

REVIEW - Atomic Structure

1. Define all of the terms in objective 1 as well as ionization energy.
2. Make your own notes on the evolution of the atomic model by referring to your textbook, the internet or your grade 11 notes. Your notes should include the Greeks, Alchemists, Dalton, Thompson, Rutherford, Chadwick, Bohr, de Broglie, Schrodinger and Pauli.
3. Set up a chart similar to the one below and fill in the first **four** columns. The chart should contain the first 20 elements.

Element	Bohr Diagram	Lewis Dot	Electron Configuration	Quantum Mechanical 3D

4. Refer to your grade 11 notes on Quantum Mechanics and summarize the following:
 - a. the "name" of each orbital and the number of sub-orbitals each orbital has
 - b. define the Pauli Exclusion Principle, Hund's Rule and the Aufbau Principle
 - c. pattern used to fill in an elements electron configuration
5. Define the following terms: periodic law, periods, groups, representative elements, transition elements, inner transition elements, alkali metals, alkaline earth metals, noble gases, halogens, metals, non-metals, metalloid.
6. Review the section on bonding (ionic, non-polar covalent, polar covalent, coordinate covalent) and also look over your Grade 11 bonding assignment in detail!

REVIEW – Stoichiometry

1. Balance the following chemical reactions.
 - a. iron (III) oxide reacts with carbon to produce iron and carbon dioxide
 - b. aluminum and sulfuric acid react to produce hydrogen gas and aluminum sulphate
 - c. iron (II) chloride, potassium permanganate and hydrochloric acid all react together to produce ferric chloride, potassium chloride, manganese (II) chloride and water
2. How many particles (atoms/molecules) are there in:
 - a. 1 mole of magnesium
 - b. 3 moles of oxygen gas
 - c. 4.2 moles of glucose ($C_6H_{12}O_6$)
3. Give the number of carbon and hydrogen atoms in 4.2 moles of glucose
4. Complete the handout "Some More Stoichiometry Questions". The answers are in brackets.
5. How would you make:
 - a. 1 L of a 0.5 mol/L solution of sodium chloride
 - b. 2 L of a 0.1 M solution of sodium carbonate
 - c. 500 mL of a 0.75 sulfuric acid solution from a 18 M solution
 - d. 100 mL of a 3.4 M hydrochloric acid solution
6. Complete the handout "Gas Law Problems".
7. Complete the handout "Stoichiometry Assignment".

SOME MORE STOICHIOMETRY QUESTIONS (answers in the brackets)

1. Calculate the mass of mercury that should have been produced when 1.72 g of mercury (II) oxide is decomposed by heating. (1.59 g)
2. When carbon and iron (III) oxide are heated together, they react to form metallic iron and carbon dioxide gas. Calculate the mass of carbon dioxide that should be produced in this reaction when 3.42 g of iron (III) oxide reacts with an excess of carbon. (1.41 g)
3. Iron reacts with oxygen to form iron (III) oxide. Determine the mass of iron (III) oxide produced when 112 g of iron reacts with an excess of oxygen gas. (160 g)

- Calculate the mass of oxygen gas produced when 43.8 g of potassium chlorate are decomposed by heating. (17.2 g)
 $\text{KClO}_3(\text{s}) \rightarrow \text{KCl}(\text{s}) + \text{O}_2(\text{g})$
- Determine the mass of copper that can be produced from the decomposition of 217 g of copper (II) chloride. (103 g)
 $\text{CuCl}_2(\text{s}) \rightarrow \text{Cu}(\text{s}) + \text{Cl}_2(\text{g})$
- Calculate the number of grams of silver that could be obtained by the reaction of a large excess of copper metal with 5.1 g of silver nitrate in aqueous solution. (3.24 g)
 $\text{Cu}(\text{s}) + \text{AgNO}_3(\text{aq}) \rightarrow \text{Ag}(\text{s}) + \text{Cu}(\text{NO}_3)_2(\text{aq})$
- What mass of aluminum is required to prepare 12.0 g of hydrogen in the following reaction?
 (108 g) $\text{Al}(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{Al}_2(\text{SO}_4)_3 + \text{H}_2(\text{g})$

GAS LAW PROBLEMS

- What volume would 10.0 g of oxygen gas occupy at 20°C and 90.0 kPa?
- A 3.50 L gas cylinder at 50°C contains 200 g of carbon dioxide gas. What is the gas pressure in the cylinder?
- The pressure in a 30 L car tire is 400 kPa. If the tire contains 120 g of nitrogen gas, what is the temperature of the tire?
- A 2.00 L glass flask contains 3.88 g of an unknown gas held at 110 kPa and 27°C. Determine the molar mass of the unknown gas.
- Calculate the volume occupied by half a mole of carbon dioxide at 33.0 kPa and -35°C.
- How many moles of gas is there in a sample that occupies a volume of 570 cm³ at 78°C and a pressure of 103 kPa?
- One liter of gas at 100 kPa and -20°C is compressed to half a liter at 40°C. What is its final pressure?
- 16.0 g of oxygen gas is introduced into an evacuated 10 L flask at -77°C. What is the pressure in this flask?
- 56.0 g of nitrogen gas is introduced into an evacuated 20 L flask at -73°C. What is the pressure in the flask?
- What mass of methane gas is represented by a volume of 1.03 L collected at 90 kPa and 25°C?
- A fire extinguisher contained 4.2 kg of liquid carbon dioxide. What volume of carbon dioxide gas can be expelled into a room if the temperature of the room is 28°C and atmospheric pressure is 98 kPa?
- At a temperature of 97°C, and a pressure of 304 kPa, 4.12 L of carbon dioxide gas was collected. How many moles of the gas were collected?
- A student collects 45.0 cm³ of hydrogen gas over water at 19°C and 104.2 kPa. How many moles of hydrogen gas were collected?
- What volume is occupied by 0.033 mol of a gas at 19°C and 50.0 kPa?
- What volume is occupied by 0.0273 mol of oxygen at 27°C and 107 kPa?
- What volume of oxygen gas at 100 kPa and 7°C is produced when 300 g of bauxite (aluminum oxide) is electrolyzed to produce aluminum?
 $\text{Al}_2\text{O}_3 \rightarrow \text{Al} + \text{O}_2$
- If 300 mL of a 1.2 M hydrochloric acid solution is used to react with excess iron, calculate:
 - the volume of hydrogen gas produced at 47°C and 105 kPa
 - the mass of iron used up
 - the concentration of iron (III) chloride produced

STOICHIOMETRY “ASSIGNMENT” (not really an assignment)

1. Calculate the mass of MgO that would be formed by the reaction of 24.3 g of magnesium with an excess of oxygen.
2. Calculate the mass of calcium carbonate that on reaction with an excess of hydrochloric acid would produce 44.8 L of carbon dioxide gas at STP. Calcium chloride and water are the other two products.
3. Calculate the volume of hydrogen gas, measured at STP that would be produced by the reaction of 2.70 g of aluminum with an excess of hydrochloric acid. Aluminum chloride is the other product of this reaction.
4. Calculate the mass of copper that would be produced by the reaction of 7.95 g of copper (II) oxide with an excess of hydrogen gas. Water is the other product.
5. Calculate the volume of propane gas (C₃H₈), measured at STP, that would be required for the formation of one mole of carbon dioxide gas. This is a combustion reaction.
6. Iron pyrite (FeS₂) reacts with oxygen to produce sulfur dioxide and iron (III) oxide. Calculate the mass of iron pyrite that would react with excess oxygen to give just 64 g of sulfur dioxide.
7. Calculate the mass of silver chloride that would be precipitated on treating 25.0 mL of a 0.1 M barium chloride solution with an excess of silver nitrate solution. The other product is barium nitrate.
8. Calculate the number of moles of carbon dioxide gas, measured at STP, that would be produced if 1.06 g of sodium carbonate is treated with 50.0 mL of a 1.0 M hydrochloric acid solution, knowing that sodium chloride and water are also produced.
9. What volume of chlorine gas, measured at 25°C and 780 mmHg, would be made by the reaction of 35 g of potassium permanganate with an excess of hydrochloric acid. Potassium chloride, manganese (II) chloride and water are also made during this reaction.
10. Iron (III) oxide reacts with chlorine gas to produce iron (III) chloride and oxygen chloride (OCl₂)
 - a. how many moles of chlorine gas reacts with 3 moles of iron (III) chloride
 - b. what mass of iron (III) chloride is produced if 25 g of chlorine reacts with excess iron (III) oxide?
 - c. what volume of oxygen chloride at 27°C and 200 kPa is made when 350 g of iron (III) oxide reacts with excess chlorine?
11. C₃H₆O₃(l) + O₂(g) → CO₂(g) + H₂O(l) (unbalanced) What volume of carbon dioxide at STP is produced when 100 L of oxygen gas at STP is consumed in burning 126.5 g of glycerine?
12. If 19 g of aluminum is dissolved in 250 mL of 0.15 M sulfuric acid, determine:
 - a. the mass of aluminum sulfate made
 - b. the excess reactant and the number of moles of it left over
13. A precipitate of silver chloride appears when 250 mL of 0.55 mol/L silver nitrate solution is added to 650 mL of 0.38 M barium chloride solution. Determine:
 - a. the mass of the silver chloride precipitate
 - b. the concentration of the barium nitrate solution produced
 - c. the concentration of the excess reactant after the reaction is over
$$\text{AgNO}_3(\text{aq}) + \text{BaCl}_2(\text{aq}) \rightarrow$$
14. 600 g of calcium is added to 5.5 L of 3.0 M sulfuric acid.
 - a. what mass of calcium sulfate is made?
 - b. what volume of hydrogen gas at 200 kPa and 127°C is formed?
15. Determine the mass of all substances that remain after 125 g of iron (III) oxide has reacted with 55 g of magnesium metal. This is a single replacement reaction.