

1. SOME BASIC CONCEPTS OF CHEMISTRY

1 How many numbers of atoms are present in 52 u of He? 1

2 State Avogadro law. 1

3 For an actual result of an observation to be 5; two students A and B reported their readings as follows:

| | Observation number | | Average |
|-----------|--------------------|------|---------|
| | 1 | 2 | |
| Student A | 4.95 | 4.93 | 4.94 |
| Student B | 4.94 | 5.05 | 4.995 |

Which of the students has made a more precise observation? Is his observation accurate too? 1

4 State Gay Lussac's law of gaseous volumes. 1

5 How many significant figures are present in (i) 0.0025 (ii) 600.0? 1

6 What is the mass of 1 L of mercury in grams and in kilograms, if the density of liquid mercury is 13.6 g cm^{-3} ? 1

7 Vitamin C is known to contain 1.29×10^{24} hydrogen atoms. Calculate the number of moles of hydrogen atoms. 1

8 What is the number of significant figures in 0.001620? 1

9 What is the SI unit of energy? 1

10 Express 5.607892 to four significant figures and write the result in standard form. 1

11 Calculate molecular mass of glucose ($\text{C}_6\text{H}_{12}\text{O}_6$) molecule. 1

12 Express the following in the scientific notation:

(i) 0.0048 (ii) 234,000 (iii) 8008 1

(iv) 500.0 (v) 6.0012

13 Round off the following figures up to three significant figures:

(i) 34.216

(ii) 10.4107 1

(iii) 0.04597

(iv) 2808

14 State the law of multiple proportion. 1

15 The following data are obtained when dinitrogen and dioxygen react together to form different compounds:

| | Mass of dinitrogen | Mass of dioxygen |
|-------|--------------------|------------------|
| (i) | 14 g | 16 g |
| (ii) | 14 g | 32 g |
| (iii) | 28 g | 32 g |
| (iv) | 28 g | 80 g |

1

- Which law of chemical combination is obeyed by the above experimental data? Give its statement.
- 16 Calculate the number of He atoms in (i) 52 u, (ii) 52 g, (iii) 52 moles of He. Atomic wt. of He is 4 u. 1
- 17 How many electrons are present in 16 g of CH₄? 1
- 18 Boron occurs in nature in the form of two isotopes, ${}^{11}_5\text{B}$ and ${}^{10}_5\text{B}$, in ratio of 81% and 19% respectively. Calculate its average atomic mass. 1
- 19 If 2 litres of N₂ is mixed with 2 litres of H₂ at a constant temperature and pressure, then what will be the volume of NH₃ formed? 1
- 20 How many atoms are present in 1 ml of NH₃ at STP? 1
- 21 Which of these weighs most?
 (i) 32 g of oxygen,
 (ii) 2 g atom of hydrogen, 1
 (iii) 0.5 mole of Fe,
 (iv) 3.01×10^{23} atoms of carbon
- 22 Calculate the number of moles of NaOH in 27 cm³ of 0.15 M NaOH solution. 1
- 23 Calculate the number of nm in 5839 Å. 1
- 24 How many cm are there in 1 pm? 1
- 25 How many gram atoms are there in 8.0 g of S? 1
- 26 0.5 mole each of H₂S and SO₂ mixed together in a reaction flask, react according to equation:
 $2\text{H}_2\text{S} + \text{SO}_2 \longrightarrow 2\text{H}_2\text{O} + 3\text{S}$ 1
 Calculate the number of moles of 'S' formed.
- 27 Calculate the mass of ferric oxide that will be obtained by complete oxidation of 2 g of Fe.
 [Atomic weights of Fe = 56 u, O = 16 u] 1
- 28 How many significant figures should be present in the answer of the following calculations?
 $\frac{0.02856 \times 298.15 \times 0.112}{0.5785}$ 1
 (i) 5×5.364
 (ii) $0.0125 + 0.7864 + 0.0215$
- 29 Calculate the mass of 112 cm³ of hydrogen gas at STP. 1
- 30 Calculate the number of atoms present in 1.4 g of N₂ molecule. 1
- 31 A hydrocarbon was found to contain 75% by mass of carbon and 25% by mass of hydrogen. What is empirical formula of the compound?
 (a) C₂H₄
 (b) C₂H₆ 1
 (c) CH₄
 (d) C₆H₆
- 32 The mass of one mole a chloride formed by metal 'X' is 111.0 g. Which one could be formula of chloride? 1

- (a) XCl
(b) XCl₂
(c) XCl₃
(d) XCl₄
- 33 Which of the following represents largest number of particles.
(a) Atoms in mole of CH₄
(b) Atoms in 0.5 mol of SO₃
(c) Atoms in 0.5 mole of CO₂
(d) Atoms in 1 mol of CO
- 34 A hydrocarbon was found to contain 85.7% by mass of carbon and 14.3% by mass of hydrogen. Molar mass of hydrocarbon is 56 g mol⁻¹. The formula for hydrocarbon is
(a) CH₄
(b) C₂H₄
(c) C₄H₈
(d) C₅H₁₀
- 35 25 cm³ of oxalic acid completely neutralised 0.064 g of NaOH. Molarity of oxalic acid solution is
(a) 0.064
(b) 0.045
(c) 0.015
(d) 0.032
- 36 If 3.01×10^{20} molecules are removed from 98 mg of H₂SO₄, then number of moles of H₂SO₄ left are
(a) 0.5×10^{-3} mol
(b) 0.1×10^{-3} mol
(c) 9.95×10^{-3} mol
(d) 1.66×10^{-3} mol
- 37 If 500 mL of a 5M solution is diluted to 1500 mL, what will be the molarity of the solution obtained?
(a) 1.5 M
(b) 1.66 M
(c) 0.017 M
(d) 1.59 M
- 38 The number of atoms present in one mole of an element is equal to Avogadro number. Which of the following element contains the greatest number of atoms?
(a) 4 g He
(b) 46 g Na
(c) 0.40 g Ca
(d) 12 g He
- 39 If the density of a solution is 3.12 g mL⁻¹, the mass of 1.5 mL solution in significant figures is _____.
(a) 4.7 g
(b) 4680×10^{-3} g

(c) 4.680 g

(d) 46.80 g

40 In the following question two or more options may be correct. Which of the following pairs have the same number of atoms?

(a) 16 g of $O_2(g)$ and 4 g of $H_2(g)$

(b) 16 g of O_2 and 44 g of CO_2

(c) 28 g of N_2 and 32 g of O_2

(d) 12 g of $C(s)$ and 23 g of $Na(s)$

1

41 Which of the following solutions have the same concentration?

(a) 20 g of NaOH in 200 mL of solution

(b) 0.5 mol of KCl in 200 mL of solution

(c) 40 g of NaOH in 100 mL of solution

(d) 20 g of KOH in 200 mL of solution

1

42 In the following question two or more options may be correct. 16 g of oxygen has same number of molecules as in

(a) 16 g of CO

(b) 28 g of N_2

(c) 14 g of N_2

(d) 1.0 g of H_2

1

43 In the following question two or more options may be correct. Which of the following terms are unitless? (a) Molality (b) Molarity (c) Mole fraction

(d) Mass percent

1

44 A mixture of 24 dm³ of hydrogen and 100 dm³ of oxygen was ignited and the reaction mixture was cooled to room temperature and pressure. What will be volume of gases remaining of the end of the reaction?

(a) 24 dm³

(b) 76 dm³

(c) 88 dm³

(d) 112 dm³

1

45 1 g of M_2CO_3 on treatment with excess HCl produces 0.01186 moles of CO_2 . The molar mass of M_2CO_3 in g mol⁻¹ is

(a) 1186

(b) 84.3

(c) 118.6

(d) 11.86

1

46 Two students performed the same experiment separately and each one of them recorded two readings of mass which are given below. Correct reading of mass is 3.0 g. On the basis of given data, mark the correct option out of the following statements.

| Student | Readings | |
|---------|----------|------|
| A | 3.01 | 2.99 |
| B | 3.05 | 2.95 |

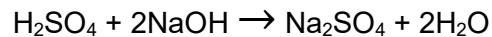
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(a) Results of both the students are neither accurate nor precise. (b) Results of student A are both precise and accurate. (c) Results of student B are neither precise nor accurate. (d) Results of student B are both precise and accurate.

47 In the following question two or more options may be correct.

Sulphuric acid reacts with sodium hydroxide as follows:

1



When 1L of 0.1M sulphuric acid solution is allowed to react with 1L of 0.1M sodium hydroxide solution, the amount of sodium sulphate formed and its molarity in the solution obtained is

- (a) 0.1 mol L⁻¹
- (b) 7.10 g
- (c) 0.025 mol L⁻¹
- (d) 3.55 g

48 The compound formed as a result of oxidation of propyl benzene by hot alkaline KMnO₄ is

- (a) Benzoic acid
- (b) 2-phenyl ethanoic acid
- (c) 3-phenyl ethanoic acid
- (d) acetophenone

1

49 A sample of drinking water was found to be severely contaminated with chloroform (CHCl₃), supposed to be carcinogenic in nature. The level of contamination was 15 ppm (by mass).

- (i) Express this in per cent by mass.
 - (ii) Determine the molality of chloroform in the water sample.
- [Given molar mass of CHCl₃ = 119.5 g mol⁻¹]

2

50 56 kg of N₂(g) and 10 kg of H₂(g) are mixed to produce NH₃(g). Calculate the number of moles of ammonia gas formed.

(Atomic mass/g mol⁻¹ N = 14, H = 1)

2

51 Calculate the mass of sodium acetate required to make 500 ml of 0.375 molar aqueous solution. Molar mass of sodium acetate is 82.0245 g mol⁻¹.

2

52 What is the SI unit of mass? How is it defined?

2

53 If the density of methanol is 0.793 kg L⁻¹, what is its volume needed for making 2.5 L of its 0.25 M solution?

2

54 What is the concentration of sugar (C₁₂H₂₂O₁₁) in mol L⁻¹ if its 20 g are dissolved in enough water to make a final volume up to 2 L?

2

55 Calculate the atomic mass (average) of chlorine using the following data:

| | % Natural Abundance | Molar Mass |
|------------------|---------------------|------------|
| ³⁵ Cl | 75.77 | 34.9689 |
| ³⁷ Cl | 24.23 | 36.9659 |

2

56 Use the data given in the following table to calculate the molar mass of naturally occurring argon isotopes:

| Isotope | Isotopic Molar Mass | Abundance |
|------------------|------------------------------|-----------|
| ³⁶ Ar | 35.96755 g mol ⁻¹ | 0.337 % |
| ³⁸ Ar | 37.96272 g mol ⁻¹ | 0.063 % |
| ⁴⁰ Ar | 39.9624 g mol ⁻¹ | 99.600 % |

2

57 Calculate the molarity of NaOH in the solution prepared by dissolving its 4 g in enough water to form 250 ml of the solution. 2

58 Match the following prefixes with their multiples:

| | Prefixes | Multiples |
|-------|----------|------------|
| (i) | micro | 10^6 |
| (ii) | deca | 10^9 |
| (iii) | mega | 10^{-6} |
| (iv) | giga | 10^{-15} |
| (v) | femto | 10 |

2

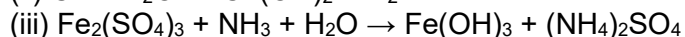
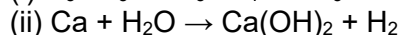
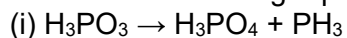
59 Calculate the number of grams of oxygen in 0.10 mol of $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$. 2

60 How many grams of Cl_2 are required to completely react with 0.4 g of H_2 to yield HCl? Also, calculate the amount of HCl formed. 2

61 Calculate the mass of sodium acetate (CH_3COONa) required to make 500 ml of 0.375 molar aqueous solution. Molar mass of sodium acetate is $82.0245 \text{ g mol}^{-1}$. 2

62 Conc. HCl is 38 % HCl by mass. What is the molarity of this solution if $d = 1.19 \text{ g cm}^{-3}$?
What volume of conc. HCl is required to make 1.00 L of 0.10 M HCl? 2

63 Balance the following equations:



2

64 How much copper can be obtained from 100 g of copper sulphate (CuSO_4)? 2

65 In a reaction $\text{A} + \text{B}_2 \rightarrow \text{AB}_2$

Identify the limiting reagent, if any, in the following reaction mixtures.

(i) 300 atoms of A + 200 molecules of B_2

(ii) 2 mol of A + 3 mol of B_2

(iii) 100 atoms of A + 100 molecules of B_2

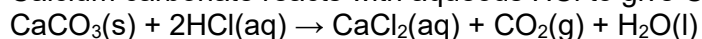
(iv) 5 mol of A + 2.5 mol of B_2

(v) 2.5 mol of A + 5 mol of B_2

2

66 The density of 3 M solution of NaCl is 1.25 g ml^{-1} . Calculate the molality of the solution. 2

67 Calcium carbonate reacts with aqueous HCl to give CaCl_2 and CO_2 according to the reaction:

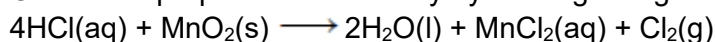


What mass of CaCO_3 is required to react completely with 25 ml of 0.75 M HCl?

(At. wt. of Ca = 40, C = 12, O = 16, Cl = 35.5 u)

2

68 Chlorine is prepared in laboratory by treating manganese dioxide (MnO_2) with aqueous hydrochloric acid according to the reaction:



How many grams of HCl react with 5.0 g of manganese dioxide?

2

(Atomic mass of Mn = 55 u, O = 16, H = 1, Cl = 35.5 u)

- 69 How much sugar ($C_{12}H_{22}O_{11}$) will be required if each person on the earth is given 10^{15} moles of sugar per day. Population of the earth is 3×10^{10} . 2
- 70 Hydrogen gas is prepared in the laboratory by reacting dilute HCl with granulated zinc.
Following reaction takes place.
 $Zn + 2HCl \longrightarrow ZnCl_2 + H_2$ 2
Calculate the volume of hydrogen gas liberated at STP when 32.65 g of zinc reacts with HCl.
1 mol of a gas occupies 22.7 L volume at STP; atomic mass of Zn = 65.3 u.
- 71 The density of 3 molal solution of NaOH is 1.110 g ml^{-1} . Calculate the molarity of the solution. 2
- 72 Calculate the molecular mass of the following: 3
(i) H_2O (ii) CO_2 (iii) CH_4
- 73 Calculate the mass per cent of different elements present in sodium sulphate (Na_2SO_4). 3
- 74 Calculate the amount of carbon dioxide that could be produced when 3
(i) 1 mole of carbon is burnt in air.
(ii) 1 mole of carbon is burnt in 16 g of dioxygen.
(iii) 2 moles of carbon are burnt in 16 g of dioxygen.
- 75 A welding fuel gas contains carbon and hydrogen only. Burning a small sample of it in oxygen gives 3.38 g of carbon dioxide, 0.690 g of water and no other products. A volume of 10 L (measured at STP) of this welding gas is found to weigh 11.6 g. Calculate (i) empirical formula, 3
(ii) molar mass of the gas and (iii) molecular formula. (At. wt. of C = 12, H = 1, O = 16 u).
- 76 Dinitrogen and dihydrogen react with each other to produce ammonia according to the following chemical equation:
 $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$
(i) Calculate the mass of ammonia produced if 2.00×10^3 g of dinitrogen reacts with 1.00×10^3 g of dihydrogen. 3
(ii) Will any of the two reactants remain unreacted?
(iii) If yes, which one and what would be its mass?
- 77 A solution is prepared by adding 2 g of a substance A to 18 g of water. Calculate the mass per cent of the solute. 3
- 78 50.0 kg of $N_2(g)$ and 10.0 kg of $H_2(g)$ are mixed to produce $NH_3(g)$. Calculate the $NH_3(g)$ formed. Identify the limiting reagent in the production of NH_3 in this situation. 3
- 79 How many grams of $KClO_3$ must be decomposed to prepare 3.36 litres of oxygen at STP? 3
(Atomic weight of K = 39, Cl = 35.5, O = 16 u)
- 80 Hydrogen reacts with nitrogen to produce ammonia according to the equation: 3
 $3H_2(g) + N_2(g) \longrightarrow 2NH_3(g)$
Determine how much ammonia would be produced if 100 g of N_2 reacts?
- 81 (i) What is limiting reactant?
(ii) Oxygen is prepared by catalytic decomposition of potassium chlorate ($KClO_3$).
Decomposition of potassium chlorate gives potassium chloride (KCl) and oxygen (O_2). 3
If 2.4 mol of oxygen is needed for an experiment, how many grams of potassium chlorate must be decomposed?
(At. mass of K = 39, Cl=35.5, O = 16)
- 82 What volume of 0.1 M NaOH solution is required to neutralise 100 ml of concentrated aqueous sulphuric acid which contains 98% 3

H₂SO₄ by mass. The density of concentrated sulphuric acid solution is 1.84 g ml⁻¹. NaOH reacts with H₂SO₄ according to the following reaction:



(Atomic mass/g mol⁻¹ H = 1, S = 32, O = 16).

- 83 Calculate the amount of water(g) produced by the combustion of 16 g of methane. 3
- 84 How many moles of methane are required to produce 22 g of CO₂(g) after combustion? 3
- 85 A compound contains 4.07% hydrogen, 24.27% carbon and 71.65% chlorine. Its molar mass is 98.96 g. What are its empirical and molecular formulae? 3
- 86 Calculate the weight of FeO formed from 2 g of VO and 5.75 g of Fe₂O₃. Also, report the limiting reagent. 3
- $$2\text{VO} + 3\text{Fe}_2\text{O}_3 \longrightarrow 6\text{FeO} + \text{V}_2\text{O}_5$$
- (Atomic mass of V = 51.4, O = 16, Fe = 55.9 g)
- 87 If 4 g of NaOH dissolves in 36 g of H₂O, calculate the mole fraction of each component in the solution. Also, determine the molarity of solution (specific gravity of solution is 1 g ml⁻¹). 3
- 88 The reactant which is entirely consumed in reaction is known as limiting reagent. In the reaction 2A + 4B → 3C + 4D, when 5 moles of A react with 6 moles of B, then 3
- (i) which is the limiting reagent?
- (ii) calculate the amount of C formed.
- 89 A vessel contains 1.6 g of dioxygen at STP (273.15 K, 1 atm pressure). The gas is now transferred to another vessel at constant temperature where pressure becomes half of the original pressure. Calculate 5
- (i) volume of the new vessel.
- (ii) number of molecules of dioxygen.
- 90 Calcium carbonate reacts with aqueous HCl to give CaCl₂ and CO₂ according to the reaction given below: 5
- $$\text{CaCO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \longrightarrow \text{CaCl}_2(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$$
- What mass of CaCl₂ will be formed when 250 ml of 0.76 M HCl reacts with 1000 g of CaCO₃? Name the limiting reagent. Calculate the number of moles of CaCl₂ formed in the reaction.
- 91 A box contains some identical red coloured balls, labelled as A, each weighing 2 grams. Another box contains identical blue coloured balls, labelled as B, each weighing 5 grams. Consider the combinations AB, AB₂, A₂B and A₂B₃ and show that the law of multiple proportion is applicable. 5