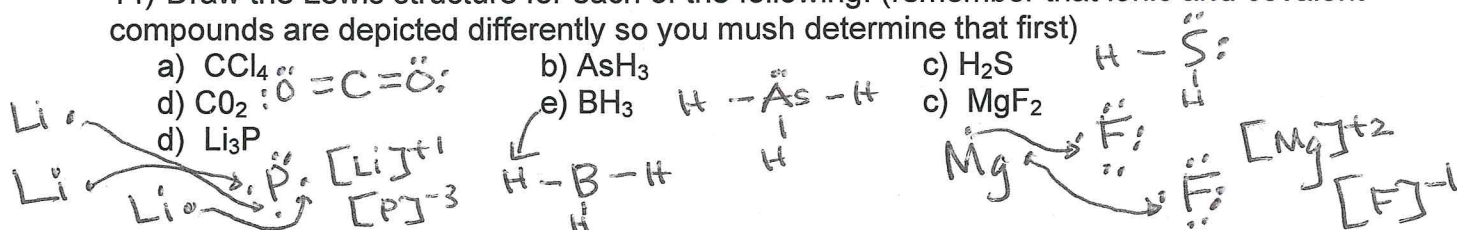


FINAL EXAM REVIEW QUESTIONS

Matter and Chemical Bonding

- 1) Classify each of the following as either an element, compound, a solution or a heterogeneous mixture:
- a) vinegar **S** b) mercury **E** c) brass **S**
d) potassium chlorate **C** e) milk of magnesia **S** f) sodium iodate **C**
- 2) Classify each of the following as either a physical change or a chemical change:
- a) burning paper **C** b) freezing water **P** c) rusting of iron **C**
d) dissolving sugar **P** e) sublimation of iodine **P** f) tarnishing of silver **C**
- 3) State the number of protons, number of electrons and number of neutrons in each of the following:
- a) ${}_{5}^{11}\text{B}$ b) ${}_{9}^{19}\text{F}$ c) ${}_{14}^{29}\text{Si}$
- 4) Draw a Bohr-Rutherford diagram for each of the following:
- a) ${}_{6}^{12}\text{C}$ b) ${}_{13}^{27}\text{Al}$ c) ${}_{20}^{40}\text{Ca}$
- 5) a) Which group of elements is the most metallic? **Alkali**
b) Which group of nonmetals is the most reactive? **Halogens**
c) Which group of nonmetals is the least reactive? **Inert/Noble Gases**
- 6) What is the most chemically reactive metal? **Fr**
- 7) What is the most chemically reactive nonmetal? **F**
- 8) Which one of the following has the largest atomic radius: Cl, Si, or **Mg**? Why?
- 9) Which one of the following has the largest ionization energy: S, Se, or **O**? Why?
- 10) Which one of the following has the largest electron affinity: S, Se, or **O**? Why?
- 11) Write an ionization equation for each of the following:
- a) Ca $\text{Ca} \rightarrow \text{Ca}^{2+} + 2e^{-}$ b) N Nitrogen is more likely to gain 3 electrons to complete its octet
 $\text{N} + 3e^{-} \rightarrow \text{N}^{-3}$
- 12) State five properties of
- a) an ionically bonded substance
b) a covalently bonded substance
- 13) Determine the type of bond between the following pairs of elements.
- a) H and P $\Delta E.N = 0$ Non-Polar b) H and S $\Delta E.N = 0.4$ Nonpolar c) Na and N $\Delta E.N = 2$ Ionic
d) C and S $\Delta E.N = 0$ Non Polar e) Cl and F $\Delta E.N = 1$ polar f) C and Si $\Delta E.N = 0.7 = \text{polar}$

14) Draw the Lewis structure for each of the following: (remember that ionic and covalent compounds are depicted differently so you must determine that first)



15) Write the chemical formula for each of the following compounds:

- a) lithium bromide LiBr
 b) calcium nitride Ca_3N_2
 c) carbon monoxide CO
 d) phosphorus(V) fluoride PF_5

16 i) Write the IUPAC/Stock name for each of the following compounds:

- a) SiCl_4 Silicon tetrachloride
 b) BaS Barium sulphide
 c) MgF_2 magnesium fluoride
 d) Li_3P Lithium phosphide

17) Write the chemical formula for each of the following compounds:

- a) magnesium nitrate $\text{Mg}(\text{NO}_3)_2$
 b) copper(II) oxide CuO
 c) potassium sulphate K_2SO_4
 d) calcium carbonate CaCO_3

18) Write the IUPAC/Stock name for each of the following compounds:

- a) $\text{Ca}(\text{OH})_2$ Calcium hydroxide
 b) NaClO_3 Sodium chlorate
 c) FeO Iron(II) oxide
 d) NH_4NO_3 ammonium nitrate

19) Write the chemical formula for each of the following compounds:

- a) sulphurous acid H_2SO_3
 b) barium nitrite $\text{Ba}(\text{NO}_2)_2$
 c) tin(IV) bromide SnBr_4
 d) ferric oxide Fe_2O_3

20) Write the IUPAC/Stock name for each of the following compounds:

- a) $\text{H}_3\text{PO}_4(\text{aq})$ Phosphoric acid
 b) CaSO_3 calcium sulphite
 c) $\text{Fe}(\text{NO}_3)_3$ Iron(III) nitrate
 d) CuCO_3 Copper(II) carbonate

21) Write the chemical formula for each of the following compounds:

- a) sodium chlorite NaClO_2
 b) potassium sulphate K_2SO_4
 c) copper(II) nitrate $\text{Cu}(\text{NO}_3)_2$
 d) ammonium perchlorate NH_4ClO_4

22) Write the IUPAC/Stock name for each of the following compounds:

- a) $\text{HNO}_2(\text{aq})$ nitrous acid
 b) $\text{Fe}(\text{OH})_3$ Iron(III) hydroxide
 c) KClO potassium hypochlorite
 d) $\text{HCl}(\text{aq})$ hydrochloric acid

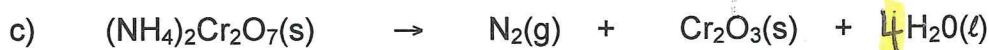
23) Write the chemical formula for each of the following compounds:

- a) potassium hydrogen sulphite KHSO_3
 b) magnesium dihydrogen phosphate $\text{Mg}(\text{H}_2\text{P})_2$
 c) lead(II) nitrate $\text{Pb}(\text{NO}_3)_2$
 d) sodium nitrite NaNO_2

24) Write the IUPAC/Stock name for each of the following compounds:

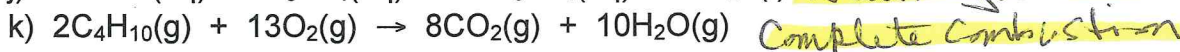
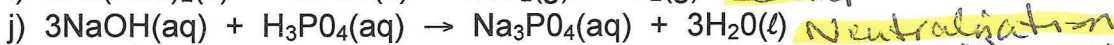
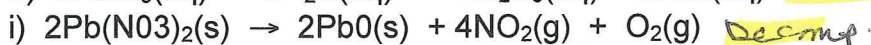
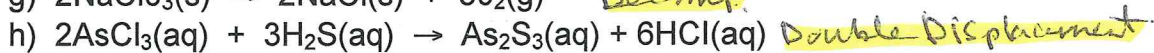
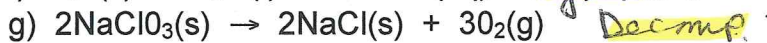
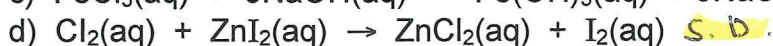
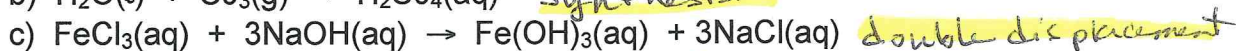
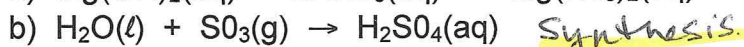
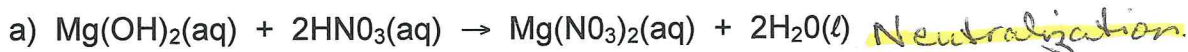
- a) $\text{Ba}(\text{NO}_2)_2$ Barium nitrite
 b) $\text{H}_2\text{S}(\text{aq})$ hydrogen sulphide
 c) LiHCO_3 Lithium hydrogen carbonate
 d) N_2O_3 dinitrogen trioxide

25) Balance the following equations:



Which one of the above equations in Qu. 25 represents the combustion of a hydrocarbon? (a)

26) Identify each of the following reactions as a synthesis, decomposition, combustion, single displacement or double displacement reaction:



Quantities In Chemical Reactions

1) Calculate the molar mass of: a) $\text{Mg}(\text{NO}_3)_2$ b) potassium carbonate

148.3 g/mol 138.2 g/mol

2) Calculate the number of moles in 556g of $\text{Fe}(\text{NO}_3)_3$.

$n = 2.3 \text{ moles}$

3) Calculate the mass of 2.5 mol of sodium carbonate.

$m = 265 \text{ g}$

4) Calculate the # of molecules in 4.00 mol of carbon dioxide gas.

$\# \text{ molecules} = 2.41 \times 10^{24}$

5) Calculate the mass of 1.55×10^{24} molecules of carbon dioxide gas.

$m = 113.28 \text{ g}$

6) Calculate the percentage composition of vitamin C ($\text{C}_6\text{H}_8\text{O}_6$).

$\% \text{ C} = 40.9$ $\% \text{ H} = 4.6\%$ $\% \text{ O} = 54.5\%$

7) Calculate the empirical formula of a compound which contains 37.5% C, 12.5% H and 50.0% O.

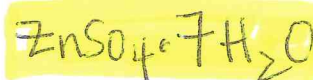
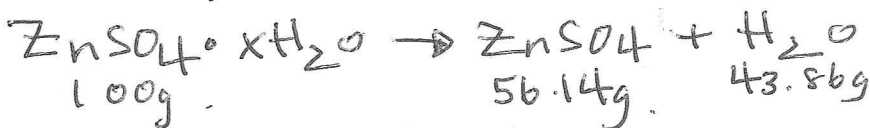
$\text{E.F.} = \text{CH}_4\text{O}$

8) Calculate the molecular formula of a compound if its simplest formula is $\text{NaC}_4\text{H}_2\text{O}_2$ and its molar mass is 210 g/mol.

$\text{M.F.} = \text{MM}_{\text{M.F.}} / \text{MM}_{\text{E.F.}} = \text{Na}_2\text{C}_8\text{H}_4\text{O}_4$

9) a) Calculate the percentage of water in $\text{Na}_2\text{CO}_3 \cdot 10 \text{H}_2\text{O}$.

b) When 100g of $\text{ZnSO}_4 \cdot x \text{H}_2\text{O}$ is heated, 43.86g of water is given off. Calculate the formula of the hydrate.



- 10) Calculate the mass of oxygen gas that reacts with 23.4g of HBr(aq) in the following reaction:



$$m_{\text{O}_2} = 2.27\text{g}$$

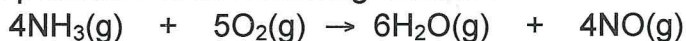
- 11)a) Sodium carbonate reacts with hydrochloric acid to produce carbon dioxide gas, water and sodium chloride solution. Calculate the mass of sodium chloride that would be produced when 50.0g of sodium carbonate reacts.

$$M_{\text{NaCl}} = 55.1\text{g}$$

- b) Calculate the % yield if a student collects 10.50g of sodium chloride from the reaction in 12) a).

$$\% \text{ yield} = \frac{\text{actual}}{\text{theoretical}} \times 100 = \frac{10.50}{55.1} \times 100 = 19\%$$

- 12) If 0.632g of $\text{NH}_3(\text{g})$ are allowed to react with 0.438g of $\text{O}_2(\text{g})$, calculate the mass of $\text{NO}(\text{g})$ that would be produced in the following reaction:



Limiting Reactant Question!

$$m_{\text{NO}} = 0.33\text{g}$$

Solutions and Solubility

L.R is O_2

E.R is NH_3

Amount excess left over = 0.44g NH_3

- 1) 30g of solute is dissolved in 100g of water. Calculate its % (m/m) concentration.

$$\% \text{ m/m} = \frac{m_{\text{solute}}}{m_{\text{solution}}} \times 100 \quad \% \text{ m/m} = 23\%$$

- 2) Calculate the mass of solute that would be in 65g of a saturated solution, if its solubility is 35% (m/m).

$$\frac{35}{100} = \frac{x}{65} \quad x = 22.75\text{g} \quad \text{or} \quad 35 = \frac{x}{65} (100) \quad x = 22.75\text{g}$$

- 3) 0.045 g of insecticide is found in a 1.7 k sample. Calculate the concentration in ppm of insecticide in the sample.

- 4) A solution was prepared by dissolving 105g of AgNO_3 in enough water to make 1.50 L of solution. Calculate the concentration of the solution in mol/L.

$$n_{\text{AgNO}_3} = 0.618\text{mol} \quad C = n/V(\text{L}) \quad C = 0.412\text{mol/L}$$

- 5) What is the difference between strong versus weak acid and bases and Concentrated versus dilute acids and bases?

- 6) a) What volume of 12.0 mol/L HCl is required to make 10.0 L of 0.150 mol/L HCl?

- b) How much water is needed? $C_1V_1 = C_2V_2$

$$\text{a) } V_{\text{HCl}} = 0.125\text{L}$$

$$\text{b) } V_{\text{H}_2\text{O}} = 9.875\text{L}$$

- 7) Write the balanced molecular chemical equation, the total ionic equation and the net ionic equation for each of the following precipitation reactions:

a) iron(III) nitrate(aq) + sodium hydroxide(aq)

b) lead(II) nitrate(aq) + potassium iodide(aq)

- 8) Calculate the volume of 0.165 mol/L sodium sulphate solution required to react with 65.0 mL of 0.175 mol/L barium chloride solution. (Double Displacement – 4 step calculation)



$$V = ? \quad V = 65\text{mL}$$

$$C = 0.165\text{mol/L} \quad C = 0.175\text{mol/L}$$

$$n_{\text{BaCl}_2} = C \times V(\text{L}) \\ = 0.175 \times 0.065 \\ = 0.011375\text{mol}$$

$$V_{\text{Na}_2\text{SO}_4} = \frac{n}{C} = \frac{0.011375\text{mol}}{0.165\text{mol/L}}$$

$$= 0.0689\text{L} \\ \approx 69\text{mL}$$

$$n_{\text{Na}_2\text{SO}_4} = 0.011375\text{mol}$$

9) What mass of solute will dissolve in 100mL of water at the following temperatures?

a. KNO_3 at 70°C = 130g/100g H_2O

b. NaCl at 100°C = 40g/100g H_2O

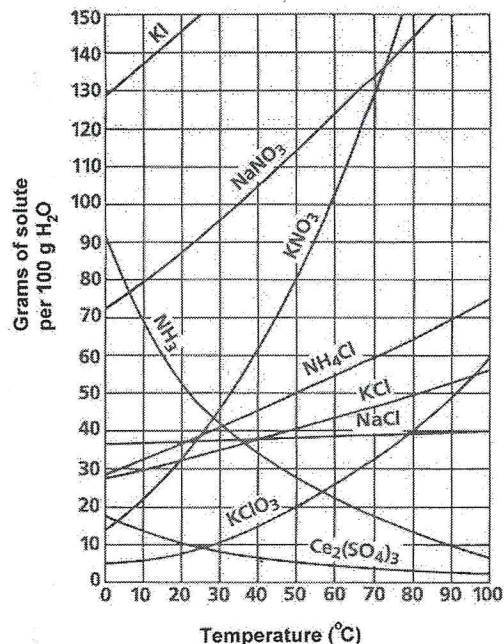
c. At 90°C , you dissolved 10 g of KCl in 100. g of water. Is this solution saturated or unsaturated?

d. Which compound is most soluble at 20°C ?

KI

e. Which is the least soluble at 40°C ?

$\text{Ce}_2(\text{SO}_4)_3$



10) a) $[\text{H}_3\text{O}^+]$ of a solution is 6.67×10^{-4} mol/L. Calculate the pH of the solution.

b) Is this an acidic solution or a basic solution?

$\text{pH} = -\log [6.67 \times 10^{-4}]$
 $\text{pH} = 3.18$

11) Write the balanced chemical equation for each of the following:

- phosphoric acid + sodium hydroxide
- sulphuric acid + potassium carbonate

12) 75.0 mL of 0.0800 mol/L HNO_3 solution was required to titrate 45.0 mL of KOH solution. Calculate the concentration of the KOH solution in mol/L. (Neutralization Question)

$C_{\text{KOH}} = 0.13 \text{ mol/L}$

Gases and Atmospheric Chemistry

1) Do the following conversions:

- -15°C to K 258K
- 575 K to $^\circ\text{C}$ 302 $^\circ\text{C}$

- 743 Torr to kPa 99.03 kPa
- 99.4 kPa to atm 0.98 atm

2) 8.0 L of a gas is at 112.5 kPa. What would the volume become if the pressure changed to 99.5 kPa? $P_1V_1 = P_2V_2$ $V_2 = 9.05 \text{ L}$

3) 15 L of a gas is at 25°C . What would the volume become if the temperature changed to -5.0°C ? $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $V_2 = 13.5 \text{ L}$

4) A gas has a volume of 25.0 L at 20°C and 101.3 kPa. What would the temperature become if the volume doubles and the pressure changes to 175 kPa?

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ $T_2 = 1012.3 \text{ K}$
 $= 739.3^\circ\text{C}$

5) What is the volume of 4.8 L of hydrogen gas if the pressure exerted on it increases from 55 kPa to 127 kPa? $P_1 V_1 = P_2 V_2$

$$V_2 = 2.1 \text{ L}$$

6) A welder needs 5000 L of oxygen gas at 150 kPa at a temperature of 21°C. To what pressure must a 50.0 L tank be filled at 13°C? (Combined Gas Law)

$$P_2 = 14591.8 \text{ kPa}$$

7) What is the final volume if 3.4 L of nitrogen gas at 400 K is cooled to 200 K?

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \quad V_2 = 1.7 \text{ L}$$

8) A gas mixture consists of 60.0% Ar, 30.0% Ne and 10.0% Kr. If the pressure of this gas mixture is 80.0 kPa, what is the partial pressure of each of the gases?

Ar. $80.0 \times 0.6 = 48 \text{ kPa}$ Ne $80 \times 0.3 = 24 \text{ kPa}$ Kr = 8 kPa

9) Calculate the number of moles in 13 L of HF(g) at STP.

$$n = PV/RT \quad n = 0.58 \text{ mols}$$

10) What is the molar mass of a compound if 560 mL of it has a mass of 1.10g at STP?

$$MM = 44 \text{ g/mol}$$

11) Calculate the mass of 4.0 mol of bromine gas, Br₂(g).

$$m = n \times MM \quad m = 4.0 \times 159.808 \text{ g/mol} = 639.23 \text{ g}$$

12) What volume will 220g of hydrogen sulphide gas occupy at STP?

$$V = nRT/P \quad V(\text{H}_2\text{S}) = 144.6 \text{ L}$$

13) What volume of oxygen gas will react with 5.0 L of hydrogen gas to form water vapour? at STP $\text{O}_2(\text{g}) + 2\text{H}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}$ $V_{\text{O}_2} = 2.5 \text{ L}$

14) 5.95g of Al reacts with sulphuric acid to form aluminum sulphate solution and hydrogen gas. What volume of hydrogen gas would be produced at 273°C and 300 kPa? $V_{\text{H}_2} = 5 \text{ L}$

15) If 0.632g of NH₃(g) are allowed to react with 0.438g of O₂(g), calculate the volume of NO(g) that would be produced at STP in the following reaction:



$$m = 0.632 \text{ g}$$

$$m = 0.438 \text{ g}$$

$$V = ?$$

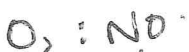
$$n_{\text{NH}_3} = 0.037$$

$$n_{\text{O}_2} = 0.01369$$



$$1 : 1$$

$$n_{\text{NO}} = 0.037 \text{ mol}$$



$$5 : 4$$

$$\frac{0.01369}{5} \times 4$$

$$n_{\text{NO}} = 0.01095$$

Limiting
Reactant
Question

$$V_{\text{NO}} = \frac{nRT}{P} = \frac{(0.01095)(8.314)(273)}{(101.3)}$$

$$V_{\text{NO}} = 0.25 \text{ L}$$