

# 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 ( $M = \text{moles solute/L of solution}$ ).
- 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:  $V \rightarrow V$ ,  $\text{mass} \rightarrow V$  and  $V \rightarrow \text{molarity}$
- Describe colloids & suspensions & how they differ from solutions and from each other
- Lab: Polarity & Solubility; Molarity and Absorption; Colligative Properties WS

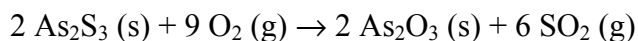
## Chapter 16: Energy and Chemical Change

- 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,  $\Delta S$ ).
- Differentiate between a spontaneous and a nonspontaneous process.
- Explain what free energy (G) is, and how to calculate the change in free energy ( $\Delta G$ ) from  $\Delta H$  and  $\Delta S$ .
- Determine the spontaneity of a process based on the sign of  $\Delta G$ .
- Lab: Specific Heat of a Metal; Hess's Law

### Chapter 14 Problems

1. A sample of SO<sub>2</sub> 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<sub>2</sub>O did she collect?
3. What volume of SO<sub>2</sub> at STP can be produced by the following reaction of when 89.5 L of O<sub>2</sub> is reacted with excess As<sub>2</sub>S<sub>3</sub>?



### Chapter 15 Problems

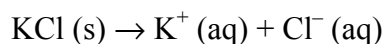
4. At what pressure will the solubility of a gas be 0.895 g/L if its solubility at 0.785 atm is 0.186 g/L?
5. What is the molarity of an aqueous solution containing 85.2 g of SrCl<sub>2</sub> in a 750 mL solution?
6. What volume of 5.0 M stock solution of HCl would you need to prepare 400 mL of 0.30 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<sub>12</sub>H<sub>26</sub>) burns in air, 8,088 kJ is released:  

$$\text{C}_{12}\text{H}_{26} (l) + 18.5 \text{ O}_2 (g) \rightarrow 13 \text{ CO}_2 (g) + 12 \text{ H}_2\text{O} (g) \Delta H_{\text{comb}} = -8,088 \text{ kJ}$$
 How much heat is released when 358.2 g C<sub>12</sub>H<sub>26</sub> 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  $\Delta H_{\text{rxn}}$  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.



a.  $q_{\text{water}} =$

b.  $\text{mol}_{\text{reactant}} =$

c.  $\Delta H_{\text{rxn}} =$

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. $\text{Br}_2 (l) \rightarrow \text{Br}_2 (g)$	_____
b. $\text{H}_2 (g) + \text{Cl}_2 (g) \rightarrow 2 \text{ HCl} (g)$	_____
c. $\text{Fe} (l) \rightarrow \text{Fe} (s)$	_____

11. For the reaction  $\text{Ca} (s) + 2 \text{ H}_2\text{O} (l) \rightarrow \text{Ca}(\text{OH})_2 (s) + \text{H}_2 (g)$ ,  $\Delta H = -411.6 \text{ kJ}$  and  $\Delta S = 31.8 \text{ J/K}$ . 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.  $T_2 = 502 \text{ K}$  (229°C); #2.  $n = 0.0197 \text{ mol N}_2\text{O}$ ; #3.  $V = 59.7 \text{ L SO}_2$ ; Chapter 15: #4.  $P = 3.78 \text{ atm}$ ; #5.  $M = 0.717 \text{ M}$ ; #6.  $V_1 = 24 \text{ mL}$ ; Chapter 16: #7.  $0.233 \text{ J/g}\cdot^\circ\text{C}$ ; #8.  $-1.70 \times 10^4 \text{ kJ}$ ; #9a.  $q = -2950 \text{ J}$ ; b.  $\text{mol} = 0.172 \text{ mol}$ ; c.  $\Delta H = +17.1 \text{ kJ/mol}$ ; #11.  $\Delta G = -421.1 \text{ kJ}$ , spontaneous