Bonding Unit Review

1. Copy and complete the following table.

Element name	Lewis symbol	Group number	Number of valence electrons	Number of lone pairs	Number of bonding electrons
calcium					
aluminium					
arsenic					
oxygen					
bromine					
neon					

2. (a) State the types of elements expected to react to form compounds containing covalent bonds.

   (b) State the types of elements expected to react to form compounds containing ionic bonds.

   (c) Explain your answers to (a) and (b) using the concept of electronegativity.

3. Using Lewis symbols and formulas, write the formation equation for each of the following compounds.
   (a) potassium bromide

   (b) sodium oxide

   (c) calcium fluoride

4. For each of the following molecular formulas, draw the Lewis, structural, and stereochemical formulas, and state the shape around the central atom.
   (a) OCl_2 (b) SiH_4 (c) NCl_3 (d) HCl (e) CH_2O

	OCl_2	**SiH_4**	**NCl_3**	**HCl**	**CH_2O**
Lewis					
Structural					
Shape					
Shape Name					

5. Classify each of the molecules represented in the previous question as polar or nonpolar.

6. Methylisocyanate is a toxic pesticide that is manufactured using the following chemical reaction.

   $CS_2 + CH_3NH_2 \longrightarrow CH_3NCS + H_2S$

   Rewrite this chemical equation using structural formulas for all reactants and products.

7. Define the three types of intermolecular forces. For each type of force, state how you would know if this type of force is likely present among molecules of a substance.

Gases Unit Review

1. Complete the following statements.

(a) At a constant temperature and chemical amount of gas, as the pressure increases, the volume_____.
(b) At a constant pressure and chemical amount of gas, as the temperature decreases, the volume_____.
(c) At a constant volume and temperature, if the chemical amount of gas inside a container is increased, the pressure _____.

2. Convert 95.8 kPa into units of millimetres of mercury and atmospheres.

3. A 1.5 L volume of gas is compressed at a constant temperature from 1.0 atm to 5.0 atm. Calculate the final volume.

4. A balloon can hold 800 mL of air before breaking. A balloon at 4.0 °C containing 750 mL of air is allowed to warm up. Assuming a constant pressure inside the balloon, determine the minimum Celsius temperature when the balloon breaks.

5. A sample of argon gas at 101 kPa and 22.0 °C occupies a volume of 150 mL. If the volume doubles at a temperature of 150°C, determine the new pressure.

6. Using the kinetic molecular theory, explain Boyle's and Charles' laws.

7. Many people use propane barbeques for outdoor cooking. Predict the volume of carbon dioxide produced when 15 L of propane completely burns at SATP.

8. Describe and compare the behaviour of real and ideal gases using the kinetic molecular theory.

9. Predict the volume that 25.0 g of oxygen gas would occupy at 22.0 °C and 98.1 kPa.

10. Compare the volume that 0.278 mol of hydrogen would occupy at STP and SATP.

11. An average bungalow requires about 400 kmol of methane per year for space heating.
    a. Determine the volume of methane at SATP used in one year.

    b. Predict the volume of methane used if the pressure is 98.5 kPa and the temperature is 12.7 °C.

Solutions, Acids and Bases Unit Review

1. Describe a homogeneous mixture and provide several examples.

2. Distinguish between electrolytes and non-electrolytes, including examples of types of substances in each category.

3. Explain, in terms of breaking and forming bonds, why the dissolving of substances in water can be either exothermic or endothermic.

4. Compounds may be ionic or molecular and may also be acids, bases, or neutral compounds.
   (a) Design an experiment to classify the solute in each of a number of different solutions.

   (b) Outline the expected results.

5. Write dissociation or ionization equations for the following pure substances dissolving in water.
   (a) lithium phosphate solid

   (b) hydrogen chloride gas

   (c) aluminium sulfate solid

6. Suppose you are given four unlabelled beakers, each containing a colourless aqueous solution of one solute. The possible solutions are NaCl(aq), HCl(aq), $BaCl_2(aq)$, and $CH_3Cl(aq)$.Write a series of diagnostic tests to distinguish each solution from the others.

7. A household cleaner contains 12.5 g of sodium hypochlorite in 500 mL of solution. Determine the percentage mass by volume concentration of this solution.

8. A drain cleaner contains 2.75 mol/L sodium hydroxide. Calculate the volume of solution that contains 0.375 mol of sodium hydroxide.

9. A windshield washer solution was prepared by dissolving 100 g of methanol in water to form 2.00 L of solution. Calculate the amount concentration of the solution.

10. For an experiment, 100 mL of a 0.251 mol/L calcium chloride solution is required.
    (a) Calculate the mass of calcium chloride that needs to be measured.

    (b) Write a specific procedure for an untrained laboratory technician to prepare this solution.

11. Predict the volume of concentrated, 14.6 mol/L phosphoric acid required to prepare 250 mL of a 0.375 mol/L solution.

12. Calculate the amount concentration of each ion in a 2.1 mol/L solution of iron(III) chloride? properties.

13. Write the acid formula for each of the following substances.
(a) aqueous hydrogen bromide

(b) aqueous hydrogen sulphite

(c) hydrofluoric acid

(d) sulfuric acid

14. Complete the following table.

$[H_3O^+(aq)]$ (mol/L)	pH	Acidic/basic/neutral
1.0×10^{-7}		
	8	
	3.7	
6.23×10^{-9}		

15. The pH of pure water is 7, of carbonated water about 5, and of a cola drink about 3. How many times more acidic is a cola drink than carbonated water and pure water?

16. Use the modified Arrhenius theory to write chemical equations explaining the following evidence.
(a) A vinegar solution is acidic.

(b) A baking soda (sodium hydrogen carbonate) solution has a pH of 8.

(c) Some muriatic (hydrochloric) acid is neutralized with a lye (sodium hydroxide) solution.

17. A simple window cleaning solution containing 0.25 mol/L ammonia has a pOH of 2.5.
(a) Convert the pOH into an amount concentration of hydroxide ions.

(b) Write a balanced chemical equation to explain this basic solution.

(c) Is ammonia a strong or weak base? Justify your answer.

18. Polyprotic acids and bases occur naturally and are manufactured for a variety of purposes. Distinguish between monoprotic and polyprotic acids and bases.

Stoichiometry Unit Review

1. 100g of iron (III) hydroxide is formed from the reaction of iron, water and oxygen. What mass of iron reacted to produce 100g or iron (III) hydroxide?

2. In photosynthesis, what volume of $CO_{2(g)}$ is used to produce 50 g of glucose? Assume SATP conditions.

3. In a reaction between 100 mL of barium nitrate and 100 mL of sodium sulfate, 3.55 g of precipitate is produced, what is the concentration of the sodium sulfate used in this reaction? Assume that the barium nitrate is present in excess quantity.

4. Determine the net ionic equation for the reaction between sodium chloride and bromine.

5. A student wanted to figure out the concentration of a solution of NaOH(aq), so she titrated 10.0 mL samples of 0.285 mol/L HCl(aq) with the unknown NaOH(aq) solution. Below are the results obtained, calculate the concentration of the NaOH(aq).

Trial	1	2	3
final burette reading (mL)	10.7	21.1	31.5
initial burette reading (mL)	0.2	10.7	21.1
volume of NaOH(aq) added (mL)	10.5	10.4	10.4
indicator colour	pink	pink	pink

6. In an experiment, 26.8 g of iron (III) chloride in solution is combined with 21.5 g of sodium hydroxide in solution. Which reactant is in excess? What mass of precipitate will be obtained?

7. Determine the net ionic equation for the reaction between zinc and hydrochloric acid.