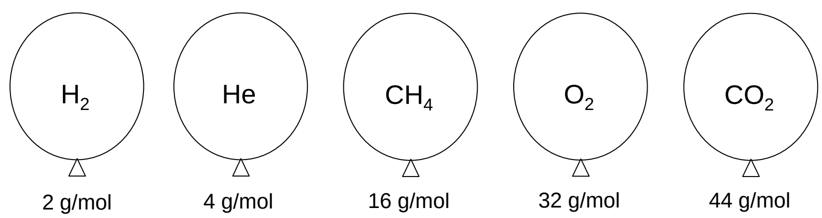
Typical errors on Chem 116 Exam 1 from previous years

- This document is a compilation of the most common errors students made when they took the practice exam that is posted.
- The intent of this document is to help you identify the kinds of errors that you might make when you solve these problems, so that you can learn to fix these errors before you take the exam.

Learning from errors on Exam 1

Use Graham's law of effusion to identify an unknown gas by comparing its effusion rate to that of a known gas under the same conditions

Which gas effuses 4x slower than H_2?



$$\frac{\text{speed of fast gas}}{\text{speed of slow gas}} = \sqrt{\frac{M_{big}}{M_{little}}} \quad or \quad \left(\frac{\text{speed of fast gas}}{\text{speed of slow gas}}\right)^2 = \frac{M_{big}}{M_{little}}$$

Conclusion: First figure out what the question is asking, then conceptualize, then estimate, then do the math

Learning from errors on Exam 1

Use various gas laws to calculate predicted values of measurable variables in a gas

Given known values for all initial conditions and all but one final variable, calculate value of unknown final variable

$$\frac{P_1V_1}{P_2V_2} = \frac{n_1RT_1}{n_2RT_2} \xrightarrow{P \text{ and } n \text{ constant}} \frac{V_1}{V_2} = \frac{T_1}{T_2}$$

- 50% of students used correct equation but forgot to change temperature to Kelvin
- 10% of students did algebra upside down and also did not convert temperature to Kelvin

Conclusion: Don't forget to use absolute (Kelvin) temperatures in equations

Learning from errors on Exam 1

Use the ideal gas law in calculating density

Given P, T and molecular formula, calculate density

Need to be able to mathematically put together:

- Ideal gas law $PV = nRT$
- Density equation $D = \frac{mass}{volume}$
- Meaning of molar mass $molar\ mass = \frac{grams}{mol} = \frac{mass}{n}$

Or just remember the gas density equation $D = \frac{Mp}{RT} = \frac{\left(\frac{g}{mol}\right)(atm)}{\left(\frac{L \bullet atm}{mol \bullet K}\right)(K)} = \frac{g}{L}$

10% of students used correct equation but forgot to use temperature in Kelvin

Learning from errors on Exam 1

Say which gases are more likely than others (in a given list) to deviate from ideal gas behavior, and why they do, based on which assumptions in kinetic molecular theory break down

SO_2 Ne CH_4 N_2 H_2

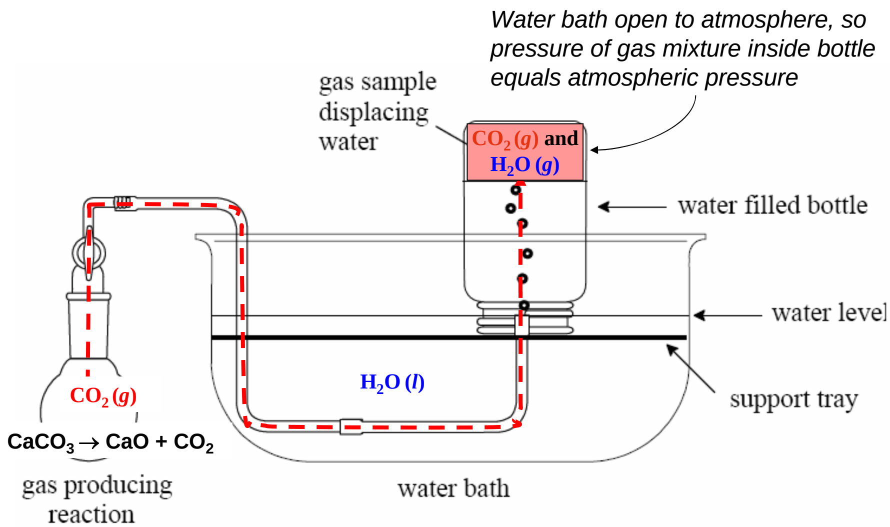
Need to be able to:

- Identify which gas deviates most from ideal (*deviate = to be different than*)
- Why does this gas have the least ideal behavior
- Identify which assumption in the kinetic molecular theory breaks down
    1. There are no attractive forces acting between gas particles (all collisions are elastic)
    2. The volume taken up by the particles themselves is negligible (gases are mostly empty space; there is a lot of empty space between particles)

30% of students correctly identified SO_2 as least ideal, and correctly stated why, but did not identify which assumption breaks down

Learning from errors on Exam 1

Use the ideal gas law in doing stoichiometry problems: collecting a gas over water (like extra homework problem from Assignment 2)



Learning from errors on Exam 1

Solution strategy

1. Interested in partial pressure of CO_2 gas collected
2. Use gas law (knowing P_{CO2}, V and T) to calculate n_{CO2}
3. Use stoichiometry to calculate moles $CaCO_3$ that must have reacted
4. Use stoichiometry to calculate mass of $CaCO_3$

Most common mistakes

- 33% of students used wrong pressure in gas law
- 20% of students made algebra mistakes or did not convert units
- 20% of students made sig fig errors (rounded too much)