Name: ____________________ Per: ___

Packet 4 :

Stoichiometry & Chemical Reactions

'18 Due Date   Assignment
(check them off as you complete them)

Thur 10/25 ___ Do WS 4.1 (#1-20)

•• Student Presentations Today ••

Fri 10/26 ___ Do WS 4.1 (#21-33)

^^^ **mole lab today** ^^^ (not in packet)

Mon 10/29 ___ Do WS 4.2

•• Student Presentations Today ••

Tue 10/30 **<--> Halloween Show Today <-->**

Wed 10/31 ___ Do WS 4.3

•• Student Presentations Today ••

Thur 11/1

~~~ **S'mores Lab Today** ~~~

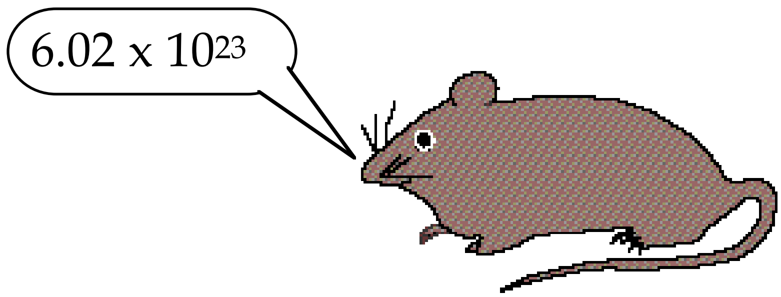
•• Student Presentations Today ••

Fri 11/2 ___ Do WS 4.4

•• Student Presentations Today ••

Wed 11/7 ___ Do WS 4.5 (side 1 only)

•• Student Presentations Today ••



the MOLE

(actually I'm a mouse - Mr. Anderson was too lazy to find a decent picture of a mole)

Thur 11/8 ___ Do WS 4.5 (side 2)

•• Bring Dry Erase Markers Today ••

•• Student Presentations Today ••

Fri 11/9 •• Bring Dry Erase Markers Today ••

•• Student Presentations Today ••

Mon 11/12 ___ Read "Evidence of Chemical Change" lab

•• Student Presentations Today ••

Tue 11/13 ___ Do WS 4.6

___ finish chemical change lab

___ Bring in 2 new clean shiny pennies

•• Student Presentations Today ••

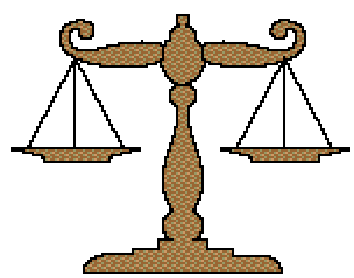
Wed 11/14 ___ Read "Baking Soda Stoichiometry" Lab

Thur 11/15 ___ Turn-in Baking Soda Stoichiometry Lab

___ finish Penny Lab in-class & keep in packet

*** Mustard Day ***

•• Student Presentations Today ••



balancing equations

Fri 11/16 **Δ•Δ Quiz Today Δ•Δ**

___ Do WS 4.7

___ Come to class with packets **ready to be turned in**, in the correct order (see below) in your pocket folder (1/2 pt), with THIS PAGE as the cover page. Make sure grade report is stapled in your packet pocket folder for 1/2 point. Be sure packet is in proper order for 1/2 point.

packet order:
- assignment sheet
- WS 4.1 ~ 4.7
- Penny lab

please don't turn in old packets or non-relevant material (-1/2)
~~~

WS 4.1 Balancing Equations / Formula Mass

For 1-6, take inventory of each side and determine whether the equation is balanced (Y) or not (N):

1. $H_2 + Cl_2$ ---> 2 HCl ____
2. $H_2 + O_2$ ---> 2 H_2O ____
3. 3 F_2 + N_2 ---> 2 NF_3 ____
4. 2 $KClO_3$ ---> 2 K + Cl_2 + 3 O_2 ____
5. 3 Na + 3 H_2O ---> 3 NaOH + H_2 ____
6. 3 K_2CO_3 + 2 $Al(OH)_3$ ---> 6 KOH + $Al_2(CO_3)_3$ ____

For 7-25, balance the equation by writing in the appropriate coefficients (lowest whole-numbers). Check your answers by taking inventory (like above). **HINT**: *use a pencil or erasable pen!!!!!!!*

7. ___ K + ___ S ---> ___ K_2S
8. ___ Li + ___ O_2 ---> ___ Li_2O
9. ___ N_2 + ___ O_2 ---> ___N_2O
10. ___ N_2 + ___ H_2 ---> ___ NH_3
11. ___ Fe + ___ O_2 ---> ___ Fe_2O_3
12. ___ KBr ---> ___ K + ___ Br_2
13. ___ $MgCl_2$ ---> ___ Mg + ___ Cl_2
14. ___ Al_2O_3 ---> ___ Al + ___ O_2
15. ___ $FeBr_3$ + ___ F_2 ---> ___ FeF_3 + ___ Br_2
16. ___ NH_4OH ---> ___ NH_3 + ___ H_2O
17. ___Na + ___H_2O ---> ___NaOH + ___H_2
18. ___NH_3 + ___O_2 ---> ___NO + ___H_2O
19. ___ BaO + ___ HCl ---> ___ $BaCl_2$ + ___ H_2O
20. ___ $Sn_3(BO_3)_4$ ---> ___ Sn + ___ B + ___ O_2
21. ___ H_3PO_4 + ___ $Ca(OH)_2$ ---> ___ $Ca_3(PO_4)_2$ + ___ H(OH) (hint- balance the (OH) separate from the (H)
22. ___ $C_5H_{12}O$ + ___ O_2 ---> ___ CO_2 + ___ H_2O
23. ___ Al_2O_3 + ___ C + ___ Cl_2 ---> ___ $AlCl_3$ + ___ CO
24. ___ SiF_4 + ___ H_2O ---> ___ H_4SiO_4 + ___ H_2SiF_6
25. ___ HNO_3 + ___ P_4O_{10} ---> ___ N_2O_5 + ___ H_3PO_4 (hint- balance the phosphorus first)

optional! ___ NH_3 + ___ NO_2 ---> ___ N_2O + ___ H_2O (challenge! you may get bonus points for this!)

For #26 - 33, Use a periodic table to determine the formula mass (atomic weight) of the following: use ans. bank...

26. N_2 _______
27. H_2O _______
28. $Ca(OH)_2$ _______
29. $Al_2(PO_4)_3$ _______
30. C_3H_7OH _______
31. $AgNO_3$ _______
32. N_2O_5 _______
33. $(NH_4)_2HPO_4$ _______

Ans (IRO+2) (#26-33): 28 18 44 60 74 108 132 170 194 339

WS 4.2.1 *The Mole* · ***SHOW ALL WORK*** *using* ***DIMENSIONAL ANALYSIS***

· Circle the leftover answer & units in answer bank when done

1. Please convert these measurements into moles:

a) 9.03×10^{23} C atoms

Ans: ______

b) 6.02×10^{23} Li atoms

Ans: ______

c) 9.03×10^{23} CO_2 molecules

Ans: ______

d) 2.44×10^{23} H_2O molecules

Ans: ______

2. Please convert these measurements into atoms / molecules: ('cules = unofficial abbrev. for molecules)

a) 3.50 moles K

Ans: ______

b) 0.573 moles NF_3

Ans: ______

c) 62.5 moles CO_2

Ans: ______

d) 7.90×10^4 moles H_2O

Ans: ______

3. Please convert these measurements into moles:

a) 56.7 g C

Ans: ______

b) 5.67 g NF_3

Ans: ______

c) 44.0 g CO_2

Ans: ______

d) 8.43×10^5 g Ag

Ans: ______

4. Please convert these measurements into mass (grams):

a) 3.50 moles K

Ans: ______

b) 0.573 moles NF_3

Ans: ______

c) 62.5 moles CO_2

Ans: ______

d) 7.9×10^9 moles H_20

Ans: ______

→ **Circle leftover answer and unit**

Ans: (IRO+1) 0.079 0.405 1.00 1.00 1.50 1.50 4.72 40.7
67.3 137 2750 7810 1.4E11 3.45E23 2.11E24 3.76E25 4.76E28

Units: (IRO+1) mol mol mol mol mol mol mol mol mol g g g g atom 'cules 'cules 'cules

WS 4.2.2

5. Please convert these measurements into atoms / molecules:

a) 17.4 g K

Ans: ______

b) 0.564 g NF_3

Ans: ______

c) 34.3 **kg** CO_2

Ans: ______

d) 3.90 x 10^4 g H_2O

Ans: ______

6. Please convert these measurements into mass (grams):

a) 4.076 x 10^{23} C atoms

Ans: ______

b) 7.54 x 10^{15} Na atoms

Ans: ______

c) 6.98 x 10^{21} CO_2 molecules

Ans: ______

d) 1 H_2O molecule

Ans: ______

7. How many molecules are present in 15.4 g of CO_2?

Ans: ___________

8. a) What would be the mass of a 16.9 mole sample of propane (C_3H_8)? b) How many propane molecules would it contain? c) How many C atoms would it contain?

(hint- multiply ans. in 'b' by # of C atoms in formula)

a: ________ b: ________ c: ________

9. How many Au atoms are there in a 2.3 cm x 5.6 cm x 12.7 cm block of gold? (D = 19.3 g/mL)
(hint- use density formula to find mass. Then convert mass into atoms)

Ans: ____________

10. a) How much would 3.45 x 10^{21} $C_{12}H_{22}O_{11}$ molecules weigh? b) How many total atoms (C, H & O combined) would it contain? (hint- multiply 3.45 E 21 by total # of atoms in formula)

a: _______ b: _______

11. 2.00 moles of O_2 gas has a volume of 44.8 L at standard conditions. What would be oxygen's density under those conditions? (D=m/V) (hint- change moles to grams. Then use density equation)

Ans: ___________

Ans 5-11 (IRO+1): 3E-23 2.88E-7 0.510 1.43 1.96 8.12 531 744 926 4.78E21 1.55E23 2.11E23 2.68E23 9.6E24 1.02E25 3.05E25 4.69E26 1.30E27
Units 5-11 (IRO+1): g g g g g g g g/L atom atom atom atom atom 'cules 'cules 'cules 'cules 'cules

WS 4.3 STOICHIOMETRY (part 1)

Show all work using dimensional analysis!

1. $4\ Na + O_2 \longrightarrow 2\ Na_2O$

a) How many moles of sodium (Na) would be needed to react with 3.82 moles of oxygen (O_2)?

Ans ________

b) How many moles of Na_2O can be produced from 13.5 moles Na?

Ans ________

c) How many moles of O_2 are needed to produce 34.7 g of Na_2O?

Ans ________

2. $C_2H_4 + 3\ O_2 \longrightarrow 2\ CO_2 + 2\ H_2O$

a) When 0.624 moles of O_2 are reacted, how many moles of carbon dioxide are produced?

Ans ________

b) How many grams of C_2H_4 are needed to produce 3.7 moles of water?

Ans ________

c) how many grams of O_2 are needed to react with 2.56 g of C_2H_4?

Ans ________

3. $N_2 + 3\ F_2 \longrightarrow 2\ NF_3$

a) When 62.0 g of fluorine are reacted, how many moles of NF_3 will be formed?
(don't forget fluorine is diatomic)

Ans ________

b) How many molecules of N_2 are needed to produce 2.85 g of NF_3?

Ans ________

c) 3.54 g of nitrogen trifluoride will form from how many grams of fluorine?

Ans ________

4. $4\ NH_3 + 7\ O_2 \longrightarrow 4\ NO_2 + 6\ H_2O$

a) What mass of NO_2 can be produced from 3.56×10^{22} molecules of oxygen?

Ans ________

b) 13.8 g of NH_3 would be able to produce how many moles of H_2O?

Ans ________

c) How many grams of O_2 are needed to produce 15.5 g of H_2O?

Ans ________

Ans (IRO+1): 0.280 0.416 1.09 1.22 1.55 2.84 6.75 8.78 15.3 22.4 32.1 52 1.21x10^22
Units (IRO+1): mol mol mol mol mol mol g g g g g g molecules

WS 4.4 STOICHIOMETRY part 2

Show all work using dimensional analysis!

1. **3 cups flour + 1 egg ---> 1 loaf bread**

a) If you have 12 cups of flour and 3 eggs, how many loaves of bread can you make?

Ans: _______

b) Which ingredient do you run out of first (limiting reactant)? Ans: ___________

---

2. **$2\ Al + 6\ HCl \longrightarrow 3\ H_2 + 2\ AlCl_3$**

a) If you start with 205 g of aluminum and 75.6 g of HCl, how many grams of H_2 can be made?

Ans ________

b) What is the limiting reagent? .... Ans ____________

c) Suppose you only made 1.98 g of H_2. What is your % yield?

Ans ________

---

3. **$2\ Fe_2S_3 + 3\ C \longrightarrow 4\ Fe + 3\ CS_2$**

a) How many grams of iron can be made from 119 g of Fe_2S_3 and 12.7 g C?

Ans ________

b) What is the limiting reagent? .... Ans ____________

c) After the above reaction, you produce 35.6 g of Fe. What is your % yield?

Ans ________

---

4. **$6\ CO_2 + 6\ H_2O \longrightarrow C_6H_{12}O_6 + 6\ O_2$**

a) How many grams of sugar can be made from 50.0 g of CO_2 and 50.0 g of water?

Ans ________

b) What is the limiting reagent? .... Ans ____________

c) What is the excess reagent? .... Ans ____________

BONUS How many grams of the excess reagent are leftover?

(hint- you'll need to use stoichiometry to solve this!)

Ans ________

Ans (IRO+2): *numerical ans's only...* 2.07 3 4 34.1 55.6 64.0 75.2 95.7

Units (IRO): g g g % % loaves

WS 4.5.1 Percent Composition

1. Determine (to 3 sig fig's) the % composition for **each** element in the following substances:

a) FeO		b) Na_2CO_3			c) $Mg(NO_3)_2$		
______ Fe	______ O	______ Na	______ C	______ O	______ Mg	______ N	______ O

d) C_4H_{10}		e) N_2	f) $Ti(MnO_4)_2$		
______ C	______ H	______ N	______ Ti	______ Mn	______ O

2. There are three types of iron ores in Missouri. Determine the % Fe in each.

Fe_2O_3	Fe_3O_4	FeS_2
% Fe= _______	% Fe= _______	% Fe= _______
name of ore:	name of ore:	name of ore:

IRO+**4**: 11.3 16.4 16.7 17.2 18.9 22.3 26.1 35.2
38.4 40.6 43.4 44.8 45.3 46.5 60.9 64.7 69.9 72.3 77.7 82.8 100

WS 4.5.2 Empirical Formula

1. A compound is 12.7% Al, 19.7% N, and 67.6% O. Determine its empirical formula.

Ans ____________

2. A compound is 39.6% C, 7.7% H, and the rest O. Determine its empirical formula.

Ans ____________

3. A compound is 23.3% Mg, 30.7% S, and 46.0% O by mass. Determine its empirical formula.

Ans ____________

4a. A compound is 85.7% C and 14.3% H by mass. Determine its empirical formula.

Ans ____________

4b. This substance's molecular weight is 84 g/mol. Determine the molecular formula.

Ans ____________

5a. A compound is 30.4% N, and 69.6% O by mass. Determine its empirical formula.

Ans ____________

5b. This substance's molecular weight is 92 g/mol. Determine the molecular formula.

Ans ____________

6a. A compound is 12.1% C, 16.2% O, and the rest Cl by mass. Determine its empirical formula.

Ans ____________

6b. This substance's molecular weight is 297 g/mol. Determine the molecular formula.

Ans ____________

(IRO+16) CH_2, C_2H_9, C_2H_3, C_6H_{12}, C_6H_9, Al_2NO_4, Al_3NO_3, AlN_3O_9, CH_2O_2, $C_3H_7O_3$, C_2H_5O, MgS_3O_2, $MgSO_3$, Mg_2SO_2, NO_2, NO_3, N_2O_4, N_2O_6, N_2O_5, N_2O, $COCl$, C_2OCl_2, $COCl_2$, CO_3Cl_2, $C_3O_3Cl_6$

WS 4.6 Types of Reactions

Complete the reactions by writing the products. *Remember* : when you form an element, don't forget about the 7 diatomic gases (N_2, O_2, F_2, H_2, Cl_2, Br_2, I_2) & to balance ionic formulas (drop & swap)

Composition Reactions	Decomposition Reactions	Combustion Reactions
1. $Na + Cl_2$ --->	6. MgO --->	11. $CH_4 + O_2$ --->
2. $K + O_2$ --->	7. $AlCl_3$ --->	12. $C_5H_{12} + O_2$ --->
3. $H_2 + F_2$ --->	8. H_2O --->	13. $O_2 + C_6H_6$ --->
4. $Li + N_2$ --->	9. Na_2CO_3 --->	14. $C_2H_5OH + O_2$ --->
5. $Mg + O_2$ --->	10. NF_3 --->	15. $C_{12}H_{22}O_{11} + O_2$ --->

Double Replacement Reactions	Single Replacement Reactions
16. $CaCl_2 + Al_2O_3$ --->	21. $AgCl + Mg$ --->
17. $LiCl + Pb(NO_3)_2$ --->	22. $Ca + FeF_3$ --->
18. $Na_2SO_4 + CaCl_2$ --->	23. $HCl + Al$ --->
19. $HCl + K_3PO_4$ --->	24. $KBr + F_2$ --->
20. $HBr + Ca(OH)_2$ --->	25. $Cl_2 + AlI_3$ --->

Determine the products & **identify the type of reaction** using these abbreviations in the spaces at left: (**CP**=composition, **DC**=decomposition, **SR**=single replacement, **DR**=double replacement, **CB**=combustion)

*** Don't forget to check the activity series for single replacement reactions. There will be 4 more NR's ***

___26. $Na + CaF_2$ --->

CP 27. $Na + F_2$ ---> NaF

___28. $AgF + CaCl_2$ --->

___29. $C_2H_4 + O_2$ --->

___30. CuI_2 --->

___31. $Mg + O_2$ --->

___32. $Pb + FeBr_2$ --->

___33. $C_2H_6O + O_2$ --->

___34. $CaSO_4 + MgCl_2$ --->

___35. $HCl + Zn$ --->

___36. $Ag_2(C_2O_4) + Ca$ --->

___37. $Na_3N + Ca$ --->

___38. $Mg + AlBr_3$ --->

___39. K_2S --->

___40. $CaCO_3$ --->

___41. $Ni + Al(C_2H_3O_2)_3$ --->

___42. $Al + SnCl_2$ --->

___43. $C_6H_{12} + O_2$ --->

___44. $Na + S$ --->

SR 45. $HCl + Pt$ ---> *no reaction*

___46. $Na_2SO_4 + Pb(NO_3)_2$ --->

___47. $Mg + S$ --->

___48. Na_2O --->

___49. $Cu + H_2SO_4$ --->

___50. $Zn + H_2SO_4$ --->

___51. CaO + HNO_3

___52. $Li_2SO_4 + MgI_2$ --->

___53. $C_2H_2 + O_2$ --->

___54. $Na + KCl$ --->

___55. $Mg + Cu(NO_3)_2$ --->

Li
K
Ca
Na
Mg
Al
Mn
Zn
Cr
Fe
Cd
Co
Ni
Sn
Pb
H
Cu
Hg
Ag
Pt
Au

WS 4.7.1 - Review

Balance these following chemical reactions:

1. ___ CO + ___ O_2 ---> ___ CO_2

2. ___ Al + ___ HNO_3 ---> ___ $Al(NO_3)_3$ + ___H_2

3. ___ C_4H_9OH + ___ O_2 ---> ___ CO_2 + ___H_2O

Use dimensional analysis to determine the following:

4. How many moles are in 3.98 g of $CuSO_4$?

Ans ________

5. How many molecules are in 0.1029 moles of He?

Ans ________

6. 8.4×10^{24} boron atoms weigh how many grams?

Ans ________

7. **$2\ KClO_3$ ---> $2\ KCl$ + $3\ O_2$**

How many grams of O_2 will be produced from 55.4 g of $KClO_3$?

Ans ________

8. **2 Na + Cl_2 ---> 2 NaCl**

a. Starting with 30.1 g of Na and 22.4 g of Cl_2, how many grams of NaCl can be made?

Ans ________

b. Afterwards, 17.1 grams of NaCl are produced by the reaction. What is the % yield?

Ans ________

WS 4.7.2 - Review

9a. A compound is 38.7% C, 16.1% H, and rest is N. What is its empirical formula?

Ans _____________

9b. The compound above has a molecular weight of 124 g/mol, determine its molecular formula.

Ans _____________

Use the activity series (at right) to predict whether the following reactions will occur...

If **YES**, then write the products -- If **NO**, then write 'N. R.' (no reaction)

Li
K
Ca
Na
Mg
Al
Mn
Zn
Cr
Fe
Cd
Co
Ni
Sn
Pb
H
Cu
Hg
Ag
Pt
Au

10. Al + $FeCl_2$ ---> ___________________

11. $Cu(NO_3)_2$ + Ca ---> _____________________

12. Zn + NaCl ---> ______________________

13. K + Ag_2S ---> _______________________

Predict the products:

14. $CuSO_4$ + AgCl ---> __________________

15. C_2H_6 + O_2 ---> ____________________

16. NI_3 ----> _________________________

17. In the penny lab, you used an acid called __________________ to react with a metal called _________ which was inside the penny. This ________________ replacement reaction produced two substances: __________________ gas and zinc __________________.

18. Suppose you made a Micro-Rocket with butane (C4H10) as the fuel.
What is the correct ratio of fuel to O2?

S'mores Stoichiometry Lab

Here is your "chemical reaction" (recipe) for making s'mores:

2 Gc + 3 Mm + 6 Cc ---> 1 Sm

Open your ingredients bag, and count & record the quantity of your ingredients:

# of Gc: _______ **# of Mm**: _______ **# of Cc**: _______

Now, use dimensional analysis to calculate how many S'mores (**Sm)** can be produced from each ingredient:

Graham crackers
Marshmallows
Chocolate chips

Limiting Reactant = ____________________ **Theoretical Yield =** ____________

Once Mr. A checks your calculations, you are ready to proceed with the "chemical reaction"!
After the s'mores are done baking, calculate the actual yield and % yield:

Actual Yield = ___________ **% Yield =** __________

1 Gc = 4.19 g
1 Mm = 0.56 g
1 Cc = 0.54 g

(ans bank (IRO+2): 2.0, 3.5, 8.2, 17.1, 21, 24)

While you're cooking your s'mores, use dimensional analysis to these problems:

1. How many Mm's are required to make 7 S'mores (Sm)?

2. How many Sm can be made with 29.5 g of Gc?

3. How many Sm can be made with **65.1 g Gc**, **7.20 g Mm**, and **6.48 g Cc**?

4. Suppose you had 120.0 g of Gc. How many g of Mm would you need such that you'd have no leftovers?

5. Explain why chemists would use the concept of *limiting reactant* when conducting chemical reactions, especially during *large quantity* reactions.

Evidence of a Chemical Change lab

Name: ______________________

Purpose: One way of knowing that a chemical change has occurred is to observe that the properties of the products differ than those of the reactants. In this activity you will observe a sequence of changes that occur when a solution is treated with a series of different reactants. All of the reactions will take place in the same test tube. At each step, you will look for evidence that a new substance is formed as a result of a chemical change.

Procedure & Observations:

1. Add 25 drops of copper (II) nitrate to the test tube. Record what you see below:

2. Add 25 drops of sodium hydroxide to the test tube. Mix the solutions using the "knocking" method. Look in the test tube for a change in phase (state of matter). Record detailed observations below:

3. Place test tube in hot water bath until mixture turns dark (a few minutes). Record observations below:

4. Remove test tube from hot water bath. Add 25 drops of HCl to the test tube. Mix **thoroughly** using the knocking method. The solution should eventually turn clear. Record observations below:

5. Place a piece of Mg in the test tube. Leave it until the reaction for 2 minutes. Record observations below:

6. Place 2 drops of $AgNO_3$ (silver nitrate) in the test tube. Record observations below:

Clean-Up: Pour solution down sink. Refill pipets if necessary.

Balancing Equations: Write formulas & **balance** the following reactions you did in the lab...

rxn #2: copper (II) nitrate + sodium hydroxide were reactants in a ***double replacement*** reaction:

rxn #3: copper (II) hydroxide + heat ---> water + copper (II) oxide:

rxn #4: copper (II) oxide + hydrochloric acid were reactants in a ***double replacement*** reaction:

rxn #5a: copper (II) chloride + magnesium were reactants in a ***single replacement*** reaction:

rxn #5b: hydrochloric acid + magnesium were reactants in a ***single replacement*** reaction:

rxn #6: excess hydrochloric acid + silver nitrate were reactants in a ***double replacement*** reaction:

Penny Lab (2 days) Name ____________________ partner ___________________

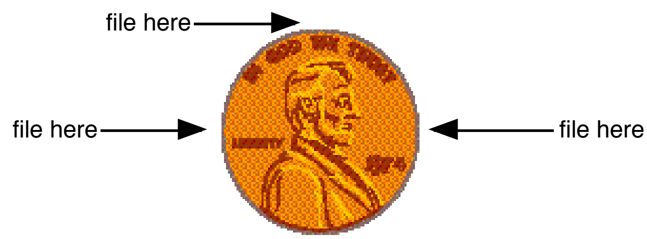
The familiar Lincoln penny has been made of 95% copper from 1909 - 1982. However, the price of copper had risen so much that the U.S. Treasury needed to change (no pun intended) (okay maybe it was intended) the composition of the penny. As of 1982, pennies have been made of mostly zinc, with a thin copper layer on the outside. In this lab, you will determine the % zinc and % copper in a penny. To do this, you will take advantage of the activity series of metals, and perform a single replacement reaction on the penny.

Procedure

1. Obtain a clean, unscratched penny (post-1982, the cleaner the better). You and your lab partner will each need different years so you can tell them apart! Record the years in the data table.
2. Using a file, carefully scratch the edge of your penny in 3 places, until the zinc core is showing.
3. Weigh each penny. Record the mass.
4. Place each penny in a beaker with ca. 30 mL of HCl. Cover. Label the beaker with your names. *(Notice the bubbling around the filed area?)* Set beaker aside in designated area.

-- Day Two --

5. Decant (pour out) HCl and rinse penny w/ water. *Carefully* remove penny & dry w/ paper towel.
6. Once dry, weigh copper shell and record mass.



Calculations / Questions

1. You should have seen bubbles forming near where you filed the penny. What gas was being formed here?

2. Which metal (Cu or Zn) is undergoing a chemical reaction?

3. Which metal (Cu or Zn) is NOT reacting?

4. Which one of the 5 types of chemical reactions is happening here?

	Penny # 1	Penny # 2
Penny Year:		
Initial Mass (whole penny)		
Final Mass (hollow penny)		
Mass Lost (this is the amount of zinc)		
% zinc in penny		

5. The actual % Zn in pennies is 97.6%. Calculate % error: (actual - experimental) ÷ actual x 100

6. Write the **complete, balanced** equation for the chemical reaction you did:

7. Assuming the average penny contains 2.50 g zinc, how much HCl is required to react the all of the zinc, without leaving any EXCESS HCl?

8. Given an unlimted quantity of pennies, how many grams of hydrogen gas can be produced from 45.0 grams of HCl?

Baking Soda Stoichiometry Lab Name: ____________________ Partner: ____________________

In this lab, you will combine your powers of observation, reasoning, equation balancing, and knowledge of stoichiometric calculations to earn a perfect 10 / 10 (hopefully).

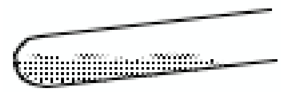
Data Table	

Procedure:

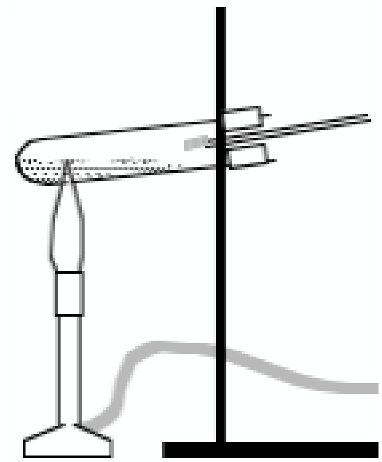
1. Obtain a large Pyrex test tube & weigh it on one of the scales in the front of the room. Record this mass in the table at right. Pyrex is a kind of glass that can be subjected to very high (and low) temperatures without shattering.

2. Go back to your lab station & place one large scoop of baking soda ($NaHCO_3$) into the test tube. Then, using the same scale as before, weigh the test tube with the baking soda. Record this mass in the data table. (You should be able to figure out the mass of the baking soda in the test tube.)

3. Holding the test tube nearly horizontal, shake the baking soda gently so that it spreads out a bit as shown:



4. Then tighten the test tube clamp gently around the test tube, just below the lip so that it is positioned nearly horizontally, about 20 cm above the lab desk as shown:



5. Light a burner and adjust it to a cool flame (vent closed) hitting the bottom half of the test tube as shown: Record the time you started heating: _______________
This will initiate a chemical change (a sort of decomposition reaction) that breaks the $NaHCO_3$ down... not into its elements, but into **three separate compounds**.

6. Put one drop of the green indicator solution on the end of the small swab. Then carefully insert this end into the mouth of the test tube as shown: See if you can observe a distinct color change. If a metal oxide like K_2O, Na_2O, or MgO is being produced, it will create a basic (alkaline) solution and turn the indicator blue. If a nonmetal oxide like NO_2, SO_3, or CO_2 is being produced, it will create an acidic solution & turn the indicator yellowish. What color does it become? _______
So, is the reaction producing a metal or nonmetal oxide? __________ Look at the chemical formula of the substance you are heating: $NaHCO_3$. So, what common oxide is being produced in the test tube? [ ]

7. What do you observe happening in the upper half of the test tube? ________________________________

What common substance appears to be a second product of this reaction? [ ]

8. Move the burner occasionally to a different spot to ensure a **thorough heating** of the **entire** bottom half of the test tube. Consider the substance that is left in the test tube... it may look just like the baking soda you started with, but it actually has been converted into something else: sodium carbonate. This is the third product. What is the correct formula for sodium carbonate? [ ] *(hint: look at your ion sheet & remember to balance charges)*

Now go down and answer questions 1-4 below, but keep an eye on the time. After you have been heating the test tube for 8~10 minutes, turn off the burner and let the test tube cool for 5~6 minutes, unless the inside walls still have moisture. If so, continue heating for a few more minutes to drive out the moisture before cooling.

Questions:

1. You should have figured out from steps #6, 7, 8 above what the three products are. Write the unbalanced chemical

equation for the reaction that just took place: ____

Check it with the teacher to make sure you have it right, then go back & balance it. (Hint: it's very easy w/ small #'s)

2. Look back at your data table above. What mass of the $NaHCO_3$ did you start with in the test tube? ____________

3. Starting with that mass of $NaHCO_3$, use stoichiometry & the balanced equation to figure out what mass of sodium carbonate you should have ended up with in the test tube. **Show work using dimensional analysis below:**

4. So... assuming all the baking soda you started with got converted into sodium carbonate, what should the test tube & its contents weigh now? [ ]

This is your official prediction. Make sure it is correct. Your grade depends on it!

If your prediction is within...	then your grade will be...
0.03 g	10 / 10
0.10 g	9 / 10
0.20 g	8 / 10
0.30 g	7 / 10
0.50 g	6 / 10
1.00 g	5 / 10
5.00 g	4 / 10
10.00 g	3 / 10
20.00 g	2 / 10
50.00 g	1 / 10
otherwise you get a 0/10	

If your test tube has been cooling for 5~6 minutes, it is ready for the official weigh-in! Bring the test tube, along with this sheet containing your prediction above, up to the balances. *Your teacher* will weigh it on the same scale you used, but not show you the weight. They will tell you your grade based on how close your prediction was to the actual weight (see table at right). If you are satisfied with your grade, congratulations! You are done. If you are not satisfied, you can go back, correct your mistake and change your prediction for a 2nd attempt. The 2nd attempt will cost you 1 point, and you may end up with a lower score. So, only try the 2nd attempt if you are fairly sure you can correct any mistake you may have made the first time.

5. Observe the substance that remains left behind in the test tube; compare it to the sealed tube of $NaHCO_3$ at your lab station. Do you notice any slight difference between the two?
____

After you have finished all of the above, rinse out the test tube into the sink, then place it in the "used" bin at the back of the lab near the sink. Take a fresh (dry) test tube and place it in the clamp for the next group.

Follow-Up Questions:

6. If you hadn't heated up the test tube long enough, would that make your prediction too high, too low, or no effect?

Explain: ____

7. CO_2 is more dense than air. So why did the CO_2 you produced from the reaction rise upwards out of the opening

of the test tube? ____

8. Why did the water only condense on the upper half of the test tube? ______________________________

9. Using your original mass of baking soda ($NaHCO_3$) from question 2, calculate the mass of H_2O that was produced:
(show work):

10. Using your original mass of baking soda ($NaHCO_3$) from question 2, calculate the mass of CO_2 that was produced:
(show work):

11. Add the two masses from #9 and #10 above along with the calculated mass of sodium carbonate produced from

question #3: **#9** ___________ **+** **#10** ___________ **+** **#3** ___________ **=**

What total mass of products does this give? ________________

12. How does this mass (#11) compare with the initial mass of $NaHCO_3$ you put in the test tube??

13. If a person accidentally leaves a pan of oil on the stove, it might get so hot it will ignite. This is known as a grease fire. Pouring water on a grease fire is a bad idea, because the water (being more dense than the grease) will sink in the oil, expand rapidly in the heat, and splatter the grease thus spreading the fire. Pouring baking soda on a grease fire is a much better idea. Why?

14. Chemical reactions can be categorized as either ***exothermic*** (heat is given off by the reaction) or ***endothermic*** (heat is taken in by the reaction). What type of reaction is the decomposition of $NaHCO_3$? ____________________

How do you know this?