Chem 108: Lab

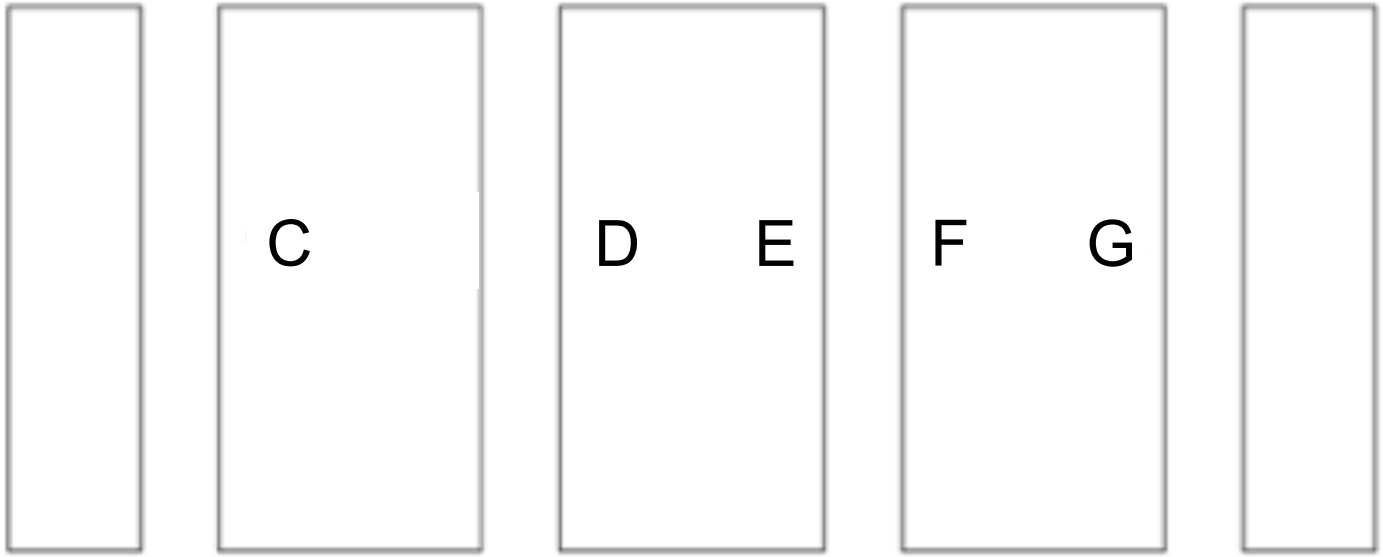
Week 8

Experiment:

What's My Formula? II

Sign in; Sit with Group.

Front of Lab



Work with the reorganized groups from last week's lab.

Chem 108: Lab

Week 8

Experiment:

What's My Formula? II

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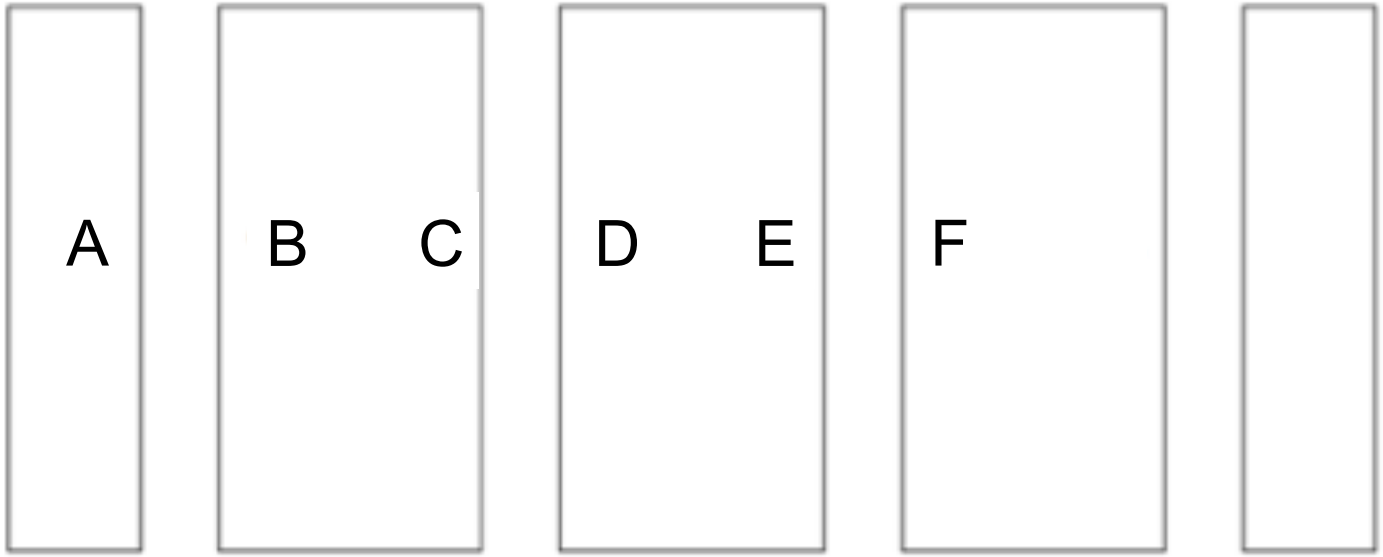
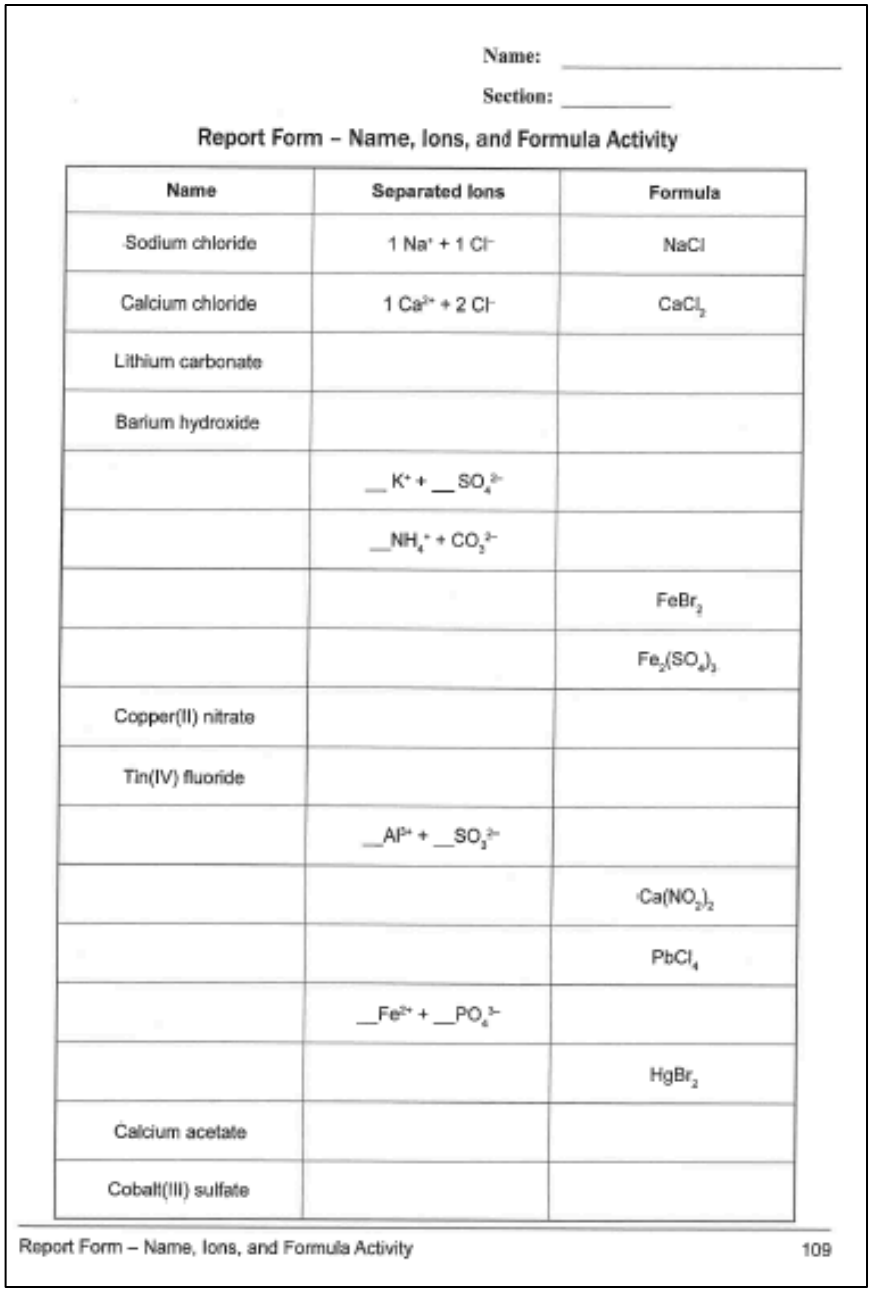


Work with the reorganized groups from last week's lab.

DUE Today

Names, Ions, Formulas

Complete Report Form
pp. 109-114
1 form per Individual or
1 per group:
With names of only those
who contributed on
the form.



Name: _____

Section: _____

Report Form – Name, Ions, and Formula Activity

Name	Separated Ions	Formula
Sodium chloride	1 Na^+ + 1 Cl^-	NaCl
Calcium chloride	1 Ca^{2+} + 2 Cl^-	$CaCl_2$
Lithium carbonate		
Barium hydroxide		
	__ K^+ + __ SO_4^{2-}	
	__ NH_4^+ + CO_3^{2-}	
		$FeBr_2$
		$Fe_2(SO_4)_3$
Copper(II) nitrate		
Tin(IV) fluoride		
	__ Al^{3+} + __ SO_3^{2-}	
		$Ca(NO_2)_2$
		$PbCl_4$
	__ Fe^{2+} + __ PO_4^{3-}	
		$HgBr_2$
Calcium acetate		
Cobalt(III) sulfate		

Report Form – Name, Ions, and Formula Activity 109

Bonds: Molecular Shapes: Molecular Modeling

Chem 108 / Dr. Rusay

Names: _____

Molecular Modeling Report Form

These pages replace the Molecular Model Lab, pp. 97-103, of the Chemistry 108 Experiments Lab Manual. Complete the following modeling related exercises and include the names of all group members, who contributed to the work, on the form.

The first column lists formulas for a number of compounds. The bonding type is to be determined for these compounds using differences in their respective electronegativity values (refer to the in class information). The second column is for the electronegativity difference, the absolute value of the difference in electronegativity between the 2 different atoms in the compound, $|EN_2 - EN_1|$. The third column is for the average electronegativity of the two atoms, $(EN_1 + EN_2)/2$.

Compound	**$\lvert EN_1 - EN_2 \rvert$**	**$\frac{EN_1 + EN_2}{2}$**	**Bonding Type**
HF			
HCl			
HBr			
HI			
CsF			
NaF			
CaO			
BaO			
NH_3			
CH_4			
CCl_4			
H_2O			
N_2O			
SO_2			
H_2			
O_2			

http://molview.org

Have completed first & second pages checked Before leaving lab

What's My Formula? Identificaton

Unknowns

$BaCl_2 \cdot 2H_2O$

$$BaCl_2 \cdot 2\,H_2O(s) \rightarrow BaCl_2\,(s) + 2\,H_2O(g)$$

Unknown Sample — Salt

85.26%

$CaSO_4 \cdot 2H_2O$

$$CaSO_4 \cdot 2\,H_2O(s) \rightarrow CaSO_4\,(s) + 2\,H_2O(g)$$

Unknown Sample — Salt

79.09%

$NaHCO_3$

$$2\,NaHCO_3(s) \rightarrow Na_2CO_3(s) + H_2O(g) + CO_2(g)$$

63.08%

Unknown Sample — Salt

$KHCO_3$

$$2\,KHCO_3(s) \rightarrow K_2CO_3(s) + H_2O(g) + CO_2(g)$$

69.02%

Unknown Sample — Salt

Experimental Calculation:

% Salt = (*Mass sample - Mass after heating*) / *Mass sample* x 100

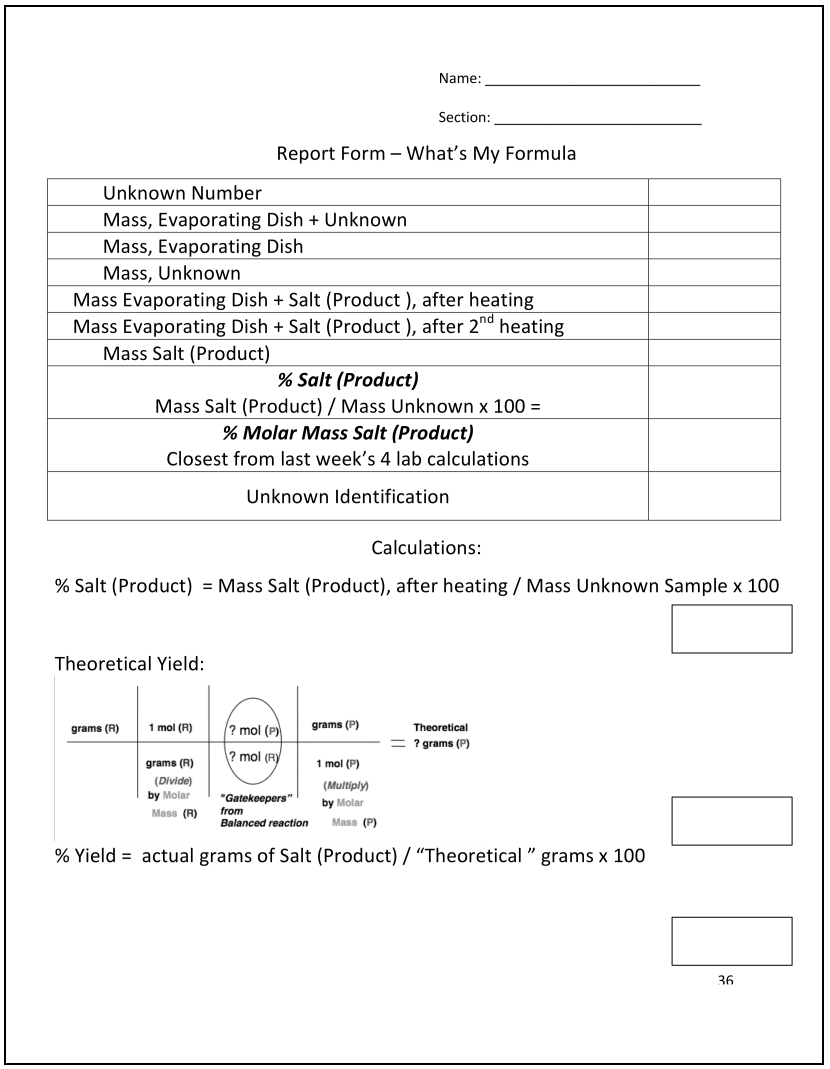
Comparison to Calculation(s) for a, b, c, d FROM last week:

% Salt = ?*Molar Mass Salt* / ?*Molar Mass Unknown Sample* x 100

What's My Formula?

Your group obtained 2 to 5 unknowns. Complete the experimental procedures and submit one complete report form for each unknown with partner's names on the data form page & a complete set of calculations for each unknown with % Yield & Theoretical Yield Calculations (replacements for pg. 36)

Complete Report Forms DUE Today



Name: _____

Section: _____

Report Form – What's My Formula

Unknown Number	
Mass, Evaporating Dish + Unknown	
Mass, Evaporating Dish	
Mass, Unknown	
Mass Evaporating Dish + Salt (Product), after heating	
Mass Evaporating Dish + Salt (Product), after 2nd heating	
Mass Salt (Product)	
% Salt (Product) Mass Salt (Product) / Mass Unknown x 100 =	
% Molar Mass Salt (Product) Closest from last week's 4 lab calculations	
Unknown Identification	

Calculations:

% Salt (Product) = Mass Salt (Product), after heating / Mass Unknown Sample x 100

Theoretical Yield:

grams (R) | 1 mol (R) | ? mol (P) / ? mol (R) | grams (P) | 1 mol (P) = Theoretical ? grams (P)

grams (R) (*Divide*) by Molar Mass (R)

"*Gatekeepers*" *from Balanced reaction*

(*Multiply*) by Molar Mass (P)

% Yield = actual grams of Salt (Product) / "Theoretical " grams x 100

36

Theoretical Mass Calculations for any Reaction

Reactants ⟷ Products

grams (Reactant) → **grams (Product)**

Moles

Molar Mass

grams (R) | **1 mol (R)** | ? mol (P) / ? mol (R) | **grams (P)** = **? grams (P)**

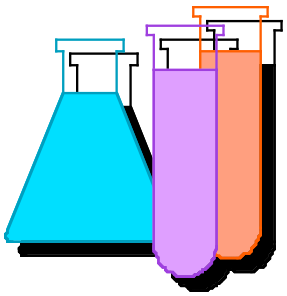
grams (R)

(*Divide*) by Molar Mass (R)

"*Gatekeepers*" *from Balanced reaction*

1 mol (P)

(*Multiply*) by Molar Mass (P)



What's My Formula?
% Yield (Example)

Heating 10.00 g of an unknown determined to be sodium bicarbonate and actually obtaining 5.98 g of sodium carbonate. What is the Percent Yield?

First calculate the **theoretical yield**. *(Adaptation of your calculations last week.)*
It considers in the calculation that everything went perfectly, and is based on the assumption of 100% accuracy. *% Yield is actual; based on reality.*

$$2\ NaHCO_3(s) \longrightarrow Na_2CO_3(s) + H_2O(g) + CO_2(g)$$

Reactant = 10.00 g
Molar Mass = 84.00 g/mol

Product = ? g (Theoretical)
Molar Mass = 105.99 g/mol

$$2\ mol\ NaHCO_3(s) : 1\ mol\ Na_2CO_3(s)$$

Theoretical Mass Calculations
Reactants ⟷ Products

Moles

grams (Reactant) ⟶ **grams (Product)**

Molar Mass

"Mole Gatekeepers" from Balanced reaction

10.00 grams ($NaHCO_3$)

1 mol ($NaHCO_3$)

? mol (Na_2CO_3)

? mol ($NaHCO_3$)

105.99 grams (Na_2CO_3)

84.00 grams ($NaHCO_3$)

1 mol (Na_2CO_3)

= **? Theoretical grams (Na_2CO_3)**

(*Divide*) by Molar Mass ($NaHCO_3$)

(*Multiply*) by Molar Mass (Na_2CO_3)

$$2\ NaHCO_3(s) \longrightarrow Na_2CO_3(s) + H_2O(g) + CO_2(g)$$

Theoretical Mass Calculations
Reactants ⟷ Products

$$2\ NaHCO_3(s) \longrightarrow Na_2CO_3(s) + H_2O(g) + CO_2(g)$$

"Mole Gatekeepers" from Balanced reaction

10.00 grams ($NaHCO_3$)

1 mol ($NaHCO_3$)

84.00 grams ($NaHCO_3$)

1 mol (Na_2CO_3)

2 mol ($NaHCO_3$)

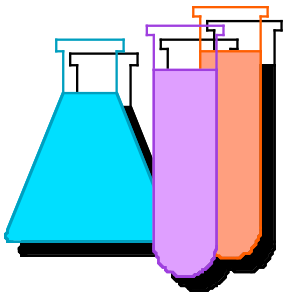
105.99 grams (Na_2CO_3)

1 mol (Na_2CO_3)

= **6.31 grams (Na_2CO_3)**

(***Divide***) by Molar Mass ($NaHCO_3$)

(***Multiply***) by Molar Mass (Na_2CO_3)



What's My Formula?

"% Yield" is used to measure the efficiency (similar to "accuracy") of any reaction in yielding "product(s)" (on the right of an equation) versus the calculated (theoretical) amount of the product based on the amount of "reactant(s)" (from the left of the equation) using the relative number of moles of each in a balanced chemical equation.

% Yield =
actual grams of product / theoretical (calculated) grams of product
x 100

For example, heating 10.00 g of sodium bicarbonate and actually obtaining 5.98 g of sodium carbonate. After calculating the theoretical yield:

$$2\ NaHCO_3(s) \longrightarrow Na_2CO_3(s) + H_2O(g) + CO_2(g)$$

$$2\ mol\ NaHCO_3(s) : 1\ mol\ Na_2CO_3(s)$$

Reactant = 10.00 g
Molar Mass = 84.00 g/mol

Product = 6.31 g (Theoretical)
Molar Mass = 105.99 g/mol

% Yield = 5.98 g (actual) / 6.31g (theoretical) x 100
= 94.6%

QUESTION

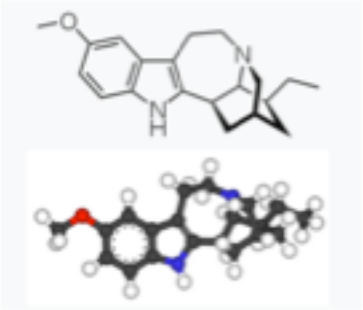
- A synthetic reaction produced 2.45g of Ibogaine, $C_{20}H_{26}N_2O$, a natural product with strong promise in treating heroin addiction, the calculated theoretical yield was 3.05g, what is the % yield?

A) 19.7% B) 39.4% C) 80.3% D) 160.6%

$C_{20}H_{26}N_2O$

(Ibogaine)

Tabernanthe iboga



ANSWER

- If a reaction produced 2.45g of Ibogaine, $C_{20}H_{26}N_2O$, a natural product with strong promise in treating heroin addiction, and the theoretical yield was 3.05g, what is the % yield?

A) 19.7% B) 39.4% C) 80.3% D) 160.6%

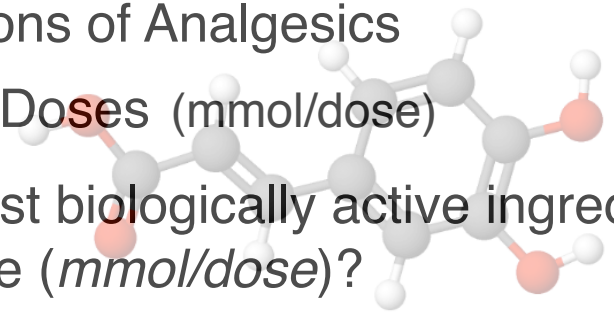
% yield = 2.45g / 3.05g x 100

= 80.3%

Post Lab: Compounds with the Same Formula [eg. $C_9H_8O_4$]

Molar Comparisons of Analgesics

Calculate Moles : Doses (mmol/dose)



Which analgesic has the most biologically active ingredient based on millimoles per dose (*mmol/dose*)?

5.0 g of the active ingredient would produce the following number of doses:

	Formula	*Doses*	*mmol/dose*
Aspirin	$C_9H_8O_4$	15.0	*1.8 mmol/dose*
Ibuprofen	$C_{13}H_{18}O_2$	25.0	?
Naproxen Sodium	$C_{14}H_{13}O_3Na$	22.7	?
Acetaminophen	$C_8H_9NO_2$	5.0	?

Molar Mass Aspirin = 180.1 g/mol

5.0 g */ 180.1 g/mol = 0.028 mol/*15 doses *= 1.8 mmol/dose*

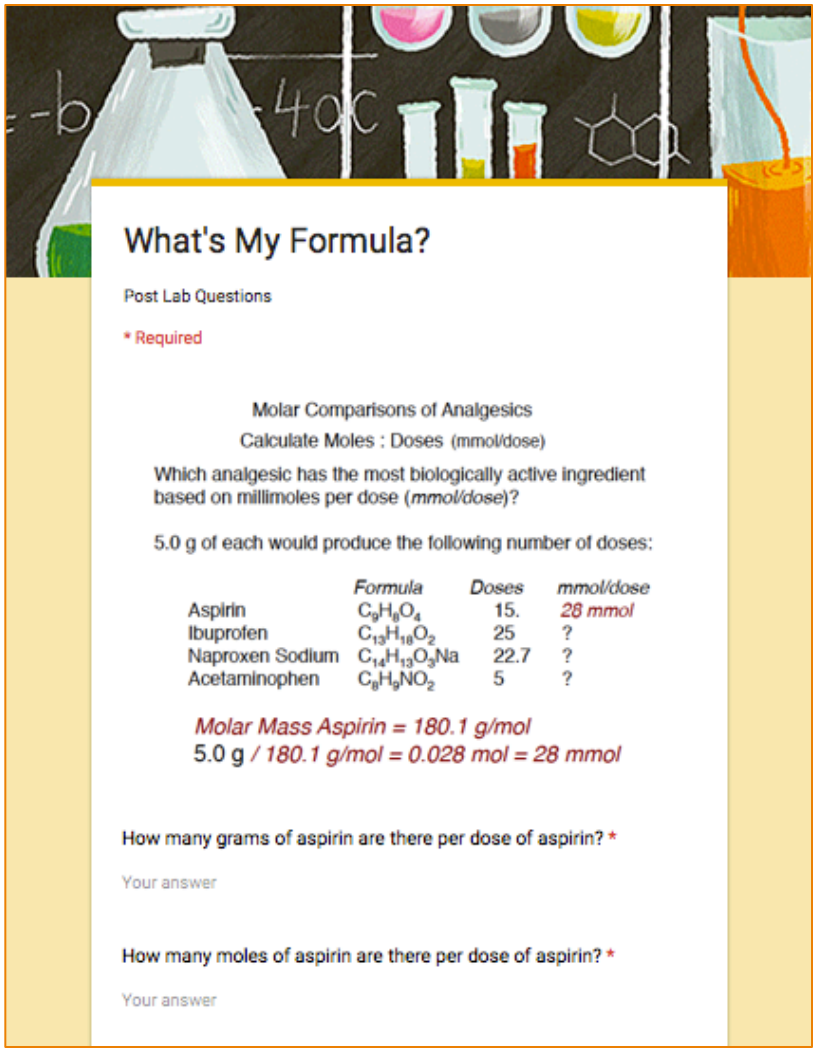
Molar Comparisons of Analgesics

Calculate Moles : Doses (mmol/dose)

Post Lab:

Must submit Individually
From calendar link

DUE
Today



What's My Formula?

Post Lab Questions

* Required

Molar Comparisons of Analgesics

Calculate Moles : Doses (mmol/dose)

Which analgesic has the most biologically active ingredient based on millimoles per dose (*mmol/dose*)?

5.0 g of each would produce the following number of doses:

	Formula	*Doses*	*mmol/dose*
Aspirin	$C_9H_8O_4$	15.	*28 mmol*
Ibuprofen	$C_{13}H_{18}O_2$	25	?
Naproxen Sodium	$C_{14}H_{13}O_3Na$	22.7	?
Acetaminophen	$C_8H_9NO_2$	5	?

Molar Mass Aspirin = 180.1 g/mol
5.0 g */ 180.1 g/mol = 0.028 mol = 28 mmol*

How many grams of aspirin are there per dose of aspirin? *

Your answer

How many moles of aspirin are there per dose of aspirin? *

Your answer