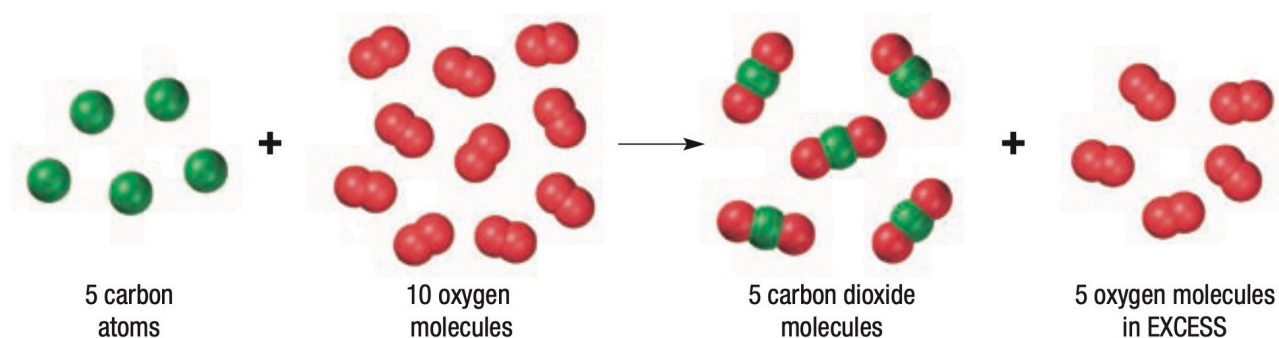


Chemistry Revision Semester 2

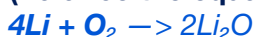


1. Explain which substance is the limiting reactant. Give reason for your answer and also state the excess reactant.

Ans. The limiting reactant is the carbon atoms because only 5 carbon atoms are present which gives only 5 carbon dioxide molecules so it limits the amount of product being formed. The excess reactant is the oxygen molecules.

2. The elements lithium and oxygen react explosively to form lithium oxide, Li_2O . How many moles of lithium oxide will form if 2 mol of lithium reacts?

(Balance the equation first)



Given: 2 mol Li

Unknown: mol of Li_2O

Working: $2 \text{ mol Li} \times 2 \text{ mol Li}_2\text{O} / 4 \text{ mol Li} = 1 \text{ mol Li}_2\text{O}$

3. The disinfectant hydrogen peroxide H_2O_2 decomposes to form water and oxygen gas. How many moles of O_2 will result from the decomposition of 5 mol of hydrogen peroxide?

(Balance)

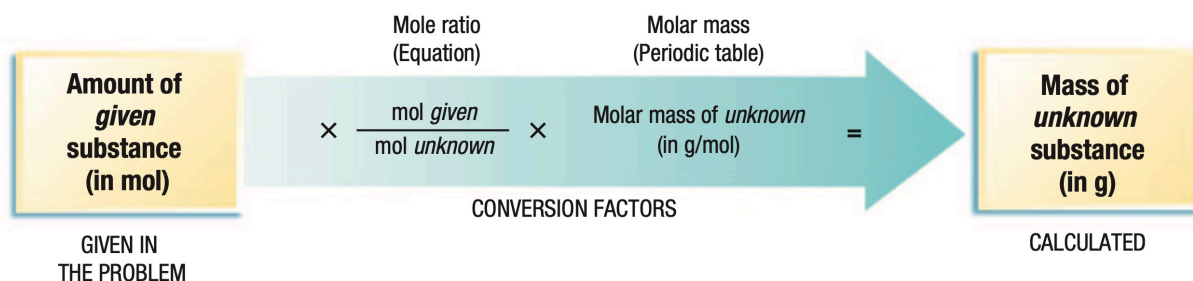


Given: 5 mol of H_2O_2

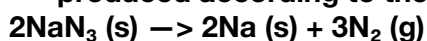
Unknown: mol of O_2

Working: $5 \text{ mol H}_2\text{O}_2 \times 1 \text{ mol O}_2 / 2 \text{ mol H}_2\text{O}_2 = 2.5 \text{ mol O}_2$

Formula to memorize:



4. When sodium azide is activated in an automobile airbag, nitrogen gas and sodium are produced according to the following equation:



If 0.500 mol NaN_3 reacts, what mass in grams of nitrogen would result?

Given: 0.500 mol NaN_3

Unknown: mass of nitrogen

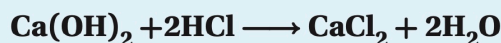
Working:

$$Mr(N_2) = 2 \times 14 = 28 \text{ g/mol}$$

$$0.500 \text{ mol NaN}_3 \times 3 \text{ mol N}_2 / 2 \text{ mol NaN}_3 \times 28 = 21.0 \text{ g N}_2$$

5.

Sample Problem F Calcium hydroxide, used to neutralize acid spills, reacts with hydrochloric acid according to the following equation:



If you have spilled 6.3 mol of HCl and put 2.8 mol of Ca(OH)_2 on it, which substance is the limiting reactant?

(this type of question will come in the exam)

Given: 6.3 mol of HCl

2.8 mol of Ca(OH)_2

Unknown: limiting reactant

Working:

$$1. \quad 6.3 \text{ mol HCl} \times 1 \text{ mol CaCl}_2 / 2 \text{ mol HCl} = 3.15 \text{ mol CaCl}_2$$

$$2. \quad 2.8 \text{ mol Ca(OH)}_2 \times 1 \text{ mol CaCl}_2 / 1 \text{ mol Ca(OH)}_2 = 2.8 \text{ mol CaCl}_2$$

Ca(OH)_2 is the limiting reactant since it produces less amount of product of CaCl_2

b. How many moles of excess reactant remains?

HCl is the excess reactant

(Use the limiting product)

$$2.8 \text{ mol CaCl}_2 \times 2 \text{ mol HCl} / 1 \text{ mol CaCl}_2 = 5.6 \text{ mol HCl}$$

5.6 mol of HCl is used up so to find the excess subtract the amount of mol of HCl with amount used up which is 5.6 mol

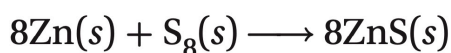
$$6.3 - 5.6 = 0.7 \text{ mol of HCl remains (excess/not used up)}$$

c. How many moles of product will be formed?

$$2.8 \text{ mol CaCl}_2$$

6.

Zinc and sulfur react to form zinc sulfide according to the following equation.



a. If 2.00 mol of Zn is heated with 1.00 mol of S_8 , identify the limiting reactant

b. How many moles of excess reactant remain?

c. How many moles of the product are formed?

a.

Given: 2.00 mol of Zn

1.00 mol of S_8

Unknown: limiting reactant

Working:

$$1. \quad 2.00 \text{ mol of Zn} \times 8 \text{ mol of ZnS} / 8 \text{ mol of Zn} = 2.00 \text{ mol of ZnS}$$

$$2. \quad 1.00 \text{ mol of S}_8 \times 8 \text{ mol of ZnS} / 1 \text{ mol of S}_8 = 8.00 \text{ mol of ZnS}$$

Zn is the limiting reactant

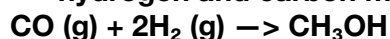
b. The excess reactant is S_8

$$2.00 \text{ mol of ZnS} \times 1 \text{ mol of S}_8 / 8 \text{ mol of ZnS} = 0.25 \text{ mol of S}_8 \text{ used in the reaction}$$

$$1 - 0.25 = 0.75 \text{ mol of S}_8 \text{ remains/is excess}$$

c. 2.00 mol of ZnS will be formed

7. Methanol, CH_3OH , is the simplest of the alcohols. It is synthesized by the reaction of hydrogen and carbon monoxide.



a. If 500 mol CO and 750 mol H_2 are present, which is the limiting reactant?

Given: 500 mol of CO

750 mol of H_2

Unknown: limiting reactant

Working:

1. $500 \text{ mol of CO} \times 1 \text{ mol of CH}_3\text{OH} / 1 \text{ mol of CO} = 500 \text{ mol of CH}_3\text{OH}$

2. $750 \text{ mol of H}_2 \times 1 \text{ mol of CH}_3\text{OH} / 2 \text{ mol of H}_2 = 375 \text{ mol of CH}_3\text{OH}$

The limiting reactant is H_2

b. How many moles of the excess reactant remains unchanged?

The excess reactant is CO

$375 \text{ mol of CH}_3\text{OH} \times 1 \text{ mol of CO} / 1 \text{ mol CH}_3\text{OH} = 375 \text{ mol of CO used up}$

$500 - 375 = 125 \text{ of CO remains unchanged}$

c. How many moles of CH_3OH are formed?

375 mol of CH_3OH are formed

8. Write all possible mole ratios: $2\text{Ca} + \text{O}_2 \rightarrow 2\text{CaO}$

a. $2 \text{ mol Ca} / 2 \text{ mol CaO}$

b. $2 \text{ mol CaO} / 2 \text{ mol Ca}$

c. $1 \text{ mol O}_2 / 2 \text{ mol CaO}$

d. $2 \text{ mol CaO} / 1 \text{ mol O}_2$

e. $2 \text{ mol Ca} / 1 \text{ mol O}_2$

f. $1 \text{ mol O}_2 / 2 \text{ mol Ca}$

9. Explain the concept of mole ratio as used in reaction stoichiometric problems:

Ans: A mole ratio is a conversion factor that relates the number of moles of any two substances involved in a chemical reaction.

10. Why is a balanced chemical equation important in stoichiometry?

Ans: It provides mole ratios needed to solve stoichiometry problems.

11. What do coefficients in a balanced chemical equation represent?

Ans: They represent the relative number of moles of reactants and products.

12. How does stoichiometry help chemists?

Ans: It helps to determine mass relationships in chemical reactions.

13. What is a limiting reactant?

Ans: A substance that restricts the amount of other reactant used in chemical reactions.

14. Write the formula to calculate % yield.

Ans. Percentage yield = actual yield / theoretical yield x100

15. What is actual yield?

Ans: The measured amount of product obtained from a chemical reaction.

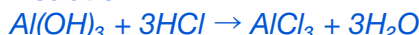
16. What is theoretical yield?

Ans: The maximum amount of product that can be produced from a given amount of reactant.

17. Some antacid medications use aluminum hydroxide to counteract the hydrochloric acid in the stomach. $\text{Al(OH)}_3 + 3\text{HCl} \rightarrow \text{AlCl}_3 + 3\text{H}_2\text{O}$. If a dose of antacid containing 28g

Al(OH)_3 reacts to produce 44g AlCl_3 , what is the percentage yield of AlCl_3

Reaction:



Given:

28g ——— 44g (actual yield)

$$M_r [\text{Al(OH)}_3] = 27 + 3 \times 16 + 3 = 27 + 48 + 3 = 78 \text{ g/mol}$$

$$M_r [\text{AlCl}_3] = 27 + 3 \times 35.5 = 133.5 \text{ g/mol}$$

$$\begin{array}{r} 78 \quad \text{—————} \quad 133.5 \\ 44 \quad \text{—————} \quad x \end{array}$$

$$X = \frac{133.5 \times 78}{44} = 47.9 \text{g (theoretical yield)}$$

$$\% \text{ yield} = (44 / 47.9) \times 100 = 92\%$$

18. Calculate the indicated quantity for each of the various chemical reactions given:

a. Theoretical yield = 20.0g, actual yield = 15.0g, percentage yield = ?

$$(15 / 20) \times 100 = 75\%$$

b. Theoretical yield = 1.0g, percentage yield = 90.0%, actual yield = ?

Convert % yield to decimal (divide by hundred)

$$1.0 \times 0.9 = 0.9\text{g}$$

19. The percentage yield for the reaction $\text{PCl}_3 + \text{O}_2 \rightarrow \text{PCl}_5$ is 83.2%. What mass of PCl_5 is expected from the reaction of 73.7g PCl_3 with excess chlorine?

Reaction:



$$M_r (\text{PCl}_3) = 31 + 3 \times 35.5 = 137.5 \text{ g/mol}$$

$$M_r (\text{PCl}_5) = 31 + 5 \times 35.5 = 208.5 \text{ g/mol}$$

$$137.5 \text{ ——— } 208.5$$

$$78 \text{ ——— } ?$$

$$x = (73.7 \times 208.5) / 137.5 = 111.76 \text{ g (theoretical yield)}$$

Actual yield = % × theoretical yield

$$= 83.2\% \times 111.76 = 92.98 \text{ g}$$

20. Write the 5 assumptions of kinetic molecular theory.

- Gases consist of large numbers of tiny particles that are far apart relative to their size. Most of the volume occupied by a gas is empty space.
- Collisions between gas particles and between particles and container walls are elastic collision (no net loss of total KE).
- Gas particles are in continuous, rapid, random motion (KE).
- There are no forces of attraction between gas particles.
- The temperature of a gas depends on the average kinetic energy of the particles of the gas.

21. Name the liquid that is filled in manometers and barometers.

Ans: mercury

22. State the condition under which a real gas behaves like an ideal gas.

Ans: high temp and low pressure are both needed.

23. Name a hypothetical gas perfectly fits the assumptions of kinetic molecular theory.

Ans: ideal gas

24. Which condition is necessary for most gases to behave nearly ideally?

Ans: *high temperature*

25. Differentiate between diffusion and effusion.

Diffusion: *spontaneous mixing of particles caused by their random motion*

Effusion: *process by which gas particles pass through a tiny opening*

26. What are crystalline and amorphous solids?

A **crystalline solid** is a substance in which the particles are arranged in an orderly, geometric, repeating pattern.

An **amorphous solid** is one in which the particles are arranged randomly.

27. Define pressure and state its SI unit.

Ans: *Pressure is force/area | unit - pascal*

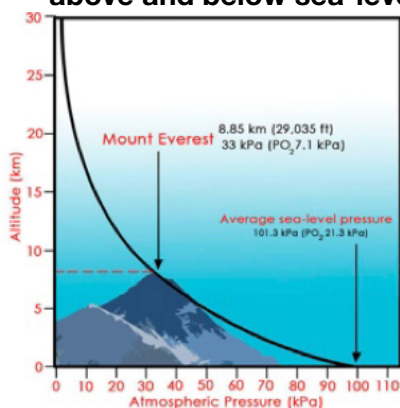
28. How much is standard atmospheric pressure equal to?

Ans: *760 mm Hg*

29. Conversion of pressure using conversion factors.

UNITS OF PRESSURE			
Unit	Symbol	Definition/relationship	Application
pascal	Pa	SI pressure unit $1 \text{ Pa} = \frac{1 \text{ N}}{\text{m}^2}$	scientific (kPa)
millimeter of mercury	mm Hg	pressure that supports a 1 mm mercury column in a barometer	blood pressure monitors
torr	torr	$1 \text{ torr} = 1 \text{ mm Hg}$	vacuum pumps
atmosphere	atm	average atmospheric pressure at sea level and 0°C $1 \text{ atm} = 760 \text{ mm Hg}$ $= 760 \text{ torr}$ $= 1.01325 \times 10^5 \text{ Pa}$ $= 101.325 \text{ kPa}$	atmospheric pressure
pounds per square inch	psi	$1 \text{ psi} = 6.89286 \times 10^3 \text{ Pa}$ $1 \text{ atm} = 14.700 \text{ psi}$	tire gauges

30. Why is the atmospheric pressure lower at higher altitudes? What happens to pressure above and below sea-level?



Ans: *As altitude increases, the amount of gas molecules in the air decreases—the air becomes less dense than air nearer to sea level. While below sea level, the atmospheric pressure is caused by the weight of the air above you so it is greater.*

DISCLAIMER:

This study material is NOT enough to study from. You still need to be diligent to study from classwork and skills evaluation, as well as your notes from notebook and uploaded PPT in the Google Classroom.