarized process for doing dimensional analysis (or conversion factor) problems. Review this information, try out practice problems, and review the returned assignment.

Also be familiar with base units, which units correspond to different measurements (i.e. grams are used to measure mass). USE SIG FIG RULES, AS NEEDED, WHEN DOING PRACTICE PROBLEMS.

SAMPLE PROBLEM:

A small bottle contains 45.5 g of calcium chloride. What is the mass of calcium chloride in milligrams?

Solution:

- ***What is given in the problem?*** **The mass of calcium chloride in grams**
- ***What are you asked to find?*** **The mass of calcium chloride in milligrams**

A table showing what you know and what you do not know can help you organize the data. Being organized is a key to developing good problem solving skills.

ITEMS	DATA
Quantity given	45.5 g calcium chloride
Units of quantity given	Grams
Units of quantity sought	Milligrams
Relationship between units	1 g = 1000 mg
Conversion factor	???
Quantity sought	??? mg calcium chloride

1. PLAN
   - *What steps are needed to convert grams to milligrams?*

   Determine a conversion factor that relates grams and milligrams. Multiply the number of grams by that factor. Arrange the factor so that units cancel to give the units sought.

Write the relationship between grams and milligrams

1. **Mass of calcium**
2. **1 g = 1000 mg**

Possible conversion factors

$$\frac{1\text{ g}}{1000\text{ mg}} \quad \text{or} \quad \frac{1000\text{ mg}}{1\text{ g}}$$

4. **45.5 g of calcium chloride** x $\frac{\textbf{1000 mg}}{\textbf{1 g}}$

The correct conversion factor is the one that when multiplied by the given quantity causes the units to cancel.

Given *conversion factor* *quantity sought*

$$\text{g calcium chloride} \times \frac{1000\text{ mg}}{1\text{ g}} = \text{mg calcium chloride}$$

$$45.5\ \cancel{\text{g}}\text{ calcium chloride} \times \frac{1000\text{ mg}}{1\ \cancel{\text{g}}} = 45.500\text{ mg calcium chloride}$$

- *Are the units correct?* Yes; milligrams are the desired units. Grams cancel to give milligrams.

PRACTICE PROBLEMS. SHOW YOUR WORK.

1. State the following measured quantities in the units indicated:
   a. 5.8899 m of magnesium ribbon in millimeters.

b. 6.7 kL of water in milliliters

c. 0.0006 g of pepper in micrograms

d. 333 mg of aspirin in grams

2. State the following measured quantities in the units indicated:
    a. 87 L of oxygen gas in kiloliters
    b. 66 mm in centimeters
    c. 26990 dm in kilometers
    d. 906 nm in millimeters

3. A leather shoestring is 400 dm long. How long is the shoestring in millimeters? How many 40 mm long segments of shoestring can be cut from the original length?
4. State the following measure quantities in units indicated.
    a. 7.5 m^2 of steel sheet in square millimeters
    b. 98.3 mm^3 of acetic acid solution in cubic meters.
    c. 522,000 cm^2 of polyethylene sheet in square millimeters.
    d. 0.065 m^3 of bromine gas in cubic centimeters.

5. A cleaning supply company needs to determine what quantity of new spray cleaner to order for a chain of stores. If each store needs 70 kL of the spray cleaner and the cleaner comes in 6 L jugs, how many jugs does each store need to order in kiloliters? If there are 40 stores serviced by one distributor, how many total jugs does the company need to order?

6. A dropper delivers liquid so that 89 drops equal 2.00 mL.
    a. What is the volume of one drop in milliliters?
    b. How many milliliters are in 40 drops?
    c. How many drops are required to get 0.87 L?

7. A large commercial truck uses 0.007 mL of gear oil for each meter it is driven. How much oil in liters is consumed if the truck is driven 10 000 km?

Section 2.3 – Significant Figures and Scientific Notation

The information below is the summarized process for determining significant figures and scientific notation problems. Review this information, try out practice problems, and review the returned assignment.

Rules for Determining Significant Figures

2. All digits that are not zeros are significant.

All are nonzero digits	**All are nonzero digits**
325 mL of ethanol *The measurement has three significant figures.*	1.325 g of zinc *The measurement has four significant figures*

3. Zeros may or may not be significant. To determine whether a zero is significant, use the following rules.
   - Zeros appearing between nonzero digits are significant.

Nonzero digits	**Nonzero digits**
40.7 L of ammonia *The measurement has three significant figures*	32 006 m of wire *The measurement has five significant figures*

   - Zeros appearing in front of nonzero digits (also called leading zeros) are not significant.

Nonzero digits	**Nonzero digits**
0.0572 m^2 of foil *The measurement has three significant figures*	0.000 2 g of RNA *The measurement has has one significant figure*

   - Zeros at the end of a number and to the right of a decimal are significant figures. Zeros between nonzero digits and significant zeros are also significant. This is a restatement of Rule 1.

Nonzero digits	**Nonzero digits**
97.00 kg of tungsten	1200.00 cm^3 of lead
Zeros to the right of a number and after a decimal point	**Zeros to the right of a number and after a decimal point**
The measurement has four significant figures	*The measurement has has six significant figures.*

- Zeros at the end of a number but to the left of a decimal may or may not be significant. If such a zero has been measured or is the first estimated digit, it is significant. On the other hand, if the zero has not been measured or estimated but is just a place holder, it is not significant. ***A decimal placed after the zeros indicates that they are significant.***

Nonzero digits

3400 g of sulfur – 2 sig digits

Nonzero digits

4000. mL of oxygen -4 sig digits

Decimal point is present, so these zeros are significant.

Rules for Calculating with Measured Quantities

Operation	Rule
Multiplication and division	Round off the calculated result to the same number of significant figures as the measurement having the fewest significant figures.
Addition and subtraction	**Round off the calculated result to the same number of decimal places as the measurement with the fewest decimal places.** If there is no decimal point, round the result back to the digit that is in the same position as the leftmost uncertain digit (ex. The 8 in 28 0000) in the quantities being added or subtracted.

Directions: Perform the following calculations, and express the result in the correct units and number of significant digits. **Follow all rounding rules (see Table 2-6 on p. 48 of your textbook). SHOW ALL UNITS!!!!!!**

Directions: Complete the following problems being sure to follow the rules of significant digits.

1. Determine the number of significant digits in the following measurements:
   - A. 9800 cm^3 _____
   - B. 500.0 mL _____
   - C. 0.00623 g _____
   - D. 60.020 kg _____
   - E. 40600 L _____
   - F. 90.6223 cm _____
   - G. 0.000 4560 g/L _____
   - H. 0.060 98 kg/m^3 _____
   - I. 520 000 cm^2 _____
   - J. 56600.000 $kg*m/s^2$ _____

2. A. 47.54 m ÷ 2.22 s _____
   B. 30.3 L ÷ 1800. s _____
   C. 1400 cm x 35.6 cm _____
   D. 33.01 cm2 x 2.7000 cm _____

3. A. 27.00 m + 5.270 m + 15.70 m _____
   B. 24.500 dL + 4.030 dL + 10.02 dL _____
   C. 0.02 kg + 1.29 kg + 0.52 kg _____
   D. 320 mg + 32500 mg – 68800 mg _____

4. A rectangle measures 87.59 cm by 35.1 mm. Express its area with the proper number of significant figures in the specified unit:

   A. in cm^2

   B. in mm^2

   C. in m^2

5. On November 20, 2009, rainwater filled a container that measured 1089 mm x 1307 mm x 1272 mm in 103 s.

   A. What is the volume of the container in cubic meters?

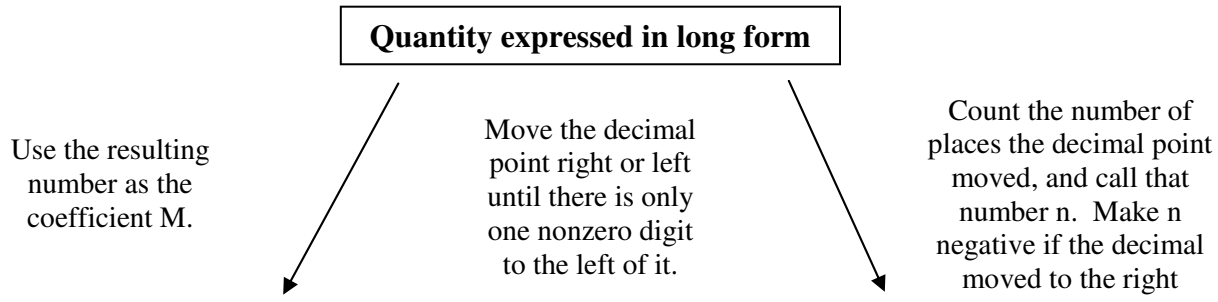
   B. What is the rate of flow in the pipe in liters per minute?

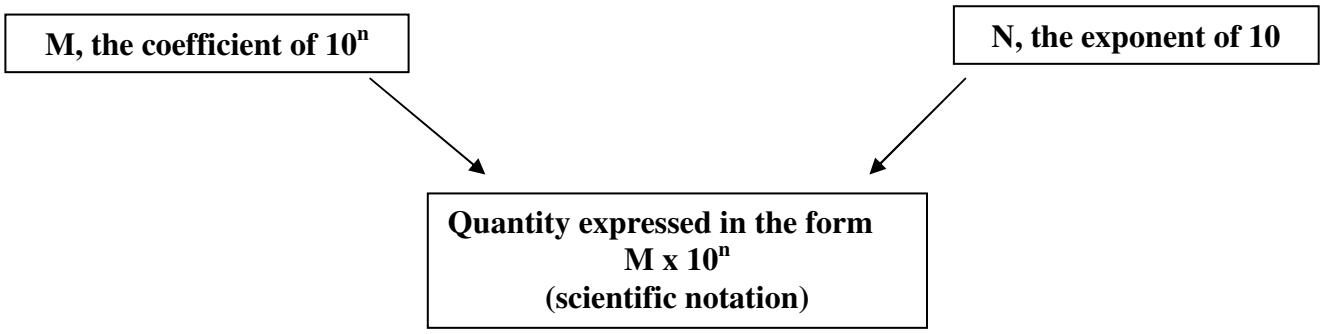
   C. What is the rate of flow in cubic meters per hour?

Working with Scientific Notation

People who work in scientific fields often have to use very large and very small numbers. Look at some examples in the following table:

1.61×10^{-3} g/cm^3	**0.001 61 g/cm^3**
1.97×10^{-10} m	**0.000 000 000 197 m**
9.46×10^{12} km	**9 460 000 000 000 km**
1.675×10^{-24} g	**0.000 000 000 000 000 000 000 001 675 g**





Directions: Express the following measurements in scientific notation. **Don't forget the units!!!!**
Example: 310 000 L = 3.1 x 10^5 L

4. 2 556 000 000 m _____
5. 0.00001500 kg _____
6. 0.000 000 0100 kg/m^3 _____
7. 9 003 000 000 Hz _____

Calculating with Quantities in Scientific Notation
Directions: Carry out the following calculations. Express the results in scientific notation and with the correct number of significant figures. For these problems **SHOW THE STEPS ON SEPARATE SHEETS OF PAPER. Put the answer on this handout, staple the sheets to handout and turn in.**

8. 4.74×10^6 km + $1.171\ 10^5$ km + 1.06×10^6 km

9. 5.72×10^{-5} m + 3.08×10^{-5} m + 1.211×10^{-2} m

10. 4.06×10^{-4} m^3 + 6.58×10^{-5} m^3 – 5.01×10^{-6} m^3

11. 3.15×10^3 mg + 5.13×10^2 mg + 5.13×10^5 mg

SHOW YOUR WORK…SERIOUSLY.
12. (2.07×10^4 cm) x (2.08×10^4 cm)

13. (6.3×10^2 mm) x (5.4×10^7 mm) x (8.89×10^{12} mm)

14. (7.28×10^1 m) x (5.2×10^{-9} m) x (3.02×10^{-9} m)

Example: (3.803×10^3 g) ÷ (5.3×10^6 mL) – SHOW YOUR WORK…SERIOUSLY.

15. (2.6658×10^9 cm) ÷ (3.43×10^3 s)

16. (7.588×10^{-9} L) ÷ (1.777×10^{-3} m^3)

17. (1.515×10^4 L) ÷ (4.06×10^8 km)