Chemistry B

Factor Label Packet

PERIODIC TABLE OF ELEMENTS WITH OXIDATION NUMBERS

+1																	0
H	+2											+3		-3	-2	-1	He
Li	Be											B	C	N	O	F	Ne
Na	Mg										+2	Al	Si	P	S	Cl	Ar
K	Ca	Sc^{+3}	Ti^{+4}	V	Cr	Mn	$Fe^{+2,+3}$	Co^{+2}	Ni^{+2}	$Cu^{+1,+2}$	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr				Mo				Pd^{+2}	Ag^{+1}	Cd	In	$Sn^{+2,+4}$	$Sb^{+3,+5}$	Te	I	Xe
Cs	Ba				W				Pt^{+2}	Au^{+1}	$Hg^{+1,+2}$	Tl	$Pb^{+2,+4}$	$Bi^{+3,+5}$	Po	At	Rn
Fr	Ra																

COMMON POLYATOMIC IONS

Cation with +1 charge		Anions with -1 charge		Anions with -2 charge		Anions with -3 charge	
Formula	Name	Formula	Name	Formula	Name	Formula	Name
NH_4^{+1}	ammonium	$C_2H_3O_2^{-1}$	acetate	CO_3^{-2}	carbonate	AsO_4^{-3}	arsenate
Hg_2^{+2}	mercury (I)	OH^{-1}	hydroxide	SO_4^{-2}	sulfate	BO_3^{-3}	borate
		ClO_4^{-1}	perchlorate	SO_3^{-2}	sulfite	PO_3^{-3}	phosphite
		ClO_3^{-1}	chlorate	$S_2O_3^{-2}$	thiosulfate	PO_4^{-3}	phosphate
		ClO_2^{-1}	chlorite	SiO_3^{-2}	silicate		
		ClO^{-1}	hypochlorite	O_2^{-2}	peroxide		
		NO_3^{-1}	nitrate	CrO_4^{-2}	chromate		
		NO_2^{-1}	nitrite	$Cr_2O_7^{-2}$	dichromate		
		BrO_3^{-1}	bromate	HPO_4^{-2}	biphosphate or hydrogen phosphate		
		IO_3^{-1}	iodate				
		CN^{-1}	cyanide	$C_2O_4^{-2}$	oxalate		
		SCN^{-1}	thiocyanate				
		MnO_4^{-1}	permanganate				
		HCO_3^{-1}	bicarbonate or hydrogen carbonate				
		HSO_4^{-1}	bisulfate or hydrogen sulfate				
		$H_2PO_4^{-1}$	dihydrogen phosphate				

COMMON CONVERSIONS

Metric			**English**	**English to Metric**
length **(m)= meters**	volume **(L)=liters**	mass **(g) = grams**	1 ft = 12 in	1 lb = 454 g
1 m = 10 dm (deci)	1 L = 10 dL	1 g = 10 dg	1 mi = 5280 ft	1 qt = .946 L
1 m = 100 cm (centi)	1 L = 100 cL	1 g = 100 cg	1 gal = 4 qt	1 in = 2.54 cm
1m = 1000 mm (milli)	1 L = 1000 mL	1 g = 1000 mg	1 ton = 2000 lbs	**Time**
1000 m = 1 km (kilo)	1000 L = 1 kL	1000 g = 1 kg		1 s = 1000 ms
				1 day = 24 hr
	1 mL = 1 cm^3			1 hr = 60 min
				1 min = 60 s

Factor Label Worksheet #1: Introducing Factor Label

Frequently Asked Factor-Label Questions:

Why are we doing this?
Factor Label is a method for solving problems. It gives us a neat and organized method to solve problems. You can use this method in chemistry, math, shopping, building, cooking and home improvement/maintenance.

I thought this was Chemistry!
Yup, it is. Throughout this course you must be able to solve problems in a neat and organized manner. Be thankful that we go at a slower pace and our math problems tend to be less complex than those in the honors chemistry class.

Do we need to memorize all of the conversions between units?
No. They will be provided for each quiz/test.

We begin by using a simple equation:

 # what you want to find = what you know x the fraction(s) you need to get your answer

One Step Factor Label Problems:

1. How many liters are in 156.2 milliliters?

2. 9.85 meters are how many centimeters?

How do you cancel out a unit that is on top? _____

Two Step Factor Label Problems

3. How many centimeters are in .456 kilometers?

4. How many seconds are in 3 days?

Factor Label Worksheet # 2: One Step Factor Label Problems

Simple algebra skills are necessary not only in chemistry, but also in every day life. Whether you are in the grocery store, video store, or a hardware store, you must be able to switch back and forth between different units. For example, a video may be listed as 101 minutes long. You want to know how long the movie is in hours. Therefore, you need to do a factor label problem.

To solve this problem we will learn a generic set-up and use it to solve EVERY PROBLEM FOR THE REST OF THE YEAR!!!

what you want to find = what you know x the fraction(s) you need to get your answer

For our video problem:
what you want to find = **hours**
what you know = the movie is **101 minutes**
the fraction (or definition) you need to get your answer = **1 hour = 60 minutes**

The set-up would look like:

$$\#\text{ hours} = 101\ \text{min} \times \frac{1\ \text{hour}}{60\ \text{min}} = 1.6833333 = \boxed{1.68\ \text{hours}}$$

Notice how I cancelled out the units and boxed the final answer.

Use the factor label method shown above to solve the following problems neatly. I realize that many of you can solve these in your head. I am giving you easy problems to learn the problem solving method you will be expected to use for the entire year.

Find the number of:

1. grams in 355 milligrams
2. centimeters in 245 meters
3. liters in 885 milliliters
4. kilograms in 352 grams
5. minutes in 24 hours
6. seconds in 101 minutes
7. meters are in 12 kilometers
8. milliseconds are in 45 seconds (1000ms = 1s)
9. centiliters in 6.72 liters
10. millimeters there are in 0.25 meters

Factor Label Worksheet # 3: Multi-Step Factor Label Problems

In worksheet #2 we learned how to do simple one step factor label problems. Most of our problems will not be that easy. They will involve two, three, and even four steps. **The only difference between this type of problem and the other is that you need to use more than one conversion or definition.**

Let's go back to our movie problem from the previous worksheet. Here we were solving for hours and we used the following format.

what you want to find = what you know x the fraction(s) you need to get your answer

For our video problem:
what you want to find = **hours**
what you know = the movie is **101 minutes**
the faction (or definition) you need to get your answer = **1 hour = 60 minutes**

The set-up was: # hours = 101 min x $\frac{1\ \text{hour}}{60\ \text{min}}$ = 1.6833333 = 1.68 hours

For some reason you need to find out how many days your movie will last. Our new problem will need to be sorted out:

what you want to find = days
what you know = the movie is **101 minutes**
the definitions you need to get your answer = **1 hour = 60 minutes**
= 1 day = 24 hours

Our set-up for the new problem:

days = 101 minutes x $\frac{1\ \text{hour}}{60\ \text{min}}$ x $\frac{1\ \text{day}}{24\ \text{hr}}$ = 0.070138 = 0.0701 days

Using the factor-label method, solve the following problems neatly and **on a separate sheet of paper**.

Find the number of:

1. seconds in a hour
2. millimeters in 0.025 kilometer
3. kilograms are in 345 milligrams
4. kilometers in 785 centimeter
5. centiliters in 35.4 milliliters
6. kiloliters in 54.8 centiliters
7. milligrams in 85.1 centigrams
8. centimeters in 42.5 kilometers
9. seconds in 4 days
10. milliseconds in one chemistry class (assume 88 minutes class) 1000 ms = 1 s

The next section is a combination of both one and two step factor label problems:

11. days in 10 weeks
12. hours in a leap year (l leap year=366 days)
13. centigrams in 5.67 grams
14. liters in 9856 milliliters
15. centiliters in 12.3 milliliters
16. meters in 10 kilometers
17. millimeters in 3.75 kilometers
18. milligrams in 0.182 kilograms
19. centimeters in 15.3 meters
20. seconds spent sleeping during an night where you get 8 hours of sleep. (HINT: Start with 8 hours of sleep per night.)

Factor Label Worksheet # 4: Scientific Notation

Scientific notation is a method of expressing numbers as one number times a power of ten. It is commonly **used to express very large or very small numbers more conveniently**, but can be used to express any number.

In scientific notation any number is written as a number between one and nine followed by ten raised to a power; that is, **the decimal point always follows the first digit**.

EXAMPLES:

2,500,000	=	2.5×10^{6}	← exponent
200	=	2×10^{2}	
3850	=	3.85×10^{3}	
0.00025	=	2.5×10^{-4}	
0.0375	=	3.75×10^{-2}	

To put numbers in scientific notation start by placing a new decimal place **after the first digit to make a number between one and nine.** Now **count back to where the original (old) decimal place was. It is this number that will become the exponent. If you move to the right the exponent will be positive. If you move to the left the exponent will be negative.** To remember this, think about a number line. The right side of a number line represents positive numbers, while the left side represents negative numbers.

Write the following numbers in scientific notation:

1. 9,000,000,000
2. 0.0285
3. 8630
4. 0.0000015
5. 1833
6. 102
7. 4,520
8. 1000
9. 0.139
10. 0.0076

To convert from scientific notation to ordinary numbers you simply **move the decimal the number of places indicated by the exponent. If the exponent is positive, you move the decimal to the right. If the exponent is negative you move the decimal to the left.**

Using your intellect, not your calculator, express the following numbers in "ordinary" numbers:

11. 6.5×10^{3}
12. 2.81×10^{-2}
13. 3.77×10^{5}
14. 1.5×10^{1}
15. 3.8×10^{-5}
16. 9.1×10^{-7}
17. 3×10^{8}
18. 1.85×10^{5}
19. 5.42×10^{2}
20. 9.415×10^{4}

Solve each of the following metric system conversions using the factor label method. You are to set each problem WITHOUT THE USE OF A CALCULATOR. Then express your final answer in scientific notation. Problems 21-30 are to be **on a separate sheet of paper!**

21. 46,500 mg is how many grams?
22. How many mm are in 8.5 km?
23. How many kg are there in 100 cg?
24. 254 meters is how many cm?
25. 4.54 kg is equal to what number of mg?
26. 0.00025 grams are how many mg?
27. 18,000,000 centimeters are how many meters?
28. 100 ml are how many cubic centimeters?
29. 0.000285 kg is how many mg?
30. 125 liters are equal to how many ml?

Factor Label Worksheet # 5: Top and Bottom Factor Label Problems

So far we have learned how to do simple one-, two- and three-step factor label problems. In ever problem so far we have changed one unit. Here we will learn how to change the bottom, and both the top and bottom units.

If you want to change the bottom units you will basically set-up the problem the same way.

what you want to find = what you know x the fraction(s) you need to get your answer

For example:

In Canada, the posted speed limit on most highways is 120 kilometers per hour. Convert this to miles per hour.

Here we need to know the definition **1 mile = 1.6 km**

For our density problem:
what you want to find = miles per hour
what you know = 120 kilometers per hour
the definition you need to get your answer = **1 mile = 1.6 km**

The set-up is: $\frac{\#\text{ mi}}{\text{hr}} = 120\ \frac{\cancel{\text{km}}}{\text{hr}} \times \frac{1\text{ mi}}{1.6\cancel{\text{km}}} = 75\ \frac{\text{mi}}{\text{hr}}$

On a separate sheet of paper, neatly solve the following problems using the factor label method. Put all answers in the scientific notation format.

1. The density of copper is 0.386 grams per milliliter. Find the density of copper in grams per cubic centimeter.
2. The speed of light is 300,000,000 meters per second. How many centimeters per second is this?
3. Given the speed of light is 300,000,000 meters per second how many meters does light travel in a minute? HINT: Find meters per minute.
4. The speed limit on many roads in Canada is 90 kilometers per hour. What is the speed in centimeters per second?
5. My new car gets 10.2 kilometers per liter. What is my gas mileage in kilometers per kiloliter?
6. The density of hydrogen gas is 0.00008 grams per cubic centimeter. What would the density be in grams per liter?

Extra Challenges

7. Spinal bifida, a birth defect can be prevented if expectant mothers take 1000 milligrams of folic acid per day. How many kilograms would these women need if they took it for 40 weeks? (Hint: find kilograms per week)
8. The density of petroleum oil is 0.90 grams per milliliter. You have 15.6 liters of petroleum oil. How many grams of petroleum oil do you have? (Hint: 0.9 g= 1 mL)
9. A car gets 15.5 kilometers per liter of gas. Gas costs $0.43 per liter in Hawaii. If Ms. Najarian drove 124 kilometers, how much money would she spend in gas?
10. A bottle of Midnight Thunder flavored Gatorade® contains 591 cubic centimeters. It will cost you $1.25. (Hint: Find the number of dollars per liter for the individual bottle)
11. A typical class ring will contain 5.5g of gold (1 ring=5.5g). There are 1.6 grams of gold for every ton of gold ore mined. How many tons of gold ore are need to make the typical class ring? (Hint: find tons per ring)
12. You buy a 2.0L bottle of Sprite for your friends. One serving of Sprite is 250 mL. Calculate the number of servings in one bottle. (Hint: find servings per bottle)

Factor Label Worksheet #6: Factor Label Review

Determine the answer using the factor label method and scientific notation. Show your work. Circle your final answer.

1. Convert 50 gallons to liters

2. Convert 40 liters to cubic centimeters

3. How many feet are in 500 inches?

4. How many grams are in 45 pounds(lbs)?

5. Convert 600 milligrams into grams?

6. Convert 2 liters into milliliters?

7. How many mg/L are in a solution that has 1.33 grams per gallon?

8. Convert 8000 gallons per minute to milliliters per day.

Extra Challenges:

9. If a pump is pumping at a rate of 15 gallons per minute and runs for 2 hours each day, how many days will it take to fill a 20000 gallon swimming pool?

10. Calculate how many feet per second water is flowing in a grit chamber if a ball floats 250 meters in 1.43 minutes.

Factor Label Worksheet #7: Review Sheet #2

Solve the following problems using the factor label techniques learned in class. Report all answers in scientific notation. Be sure to include units and circle your final answer.

1. How many milliliters are in 0.255 liters? 2.55×10^{2} mL

2. How many liters are in 233 milliliters? 2.33×10^{-1} L

3. How many grams are in 125 pounds? 5.675×10^{4} g

4. How many days are in 520 minutes? 3.61×10^{-1} day

5. How many kilograms are in 875 decigrams? 8.75×10^{-2} kg

6. How many inches are in 6.5 miles? 4.1184×10^{5} in

7. How many gallons are in 4.6×10^{4} milliliters? 1.22×10^{1} gal

8. How many tons are in 3.5×10^{5} grams? 3.85×10^{-1} ton

9. The density of the sun is 0.00141 grams per liter. What is it in grams per cubic centimeter? 1.41×10^{-6} g/cm^3

10. The density of the planet Mercury is 5.43 grams per cubic centimeter. What is it in grams per liter? 5.43×10^{3} g/L

11. A car going 6000 meters per hour is traveling how many kilometers per hour? 6×10^{0} km/hr

Extra Challenges:

12. A car going 55 kilometers per hour is traveling how many miles per hour? 3.42×10^{1} mi/hr

13. A car gets 10.2 kilometers per liter. What is the gas mileage in miles per gallon? 2.4×10^{1} mi/gal