# Dr. Casagrande's Chemistry 1 Final Exam Review Sheet 2

**Chapter 14: The Gas Laws**

- State and describe the gas laws.
- Apply the gas laws to problems involving the pressure, temperature, and volume of a gas.
- State the relationship among pressure, volume, and temperature in the combined gas law.
- Apply the combined gas law to problems involving changes in pressure, temperature, and volume of a gas sample.
- Relate the number of particles (moles) and volumes of gases using Avogadro's principle.
- Relate the amount of gas present to its pressure, temperature, and volume by using the ideal gas law.
- Compare the properties of real and ideal gases, and explain the temperature and pressure ranges where gases display non-ideal behavior.
- Determine volume ratios for gaseous reactants and products by using coefficients from a balanced chemical equation.
- Calculate the amounts of gaseous reactants and products in a chemical reaction using the gas laws.
- Use the stoichiometry flowchart to convert between mass of a product or reactant and volume of a product or reactant in stoichiometry problems.
- Labs: Boyle's & Charles' Law, Ideal Gas Constant (Eudiometer); Scuba Diving Article.

**Chapter 15: Solutions**

- Describe the characteristics of solutions and identify the various types.
- Relate intermolecular forces and the process of solvation.
- Define solubility and identify factors affecting it.
- Describe the differences between unsaturated, saturated, and supersaturated solutions
- Express the concentrations of solutions in units of molar ($M$ = moles solute/L of solution).
- Describe how to prepare a solution from the solid solute and the solvent.
- Describe how to prepare a dilution from a stock solution and additional solvent.
- Describe and explain colligative properties
- Solution stoichiometry problems: V $\rightarrow$ V, mass $\rightarrow$ V and V $\rightarrow$ molarity
- Describe colloids & suspensions & how they differ from solutions and from each other
- Lab: Polarity & Solubility; Molarity and Absorption; Colligative Properties WS

**Chapter 16: Energy and Chemical Change**

- Explain what energy is and recall the units used for energy.
- Explain what chemical potential energy is and relate changes in chemical potential energy to heat gained or lost during a reaction.
- Determine the q, C, or $\Delta$T of any substance given its mass and the other two quantities.
- Determine the heat released for a given mass of a substance during combustion or the mass needed to release a certain amount of energy, given the Heat of Combustion.
- Determine the heat absorbed or released by a reaction by calculating the heat released or absorbed by water using $q = mC\Delta T$
- Describe how to use a calorimeter to measure the heat of a reaction.
- Explain what enthalpy (H) is and that the heat of a reaction is the change in enthalpy ($\Delta$H) from the reactants to the products.
- Define *thermochemistry* and explain what the universe, the surroundings, and the system are.
- Tell whether a given reaction is exothermic or endothermic.
- Write a thermochemical equation and calculate the heat of reaction per mole of reactant.
- ~~Use Hess's Law of summation of enthalpies of reaction to calculate the enthalpy change for a reaction.~~

- ~~Explain what the standard enthalpies of formation ($\Delta H_f^0$) are and why $\Delta H_f^0 = 0$ for elements.~~
- ~~Determine the enthalpy change for a reaction using the standard enthalpies of formation of its products and reactants.~~
- Explain what entropy (S) is and know how to predict whether a process or reaction will increase or decrease entropy (change of entropy, ΔS).
- Differentiate between a spontaneous and a nonspontaneous process.
- Explain what free energy (G) is, and how to calculate the change in free energy (ΔG) from ΔH and ΔS.
- Determine the spontaneity of a process based on the sign of ΔG.
- Lab: Specific Heat of a Metal; ~~Hess's Law~~

**Chapter 14 Problems**

1. A sample of $SO_2$ gas has a volume of 84 L at a pressure of 1.5 atm and a temperature of –35°C. At what temperature will the fluorine occupy 95 L at 2.8 atm?

2. A student collects 545 mL of nitrous oxide gas at a temperature of 47°C and a pressure of 722 mm Hg. How many moles of $N_2O$ did she collect?

3. What volume of $SO_2$ at STP can be produced by the following reaction of when 89.5 L of $O_2$ is reacted with excess $As_2S_3$?

$$2\ As_2S_3\ (s) + 9\ O_2\ (g) \rightarrow 2\ As_2O_3\ (s) + 6\ SO_2\ (g)$$

**Chapter 15 Problems**

4. At what pressure will the solubility of a gas be 0.895 g/L if its solubility at 0.785 atm is 0.186 g/L?

5. What is the molarity of an aqueous solution containing 85.2 g of $SrCl_2$ in a 750 mL solution?

6. What volume of 5.0 M stock solution of HCl would you need to prepare 400 mL of 0.30 M solution?

**Chapter 16 Problems**

7. 35.0 g of silver is heated from 21.5°C to 195.3°C, and absorbs 1417 joules of heat in the process. Calculate the specific heat capacity of silver.

8. When 1 mol dodecane ($C_{12}H_{26}$) burns in air, 8,088 kJ is released:

$$C_{12}H_{26}\ (l) + 18.5\ O_2\ (g) \rightarrow 13\ CO_2\ (g) + 12\ H_2O\ (g)\ \Delta H_{comb} = -\ 8{,}088\ kJ$$

How much heat is released when 358.2 g $C_{12}H_{26}$ is burned?

9. When a 12.8-g sample of KCl dissolves in 75.0 g of water in a calorimeter, the temperature drops from 31.0°C to 21.6°C. Calculate mole $\Delta H_{rxn}$ for the process, in **kJ/mol**. [Watch the sign of $\Delta T$!] Is the reaction ***endothermic*** or ***exothermic***? *Justify* your answer with your calculations. If your calculations are ambiguous or contradictory, this will be marked incorrect.

$$KCl\ (s) \rightarrow K^+\ (aq) + Cl^-\ (aq)$$

a. $q_{water}$ =

b. $mol_{reactant}$ =

c. $\Delta H_{rxn}$ =

Reaction is [**exothermic, endothermic**]

10. Predict the sign of $\Delta S$ (+, –, or "can't tell") for the following processes:

| Reaction or Process | $\Delta S$ Sign |
|---|---|
| a. $Br_2\ (l) \rightarrow Br_2\ (g)$ | _____ |
| b. $H_2\ (g) + Cl_2\ (g) \rightarrow 2\ HCl\ (g)$ | _____ |
| c. $Fe\ (l) \rightarrow Fe\ (s)$ | _____ |

11. For the reaction $Ca\ (s) + 2\ H_2O\ (l) \rightarrow Ca(OH)_2\ (s) + H_2\ (g)$, $\Delta H = -411.6$ kJ and $\Delta S = 31.8$ J/K. **Calculate** $\Delta G$*, in kJ,* for the reaction at a temperature of 298 K [watch units!]. Will this reaction be **spontaneous**? *Justify* your answer with a calculation.

Answers to Chapter Problems
Chapter 14: #1. $T_2$= 502 K (229°C); #2. n = 0.0197 mol $N_2O$; #3. V = 59.7 L $SO_2$; Chapter 15: #4. P = 3.78 atm; #5. M = 0.717 M; #6. $V_1$ = 24 mL; Chapter 16: #7. 0.233 J/g·°C; #8. −1.70×10⁴ kJ; #9a. q = −2950 J, b. mol = 0.172 mol, c. ΔH = +17.1 kJ/mol; #11. ΔG = −421.1 kJ, spontaneous