

Yw

SI Chemistry Semester Review – Spring 2008

Key objectives from our work this semester:

- Be able to identify the alkali metals, alkaline earth metals, halogens, and noble gases.
- Know the three main subatomic particles, their charges, and their location in an atom.
- Know the periodic trends.

Examples: What happens to atomic radius within a period? within a family? What happens to ionization energy within a period? within a family? What happens to electronegativity within a period? within a family?

- Know what an isotope is
- Using the periodic table, be able to determine the charge of an ion formed by an atom of the representative elements

Examples: What ion does sulfur form? What ion does bromine form? What ion does strontium form?

S²⁻ S²⁻ Br⁻¹

Be able to identify, name, and write formulas for ionic and covalent compounds

Examples: Write the formulas for the following compounds and determine whether they are ionic or covalent compounds.

Potassium iodide KI ionic
 Dinitrogen^{mon}oxide N₂O covalent
 Aluminum oxide Al₂O₃ ionic
 Iron (III) sulfide Fe₂S₃ ionic
 Copper (I) oxide Cu₂O ionic
 Carbon tetrachloride CCl₄ covalent
 Calcium Carbonate CaCO₃ ionic
 Diphosphorus pentoxide P₂O₅ covalent

Name these compounds and identify them as ionic or covalent compounds:

Fe(OH)₂ iron(II) hydroxide ionic
 N₂O₄ dinitrogen tetroxide covalent
 K₂S potassium sulfide ionic
 Al₂O₃ aluminum oxide ionic
 CaSO₄ calcium sulfate ionic
 CF₄ carbon tetrafluoride covalent

- Be able to determine the number of significant figures in a number and do metric conversions

Examples: Determine the number of significant numbers in the following:

303 10.045 .0032 78.2 1000 1.2

Convert the following:

34 cm to meters $34 \text{ cm} \times \frac{1 \text{ m}}{100 \text{ cm}} = 0.34 \text{ m}$

567 mm to cm $567 \text{ mm} \times \frac{1 \text{ cm}}{10 \text{ mm}} = 56.7 \text{ cm}$

56 mg to grams $56 \text{ mg} \times \frac{1 \text{ g}}{1000 \text{ mg}} = 0.056 \text{ g}$

87 grams to cg $87 \text{ g} \times \frac{100 \text{ cg}}{1 \text{ g}} = 8700 \text{ cg}$

- Using the formula for density, know how to calculate the mass, volume or density of a substance $D = \frac{\text{mass}}{\text{Vol}}$
- Know Avogadro's number 6.02×10^{23}
- Know how to calculate the molar mass of a substance

Example Using a periodic table, determine the molar mass of the following:

KI 165.997 g/mol Ca(OH)₂ 74.0958 g NaNO₃ 85.0 g Li₂S 45.942 g

- Know how to do all types of molar conversions

$3.00 \text{ mol CO}_2 \times \frac{44.01 \text{ g}}{1 \text{ mol CO}_2} = 132 \text{ g}$

Examples

How many grams are present in 3.00 moles of CO₂?

$50.0 \text{ g Al(OH)}_3 \times \frac{1 \text{ mol}}{78.0057 \text{ g}} = 0.641 \text{ mol Al(OH)}_3$

How many moles of Al(OH)₃ are present in 50.0 grams?

How many molecules of water are present in 0.25 moles of water? $.25 \text{ mol} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}} = 1.51 \times 10^{23} \text{ molecules}$

How many moles of CO are present in 3.5×10^{21} molecules of CO?

How many grams of CaCO₃ are present in 1.5×10^{20} molecules of CaCO₃?

How many molecules of CCl₄ are present in 264 grams of CCl₄?

$3.5 \times 10^{21} \text{ molecules} \times \frac{1 \text{ mol CO}}{6.02 \times 10^{23} \text{ molecules}} = 0.0058 \text{ mol CO}$

- Be able to write balanced equations and use them to solve stoichiometry problems

$1.5 \times 10^{20} \text{ molecules CaCO}_3 \times \frac{1 \text{ mol CaCO}_3}{6.02 \times 10^{23} \text{ molecules}} \times \frac{89.09 \text{ g}}{1 \text{ mol CaCO}_3} = 0.0222 \text{ g CaCO}_3$

Examples:

$264 \text{ g CCl}_4 \times \frac{1 \text{ mol CCl}_4}{153.822 \text{ g}} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol CCl}_4} = 1.03 \times 10^{24} \text{ molecules}$

Silver nitrate reacts with potassium chloride to form silver chloride and potassium nitrate

If you have 5 moles of silver nitrate how many moles of silver chloride will you form?



1:1 mole ratio ∴ 5 moles AgCl

$$67.0g \text{ KCl} \times \frac{1 \text{ mol KCl}}{74.551g} \times \frac{1 \text{ mol AgCl}}{1 \text{ mol KCl}} \times \frac{143.323g}{1 \text{ mol AgCl}} = \boxed{129g \text{ AgCl}}$$

If you have 67.0 grams of potassium chloride how many grams of silver chloride can you form?



Pentane (C₅H₁₂) burns completely in the presence of oxygen producing carbon dioxide and water

$$10 \text{ mol} \times \frac{8 \text{ mol O}_2}{1 \text{ mol C}_5\text{H}_{12}} = \boxed{80 \text{ mol O}_2}$$

If you have 10 moles of pentane how many moles of oxygen are required?

$$30.0g \text{ C}_5\text{H}_{12} \times \frac{1 \text{ mol C}_5\text{H}_{12}}{72.05g} \times \frac{6 \text{ mol H}_2\text{O}}{1 \text{ mol C}_5\text{H}_{12}} \times \frac{18.0152g}{1 \text{ mol H}_2\text{O}} = \boxed{45.0g \text{ H}_2\text{O}}$$

If you burn 30.0 grams of pentane how many grams of water will form?

- Know how to identify synthesis, decomposition, single replacement, double replacement, and combustion reactions. (see packet)

- Know how to determine the percent composition of a compound

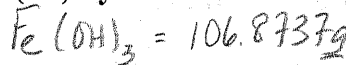
Examples:

$$\text{Al}_2\text{O}_3 = 101.96g/\text{mol}$$

$$\% \text{ Al} = \frac{53.96}{101.96} \times 100 = \boxed{52.9\%} \quad \therefore 47.1\% \text{ O}$$

What is the percent composition of Aluminum oxide? Iron(III) hydroxide?

What is the percent of oxygen in calcium carbonate?



$$\% \text{ Fe} = \frac{55.85}{106.8737} \times 100 = \boxed{52.2\%}$$

- Know how to do Molarity problems

$$\text{CaCO}_3 \quad \frac{48g/\text{mol}}{100.09g/\text{mol}} \times 100 = \boxed{48.0\%}$$

$$\% \text{ O} = \frac{48.0}{106.8737} \times 100 = \boxed{44.9\%}$$

Examples:

What is the molarity of a salt solution containing 42.0 grams of NaCl in 300.0 ml of solution?

$$\frac{42.0g \text{ NaCl}}{300.0 \text{ ml}} \times \frac{1000 \text{ ml}}{1 \text{ L}} \times \frac{1 \text{ mol}}{58.443g} = \boxed{2.40 \text{ M}}$$

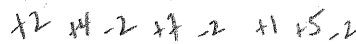
$$\therefore \text{H} = \boxed{2.9\%}$$

How many moles of KI are present in 45.0 ml of .500 M KI?

$$\frac{0.500 \text{ mol}}{1 \text{ L}} \times 0.045 \text{ L} = \boxed{0.0225 \text{ mol KI}}$$

- Know the meaning of the terms, anode, cathode, oxidation, reduction, and salt bridge
- Know how to write half cell reactions (oxidation and reduction) and balanced redox reactions
- Know how to determine oxidation state

Example: Determine the oxidation state of each element in : CaCO₃, MnO₄⁻, K₃PO₄



- Know how to use a table of reduction potentials to determine the anode, cathode and voltage of a cell composed of two different metals and solutions of their ions
- Know the definition of equilibrium

- Know how K_a represents the equilibrium of a weak acid
- Know Le Chatelier's Principle and how to apply it
- Be able to determine the direction of shift in an equilibrium system which undergoes a "disturbance" or a perturbation

Example:

For the equilibrium $2 \text{NO}_2(\text{g}) \leftrightarrow \text{N}_2\text{O}_4(\text{g})$ which is an exothermic reaction, determine the shift that will occur with the following "disturbances".

Remove dinitrogen tetroxide *Shift to products (right)*

Add nitrogen dioxide *Shift to products (right)*

Cool the system *Shift to products (right)*

Decrease the volume of the container *Shift to products (right)*

Add Argon gas *no effect*

- Know characteristics of acids and bases, including respective pH values
- Be able to calculate the molarity of an unknown acid or base given information in an acid-base titration



Example: What is the concentration of HCl if it takes 30.0 ml of this acid to completely neutralize 42.5 ml of .500 M NaOH?

$$\frac{0.500 \text{ mol NaOH}}{\text{L}} \times 0.0425 \text{ L} = 0.0212 \text{ mol NaOH} \times \frac{1 \text{ mol HCl}}{1 \text{ mol NaOH}} = 0.0212 \text{ mol HCl}$$

How many ml of .400 M H_2SO_4 are needed to neutralize 35 ml of .200 M NaOH?



- Know some uses for indicators

$$0.200 \text{ mol NaOH} \times 0.035 \text{ L} = 0.00700 \text{ mol NaOH} \times \frac{1 \text{ mol H}_2\text{SO}_4}{2 \text{ mol NaOH}} \times \frac{1 \text{ L}}{0.400 \text{ mol H}_2\text{SO}_4} = 0.00875 \text{ L} = 8.75 \text{ ml}$$

- Know how to do a variety of gas law problems (refer to gas law practice sheets for review)

- Know how to use the equation $q = m \times c \times \Delta T$ to solve a variety of problems

Example:

What is the specific heat of a metal, if 10.0 grams of the metal at a temperature of 86.0°C raises the temperature of 150.0 grams of water from 22.0°C to 23.4°C ?

$$q_{\text{H}_2\text{O}} = q_{\text{metal}}$$

$$(150.0 \text{ g}) \left(\frac{4.184 \text{ J}}{\text{g}^\circ\text{C}} \right) (1.4^\circ\text{C}) = (10.0 \text{ g}) (x) (62.6^\circ\text{C})$$

$$\frac{1.40 \text{ J}}{\text{g}^\circ\text{C}} = x$$