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Class	9th	Chapter	04
Subject	Solved	Board	Punjab

CHAPTER 4: STOICHIOMETRY

EXERCISE MULTIPLE CHOICE QUESTIONS (MCQs)

(i) How many atoms are present in one gram of H_2O?

Answer: (c) 0.334×10^{23} atoms

(ii) Which is the correct formula of calcium phosphide?

Answer: (d) Ca_3P_2

(iii) How many atomic mass units (amu) are there in one gram?

Answer: (c) 6.022×10^{23} amu

(iv) Structural formula of 2-hexene is $CH_3–CH=CH–(CH_2)_2–CH_3$. What will be its empirical formula?

Answer: (d) CH_2

(v) How many moles are there in 25 g of H_2SO_4?

Answer: (c) 0.255 moles

(vi) A necklace has 6 g of diamonds in it. What are the number of carbon atoms in it?

Answer: (d) 3.01×10^{23}

(vii) What is the mass of Al in 204 g of aluminium oxide, Al_2O_3?

Answer: (d) 108 g

(viii) Which one of the following compounds will have the highest percentage of the mass of nitrogen?

Answer: (b) N_2H_4

(ix) When one mole of each of the following compounds is reacted with oxygen, which will produce the maximum amount of CO_2?

Answer: (c) Ethane (C_2H_6)

(x) What mass of 95% $CaCO_3$ will be required to neutralize 50 cm^3 of 0.5 M HCl solution?

Answer: (c) 1.32 g

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EXERCISE QUESTIONS FOR SHORT ANSWERS

i. Write down the chemical formula of barium nitride.

Answer: Ba_3N_2

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

Answer:

Empirical formula mass = 12 + (2 × 1) + 16 = 30 g/mol

Ratio, n = Molar mass / Empirical formula mass

n = 180 / 30 = 6

Molecular formula = $(CH_2O)_6 = C_6H_{12}O_6$

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

Answer:

Molar mass of H_2O = 18 g/mol

Number of molecules = (Given mass / Molar mass) × Avogadro's number

= (1.5 / 18) × 6.022×10^{23}

= 5.018×10^{22} molecules

iv. What is the difference between a mole and Avogadro's number?

Answer: A mole is the amount of a substance that contains Avogadro's number of particles, representing the mass equal to the atomic or molecular mass expressed in grams. Avogadro's number is the specific fixed numerical value (6.022×10^{23}) representing the quantity of elementary entities in one mole.

v. Write down the chemical equation of the following reaction: Copper + Sulphuric acid → Copper sulphate + Sulphur dioxide + Water.

Answer:

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

EXERCISE CONSTRUCTED RESPONSE QUESTIONS

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

Answer: Empirical formula represents the simplest whole-number ratio of atoms in a compound, whereas molecular formula gives the exact actual number of atoms. Different compounds can possess the exact same atomic ratio, like acetylene (C_2H_2) and benzene (C_6H_6), which both share the empirical formula CH, but have distinct molecular formulas and molecular masses.

ii. Write down the chemical formulas of the following compounds: Calcium phosphate, Aluminium nitride, Sodium acetate, Ammonium carbonate, and Bismuth sulphate.

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Answer:

- Calcium phosphate: $Ca_3(PO_4)_2$
- Aluminium nitride: AlN
- Sodium acetate: CH_3COONa
- Ammonium carbonate: $(NH_4)_2CO_3$
- Bismuth sulphate: $Bi_2(SO_4)_3$

iii. Why does Avogadro's number have an immense importance in chemistry?

Answer: Avogadro's number links the submicroscopic scale of individual atoms and molecules to the macroscopic scale of grams measured in the laboratory, enabling quantitative calculations and stoichiometric predictions in chemical reactions.

iv. When 8.657 g of a compound were converted into elements, it gave 5.217 g of carbon, 0.962 g of hydrogen and 2.478 g of oxygen. Calculate the percentage of each element present in this compound.

Answer:

Percentage of C = (5.217 / 8.657) × 100 = 60.26%

Percentage of H = (0.962 / 8.657) × 100 = 11.11%

Percentage of O = (2.478 / 8.657) × 100 = 28.62%

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

Answer: The maximum possible masses of products are calculated stoichiometrically using a balanced chemical equation and limiting reactant analysis, assuming complete conversion, and then multiplying by the percentage yield achieved at dynamic equilibrium.

EXERCISE DESCRIPTIVE QUESTIONS

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

Answer: The formulas and symbols of all reactants and products must be correct, the law of conservation of mass must be satisfied by balancing the total number of atoms of each element on both sides, and the physical states of reactants and products should be indicated.

ii. Explain the concepts of Avogadro's number and mole.

Answer: Avogadro's number (6.022×10^{23}) is the fundamental constant defining the exact number of particles (atoms, ions, or molecules) contained in one mole of any pure substance. A mole is the quantity of matter containing Avogadro's number of units, serving as the bridge between macroscopic mass measurements in laboratory work and microscopic counting of individual atoms or molecules.

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

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

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Answer:

Given mass of CH_4 = 10 g

Molar mass of CH_4 = 16 g/mol

Molar mass of CO_2 = 44 g/mol

Moles of CH_4 = 10 / 16 = 0.625 moles

From the balanced equation, 1 mole of CH_4 produces 1 mole of CO_2.

Moles of CO_2 produced = 0.625 moles

Mass of CO_2 = 0.625 × 44 = 27.5 g

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

$3C(s) + O_2(g) + H_2O(l) \rightarrow H_2(g) + 3CO(g)$

Answer:

From the balanced equation, 3 moles of C produce 3 moles of CO (a 1:1 mole ratio).

Therefore, to produce 10 moles of CO, exactly 10 moles of C (coal) are needed.

v. How much SO_2 is needed in grams to produce 10 moles of sulphur?

$2H_2S(g) + SO_2(g) \rightarrow 2H_2O(l) + 3S(s)$

Answer:

From the balanced equation, 3 moles of S require 1 mole of SO_2.

Moles of SO_2 needed = 10 / 3 = 3.333 moles

Molar mass of SO_2 = 32 + (2 × 16) = 64 g/mol

Mass of SO_2 needed = 3.333 × 64 = 213.33 g

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

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

Answer:

Target mass of urea, $CO(NH_2)_2$ = 1000 g

Molar mass of urea = 60 g/mol

Moles of urea = 1000 / 60 = 16.667 moles

From the equation, 1 mole of urea requires 2 moles of NH_3.

Moles of NH_3 needed = 16.667 × 2 = 33.333 moles

Molar mass of NH_3 = 17 g/mol

Mass of NH_3 needed = 33.333 × 17 = 566.67 g

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vii. Calculate the number of atoms in the following:

(a) 3 g of H_2

Answer:

Moles = 3 / 2 = 1.5 moles of H_2

Molecules = $1.5 \times 6.022 \times 10^{23} = 9.033 \times 10^{23}$ molecules

Since each H_2 molecule has 2 atoms:

Total atoms = $2 \times 9.033 \times 10^{23}$

= 1.806×10^{24} atoms

(b) 3.4 moles of N_2

Answer:

Molecules = $3.4 \times 6.022 \times 10^{23} = 2.047 \times 10^{24}$ molecules

Total atoms = $2 \times 2.047 \times 10^{24}$

= 4.095×10^{24} atoms

(c) 10 g of $C_6H_{12}O_6$

Answer:

Molar mass = 180 g/mol

Moles = 10 / 180 = 0.0556 moles

Molecules = $0.0556 \times 6.022 \times 10^{23} = 3.345 \times 10^{22}$ molecules

Total atoms per molecule = 24

Total atoms = $24 \times 3.345 \times 10^{22}$

= 8.028×10^{23} atoms

EXERCISE INVESTIGATIVE QUESTIONS

i. It is generally believed that drinking eight glasses of water every day is required to keep oneself hydrated, especially in the summer. If a glass occupies 400 cm^3 of water on the average, how many moles of water are needed for a single adult?

Answer:

Total volume of water = $8 \times 400\ cm^3 = 3200\ cm^3$

Since the density of water is 1 g/cm^3:

Mass of water = 3200 g

Molar mass of H_2O = 18 g/mol

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Moles of water needed = 3200 / 18

= 177.78 moles

ii. The chemical formula for sand is SiO_2 but the sand does not exist in the form of discrete molecules like H_2O. How has its formula been determined, keeping in view its structure?

Answer: Silicon dioxide (SiO_2) forms a giant three-dimensional covalent network crystal lattice where every silicon atom is covalently bonded to four oxygen atoms tetrahedrally, and each oxygen atom bridges two silicon atoms. The chemical formula SiO_2 is determined as an empirical formula representing the simplest 1:2 fixed stoichiometric ratio of silicon to oxygen atoms throughout the continuous lattice structure.

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