CHEMISTRY 9th (New Book)

CHAPTER NO 4 STOICHIOMETRY

Exercise Multiple Choice Questions

1.	0.334×10^{23} atoms	2.	Ca_3P_2
3.	6.022×10^{23} amu	4.	CH_2
5.	0.255 moles	6.	3.01×10^{23}
7.	108 g	8.	N_2H_4
9.	Ethane (C_2H_6)	10.	1.32 g

Q#2: Short Question Answer

i. Write down the chemical formula of barium nitride.

Barium Nitride: Ba_3N_2

ii. Find out the molecular formula of a compound whose empirical formula is CH_2O and its molar mass is 180.

- Empirical formula = CH_2O
- Empirical formula mass of CH_2O = 12 (C) + 2×1 (H) + 16 (O) = **30 g/mol**
- Molecular formula mass = **180 g/mol**

Steps: n = (molecular mass)/(formula mass)

n = 180/30 = 6

6 (CH_2O) = $C_6H_{12}O_6$ (Glucose)

iii. How many molecules are present in 1.5 g H_2O?

- Step 1: Molar mass of H_2O = 2(1) + 16 = **18 g/mol**
- Step 2: Moles of H_2O = 1.5 ÷ 18 = **0.0833 mol**
- Step 3: 0.0833 × 6.022×10^{23} = **5.01×10^{22} molecules**

Final Answer: 5.01×10^{22} molecules of H_2O

iv. Difference between a mole and Avogadro's number:

Mole	Avogadro's Number
A unit of measurement for amount of substance.	A fixed numerical value: 6.022×10236.022 10^{23}.
Represents a collection of particles (atoms, molecules, ions, etc.).	Represents the number of particles present in one mole.
Symbol: **mol**.	Symbol: N_A.

v. Write down the chemical equation of the following reaction:

$$Cu + 2H_2SO_4 \rightarrow CuSO_4 + 2H_2O + SO_2$$

Q #3: Constructed Response Questions

i. Different compounds will never have the same molecular formula but they can have the same empirical formula.

- **Empirical formula** shows the simplest whole-number ratio of atoms in a compound.
- **Molecular formula** shows the actual number of each type of atom.

Examples:

- Glucose → $C_6H_{12}O_6$
- Acetic acid → $C_2H_4O_2$
- Formaldehyde → CH_2O

All have the same empirical formula: **CH_2O**

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ii. Write down the chemical formulas of the following compounds:

Name of compound	Chemical Formula
Calcium Phosphate	$Ca_3(PO_4)_2$
Aluminium Nitride	AlN
Sodium Acetate	CH_3COONa
Ammonium Carbonate	$(NH_4)_2CO_3$
Bismuth Sulphate	$Bi_2(SO_4)_3$

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iii. Importance of Avogadro's number in chemistry:

Avogadro's number (6.022×10^{23}) helps count atoms, molecules, or ions by weighing them. It connects the microscopic world of particles to the macroscopic world of grams and moles.

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iv. When 8.657 g of a compound were converted into elements, it gave:

- Carbon = 5.217 g
- Hydrogen = 0.962 g
- Oxygen = 2.478 g

Calculations:

- % C = (5.217 ÷ 8.657) × 100 = **60.26%**
- % H = (0.962 ÷ 8.657) × 100 = **11.11%**
- % O = (2.478 ÷ 8.657) × 100 = **28.62%**

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v. How to calculate the masses of products formed in a reversible reaction?

Steps:

1. Write the balanced chemical equation.
2. Determine initial moles of reactants.
3. Identify the limiting reactant.
4. Assume that *x* moles of reactants convert to products.
5. Determine the change in concentrations.
6. Apply the equilibrium constant (Kc) to solve for *x*.
7. Calculate equilibrium moles of products.
8. Convert moles to masses using molar masses.

ZQ #4: Descriptive Questions

1. Which conditions must be fulfilled before writing a chemical equation for a reaction?

Ans: Following conditions must be fulfilled before writing a chemical equation.

- Identification of reactants and products along with their physical state
- Type of reaction i.e. Combustion, synthesis etc.
- Balancing of atoms on both sides of the reaction according to law of conservation of mass.

2. Explain the concepts of Avogadro's numbers and mole.

Ans: See answer in Question number 7 & 8

3. How many grams of CO_2 will be produced when react 10 g of CH_4 with excess of O_2 according to the following equation?

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

Ans: Moles of $CH_4 = \frac{\text{Mass of CH4}}{\text{Molar mass of CH4}} = \frac{10\text{ g}}{16\text{ g/mol}} = 0.625$ moles

From above equation it is clear that one mole of CH_4 produces one mole of CO_2 so, 0.625 moles of CH_4 will produce 0.625 moles of CO_2

Mass of CO_2 = moles of CO_2 × molar mass of CO_2

Molar mass of $CO_2 = 12 + 32 = 44$ gmol$^-$

Mass of CO_2 = moles of CO_2 × molar mass of CO_2

Mass of $CO_2 = 0.625$ mole × 44 gmol$^-$

Mass of $CO_2 = 27.5$ g

4. How many moles of coal are needed to produce 10 moles of CO according to the following equation?

$$3C + O_2 + H_2O \rightarrow H_2 + 3CO$$

Ans: From the above reaction it is clear that 3 moles of Coal produced 3 moles of CO, so 10 moles of Coal produced 10 moles of CO.

5. How much SO_2 is needed in grams to produce 10 moles of Sulphur?

$$2H_2S + SO_2 \rightarrow 2H_2O + 3S$$

Ans: According to reaction

1 mole of SO_2 produces moles of S = 3 mole

6. How much ammonia is needed in grams to produce 1kg of urea fertilizer?

$$2NH_3 + CO_2 \rightarrow CO(NH_2)_2 + H_2O$$

7. Calculate the number of atoms in the following.

(a) 3g of H_2 (b) 3.4 moles of N_2 (c) 10g of $C_6H_{12}O_6$

Ans: a) We know that

$$\text{Number of molecules of } H_2 = \frac{\text{Mass of H2}}{\text{Molar mass of H2}} \times 6.02\times10^{23}$$

$$\text{Number of molecules of } H_2 = \frac{3\text{ g}}{2.016} \times 6.02\times10^{23} = 8.95\times10^{23} \text{ molecules}$$

Number of atoms in one molecule = 2

Number of atoms in 8.95×10^{23} molecule $= 2 \times 8.95\times10^{23}$

$= 17.9\times10^{23}$

$= 1.79\times10^{24}$ atoms

b) We know that

Number of molecules of N_2= number of moles $\times 6.02\times10^{23}$

Number of molecules of $N_2 = 3.4 \times 6.02\times10^{23} = 20.46\times10^{23}$ molecules

Number of atoms in one molecule = 2

Number of atoms in 20.46×10^{23} molecule $= 2 \times 20.46\times10^{23}$

$= 40.92\times10^{23}$

$= 4.09\times10^{24}$ atoms

c) We know that

$$\text{Number of molecules of } C_6H_{12}O_6 = \frac{\text{Mass of C6H12O6}}{\text{Molar mass of C6H12O6}} \times 6.02\times10^{23}$$

$$\text{Number of molecules of } C_6H_{12}O_6 = \frac{10\text{ g}}{180\ g/mol} \times 6.02\times10^{23} = 0.334\times10^{23}$$

Number of atoms in one molecule = 24

Number of atoms in 0.334×10^{23} molecule $= 24 \times 0.334\times10^{23}$

$= 8.02\times10^{23}$ atoms