Problems

Give the number of significant figures in each of the following:

____ 402 m	____ 34.20 lbs	____ 0.03 sec
____ 0.00420 g	____ 3 200 liters	____ 0.0300 ft.
____ 5.1×10^4 kg	____ 0.48 m	____ 1 400.0 m
____ 78 323.01 g	____ 1.10 torr	____ 760 mm Hg

Multiply each of the following, observing significant figure rules:

17 m x 324 m = _____ 1.7 mm x 4 294 mm = _____

0.005 in x 8 888 in = _____ 0.050 m x 102 m = _____

0.424 in x .090 in = _____ 324 000 cm x 12.00 cm = _____

Divide each of the following, observing significant figure rules:

23.4 m ÷ 0.50 sec = _____ 12 miles ÷ 3.20 hours = _____

0.960 g ÷ 1.51 moles = _____ 1 200 m ÷ 12.12 sec = _____

Add each of the following, observing significant figure rules:

3.40 m	102.45 g	102. cm
0.022 m	2.44 g	3.14 cm
0.5 m	1.9999 g	5.9 cm

Subtract each of the following, observing signigicant figure rules:

42.306 m	14.33 g	234.1 cm
1.22 m	3.468 g	62.04 cm

Work each of the following problems, observing significant figure rules:

Three determinations were made of the percentage of oxygen in mercuric oxide. The results were 7.40%, 7.43%, and 7.35%. What was the average percentage?

A rectangular solid measures 13.4 cm x 11.0 cm x 2.2 cm. Calculate the volume of the solid.

If the density of mercury is 13.6 g/ml, what is the mass in grams of 3426 ml of the liquid?

A copper cylinder, 12.0 cm in radius, is 44.0 cm long. If the density of copper is 8.90 g/cm^3, calculate the mass in grams of the cylinder. (assume pi = 3.14)

Unit Dimensional Analysis Activity – Version 2

Why? In this activity we will see that it is possible to look at a situation from several points of view, or to take measurements of that same situation using different units of measure. Every measurement has 2 components: **magnitude** and **dimension**. **Magnitude** is the value of the number in the measurement and **dimension** is the unit of measure (e. g. grams, centimeters, inches or liters.)

- *If a measurement is given, can we convert that measurement to different units to meet our needs?*

Model: Car Trip
Given:
90 miles
75 minutes
3 gallons of gasoline
$12.00
1 bathroom break
27 songs on your iPod®

Group Instructions: When addressing each question, one group member should be assigned the task of reading the question aloud for the rest of the group. The manager should rotate that role among group members throughout the assignment.

Critical Questions:

1. How long does it take to drive 90 miles?

2. How long does it take to drive 180 miles?

3. How many miles can you drive on 3 gallons of gas?

4. How many miles can you drive on 1 gallon of gas?

5. Show how you solved question # 4. Be sure to include the units in your calculations.

6. Show the miles per gallon as a **fraction** (ratio) with numerator and denominator. Which is the numerator? Which is the denominator?

7. Using a grammatically correct sentence describe how you made the choice for # 6.

8. Is there another way to write the **fractional relationship** of gallons and miles? Show this way.

9. Why might you want to write the ratio this 2nd way?

10. Here are 3 other ratio relationships that we can obtain from the model:

1 bathroom break	3 gallons	27 songs
90 miles	75 minutes	$12.00

Write 4 other such relationships that you can obtain from the model:

These relationships are called **Conversion Factors**.
What are the components of a conversion factor?
Using complete sentences consult with your group and come up with a description of a conversion factor. What are its essential components and what is its purpose?

11. Which one of the conversion factors from #10 would you use to determine how long it would take to burn 8 gallons of gas?

12. Construct the conversion factor needed to determine how many songs you would hear in 500 miles.

13. Solve # 12 mathematically. Show your work below and be sure to *include units*.

Reflections:

14. As a group, write grammatically correct English sentences to describe the objective of the activity at this point. Be prepared to share your answer with the class.

15. After having shared with the class, does your group still agree with your initial assessment of what the objective is?

16. As a group, can you think of a situation when a scientist or chemist might need to use conversion factors to solve a problem? Give an example.

Exercises:

Using **conversion factors** to solve a problem is called **Dimensional Analysis**. You should now be able to solve the following problems.

17. Solve this problem *without using a calculator*: $\frac{6 \times 17 \times 3 \times 13}{13 \times 9 \times 17} =$

18. Write a mathematical rule that makes this problem easier to solve.

19. Solve this problem:

$$\frac{\text{miles} \times \text{songs} \times \text{gallons}}{\text{miles} \times \text{gallons}} =$$

It is often convenient to represent calculations of this type as a "cancellation line." The cancellation line for Problem 17 would look like this: $\frac{6 \mid \cancel{17} \mid 3 \mid \cancel{13}}{\cancel{13} \mid 9 \mid \cancel{17}} = 2$

Cancellation lines can also be used with units: Ex. Calculate the number of minutes in 5 days

$$\frac{5 \cancel{\text{days}} \mid 24 \cancel{\text{hours}} \mid 60 \text{ minutes}}{\mid 1 \cancel{\text{day}} \mid 1 \cancel{\text{hour}}} = 7200 \text{ min.}$$

Use a cancellation line to solve the remaining problems.

20. How many miles would you have to drive to hear 43 songs? Show how you solve the problem using units and conversion factors.

21. Using your answer from # 20, how many minutes would this take? Again show how you solve the problem using units and conversion factors.

22. Show how you can combine problems # 20 and # 21 into one. Draw a line through any units that cancel. Put your answer on the board.

23. Write a grammatically correct English sentence to describe which unit you will be left with in the answer.

On your own

24. The average human heart beats 72 beats/minute. If you live to be 80 years old, how many times does your heart beat. What conversion factors do you need to know to solve this problem. List these conversion factors.

25. What units should the answer be in? What value would you use to begin the problem and why? Solve the problem and show your work. Include all units and show cancellations of the units.

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DIMENSIONAL ANALYSIS AND UNIT CONVERSIONS

Dimensional analysis is a useful problem strategy for dealing with problems involving measurements. Measurements must have both a value and a unit, which must also be accounted for in any mathematical manipulation of the measurement. Dimensional analysis can be summarized in five simple steps, as shown below:

1. Write the value and unit of the known quantity
2. Draw a bracket (or a new fraction)
3. Place the known's unit on BOTTOM of the bracket/fraction
4. Place the desired unit on TOP of the bracket/fraction
5. Fill in the conversion factor and calculate!

TIP: it is easier if the bigger unit always receives the value "1" in the conversion factor

EXAMPLE: If the earth has a diameter of 12756 km, then how many miles is the diameter of the earth? (1km=1.6miles)

$$12756 \text{ km} \times \frac{1\ mile}{1.6\ km} = 7973 \text{ miles}$$

Complete the following conversions, showing ALL work.

1. A bullet has a mass of 452.2g. Express this in kilograms.

2. The distance from the earth to the sum is approximately 9.6×10^{8} miles. How many kilometers is this? (1 mile = 1.6 km)

3. A block of wood has a volume of 455 mL. How many nanoliters does it occupy?

4. An arrow is travelling with a velocity of 357 ft/s. How many meters per second is this? (2.54cm = 1in)

NAME _____ DATE_____ PERIOD_____

5. A candy bar can supply 325000 calories when burned. How many joules of energy is this? (1cal = 4.184J)
6. A car engine is making 3600 rotations per second. How many rotations is the car making per day?
7. A certain book measures 25.25cm on one side. Express this value in micrometers.
8. Calculate the number of kilomoles of lead present in 452 centimoles of lead.
9. 400K is equivalent to what temperature in degrees Celsius?
10. If you are travelling down the interstate and the speed limit is 70 miles per hour, are you speeding if you are travelling 0.022 kilometers per second?

Name: _____Date:_____ Period: _____

PRACTICE PROBLEMS

1. Find the mass of 0.89 mol of $CaCl_2$.

2. A bottle of $PbSO_4$ contains 158.1 g of the compound. How many moles of $PbSO_4$ are in the bottle?

3. Find the mass of 1.112 mol of HF.

4. Determine the number of moles of C_5H_{12} that are in 362.8 g of the compound.

5. Find the mass of 0.159 mol of SiO_2.

6. You are given 12.35 g of $C_4H_8O_2$. How many moles of the compound do you have?

7. Find the mass of 3.66 mol of N_2.

8. A bottle of $KMnO_4$ contains 66.38 g of the compound. How many moles of $KMnO_4$ does it contain?

9. Determine the number of atoms that are in 0.58 mol of Se.

10. How many moles of barium nitrate ($BaNO_3$) contain 6.80×10^{24} formula units??

11. Determine the number of atoms that are in 1.25 mol of O_2.

12. How many moles of magnesium bromide ($MgBr_2$) contain 5.38×10^{24} formula units?

13. Determine the number of formula units that are in 0.688 mol of $AgNO_3$.

14. How many moles of ethane (C_2H_6) contain 8.46×10^{24} formula aunits?

15. Determine the number of formula units that are in 1.48 mol of NaF.

16. How many formula units are in 3.5 g of NaOH.

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PRACTICE PROBLEMS – CONTINUED

17. If you burned 6.10×10^{24} molecules of ethane (C_2H_6), what mass of ethane did you burn?

18. How many formula units are in 5.1 g of TiO_2?

19. What is the mass of 3.62×10^{24} molecules of methanol (CH_3OH)?

20. How many formula units are in 1.4 g of $PbCl_2$?

21. Determine the mass of 2.94×10^{24} molecules of decane ($C_{10}H_{22}$).

22. How many formula units are in 5.6 g of H_2S?

23. A container with a volume of 893 L contains how many moles of air at STP?

24. A chemical reaction produces 0.37 mol of N_2 gas. What volume will that gas occupy at STP?

25. A canister with a volume of 694 L contains how many moles of oxygen at STP.

26. A chemical reaction produces 13.8 mol of CO gas. What volume will that gas occupy at STP?

27. A tube with a volume of 3.68 L contains how many moles of neon gas at STP?

28. A chemical reaction produces 0.884 mol of H_2S gas. What volume will that gas occupy at STP?

29. A container with a volume of 101 L contains how many moles of argon gas at STP?

30. A chemical reaction produces 138 mol of HBr gas. What volume will that gas occupy at STP?

Pre-AP Chemistry – Fall 2014 – Conversion Practice Problems

The following questions will test and hone your skill at using dimensional analysis to perform calculations involving the metric system, density, molar mass, and molarity conversions. All work must be shown using dimensional analysis if possible, even if only part of a problem can be solved that way. You should follow significant figure rules at all times and may use the periodic table as needed.

1. Jimmy has a rectangular piece of paper that measures 1.121m on one side and 37.6cm on the other side. What is the area of the paper in square decimeters? ANS: 42.1 dm^2

2. A certain piece of metal has a mass of 15.0mg and a volume of 3245µL. What is the density of the piece of metal in grams per milliliter? ANS: 0.00462 g/mL

3. Determine the molar mass of glucose, $C_6H_{12}O_6$. How many moles of glucose would I have if Janie gave me 1.2kg of glucose? ANS: 180.1 g/mol , 6.7 mol

4. If Sammy has 6.43×10^{-3} mol of iron, then how many nanomoles of iron does he have? ANS: 6.43×10^6 nmol

5. What mass of lead is needed to obtain a volume of 678cm^3 if the density of lead is known to be 11.36g/mL? ANS: 7.70×10^3 g

6. Find the molarity of a solution prepared by dissolving 34.2g of KBr into enough water to make 430mL of solution. ANS: 0.67 mol/L

7. I need 189.16g of sucrose ($C_{12}H_{22}O_{11}$) to complete an experiment. All I have on hand from which to obtain the sucrose is a 0.23M solution of sucrose. What volume of solution do I require? ANS: 2.5 L

8. I am performing a reaction with silver metal and need to obtain 100.0g of silver to complete it. I don't have a scale, but do have some silver foil that has a width of 13.5cm and a thickness of 1.2×10^{-4} cm. If I know that the density of silver is 10.49g/mL then what length of the silver foil should I use? ANS: 5900 cm

9. How many moles of copper do I have if I obtain a copper cube with a side measurement of 134.1mm? The density of copper is known to be 8.96g/mL. ANS: 340 mol

10. What is the molarity of a solution prepared by adding 75.0g of aluminum nitrate to enough water to make 5434mL of solution? What volume of the solution should I use if I need 1.5mol of nitrate for an experiment? ANS: 0.0648 mol/L , 7.7 L