CHEM 200/202

Professor Theresa Carlson
Office: GMCS-213B

All emails are to be sent to:
chem200@sdsu.edu

My office hours will be held on zoom via MSLC on **Mondays & Wednesday from 8:00 am to 10:00 am** or by appointment

HOW THE CLASS WILL WORK

Email (for all needs): *chem200@sdsu.edu*
Website: https://sdsuchem200.sdsu.edu/ (Website is meant for waitlisters and has everything except: grades and Turnitin. For the previous two items please find on Canvas when you are enrolled. **The CHEM 200 Website will close after Exam 1**)

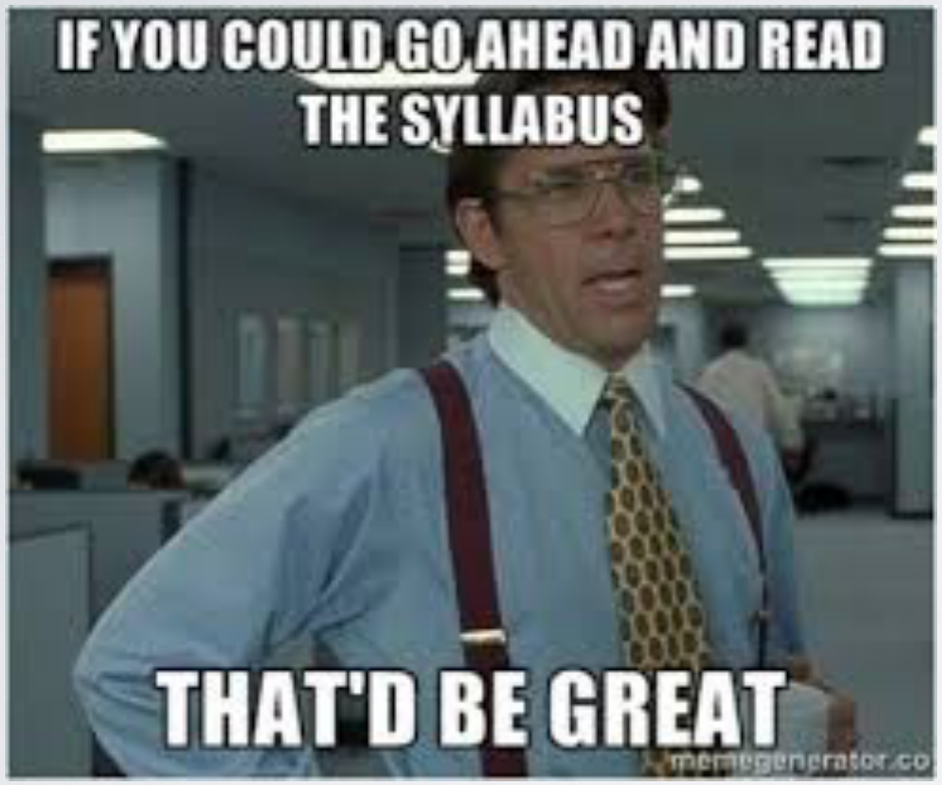
Instructor: Prof. Theresa Carlson, M.A.
Lecture: 12:00 PM – 12:50 PM MWF in HT-140
Help Room (Zoom): 8:00 AM - 10:00 AM Mondays & Wednesdays **Zoom *via* https://mlc.sdsu.edu/**

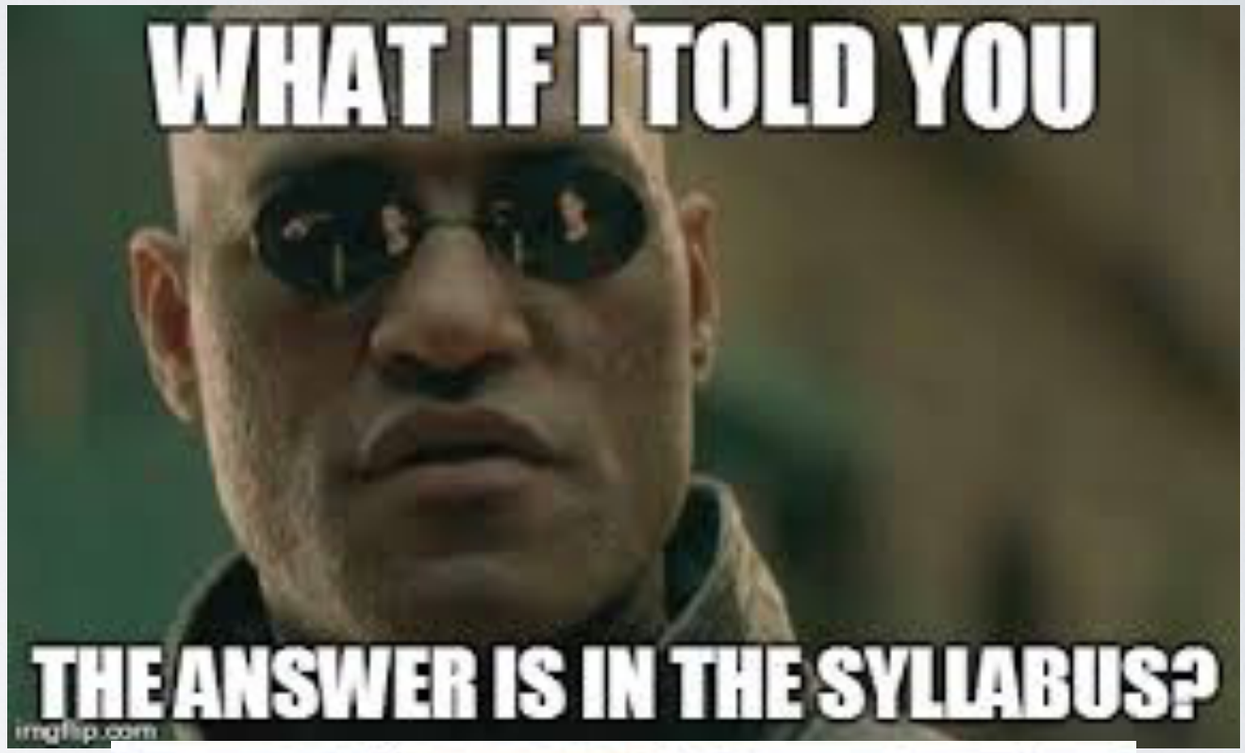
Lab Coordinator: Megan Bowles, M.A.
Help Room (Zoom): 9:00 AM - 11:00 AM Tuesdays **Zoom *via* https://mlc.sdsu.edu/**

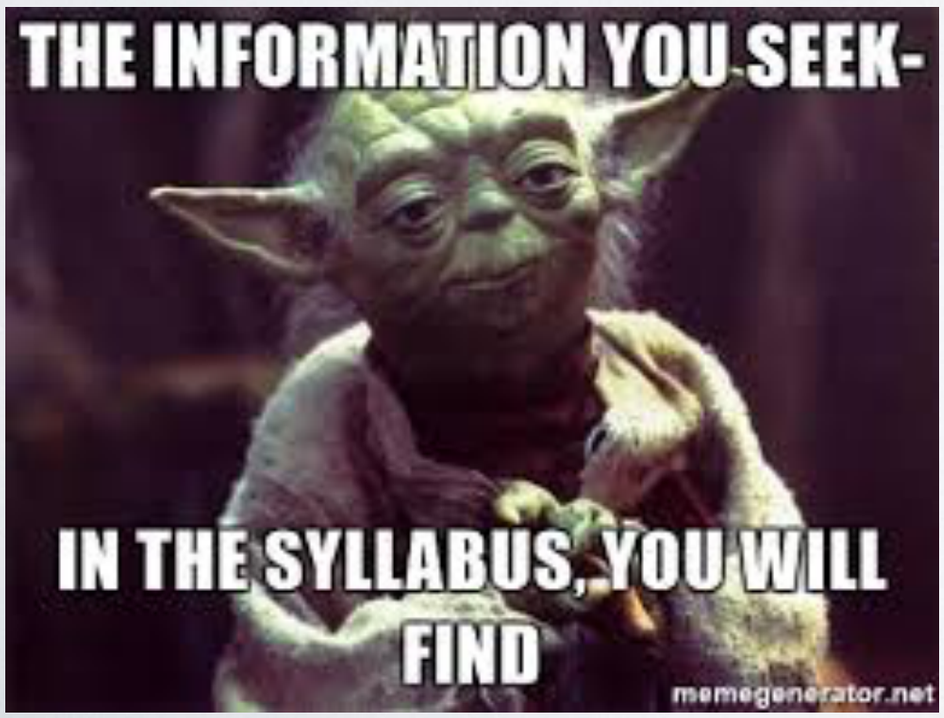
Mode of Instruction: Face-to-Face. Lectures will be recorded using Course Capture/Mediasite and available on Canvas. Attendance is strongly encouraged. There will be 40 points out of 43 points for lecture participation. Labs sessions are in-person as well.

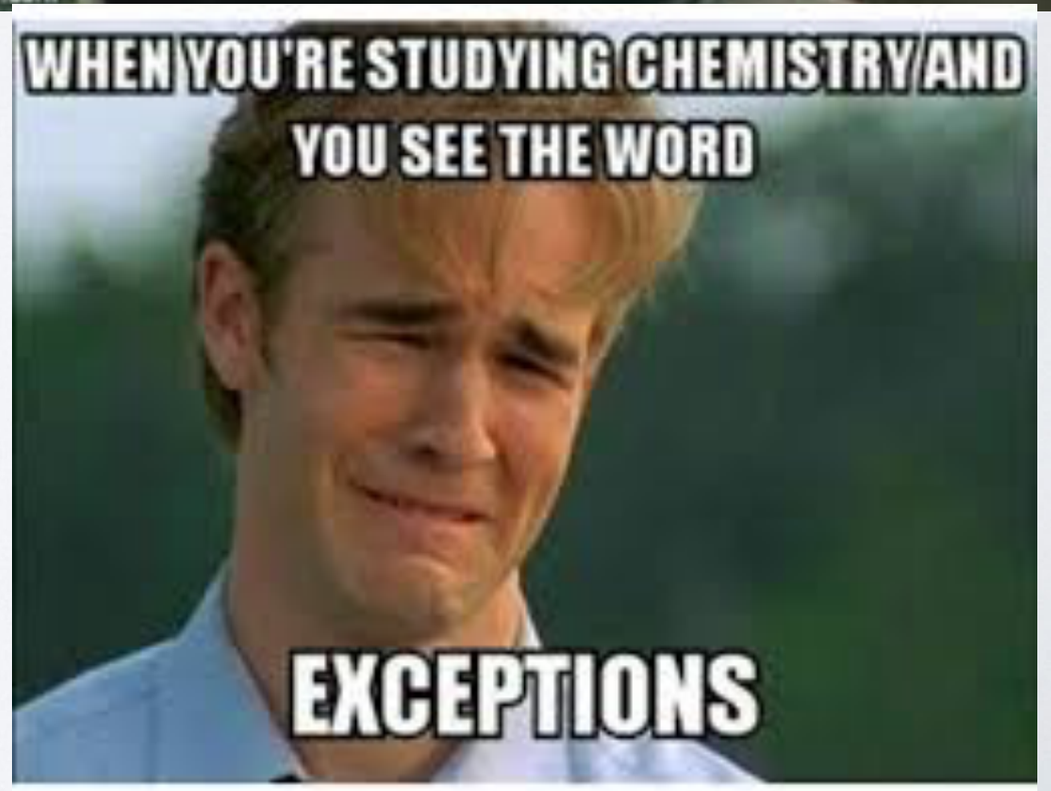
Exams will take place online via OWL.

PLEASE READ THE SYLLABUS









IMPORTANT ANNOUNCEMENTS

1. Email chem200@sdsu.edu ONLY unless its regarding lab or discussion which then you need to email your respective TA.

2. Follow the directions in adding OWL that Theresa provided you in Module 1.0 > Adding OWL (READ). She made a video and has a pdf file with directions.

3. **There is no course key for OWL.**

4. **Read the announcements and emails that Theresa, Megan, or your TAs sends out.**

5. Again read the syllabus. A lot of questions are being asked that are in the syllabus. For example, emailing when the lab will be and what will take place can be answered by the syllabus. In the syllabus there is a lab schedule, read, use it, and print it out.

6. And for good measure read the announcements before sending out emails. The majority (98%) of questions can be answered by: the syllabus, videos Theresa has made, and in the announcements.

UPCOMING IMPORTANT DATES

- Safety Quiz due **Friday, February 3rd at 11:59 pm** (in OWL Lab & Canvas), *must pass with >60% to do in-person labs*

- How to write a lab notebook and prelab due **Sunday, February 5th at 11:59 pm**

- Volumetric Prelab due **Sunday, February 5th at 11:59 pm**

- Volumetric Lab Report due **Sunday, February 12th at 11:59 pm**

- Chapter 1-4 Chapter Problem Sets in OWL Lecture due **Thursday, February 9th at 11:59 pm** (**Start Now)**

- Chapter 1-4 Chapter Assessments in OWL Lecture is **Thursday, February 9th at 11:59 pm** (**Start Now**); 2 chances, no time limit

- Exam 1 starts at **3 pm Friday, February 10th and will close on Saturday, February 11th at 3pm** in OWL Lecture; Chapters 1-4. You have 24hrs. *Only 2 hrs once you start; be sure to give yourself a full 2 hr time slot.*

SUPPLEMENTAL INSTRUCTION (SI)

- Study sessions lead by former CHEM 200/202 students that excelled in the previous semesters class.
- Occur 15+ times a week.
- Free to access, no reporting to faculty.

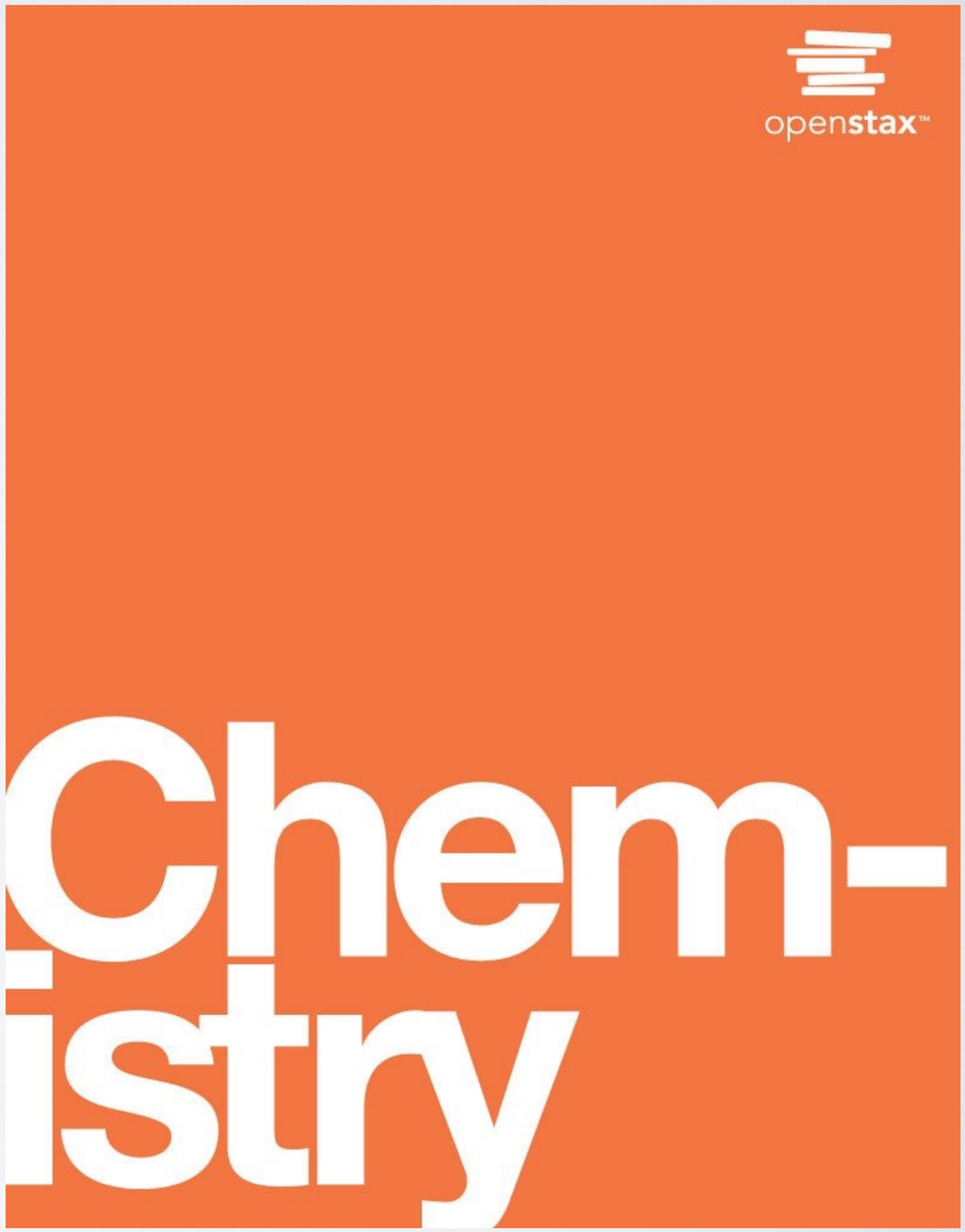
THE MATH AND SCIENCE LEARNING CENTER (MSLC)

Students are encouraged to make use of The Mathematics and Statistics Learning Center (MSLC) for free STEM tutoring, located in the Love Library, Room 328. For a full list of courses tutored, please visit the MSLC website: https://mlc.sdsu.edu/ .

The MSLC is supported by your student success fee. We strongly encourage you to use this wonderful, free resource. Some students believe that they shouldn't need to ask for help, but research has shown that the average grade for students who attend the MLC is almost one full grade higher than those who don't seek such support.

TEXTBOOK

- **Openstax Chemistry**
- **PDF is Free!***
- **Redshelf (in Canvas) is an interactive ebook for FREE!**
- Free for Kindle
- Available from iBooks ($4.99)



IONIC OR COVALENT

NF_3

BaO

$(NH_4)_2CO_3$

$Sr(H_2PO_4)_2$

IBr

Na_2O

QUESTION

Which is the correct molecular formula for manganese(II) nitrate?

1. Mg_2NO_3 Impossible compound
2. Mn_2NO_3 Impossible compound
3. Mg_3N_2 Magnesium nitride
4. $Mn(NO_3)_2$ Manganese(II) nitrate
5. Mn_3N_2 Manganese(II) nitride
6. $Mn(NO_2)_2$ Manganese(II) nitrite

WRITE MOLECULAR FORMULAS

Rubidium Bromide

Magnesium Selenide

Sodium Oxide

Calcium Chloride

Hydrogen Fluoride

Gallium Phosphide

Aluminum Bromide

Ammonium Sulfate

NAME EACH IONIC COMPOUND

$Ca(H_2PO_4)_2$

$FeSO_4$

$CaCO_3$

MgO

$NaNO_2$

KI

CHAPTER 3

Composition of Substances and Solutions

CALCULATE THE FORMULA MASS, NUMBER OF MOLES OF COMPOUND AND EACH ATOM

0.1488 g of H_3PO_4

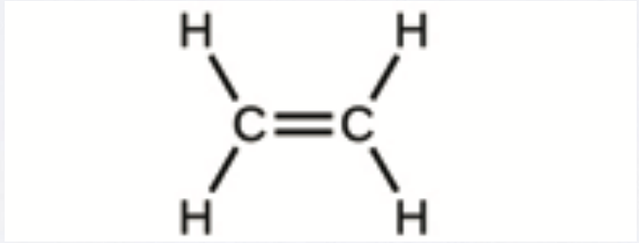
78.452 g of $Al_2(SO_4)_3$

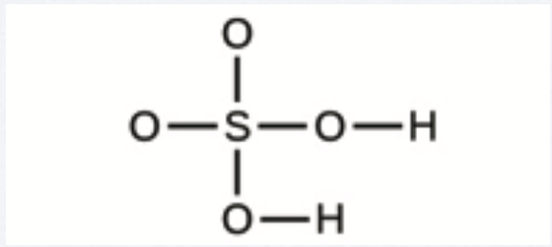
2.12 g of KBr

MOLECULAR VS. EMPIRICAL FORMULA

- **The molecular formula** is the actual number of atoms of each type in a molecule.
  - Water: H_2O
  - Hydrogen peroxide: H_2O_2
  - Glucose: $C_6H_{12}O_6$
- **The empirical formula** is the smallest whole number ratio of all atoms in an atom.
  - Water: H_2O
  - Hydrogen peroxide: HO
  - Glucose: CH_2O

WRITE THE MOLECULAR & EMPIRICAL FORMULAS





DETERMINING THE MOLECULAR FORMULA FROM THE EMPIRICAL FORMULA

- In order to calculate the molecular formula from the empirical formula we need more information about the compound. Typically this will involve the formula mass of the compound.

- Example:

  - Nicotine contains 74.02% C, 8.710% H and 17.27% N. A 40.57 g mass of nicotine contains 0.2500 mol. What is the molecular formula?

Use the References to access important values if needed for this question.

A compound is found to contain **31.42** % **sulfur** , **31.35** % **oxygen** , and **37.23** % **fluorine** by mass.

To answer the question, enter the elements in the order presented above.

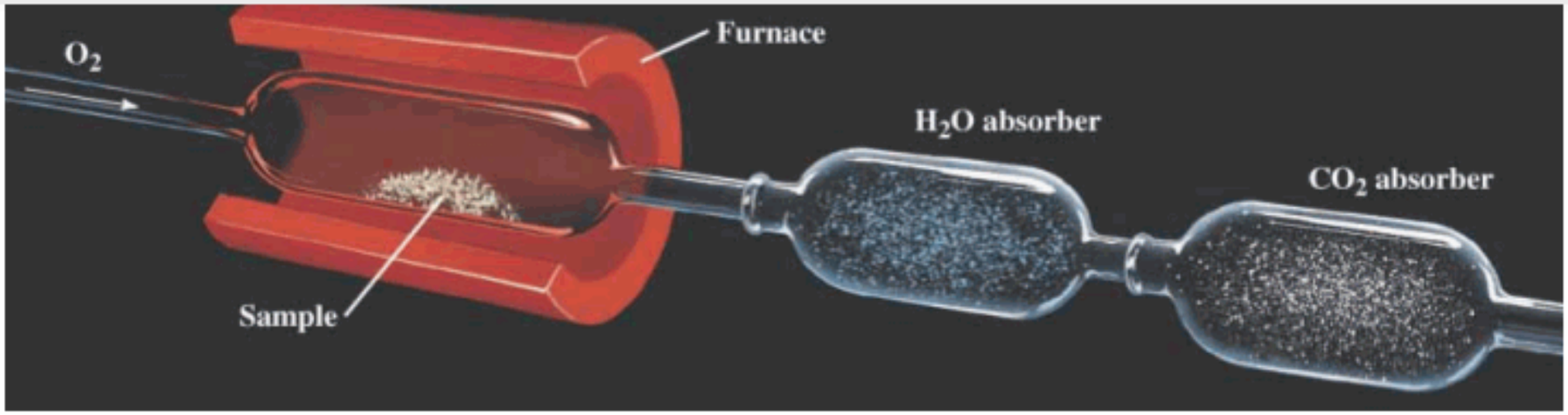
QUESTION 1:

The empirical formula for this compound is [ ] .

QUESTION 2:

The molar mass for this compound is **102.1** g/mol.

The molecular formula for this compound is [ ] .



A **3.270** gram sample of an organic compound containing C, H and O is analyzed by combustion analysis and **4.793** grams of CO_2 and **1.962** grams of H_2O are produced.

In a separate experiment, the molar mass is found to be **60.05** g/mol. Determine the empirical formula and the molecular formula of the organic compound.

Enter the elements in the order C, H, O

empirical formula =

molecular formula =

MOLARITY

- **Molarity** is the most common measurement of concentration used in chemistry.

- Molarity is the measure of the number of moles of a **solute** per liter **solution**

- Molarity is expressed as **mol/L** or **M**.

- Molarity can also be expressed with **prefixes**:

  - $2\ mM = 2\times10^{-3}M;\ 3.4\ \mu M = 3.4\times10^{-6}M;\ 7.8\ nM = 7.8\times10^{-9}M$

CONCENTRATION CALCULATIONS

How many moles of hydrogen chloride are in 0.0365 L of a 2.00 M HCl solution?

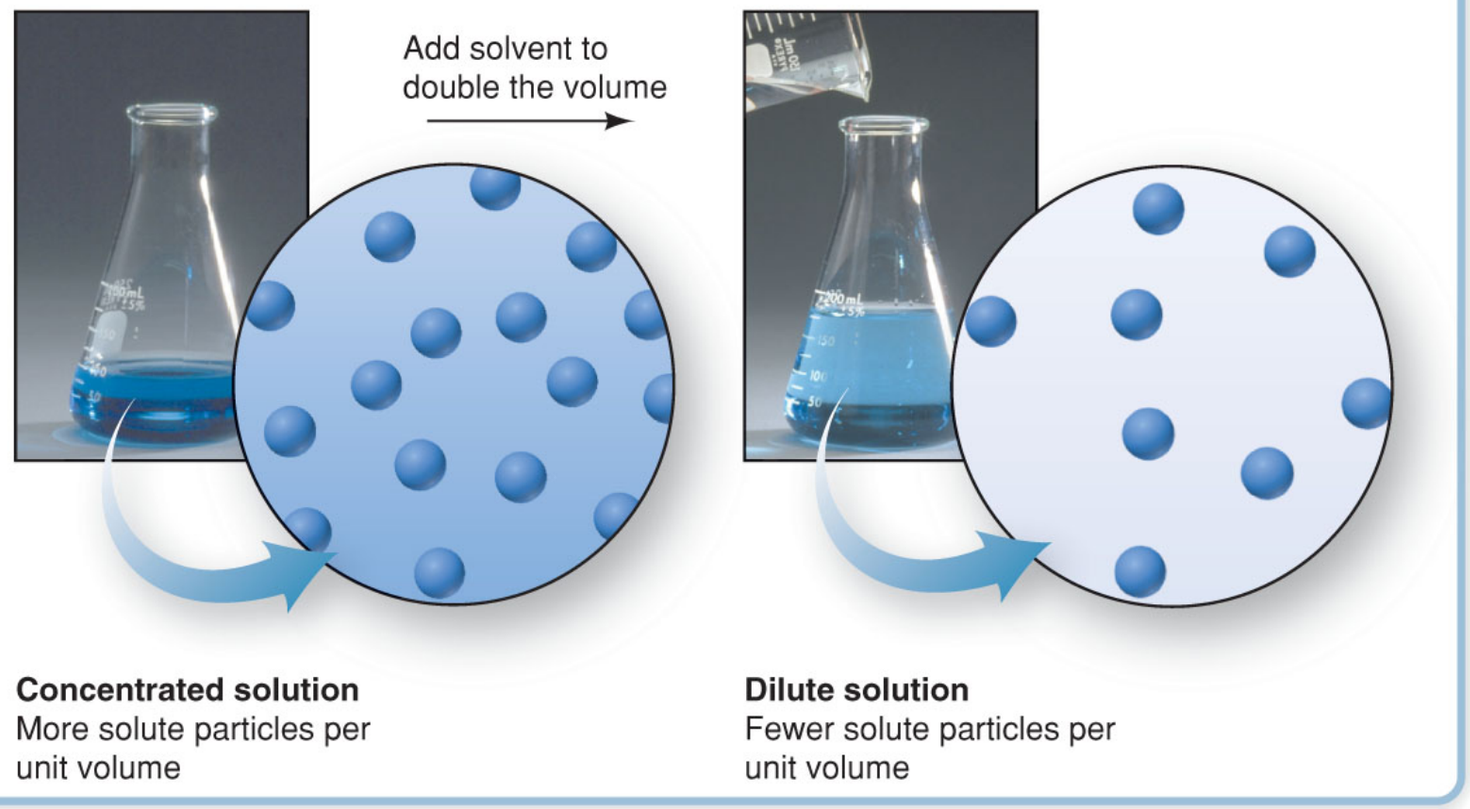
How many grams of HCl are present in that solution?

CONCENTRATED & DILUTE SOLUTIONS

- Concentrated solutions have more *solute* per unit volume than dilute solutions.

- Concentrated solutions can be made dilute by adding more *solvent*.

- Dilute solutions can be made more concentrated by adding more *solute*, or by removing (selectively) more *solvent*.



DILUTIONS CALCULATIONS

- Solutions often need to be **diluted** to obtain the **desired concentration**, from a higher concentration stock solution.

- Calculations for dilutions require us to determine the total **number of moles** involved in the dilution.

- M_1V_1 = # of moles = M_2V_2

QUESTION

Take 25.00 mL of a 0.0400 M $KMnO_4$ solution.

Dilute the 25.00 mL solution to 1.000 L with water.

What is the resulting molarity of the diluted solution?

0.00100 M $KMnO_4$

QUESTION

Which one of the following solutions is the most dilute?

A: 0.500 M HCl solution

B: 0.50 L of solution containing 0.40 moles of HCl

C: 75 mL of solution containing 0.40 moles of HCl

QUESTION

Which one of the following solutions is the most dilute?

A: 0.500 M HCl solution

B: 0.50 L of solution containing 0.40 moles of HCl

$0.40\ \text{mol} \div 0.50\ \text{L} = 0.80\ \text{M} > 0.50\ \text{M}$

C: 75 mL of solution containing 0.40 moles of HCl

$0.40\ \text{mol} \div 0.075\ \text{L} = 5.3\ \text{M} > 0.50\ \text{M}$

QUESTION

Each of the following salts are soluble in water. Which will produce the largest number of ions, per mole, of dissolved solute?

Answers

A	Aluminum chloride	$AlCl_3$: 4 moles of ions
B	Sodium chloride	$NaCl$: 2 moles of ions
C	Ammonium nitrate	NH_4NO_3 : 2 moles of ions
D	Sodium sulfate	Na_2SO_4 : 3 moles of ions
E	Calcium nitrate	$Ca(NO_3)_2$: 3 moles of ions

QUESTION

What is the total concentration of ions in a 0.10 M iron(III) sulfate solution?

Answers

A 0.10 M

B 0.20 M

C 0.30 M

D 0.40 M

E 0.50 M

$Fe_2(SO_4)_3 \longrightarrow 2Fe^{3+} + 3SO_4^{2-}$

0.10 M 2(0.10 M) + 3(0.10 M) = 0.50 M

OTHER UNITS OF CONCENTRATION

- Concentrations are used to express the amount of solute in a solution, this can be done in more ways than just molarity (mol/L).

- Mass percent (w/w%)
- Volume percent (v/v%)
- Mass-volume percent (w/v%)
- Parts per million (ppm) and parts per billion (ppb)

EXPRESSING CONCENTRATION IN PERCENTAGES

- The expression of concentration as a percentage is very similar to how percentage grades are expressed.

- The key is to use the proper units for each calculation.

Mass percent (w/w%)

$$\text{mass percentage} = \frac{\text{mass of component}}{\text{mass of solution}} \times 100\%$$

Volume percent (v/v%)

$$\text{volume percentage} = \frac{\text{volume solute}}{\text{volume solution}} \times 100\%$$

ppm and ppb

$$\text{ppm} = \frac{\text{mass solute}}{\text{mass solution}} \times 10^6 \text{ ppm}$$

$$\text{ppb} = \frac{\text{mass solute}}{\text{mass solution}} \times 10^9 \text{ ppb}$$

MASS % PROBLEM

A throat spray is 1.40% by mass phenol, C_6H_5OH, in water. If the solution has a density of 0.9956 g/ml, calculate the molarity of the solution.

PPM/PPB PROBLEM

The EPA monitors lead (Pb) in tap water to ensure that it does not exceed 15 ppb. What is this concentration in ppm? At this concentration what mass of lead (in μg) would be contained in a typical glass of water (300. mL)? The density of water is 1.00 g/mL.

CONVERSION AMONG CONCENTRATIONS

A solution consists of **73.9** g of **potassium bromide (KBr)**, **113.1** g water, and has a volume of **137** mL.

Calculate the weight percent of **KBr**, the molality of **KBr**, the mole fraction of **KBr**, and the molarity of **KBr** in the solution.

weight percent = [ ] %

molality = [ ] m

mole fraction = [ ]

molarity = [ ] M

$$\text{molality } (m) = \frac{\text{moles of solute}}{\text{kg solvent}}$$