

SCH3U1 EXAM OUTLINE

<b>UNIT 1</b> <b>Matter and Chemical Bonding</b> <b>(Ch. 1 &amp; 2)</b>	<b>UNIT 2</b> <b>Types of Chemical Reactions</b> <b>(Ch.3)</b>	<b>Unit 3</b> <b>Quantities of Chemical Reactions</b> <b>(Ch. 4 &amp; 5)</b>	<b>Unit 4</b> <b>Solutions and Solubility</b> <b>(Ch. 6-8)</b>	<b>Unit 5</b> <b>Gases and Atmospheric Chemistry</b> <b>(Ch. 9 &amp; 10)</b>
<ul style="list-style-type: none"> <li>-Organization of the periodic table – groups, periods etc.</li> <li>-Atomic number, mass number, and isotopes.</li> <li>-Periodic trends (atomic radius, ionization energy etc.)</li> <li>-Ionic and Covalent bonding.</li> <li>-Electron dot diagrams &amp; Lewis Structures.</li> <li>-Models of the atom (Dalton – Bohr).</li> <li>-Electronegativity and bond polarity.</li> <li>-Names and formulas of ionic, polyatomic, and molecular compound</li> </ul>	<ul style="list-style-type: none"> <li>-Types of chemical reactions: Complete combustion, Synthesis, Decomposition, Single Displacement, Double Displacement.</li> <li>-Write and balance chemical equations</li> <li>-The activity series</li> <li>-The solubility table</li> </ul>	<ul style="list-style-type: none"> <li>-Relative atomic mass</li> <li>-Mole calculations:  <math>n = m/M</math>  <math>n = N/N_A</math>                      where <math>N_A = 6.02 \times 10^{23}</math></li> <li>-Percentage composition</li> <li>-Empirical Formulas</li> <li>-Molecular Formulas</li> <li>-Stoichiometry:                      Calculating masses of R and P using mole ratio from balanced equation</li> <li>Limiting reagents</li> <li>Percentage yield</li> </ul>	<ul style="list-style-type: none"> <li>-Solutes / Solvents / Solutions</li> <li>-Molar Concentration  <math>C = n/V</math></li> <li>-Solution preparation                      mass of solute                      dilution  <math>(C_1V_1 = C_2V_2)</math></li> <li>-Solubility</li> <li>-Solubility curves</li> <li>-Balanced, total ionic, and net ionic equations</li> <li>-Qualitative analysis</li> <li>-Characteristics of acids and bases</li> <li>-pH calculations</li> <li>-Titration calculations</li> </ul>	<ul style="list-style-type: none"> <li>-Pressure and Temperature conversions</li> <li>-Boyle's Law  <math>P_1V_1 = P_2V_2</math></li> <li>-Charles' Law  <math>\frac{V_1}{T_1} = \frac{V_2}{T_2}</math></li> <li>-Gay-Lussac's Law  <math>\frac{P_1}{T_1} = \frac{P_2}{T_2}</math></li> <li>-Combined Gas Law  <math>\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}</math></li> <li>-Ideal Gas Law  <math>PV = nRT</math></li> <li>-Molar volume,  <math>n = \frac{V}{V}</math></li> </ul>

STUDENT'S NAME: \_\_\_\_\_

PART A: MULTIPLE CHOICE (30 Marks). Indicate the correct answer by placing the letter in the space provided.

- Ceesium-137 has
  - 85 protons, 55 electrons, 55 neutrons, 1 valence electron
  - 55 protons, 55 electrons, 55 neutrons, 2 valence electrons
  - 55 protons, 55 electrons, 78 neutrons, 1 valence electron
  - 55 protons, 55 electrons, 62 neutrons, 1 valence electron
- Which of the following matches of group number and common name is incorrect?
  - Group 7 - transition metals
  - Group 2 - alkali earth metals
  - Group 17 - halogens
  - Group 2 - actinides
  - Group 18 - noble gases

3. Which ion has the largest radius?

- Na<sup>+</sup>
- Mg<sup>2+</sup>
- P<sup>3-</sup>
- S<sup>2-</sup>
- Cl<sup>-</sup>

4. Which of the following elements requires the least amount of energy to remove an electron from an atom to form an ion?

- O
- He
- K
- H
- Fr

5. As you go down a column of the periodic table, the ionization energy decreases because:
 

- there are more protons in the nucleus
- atoms become less metallic
- the outer electrons are screened from the effective nuclear charge
- the atoms get smaller and the electrons are closer to the nucleus

Examine the following 1st, 2nd, and 3rd ionization energies.

	1st (eV)	2nd (eV)	3rd (eV)
Element X	5,139	47,266	71,64
Element Y	7,646	15,035	80,143
Element Z	21,584	40,962	63,45

6. Element X is most likely a
- Group 1 element
  - Group 2 element
  - transition metal
  - Group 17 element
  - noble gas

7. Element Y is most likely

- Group 1 element
- Group 2 element
- transition metal
- Group 17 element
- noble gas

8. The reaction  $\text{NaOH(aq)} + \text{HCl(aq)} \rightarrow \text{H}_2\text{O(l)} + \text{NaCl(aq)}$

- is a combustion reaction
- is a single displacement reaction
- is a decomposition reaction
- is an acid base reaction
- is a synthesis reaction

9. Which of the following is the proper electron dot diagram for NaCl?

- $[\text{Na} \cdot \dot{\text{Cl}} \cdot ]$
- $[\text{Na}^+ \cdot \dot{\text{Cl}} \cdot ]^-$
- $[\text{Na}^+ \text{Cl}]$
- $[\text{Na}]^+ [\dot{\text{Cl}} \cdot ]^-$
- $[\text{Na}] [\text{Cl}]$

10. How many hydrogen atoms, H, are there in 33g of  $(\text{NH}_4)_2\text{SO}_4$ ?

- $6.0 \times 10^{23}$  atoms
- 8 atoms
- $2.5 \times 10^{24}$  atoms
- $1.5 \times 10^{23}$  atoms

11. The number of carbon atoms present in 0.062 mol of acetic acid,  $\text{CH}_3\text{COOH}$ , is

- $7.5 \times 10^{22}$  atoms
- $3.8 \times 10^{22}$  atoms
- $1.5 \times 10^{23}$  atoms
- $6.0 \times 10^{23}$  atoms
- $4.4 \times 10^{22}$  atoms

12. Ammonium nitrate,  $\text{NH}_4\text{NO}_3$ , is commonly used for fertilizer. The percentage of nitrogen, by mass, in this fertilizer is

- 17.5%
- 22.5%
- 35.0%
- 47.5%
- 55.0%

13. Consider the following equation:  ${}_{82}^{214}\text{Pb} \rightarrow {}_{82}^{214}\text{Pb} + \text{_____}$   
The missing nuclear particle required to complete this balanced nuclear equation is

- ${}_{2}^4\text{He}$
- ${}_{-1}^0\text{e}$
- ${}_{-1}^0\text{e}$
- ${}_{-1}^1\text{e}$
- ${}_{-1}^1\text{e}$

14. Which of the following is not an electrolyte?

- sugar dissolved in water
- salt dissolved in water
- an acid solution
- a basic solution
- Gatorade solution

15. Which of the following contains H-bonding, dipole-dipole interactions and LDF's?

- $\text{CO}_2$
- $\text{CH}_4$
- $\text{NaHCO}_3$
- $\text{H}_2\text{O}$
- $\text{HNO}_3$

16. Ionic bonds are usually formed between two elements with the following combination of properties:

- low ionization energy and low electron affinity
- low ionization energy and high electron affinity
- medium ionization energy and medium electron affinity
- high ionization energy and high electron affinity

17. What is the molar concentration of 0.20 mol of potassium hydroxide in 0.75 L of solution?

- 0.37 mol/L
- 3.75 mol/L
- 2.66 mol/L
- 0.27 mol/L
- 0.17 mol/L

18. As the temperature of a solution increases, the solubility of salts \_\_\_\_\_ and the solubility of gases \_\_\_\_\_

- doesn't change, doesn't change
- increases, decreases
- increases, increases
- decreases, decreases
- decreases, increases

19. If solutions of potassium chloride and silver nitrate are mixed, which of the following are spectator ions?

- $\text{Ag}^+$  and  $\text{Cl}^-$
- $\text{K}^+$  and  $\text{Cl}^-$
- $\text{Ag}^+$  and  $\text{NO}_3^-$
- $\text{K}^+$  and  $\text{NO}_3^-$
- none of the above

20. Consider the following equation:  $\text{HC}_2\text{H}_3\text{O}_2(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{C}_2\text{H}_3\text{O}_2^-(\text{aq}) + \text{H}_3\text{O}^+(\text{aq})$   
Which are conjugate acid-base pairs?

- $\text{HC}_2\text{H}_3\text{O}_2(\text{aq})$  and  $\text{H}_2\text{O}(\text{l})$
- $\text{HC}_2\text{H}_3\text{O}_2(\text{aq})$  and  $\text{C}_2\text{H}_3\text{O}_2^-(\text{aq})$
- $\text{C}_2\text{H}_3\text{O}_2^-(\text{aq})$  and  $\text{H}_3\text{O}^+(\text{aq})$
- $\text{H}_2\text{O}(\text{l})$  and  $\text{H}_3\text{O}^+(\text{aq})$
- a, b and d only

21. Blackberries have a  $[\text{H}^+(\text{aq})] = 4.0 \times 10^{-4} \text{ mol/L}$ . What is their pH?

- 3.40
- 4.00
- 3.00
- 6.00
- 2.00

SCH3U - EXAM REVIEW - UNIT 1  $\frac{1}{2}$  UNIT 2

1. Complete the table below.

Element name	Element symbol	Atomic number	Group number	Family name	Period number	Metal or nonmetal
fluorine						
	Ba					
			noble gas		3	

2. What is the difference between ionization energy and electron affinity?  
 3. Why does ionization energy increase from left to right in a period on the periodic table?  
 4. Examine the following 1st, 2nd, and 3rd ionization energies and state which element is most likely a noble gas.

	1st (eV)	2nd (eV)	3rd (eV)
Element X	5.139	47.286	71.64
Element Y	7.646	15.035	80.143
Element Z	21.564	40.962	63.45

5. The electronegativity of magnesium, Mg, is 1.2. Would you expect aluminum's electronegativity to be higher or lower?  
 6. For a science fair project, a student wants to design a simple device for removing certain gases from polluted air. He knows that polar molecules dissolve well in water, so he bubbles polluted air through a jug of water to remove unwanted gases. For his project, the student uses air containing the following gases:  
 7.  $N_2(g)$   
 8.  $O_2(g)$   
 9.  $CH_4(g)$   
 10.  $CO_2(g)$   
 11.  $HF(g)$   
 12.  $NH_3(g)$   
 13.  $C_3H_8(g)$   
 14.  $CH_3OCH_3(g)$

List the gases that will dissolve by writing down their corresponding numbers.

7. List three empirical properties of the molecular elements (i.e., nonmetals).  
 8. A student records the following evidence in a lab book.

Unknown substance	Pure state	Solubility in water	Solution conductivity
I	solid	high	low
II	solid	low	low
III	solid	high	none
IV	solid	high	high

Which of the substances in the table above is most likely an ionic compound? Explain your answer.

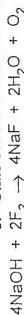
9. Briefly describe how polar covalent bonds occur.  
 10. Explain, in your own words, how and why ionic bonding occurs.  
 11. Use electron dot diagrams to explain the formula for  $Na_2O$ .  
 12. Predict the products for the following chemical reaction:  
 13. Predict the products and write a balanced chemical equation for the following chemical reaction: A sulfuric acid spill is neutralized by a sodium hydroxide solution.  
 14. Predict the products and write a balanced chemical equation for the following chemical reaction: Scrap iron is added to an aqueous solution of copper(II) nitrate to recover the copper.  
 15. Predict the products and write a balanced chemical equation for the following chemical reaction: Aqueous aluminum chloride is added to a solution suspected to contain sodium carbonate.  
 16. Complete the following chemical reaction equation, including states of matter and balancing:



SCH3U - EXAM REVIEW - UNIT 3

1. Zinc oxide can be used for treating certain skin conditions. Determine the molar mass of  $ZnO$ .  
 2. Calculate the number of fluoride ions present in 0.669 mol of barium fluoride,  $BaF_2$ .  
 3. Define the term "limiting reagent".  
 4. Balance the following equation by inspection:  $CoCl_2 + NaOH \rightarrow NaCl + Co(OH)_2$   
 5. Translate the following into a balanced chemical equation:  
 Four moles of ammonia gas reacts with 5 mol of oxygen gas and produces 4 mol of nitrogen dioxide gas and 6 mol of water in the gaseous state.

6. State the mole ratio between the reactants in the following balanced equation:



7. If 109.6 g of sodium hydroxide was the amount obtained in a reaction for which the theoretical yield was 170.5 g, determine the percentage yield.  
 8. Natural neon contains three isotopes: Ne-20, Ne-21, and Ne-22. In a sample, 90.92% of the atoms are Ne-20, 0.26% of the atoms are Ne-21, and 8.82% of the atoms are Ne-22. Using a sample population of 10 000 neon atoms, calculate the average atomic mass of neon.  
 9. Calculate the mass found in 1.27 mol of sodium phosphate.  
 10. Titanium dioxide,  $TiO_2$ , can be used as an abrasive in toothpaste. Calculate the percentage of titanium, by mass, in titanium dioxide.  
 11. Glucose contains 39.95% C, 6.71% H, and 53.34% O, by mass. If the molar mass of glucose was found experimentally to have a molar mass of 180.0 g/mol, calculate its molecular formula.  
 12. Consider the following combustion reaction:  $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$   
 Determine the mass of carbon dioxide that will be formed when 131.0 g of propane,  $C_3H_8$ , is reacted with excess oxygen.  
 13. Consider the following balanced equation:  $Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + 2H_2O$   
 Determine the mass of magnesium chloride produced when 5.91 g of  $Mg(OH)_2$  is combined with 9.98 g of HCl.  
 14. Sodium chloride is produced when sodium metal combines with chlorine gas as shown in the following balanced equation:  $2Na + Cl_2 \rightarrow 2NaCl$   
 In an experiment, 36.9 g of sodium chloride is produced when 15.9 g of Na and 27.4 g of chlorine are combined. Determine the percentage yield of the product.

SCH3U - EXAM REVIEW- UNIT 4

1. Using the solubility table below, state whether the following ionic compounds are soluble or insoluble in water.

Compound	Soluble or insoluble
(a) PbI <sub>2</sub>	
(b) KClO <sub>3</sub>	
(c) CaCO <sub>3</sub>	
(d) BaSO <sub>4</sub>	

2. A sample of well water is known to contain a high concentration of iron. What solution could you use to test the water to get a positive precipitate test for the dissolved iron?
3. Consider the following reaction: Barium chloride solution is mixed with potassium sulphate solution to produce a solid precipitate barium sulphate and a solution of potassium chloride.

For this reaction, write  
 (a) a balanced chemical equation  
 (b) a total ionic equation  
 (c) a net ionic equation

4. Write the ionic equation to represent the dissociation of calcium hydroxide.  
 5. How does dilution affect the pH of  
 (a) acidic solutions?  
 (b) basic solutions?
6. D5W is an intravenous solution used as a fluid and nutrient replenisher for patients. As a hospital pharmacist you need to make 750 mL of this solution with a concentration of 0.30 mol/L. What mass of glucose, C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>, will you need to dissolve in water?
7. T.S.P. is an all purpose cleaner that can be used to clean driveways. What volume of solution would you get if you dissolved 150.0 g of sodium phosphate with water to produce a 0.23 mol/L solution?

OMIT

8. A "sports drink" contains 50 mg of sodium ions and 55 mg of potassium ions per 400 mL serving. Calculate the concentration of the sodium and potassium ions in ppm.

9. How much water must be added to 600 mL of a 1.5 mol/L CaCl<sub>2</sub> solution to make the concentration of the resulting solution 1.0 mol/L?

OMIT

10. Some commercial bleach solutions contain 5.25% W/V sodium hypochlorite. Calculate the sodium hypochlorite concentration in mol/L.  
 11. A student mixed 100.0 mL of a 0.100 mol/L solution of barium chloride with 100.0 mL of a 0.100 mol/L solution of iron(III) sulphate. The barium sulphate precipitate was filtered, dried, and was measured to have a mass of 2.0 g. Calculate the % yield of the barium sulphate.  
 12. A swimming pool has a pH of 7.5. Calculate the hydrogen ion concentration in the pool.  
 13. A teaspoon of milk of magnesia contains 12.0 mg of magnesium hydroxide. What volume of 0.01 mol/L HCl in a person's stomach would be neutralized by this teaspoon of antacid?

SCH3U - EXAM REVIEW UNIT 5

- OMIT 1. Make a list of five ways that the knowledge of gases is used in the proper design and functioning of an automobile.

2. Explain Boyle's law using the kinetic molecular theory.  
 3. Explain Charles's law using the kinetic molecular theory.  
 4. Solve for the missing variable in the following chart:

P <sub>1</sub>	P <sub>2</sub>	V <sub>1</sub>	V <sub>2</sub>
101 kPa	125 kPa	7.52 L	?

- OMIT 5. The total pressure of a gas mixture of He and CO is 12 atm. If there is twice as much CO as He, what is the partial pressure for both gases?

6. Butane from a lighter undergoes combustion in the following manner:



What volume of butane was burned to produce 325 mL of CO<sub>2</sub>(g)?

7. A balloon filled with helium gas has a volume of 5.80 L measured at 101.325 kPa and is placed into a hyperbaric chamber at a pressure of 1265 mm of Hg. What will the new volume be if the temperature remains constant throughout the process?  
 8. A gas occupies a volume of 825 mL at a temperature of 25°C and a pressure of 0.985 atm. What will the new pressure be, if the volume is decreased to 555 mL while the temperature remains constant?  
 9. Determine the number of moles of neon gas contained in a 5.25-L gas tank at 105 kPa and a temperature of 299 K. If the gas is nitrogen instead of neon, will the answer be the same? Explain your reasoning.  
 10. What would be the difference in size of a 10.5-L balloon filled with He gas at STP if it is brought in from outside to conditions identical to SATP?  
 11. A fire extinguisher filled with carbon dioxide has a mass of 3500 g. After releasing all of the CO<sub>2</sub>, the mass of the extinguisher is 2735 g. What was the pressure reading on the gauge before any CO<sub>2</sub> was released, if the volume of the extinguisher is 4.25 L and it is stored at a temperature of 25°C?  
 12. Magnesium was added to hydrochloric acid, HCl, and produced 5.25 L of H<sub>2</sub> gas at a temperature of 325 K and a pressure of 100 kPa. What mass of Mg was used in this single displacement reaction?  
 13. Acetylene is burned in the presence of oxygen gas during the welding process according to the following balanced chemical equation:  $2C_2H_2(g) + 5O_2(g) \rightarrow 2H_2O(g) + 4CO_2(g)$

If you have 40 L of acetylene at STP, what volume of oxygen gas will you need at STP to completely burn the acetylene?

## 11U CHEMISTRY EXAM REVIEW QUESTIONS (PART 1)

1

- Classify the following as chemical or physical properties of matter.
  - silver does tarnish
  - gold is a conductor of electricity
  - potassium iodide dissolves in water
  - Oxygen supports combustion
  - Mercury metal can evaporate
  - Lead has a high density
- Identify each of the changes below as chemical (C) or physical (P).
  - twisting copper wire into a coil
  - burning coal
  - melting wax
  - fermentation of grapes to make wine
- Classify each of the following as a pure substance (PS), a solution (S), or a mechanical mixture (MM).
  - plain Jell-O
  - neon gas
  - vinegar
  - Raisin Bran cereal
  - calcium carbonate
  - air
- What is the name for the smallest particle of a covalently-bonded compound?
  - Only pure substances are homogeneous, true or false?
  - Explain your answer to b).
- J.J. Thomson discovered the \_\_\_\_\_ while studying \_\_\_\_\_ rays
  - Very briefly describe Thomson's model of the atom.
- Rutherford did an experiment that disproved Thomson's model of the atom. In his experiment Rutherford shot a beam of \_\_\_\_\_ particles at a thin sheet of \_\_\_\_\_. Most of these particles \_\_\_\_\_ and this proved that 99.99% of the atom is consists of \_\_\_\_\_. However, about 1 in 20,000 of the particles were \_\_\_\_\_ and this proved the existence of a very dense \_\_\_\_\_ in the atom. Based on the fact that the positive charge on an atom is a multiple of that of hydrogen, Rutherford concluded that this structure contained a subatomic particle called the \_\_\_\_\_. Later experiments by \_\_\_\_\_ discovered the last major subatomic particle found in this region, the \_\_\_\_\_.

7. Consider the following atoms:



Which of these atoms (if any) are isotopes of the same element? Explain your reasoning.

8. Draw Bohr-Rutherford diagrams for the following isotopes of each element.

a) Sodium-23 ( ${}^{23}_{11}\text{Na}$ )b) Phosphorus-31 ( ${}^{31}_{15}\text{P}$ )

9. Use the information given below to calculate the average atomic mass of element X.

ISOTOPE	ABUNDANCE (%)	MASS (u or g/mol)
${}^{30}_X$	12.64	302.04
${}^{31}_X$	18.23	304.12
${}^{38}_X$	69.13	305.03

2

10. Element X is composed of isotopes X-56 (mass 56.0 u) and X-59 (mass 59.0 u). What is the % abundance of each of these isotopes if the atomic mass is 57.3 u?

11. On the periodic table label the following groups of elements: metals, nonmetals, transition metals, halogens, noble gases, alkali metals, metalloids and the inner transition metals.

12. How many valence electrons are there in:

- calcium
- fluorine

13. Which of the following ions would you expect to be stable?



14. Consider the following electron configurations for neutral atoms:

- 2, 8, 7
- 2, 8
- 2, 8, 8
- 2, 8, 8, 2
- 2, 8, 8, 1

a) Which of these would you expect to be an alkaline earth metal?

b) List the five atoms in order of increasing atomic radii.

c) Which of these would you expect to have the lowest ionization energy?

d) Which of these would you expect to be in the same family?

15. All of the trends on the periodic table can be explained by two factors:

- the number of occupied Bohr energy levels (orbits)
- the number of protons in the nucleus (nuclear charge)

Answer each of the following using these 2 factors:

a) Circle which is bigger and state why. Li or Na

b) Circle which is bigger and state why. O or F

c) Circle which is bigger and state why.  $\text{Na}^+$  or Ne

d) Circle which has the higher ionization energy and state why. S or Cl

e) Circle which has the greater electron affinity and state why. Cl or Br

f) Circle which has the greatest metallic character and state why. Be or Mg

16. Write the ionization equations for each of the following:

- calcium
- phosphorus

17. Explain the difference between covalent, polar covalent and ionic bonds.

18. Determine the bond type in the following compounds using electronegativity values.  
 a)  $\text{BCl}_3$     b)  $\text{NI}_3$   
 c)  $\text{Al}_2\text{O}_3$                                          d)  $\text{Cs}_2\text{S}$

19. Draw a Lewis structure and name the shape for these compounds.

Compound Name	Formula	Lewis Structure	Name of 3D Shape
carbon tetrachloride			
nitrogen			
nitrogen trifluoride			
hydrogen peroxide			
boron trihydride			

20. Complete the following table.

Formula	Name	Name	Formula
$\text{PbS}$		nitric acid	
$\text{SnSO}_3 \cdot 6\text{H}_2\text{O}$		plumbic iodide	
$\text{SF}_6$		neon	
$\text{Na}_2\text{O}_2$		iron (III) hydrogen sulfite	
$\text{Al}(\text{IO}_3)_3$		chlorine	
$\text{NaBrO}$		potassium bromite	
$\text{Ca}(\text{HCO}_3)_2$		copper (II) sulfate monohydrate	
$\text{MgO}$		manganese (II) hypochlorite	
$\text{KH}_2\text{PO}_4$		hydrosulfuric acid	
$\text{HClO}_3$ (aq)		$\text{BaO}_2$	
$\text{KNO}_2$		manganese dioxide	
$\text{Fe}(\text{OH})_2$ (aq)		sulfuric acid	
$\text{NH}_4\text{OH}$		silver sulfide	
$\text{Mg}_3\text{P}_2$		lead (IV) perchlorate	
$\text{Au}(\text{OH})_3$		magnesium phosphite	

21. Balance the following reactions.

- a)  $\text{Ca}_3(\text{PO}_4)_2 + \text{SiO}_2 + \text{C} \rightarrow \text{P}_4 + \text{CaSiO}_3 + \text{CO}$   
 b)  $\text{Al}_2\text{C}_6 + \text{H}_2\text{O} \rightarrow \text{Al}(\text{OH})_3 + \text{C}_2\text{H}_2$   
 c)  $\text{FeCl}_3 + \text{KMnO}_4 + \text{HCl} \rightarrow \text{FeCl}_2 + \text{KCl} + \text{MnCl}_2 + \text{H}_2\text{O}$   
 d)  $\text{BiO}_2 + \text{H}_2 \rightarrow \text{Bi} + \text{H}_2\text{O}$   
 e)  $\text{FeS} + \text{O}_2 \rightarrow \text{Fe}_2\text{O}_3 + \text{SO}_2$

22. For each pair of reactants, predict if a reaction will occur. If a reaction occurs, complete the word equation. If no reaction occurs, write NR.

- a) tin (s) + potassium iodide (aq)  
 b) fluorine (aq) + sodium chloride (aq)  
 c) sodium (s) + calcium sulfate (aq)

23. a) Complete these reactions and write a balanced chemical equation.

- b) Write the type of reaction (synthesis, decomposition, single displacement, double displacement, combustion, neutralization) beside each.

- a) water  $\rightarrow$  \_\_\_\_\_  
 b) silver + copper (II) sulfate  $\rightarrow$  \_\_\_\_\_  
 c) carbon dioxide + water  $\rightarrow$  \_\_\_\_\_  
 d) barium chloride + sodium sulfate  $\rightarrow$  \_\_\_\_\_  
 e) butane ( $\text{C}_4\text{H}_{10}$ ) + oxygen  $\rightarrow$  \_\_\_\_\_  
 f) sodium hydroxide + nitric acid  $\rightarrow$  \_\_\_\_\_

24. In an experiment designed to compare the reactivity of 4 metals (W, X, Y and Z), the metallic elements were reacted with aqueous solutions containing their ions and an anion A. The following observations were made when the single displacement reactions were attempted:

- a)  $\text{Z (s)} + \text{WA (aq)} \rightarrow \text{ZA (aq)} + \text{W (s)}$   
 b)  $\text{W (s)} + \text{XA (aq)} \rightarrow \text{NR}$   
 c)  $\text{X (s)} + \text{ZA (aq)} \rightarrow \text{XA (aq)} + \text{Z (s)}$   
 d)  $\text{W (s)} + \text{YA (aq)} \rightarrow \text{WA (aq)} + \text{Y (s)}$

## 11U CHEMISTRY EXAM REVIEW (Part 2)

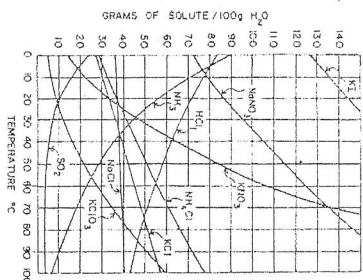
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- Explain the difference between each pair of terms.
  - limiting and excess reactant
  - actual yield and theoretical yield
  - empirical and molecular formula
- Calculate the percent composition of sodium thiosulfate,  $\text{Na}_2\text{S}_2\text{O}_3$ .
- A compound contains 56.6% potassium, 8.7% carbon and 34.7% oxygen. Determine the empirical formula for the compound.
- Hydroquinone is an organic compound commonly used as a photographic developer. It has a molecular mass of 110 g/mol and a composition of  $\text{C}_6\text{H}_4\text{O}_2$ . Calculate the molecular formula of hydroquinone.
- Use this equation for all three problems:
 
$$2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{g})$$
  - How many moles of water are produced when 5.00 moles of oxygen are consumed?
  - If 3.00 moles of water are produced, how many grams of oxygen must be consumed?
  - How many moles of hydrogen must be used, given the data in problem b)?
  - What mass of water is produced when 105 g of hydrogen reacts with excess oxygen?
- What mass of sodium carbonate must be used to produce 10.36 L of carbon dioxide at 24°C and 103 kPa according to the following neutralization reaction?
 
$$\text{HCl}(\text{aq}) + \text{Na}_2\text{CO}_3(\text{s}) \rightarrow \text{NaCl}(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$$
- If 129.0 g of oxygen gas and 300 g of propane are mixed and allowed to react as shown below, determine the volume of water vapour formed at 116 kPa and 120°C.
 
$$\text{C}_3\text{H}_8(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{g})$$
- One of the reactions used in the smelting of copper ores to produce copper and sulfur dioxide involves reacting copper(I) oxide with copper(I)sulfide. When 250 kg of copper (I) oxide is heated with 129 kg of copper (II) sulfide, 285 kg of copper is recovered.
 
$$\text{Cu}_2\text{O}(\text{s}) + \text{Cu}_2\text{S}(\text{s}) \rightarrow \text{Cu}(\text{s}) + \text{SO}_2(\text{g})$$
  - Write the balanced chemical equation for the reaction.
  - Determine the limiting reagent.
  - Calculate the theoretical yield using stoichiometry.
  - Determine the percentage yield of copper.
- A crystal is added to a solution. Describe what happens to the crystal if the solution is unsaturated, saturated or supersaturated.

## SCH3U Exam Review

5

- Consider the solubility curves.
  - What is the solubility of  $\text{KNO}_3$  at 50°C?
  - What must the temperature be to create a saturated solution of  $\text{KNO}_3$  using 50 g of the salt and 50 g of water?
  - What mass of  $\text{KNO}_3$  will precipitate if a saturated solution of  $\text{KNO}_3$  at 60°C is cooled to 10°C?
- 25 g of sodium chloride is dissolved in 100 g of water. What is the concentration in:
  - % by mass
  - mol / L (the density of the solution is 1.15 g/mL)
- What mass of lead (II) nitrate is required to make 4.5 L of a 0.75 mol/L solution?
- Concentrated phosphoric acid has a concentration of 18.0 mol/L. What volume of concentrated phosphoric acid is needed to make 8.00 L of a 1.50 mol/L solution?
- The water in a swimming pool has tested positive for lead at a concentration of 4.8 ppm. What mass of lead would there be in a 60,000 L pool? (Dens, 1.00 g/mL = 1.00 kg/L.)
- Calculate the concentration (in mol/L) of a 7.50% by mass acetic acid solution if the density is 1.02 g/mL. Acetic acid has the formula  $\text{CH}_3\text{COOH}$ .
- Write a balanced dissociate equation for these salts.
  - $\text{KCl}(\text{s})$
  - $\text{Ba}(\text{NO}_3)_2(\text{s})$
  - $(\text{NH}_4)_2\text{SO}_4(\text{s})$
- Complete balanced chemical equations for the following precipitation reactions. Include the state symbols s or aq.
  - $\text{Fe}(\text{NO}_3)_3(\text{aq}) + \text{NaOH}(\text{aq}) \rightarrow$
  - $\text{AgNO}_3(\text{aq}) + \text{MgCl}_2(\text{aq}) \rightarrow$
- Complete a balanced chemical equation, total ionic equation and net ionic equation.
 
$$\text{Pb}(\text{NO}_3)_2(\text{aq}) + \text{KI}(\text{aq}) \rightarrow$$
- Complete balanced neutralization reactions.
  - $\text{H}_3\text{PO}_4(\text{aq}) + \text{NaOH}(\text{aq}) \rightarrow$
  - $\text{HI}(\text{aq}) + \text{Na}_2\text{CO}_3(\text{aq}) \rightarrow$
- Describe the Arrhenius and Bronsted-Lowry definitions of an acid and a base.



21. Write an equation that demonstrates how pure water can act as both a Bronsted-Lowry acid and Bronsted-Lowry base at the same time.
22. List 3 properties of acids and 3 properties of bases.
23. Distinguish between strong acids (e.g. hydrochloric acid) and weak acids (e.g. acetic acid)
24. What is the pH of the following solutions?
  - a) 0.05 mol/L HCl
  - b) 0.00005 mol/L  $\text{HNO}_3$
25. What is the hydronium concentration of a hydrobromic acid solution with a pH of 0.7?
26. What volume of 0.520 mol/L sodium hydroxide are needed to neutralize 100 mL of a 7.50 mol/L hydrobromic acid solution? Include a balanced chemical equation.
27. 10.0 mL of 0.150 mol/L sulfuric acid is titrated with 24.5 mL of sodium hydroxide. Calculate the concentration of the base. Include a balanced chemical equation.
28. Sketch and label a heating curve for benzene ( $m_p = 5.5^\circ\text{C}$ ;  $b_p = 80.1^\circ\text{C}$ ).
29. A sample of gas has a volume of 54.0 L at  $22^\circ\text{C}$ . What will the volume be if it is cooled to  $-50^\circ\text{C}$ ?
30. The pressure on 925 mL of a gas is 1.20 kPa. What must the pressure be changed to in order to make the volume 0.700 L?
31. A 50.0 L volume of gas is at  $42^\circ\text{C}$  and 87 kPa. Calculate the temperature required to change the volume to 42.5 L at a pressure of 770 mmHg.
32. A student collects 300 mL of hydrogen over water at 105.7 kPa and  $25^\circ\text{C}$ . How many moles of the gas were collected? Be sure to correct for vapour pressure.
33. Calculate the number of:
  - a) moles in 45.2 L of carbon dioxide gas at STP
  - b) molecules in 45.2 L of carbon dioxide gas at STP
  - c) moles in 45.2 L of oxygen gas at STP
  - d) moles in 45.2 L of carbon dioxide gas at  $25^\circ\text{C}$  and 97.0 kPa.
  - e) 45.2 g of carbon dioxide gas at STP
  - f) 45.2 g of oxygen gas at STP.
34. What is the density of methane gas ( $\text{CH}_4$ ) at  $20^\circ\text{C}$  and 115 kPa?
35. If 1.00 L of nitrogen gas is reacted with 3.0 L of fluorine gas, how many litres of nitrogen trifluoride gas will be produced, assuming pressure and temperature remain constant?
36. A student collected 245 mL of an unknown gas X over water at an atmospheric pressure of 108.6 kPa and a temperature of  $20^\circ\text{C}$ . If the mass of the gas is 0.7802 g, determine the molar mass.