Chapter 1

Some Basic Concepts of Chemistry

1. The molality of a urea solution in which 0.0100 g of urea, $[(NH_2)_2CO]$ is added to 0.3000 dm^3 of water at STP is **[AIEEE-2011]**

   (1) 3.33×10^{-2} m (2) 0.555 m

   (3) 5.55×10^{-4} m (4) 33.3 m

2. The density of a solution prepared by dissolving 120 g of urea (mol. mass = 60 u) in 1000 g of water of 1.15 g/mL. The molarity of this solution is **[AIEEE-2012]**

   (1) 1.78 M (2) 1.02 M

   (3) 2.05 M (4) 0.50 M

3. The molarity of a solution obtained by mixing 750 mL of 0.5 (M) HCl with 250 mL of 2 (M) HCl will be **[JEE (Main)-2013]**

   (1) 0.875 M (2) 1.00 M

   (3) 1.75 M (4) 0.975 M

4. At 300 K and 1 atm, 15 mL of a gaseous hydrocarbon requires 375 mL air containing 20% O_2 by volume for complete combustion. After combustion the gases occupy 330 mL. Assuming that the water formed is in liquid form and the volumes were measured at the same temperature and pressure, the formula of the hydrocarbon is **[JEE (Main)-2016]**

   (1) C_3H_8 (2) C_4H_8

   (3) C_4H_{10} (4) C_3H_6

5. 1 gram of a carbonate (M_2CO_3) on treatment with excess HCl produces 0.01186 mole of CO_2. The molar mass of M_2CO_3 in g mol^{-1} is **[JEE (Main)-2017]**

   (1) 118.6 (2) 11.86

   (3) 1186 (4) 84.3

6. The most abundant elements by mass in the body of a healthy human adult are :

   Oxygen (61.4%); Carbon (22.9%); Hydrogen (10.0%) and Nitrogen (2.6%).

   The weight which a 75 kg person would gain if all ^1H atoms are replaced by ^2H atoms is **[JEE (Main)-2017]**

   (1) 7.5 kg (2) 10 kg

   (3) 15 kg (4) 37.5 kg

7. The ratio of mass percent of C and H of an organic compound ($C_XH_YO_Z$) is 6 : 1. If one molecule of the above compound ($C_XH_YO_Z$) contains half as much oxygen as required to burn one molecule of compound C_XH_Y completely to CO_2 and H_2O. The empirical formula of compound $C_XH_YO_Z$ is **[JEE (Main)-2018]**

   (1) $C_3H_6O_3$ (2) C_2H_4O

   (3) $C_3H_4O_2$ (4) $C_2H_4O_3$

8. A solution of sodium sulfate contains 92 g of Na^+ ions per kilogram of water. The molality of Na^+ ions in that solution in mol kg^{-1} is **[JEE (Main)-2019]**

   (1) 16 (2) 4

   (3) 8 (4) 12

9. For the following reaction, the mass of water produced from 445 g of $C_{57}H_{110}O_6$ is

   $$2C_{57}H_{110}O_6(s) + 163O_2(g) \rightarrow 114CO_2(g) + 110H_2O(l)$$

   [JEE (Main)-2019]

   (1) 890 g (2) 490 g

   (3) 445 g (4) 495 g

10. The amount of sugar ($C_{12}H_{22}O_{11}$) required to prepare 2 L of its 0.1 M aqueous solution is **[JEE (Main)-2019]**

    (1) 136.8 g (2) 17.1 g

    (3) 34.2 g (4) 68.4 g

11. 8 g of NaOH is dissolved in 18 g of H_2O. Mole fraction of NaOH in solution and molality (in mol kg^{-1}) of the solution respectively are **[JEE (Main)-2019]**

(1) 0.2, 22.20 (2) 0.167, 22.20

(3) 0.167, 11.11 (4) 0.2, 11.11

12. The percentage composition of carbon by mole in methane is **[JEE (Main)-2019]**

(1) 80% (2) 75%

(3) 20% (4) 25%

13. For a reaction, $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$.

Identify dihydrogen (H_2) as a limiting reagent in the following reaction mixtures. **[JEE (Main)-2019]**

(1) 35 g of N_2 + 8 g of H_2

(2) 28 g of N_2 + 6 g of H_2

(3) 56 g of N_2 + 10 g of H_2

(4) 14 g of N_2 + 4 g of H_2

14. What would be the molality of 20% (mass/mass) aqueous solution of KI? (molar mass of KI = 166 g mol^{-1}) **[JEE (Main)-2019]**

(1) 1.48 (2) 1.51

(3) 1.08 (4) 1.35

15. The minimum amount of $O_2(g)$ consumed per gram of reactant is for the reaction:

(Given atomic mass : Fe = 56, O = 16, Mg = 24, P = 31, C = 12, H = 1) **[JEE (Main)-2019]**

(1) $2Mg(s) + O_2(g) \rightarrow 2MgO(s)$

(2) $4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s)$

(3) $C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$

(4) $P_4(s) + 5O_2(g) \rightarrow P_4O_{10}(s)$

16. The mole fraction of a solvent in aqueous solution of a solute is 0.8. The molality (in mol kg^{-1}) of the aqueous solution is **[JEE (Main)-2019]**

(1) 13.88×10^{-2} (2) 13.88×10^{-3}

(3) 13.88 (4) 13.88×10^{-1}

17. 5 moles of AB_2 weigh 125×10^{-3} kg and 10 moles of A_2B_2 weigh 300×10^{-3} kg. The molar mass of A(M_A) and molar mass of B(M_B) in kg mol^{-1} are **[JEE (Main)-2019]**

(1) $M_A = 25 \times 10^{-3}$ and $M_B = 50 \times 10^{-3}$

(2) $M_A = 50 \times 10^{-3}$ and $M_B = 25 \times 10^{-3}$

(3) $M_A = 5 \times 10^{-3}$ and $M_B = 10 \times 10^{-3}$

(4) $M_A = 10 \times 10^{-3}$ and $M_B = 5 \times 10^{-3}$

18. 25 g of an unknown hydrocarbon upon burning produces 88 g of CO_2 and 9 g of H_2O. This unknown hydrocarbon contains **[JEE (Main)-2019]**

(1) 22 g of carbon and 3 g of hydrogen

(2) 24 g of carbon and 1 g of hydrogen

(3) 20 g of carbon and 5 g of hydrogen

(4) 18 g of carbon and 7 g of hydrogen

19. Amongst the following statements, that which was not proposed by Dalton was **[JEE (Main)-2020]**

(1) All the atoms of a given element have identical properties including identical mass. Atoms of different elements differ in mass

(2) Matter consists of indivisible atoms.

(3) Chemical reactions involve reorganization of atoms. These are neither created nor destroyed in a chemical reaction.

(4) When gases combine or reproduced in a chemical reaction they do so in a simple ratio by volume provided all gases are at the same T & P.

20. A solution of two components containing n_1 moles of the 1st component and n_2 moles of the 2nd component is prepared. M_1 and M_2 are the molecular weights of component 1 and 2 respectively. If d is the density of the solution in g mL^{-1}, C_2 is the molarity and x_2 is the mole fraction of the 2nd component, then C_2 can be expressed as **[JEE (Main)-2020]**

(1) $C_2 = \frac{1000\, x_2}{M_1 + x_2(M_2 - M_1)}$

(2) $C_2 = \frac{1000\, d\, x_2}{M_1 + x_2(M_2 - M_1)}$

(3) $C_2 = \frac{d\, x_2}{M_2 + x_2(M_2 - M_1)}$

(4) $C_2 = \frac{d\, x_1}{M_2 + x_2(M_2 - M_1)}$

21. The average molar mass of chlorine is 35.5 g mol^{-1}. The ratio of ^{35}Cl to ^{37}Cl in naturally occurring chlorine is close to **[JEE (Main)-2020]**

(1) 1 : 1 (2) 2 : 1

(3) 3 : 1 (4) 4 : 1

22. Ferrous sulphate heptahydrate is used to fortify foods with iron. The amount (in grams) of the salt required to achieve 10 ppm of iron in 100 kg of wheat is_____. **[JEE (Main)-2020]**

Atomic weight : Fe = 55.85; S = 32.00; O = 16.00

23. $NaClO_3$ is used, even in spacecrafts, to produce O_2. The daily consumption of pure O_2 by a person is 492 L at 1 atm, 300 K. How much amount of $NaClO_3$, in grams, is required to produce O_2 for the daily consumption of a person at 1 atm, 300 K? _____. **[JEE (Main)-2020]**

$NaClO_3(s) + Fe(s) \rightarrow O_2(g) + NaCl(s) + FeO(s)$

$R = 0.082$ L atm mol^{-1} K^{-1}

24. The molarity of HNO_3 in a sample which has density 1.4 g/mL and mass percentage of 63% is _____. (Molecular Weight of HNO_3 = 63)

[JEE (Main)-2020]

25. The ratio of the mass percentages of 'C & H' and 'C & O' of a saturated acyclic organic compound 'X' are 4 : 1 and 3 : 4 respectively. Then, the moles of oxygen gas required for complete combustion of two moles of organic compound 'X' is _____.

[JEE (Main)-2020]

26. The mole fraction of glucose ($C_6H_{12}O_6$) in an aqueous binary solution is 0.1. The mass percentage of water in it, to the nearest integer, is _____ **[JEE (Main)-2020]**

27. 6.023×10^{22} molecules are present in 10 g of a substance 'x'. The molarity of a solution containing 5 g of substance 'x' in 2 L solution is _____ $\times 10^{-3}$. **[JEE (Main)-2020]**

28. The mass of ammonia in grams produced when 2.8 kg of dinitrogen quantitatively reacts with 1 kg of dihydrogen is _____. **[JEE (Main)-2020]**

29. The minimum number of moles of O_2 required for complete combustion of 1 mole of propane and 2 moles of butane is _____. **[JEE (Main)-2020]**

30. 4.5 g of compound A (MW = 90) was used to make 250 mL of its aqueous solution. The molarity of the solution in M is $x \times 10^{-1}$. The value of x is _____. (Rounded off to the nearest integer)

[JEE (Main)-2021]

31. The formula of a gaseous hydrocarbon which requires 6 times of its own volume of O_2 for complete oxidation and produces 4 times its own volume of CO_2 is C_xH_y. The value of y is _____.

[JEE (Main)-2021]

32. Complete combustion of 1.80 g of an oxygen containing compound ($C_xH_yO_z$) gave 2.64 g of CO_2 and 1.08 g of H_2O. The percentage of oxygen in the organic compound is : **[JEE (Main)-2021]**

(1) 50.33 (2) 53.33

(3) 51.63 (4) 63.53

33. The number of significant figures in 50000.020×10^{-3} is _____. **[JEE (Main)-2021]**

34. The $NaNO_3$ weighed out to make 50 mL of an aqueous solution containing 70.0 mg Na^+ per mL is _____ g. (Rounded off to the nearest integer)

[Given : Atomic weight in g mol^{-1} - Na : 23; N : 14; O : 16] **[JEE (Main)-2021]**

35. A 6.50 molal solution of KOH (aq.) has a density of 1.89 g cm^{-3}. The molarity of the solution is ___ mol dm^{-3}. (Round off to the Nearest Integer).

[Atomic masses : K : 39.0 u; O : 16.0 u; H : 1.0 u]

[JEE (Main)-2021]

36. Complete combustion of 750 g of an organic compound provides 420 g of CO_2 and 210 g of H_2O. The percentage composition of carbon and hydrogen in organic compound is 15.3 and _____respectively. (Round off to the Nearest Integer). **[JEE (Main)-2021]**

37. When 35 mL of 0.15 M lead nitrate solution is mixed with 20 mL of 0.12 M chromic sulphate solution, _____ $\times 10^{-5}$ moles of lead sulphate precipitate out. **[JEE (Main)-2021]**

(Round off to the Nearest Integer).

38. The number of chlorine atoms in 20 mL of chlorine gas at STP is _____ 10^{21}. (Round off to the Nearest integer). **[JEE (Main)-2021]**

[Assume chlorine is an ideal gas at STP

$R = 0.083$ L bar $mol^{-1}K^{-1}$, $N_A = 6.023 \times 10^{23}$]

39. Complete combustion of 3 g of ethane gives $x \times 10^{22}$ molecules of water. The value of x is _____.

(Round off to the Nearest Integer).

[Use : $N_A = 6.023 \times 10^{23}$;

Atomic masses in u : C : 12.0 ; O : 16.0 ; H : 1.0]

[JEE (Main)-2021]

40. 250 mL of 0.5 M NaOH was added to 500 mL of 1 M HCl. The number of unreacted HCl molecules in the solution after complete reaction is _____ $\times 10^{21}$. (Nearest integer) ($N_A = 6.022 \times 10^{23}$)

[JEE (Main)-2021]

41. If the concentration of glucose ($C_6H_{12}O_6$) in blood is 0.72 g L^{-1}, the molarity of glucose in blood is _____ $\times 10^{-3}$ M. (Nearest integer)

(Given : Atomic mass of C = 12, H = 1, O = 16 u)

[JEE (Main)-2021]

42. Consider the complete combustion of butane, the amount of butane utilized to produce 72.0 g of water is _____ $\times 10^{-1}$ g. (in nearest integer)

[JEE (Main)-2021]

43. The number of significant figures in 0.00340 is _____.

[JEE (Main)-2021]

44. The density of NaOH solution is 1.2 g cm^{-3}. The molality of this solution is _____ m.

(Round off to the Nearest Integer)

[Use : Atomic masses : Na : 23.0 u, O : 16.0 u H : 1.0 u Density of H_2O : 1.0 g cm^{-3}]

[JEE (Main)-2021]

45. An aqueous KCl solution of density 1.20 g ml^{-1} has a molality of 3.30 mol kg^{-1}. The molarity of the solution in mol L^{-1} is _____. (Nearest integer)

[Molar mass of KCl = 74.5] **[JEE (Main)-2021]**

46. 100 mL of Na_3PO_4 solution contains 3.45 g of sodium. The molarity of the solution is _____ $\times 10^{-2}$ mol L^{-1}. (Nearest integer)

[Atomic Masses - Na : 23.0 u, O : 16.0 u, P : 31.0 u]

[JEE (Main)-2021]

47. 100 g of propane is completely reacted with 1000 g of oxygen. The mole fraction of carbon dioxide in the resulting mixture is $x \times 10^{-2}$. The value of x is _____. (Nearest integer)

[Atomic weight : H = 1.008; C = 12.00; O = 16.00]

[JEE (Main)-2021]

48. The molarity of the solution prepared by dissolving 6.3 g of oxalic acid ($H_2C_2O_4 \cdot 2H_2O$) in 250 mL of water in mol L^{-1} is $x \times 10^{-2}$. The value of x is _____. (Nearest integer)

[Atomic mass : H : 1.0, C : 12.0, O : 16.0]

[JEE (Main)-2021]

49. Sodium oxide reacts with water to produce sodium hydroxide. 20.0 g of sodium oxide is dissolved in 500 mL of water. Neglecting the change in volume, the concentration of the resulting NaOH solution is _____ $\times 10^{-1}$ M. (Nearest integer)

[Atomic mass : Na = 23.0, O = 16.0, H = 1.0]

[JEE (Main)-2021]

50. If 80 g of copper sulphate $CuSO_4 \cdot 5H_2O$ is dissolved in deionised water to make 5 L of solution. The concentration of the copper sulphate solution is $x \times 10^{-3}$ mol L^{-1}. The value of x is _____.

[Atomic masses Cu : 63.54 u, S : 32 u, O : 16 u, H : 1 u] **[JEE (Main)-2021]**

51. The number of atoms in 8 g of sodium is $x \times 10^{23}$. The value of x is _____. (Nearest integer)

[Given : $N_A = 6.02 \times 10^{23}$ mol^{-1}

Atomic mass of Na = 23.0 u] **[JEE (Main)-2021]**

52. If a rocket runs on a fuel ($C_{15}H_{30}$) and liquid oxygen, the weight of oxygen required and CO_2 released for every litre of fuel respectively are:

(Given : density of the fuel is 0.756 g/mL)

[JEE (Main)-2022]

(1) 1188 g and 1296 g

(2) 2376 g and 2592 g

(3) 2592 g and 2376 g

(4) 3429 g and 3142 g

53. The number of N atoms in 681 g of $C_7H_5N_3O_6$ is $x \times 10^{21}$. The value of x is _____. ($N_A = 6.02 \times 10^{23}$ mol^{-1}) (Nearest Integer)

[JEE (Main)-2022]

54. A protein 'A' contains 0.30% of glycine (molecular weight 75). The minimum molar mass of the protein 'A' is _____ $\times 10^3$ g mol^{-1} [nearest integer]

[JEE (Main)-2022]

55. A commercially sold conc. HCl is 35% HCl by mass. If the density of this commercial acid is 1.46 g/mL, the molarity of this solution is :

(Atomic mass : Cl = 35.5 amu, H = 1 amu)

[JEE (Main)-2022]

(1) 10.2 M (2) 12.5 M

(3) 14.0 M (4) 18.2 M

56. CNG is an important transportation fuel. When 100 g CNG is mixed with 208 g oxygen in vehicles, it leads to the formation of CO_2 and H_2O and produced large quantity of heat during this combustion, then the amount of carbon dioxide, produced in grams is _____. [nearest integer]

[Assume CNG to be methane]

[JEE (Main)-2022]

57. The moles of methane required to produce 81 g of water after complete combustion is _____ $\times 10^{-2}$ mol. [nearest integer]

[JEE (Main)-2022]

58. Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R).**

Assertion (A) : At 10°C, the density of a 5 M solution of KCl [atomic masses of K & Cl are 39 & 35.5 g mol^{-1} respectively], is 'x' g ml^{-1}. The solution is cooled to –21°C. The molality of the solution will remain unchanged.

Reason (R) : The molality of a solution does not change with temperature as mass remains unaffected with temperature.

In the light of the above statements, choose the **correct** answer from the options given below.

[JEE (Main)-2022]

(1) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**.

(2) Both **(A)** and **(R)** are true but **(R)** is not the correct explanation of **(A)**.

(3) **(A)** is true but **(R)** is false.

(4) **(A)** is false but **(R)** is true.

59. Two elements A and B which form 0.15 moles of A_2B and AB_3 type compounds. If both A_2B and AB_3 weigh equally, then the atomic weight of A is _____ times of atomic weight of B.

[JEE (Main)-2022]

60. Compound A contains 8.7% Hydrogen, 74% Carbon and 17.3% Nitrogen. The molecular formula of the compound is,

Given : Atomic masses of C, H and N are 12, 1 and 14 amu respectively.

The molar mass of the compound A is 162 g mol^{-1}.

[JEE (Main)-2022]

(1) $C_4H_6N_2$ (2) C_2H_3N

(3) C_5H_7N (4) $C_{10}H_{14}N_2$

61. Using the rules for significant figures, the correct answer for the expression $\frac{0.02858 \times 0.112}{0.5702}$ will be

[JEE (Main)-2022]

(1) 0.005613 (2) 0.00561

(3) 0.0056 (4) 0.006

62. 56.0 L of nitrogen gas is mixed with excess of hydrogen gas and it is found that 20 L of ammonia gas is produced. The volume of unused nitrogen gas is found to be ____ L. **[JEE (Main)-2022]**

63. Chlorophyll extracted from the crushed green leaves was dissolved in water to make 2 L solution of Mg of concentration 48 ppm. The number of atoms of Mg in this solution is $x \times 10^{20}$ atoms. The value of x is _____. (Nearest integer)

(Given : Atomic mass of Mg is 24 g mol^{-1}; $N_A = 6.02 \times 10^{23}$ mol^{-1}) **[JEE (Main)-2022]**

64. When 800 mL of 0.5 M nitric acid is heated in a beaker, its volume is reduced to half and 11.5 g of nitric acid is evaporated. The molarity of the remaining nitric acid solution is $x \times 10^{-2}$ M. (Nearest integer)

(Molar mass of nitric acid is 63 g mol^{-1})

[JEE (Main)-2022]

65. Haemoglobin contains 0.34% of iron by mass. The number of Fe atoms in 3.3 g of haemoglobin is

(Given : Atomic mass of Fe is 56 u, $N_A = 6.022 \times 10^{23}$ mol^{-1}) **[JEE (Main)-2022]**

(1) 1.21×10^5 (2) 12.0×10^{16}

(3) 1.21×10^{20} (4) 3.4×10^{22}

66. In the given reaction,

$$X + Y + 3Z \rightleftarrows XYZ_3$$

if one mole of each of X and Y with 0.05 mol of Z gives compound XYZ_3. (Given : Atomic masses of X, Y and Z are 10, 20 and 30 amu, respectively.) the yield of XYZ_3 is _____ g. (Nearest integer)

[JEE (Main)-2022]

67. On complete combustion of 0.492 g of an organic compound containing C, H and O, 0.7938 g of CO_2 and 0.4428 g of H_2O was produced. The % composition of oxygen in the compound is _____.

[JEE (Main)-2022]

68. 2 L of 0.2 M H_2SO_4 is reacted with 2 L of 0.1 M NaOH solution, the molarity of the resulting product Na_2SO_4 in the solution is _____ millimolar. (Nearest integer) **[JEE (Main)-2022]**

69. $\underset{20\,g}{N_{2(g)}} + \underset{5\,g}{3H_{2(g)}} \rightleftharpoons 2NH_{3(g)}$

Consider the above reaction, the limiting reagent of the reaction and number of moles of NH_3 formed respectively are : **[JEE (Main)-2022]**

(1) H_2, 1.42 moles

(2) H_2, 0.71 moles

(3) N_2, 1.42 moles

(4) N_2, 0.71 moles

70. Consider the reaction

$$4HNO_3(l) + 3KCl(s)$$

$$\rightarrow Cl_2(g) + NOCl(g) + 2H_2O(g) + 3KNO_3(s)$$

The amount of HNO_3 required to produce 110.0 g of KNO_3 is

(Given : Atomic masses of H, O, N and K are 1, 16, 14 and 39 respectively.) **[JEE (Main)-2022]**

(1) 32.2 g

(2) 69.4 g

(3) 91.5 g

(4) 162.5 g

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Chapter 1

Some Basic Concepts of Chemistry

1. Answer (3)

$$m = \frac{W_1}{M_1 \times W_2(\text{in kg})} = \frac{0.01}{60 \times 0.3} = 0.000555$$

$= 5.55 \times 10^{-4}$ m

2. Answer (3)

3. Answer (1)

The molarity of a solution obtained by mixing 750 mL of 0.5 M HCl with 250 mL of 2 M HCl is given by

$$\text{Molarity} = \frac{750 \times 0.5 + 250 \times 2}{1000} = 0.875 \text{ M}$$

4. Answer (1)

$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$

So, volume of O_2 required for the combustion of 1 mL hydrocarbon = 5 mL.

So, volume of O_2 requierd for the combustion of 15 mL of hydrocarbon = 75 mL (*i.e.*, 20% of 375 mL air)

NOTE : But for this, the total volume of gases after combustion should be 345 mL, rather than 330 mL.

5. Answer (4)

$M_2CO_3 + 2HCl \rightarrow 2MCl + H_2O + CO_2$

$$n_{M_2CO_3} = n_{CO_2}$$

$$\frac{1}{M_{M_2CO_3}} = 0.01186$$

$$M_{M_2CO_3} = \frac{1}{0.01186}$$

$= 84.3$ g/mol

6. Answer (1)

$$\text{Mass of hydrogen} = \frac{10}{100} \times 75 = 7.5 \text{ kg}$$

Replacing ^1H by ^2H would replace 7.5 kg with 15 kg

$\therefore$ Net gain = 7.5 kg

7. Answer (4)

Element	Relative mass	Relative mole	Simplest whole number ratio
C	6	$\frac{6}{12} = 0.5$	1
H	1	$\frac{1}{1} = 1$	2

So, X = 1, Y = 2

Equation for combustion of C_XH_Y

$$C_XH_Y + \left(X + \frac{Y}{4}\right)O_2 \longrightarrow XCO_2 + \frac{Y}{2}H_2O$$

Oxygen atoms required = $2\left(X + \frac{Y}{4}\right)$

As per information,

$$2\left(X + \frac{Y}{4}\right) = 2Z$$

$$\Rightarrow \left(1 + \frac{2}{4}\right) = Z$$

$\Rightarrow Z = 1.5$

Molecule can be written

$C_XH_YO_Z$

$C_1H_2O_{3/2}$

$\Rightarrow C_2H_4O_3$

8. Answer (2)

$$92 \text{ g of } Na^+ = \frac{92}{23} = 4 \text{ moles}$$

$$\text{Molality} = \frac{\text{number of moles}}{\text{mass of solvent (in kg)}}$$

$$= \frac{4}{1} = 4 \text{ mol kg}^{-1}$$

9. Answer (4)

$2C_{57}H_{110}O_6(s) + 163O_2(g) \rightarrow 114CO_2(g) + 110H_2O(l)$

$n = \frac{445}{890} = 0.5$

$\therefore$ Moles of water $= \frac{110}{2} \times 0.5 = 27.5$

$\therefore$ Mass of water = 27.5 × 18

= 495 g

10. Answer (4)

$\text{Molarity} = \frac{\text{Mole of sugar}}{\text{Volume of solution (in L)}}$

$\Rightarrow 0.1 = \frac{\text{Mole of sugar}}{2\,\text{L}}$

Mole of sugar = 0.2 mol

Mass of sugar = Mole × Molar mass of sugar

= 0.2 × 342 = 68.4 g

11. Answer (3)

$\text{Mole faction} = \frac{n_2}{n_2 + n_1} = \frac{\frac{1}{5}}{\frac{1}{5} + 1} = 0.167$

$n_2 = \frac{8}{40}$ $n_1 = \frac{18}{18}$

$\text{Molality} = \frac{8}{40} \times \frac{1000}{18} = 11.11\,\text{m}$

12. Answer (3)

In CH_4

one atom of carbon among 5 atoms (1C + 4H atoms)

$\therefore$ Mole % of C $= \frac{1}{5} \times 100 = 20\%$

13. Answer (3)

28 g N_2 react with 6 g H_2

$\underset{\substack{1\text{ mole}\\28\text{ g}}}{N_2} + \underset{\substack{3\text{ moles}\\6\text{ g}}}{3H_2} \longrightarrow 2NH_3$

For 56 g of N_2, 12 g of H_2 is required.

14. Answer (2)

20% w/w KI solution

i.e. 100 g solution contains 20 g KI

$\therefore$ Mass of solvent = 100 – 20 = 80 g

$\therefore$ Molality $= \frac{20 \times 1000}{166 \times 80} \simeq 1.51$ molar

15. Answer (2)

(1) $2\,Mg + O_2 \longrightarrow 2\,MgO$

1 g requires $\frac{32}{48}$ g = 0.66 g of O_2

(2) $4Fe + 3O_2 \longrightarrow 2Fe_2O_3$

1 g Fe requires = 0.43 g of oxygen

(3) $C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$

1 g of C_3H_8 requires = 3.6 g of O_2

(4) $P_4 + 5O_2 \longrightarrow P_4O_{10}$

1 g of P requires = 1.3 g of oxygen

16. Answer (3)

Let, total 1 moles be present.

$n_{solute} = 0.2$

$n_{solvent} = 0.8 \Rightarrow g_{solvent} = 0.8 \times 18$

$\therefore$ $m = \frac{0.2 \times 1000}{0.8 \times 18}$

$= \frac{1000}{4 \times 18} \approx 13.88$

17. Answer (3)

5 mol AB_2 weighs 125 g

$\therefore$ AB_2 = 25 g/mol

10 mol A_2B_2 weighs 300 g

$\therefore$ A_2B_2 = 30 g/mol

$\therefore$ Molar mass of A = 5

Molar mass of B = 10

18. Answer (2)

$C_xH_y + \underset{\text{(excess)}}{\left(x + \frac{y}{4}\right)O_2} \longrightarrow xCO_2 + \frac{y}{2}H_2O$

25 g	88 gm	9 g
	2 moles	$\frac{1}{2}$ moles
	$\Rightarrow x = 2$	$\Rightarrow y = 1$

$\therefore$ x = 2 and y = 1

Hydrocarbon : $(C_2H)_n$

2 mol carbon contains 24 g

1 mol hydrogen contains 1 g

19. Answer (4)

"When gases combine or reproduced in a chemical reaction, they do so in a simple ratio by volume provided all gases are at the same T & P"

This is not a postulate of Dalton's theory

20. Answer (2)

To express C_2 in terms of mole fraction x_2

	1st component	2nd component
mole	n_1	n_2
m.w	M_1	M_2
mass	n_1M_1	n_2M_2

mass of solution = $n_1M_1 + n_2M_2$

mole fraction $x_2 = \frac{n_2}{n_1+n_2}$

$n_1 = \frac{n_2(1-x_2)}{x_2}$

Mass of solution = $n_1M_1 + n_2M_2$

$= \frac{n_2M_1(1-x_2)}{x_2} + n_2M_2$

$= \frac{n_2}{x_2}[M_2x_2 - x_2M_1 + M_1]$

Volume of solution

$= \frac{n_2[M_2x_2 - x_2M_1 + M_1]}{1000dx_2}$ Litre

$C_2 = \frac{1000n_2dx_2}{n_2[M_2x_2 - x_2M_1 + M_1]}$

$$\boxed{C_2 = \frac{1000\,dx_2}{M_1 + x_2(M_2 - M_1)}}$$

21. Answer (3)

Average molar mass = $\frac{35\times3 + 37\times1}{4} = 35.5$

$\Rightarrow$ $^{35}Cl : {}^{37}Cl = 3 : 1$

22. Answer (4.97)

Mass of iron needed in 100 kg wheat = $\frac{10}{10^6}\times10^5$

= 1.0 gm

Molecular mass of $FeSO_4.7H_2O$ is 277.85

55.85 gm iron is present in 277.85 gm of salt

1 gm iron is present in $\frac{277.85}{55.85} = 4.97$ gm.

23. Answer (2130.00)

$NaClO_3(s) + Fe(s) \longrightarrow NaCl(s) + FeO(s) + O_2(g)$

moles of $NaClO_3$ = moles of O_2

moles of $O_2 = \frac{PV}{RT} = \frac{1\times492}{0.082\times300} = 20$ mol

mass of $NaClO_3$ = 20 × 106.5 = 2130 g = 2130.00

24. Answer (14.00)

63% W/W HNO_3 solution having density 1.4 g/mL i.e. 100 g solution has 63 g HNO_3

Volume of 100 g solution = $\frac{100}{1.4}$ mL

$\therefore$ Molarity = $\frac{63\times1.4\times1000}{63\times100} = 14$ mol / L

25. Answer (5)

Let the masses of C, H and O in organic compound X be x, y and z respectively

	Mass			Moles
C	x	4	12	1
H	y	1	3	3
O	z	$\frac{16}{3}$	16	1

$\therefore$ Empirical formula : CH_3O

Molecular formula : $C_2H_6O_2$

$$\underset{(X)}{2C_2H_6O_2} + 5O_2 \rightarrow 4CO_2 + 6H_2O$$

$\therefore$ Number of moles of O_2 required to oxidise 2 moles of (X) = 5.

26. Answer (47)

Mole fraction of glucose in aqueous solution = 0.1

Mass percentage of water in it

$$= \left[\frac{0.9\times18}{0.9\times18+0.1\times180}\right]\times100$$

$$= 47.37 \simeq 47$$

27. Answer (25.00)

Mass of 6.023×10^{22} molecules of a substance = 10 g

Mass of 6.023×10^{23} molecules of the substance = 100 g

Molar mass of the substance = 100 g mol^{-1}

$$\text{Molarity of the solution} = \frac{5}{100\times2} = 2.5\times10^{-2}$$

$$= 25 \times 10^{-3}$$

28. Answer (3400)

$N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

$$\text{Number of moles of } N_2 = \frac{2.8\times10^3}{28} = 100$$

$$\text{Number of moles of } H_2 = \frac{1000}{2} = 500$$

Number of moles of NH_3 produced = 200

Mass of NH_3 produced = 200 × 17 = 3400 gm

29. Answer (18)

$C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(l)$

$C_4H_{10}(g) + \frac{13}{2}O_2(g) \longrightarrow 4CO_2(g) + 5H_2O(l)$

No. of moles of O_2 required to oxidise 1 mole of propane and 2 moles of butane = $5 + 2 \times \frac{13}{2} = 18$

30. Answer (2)

$$\text{Molarity} = \frac{\text{no. of moles of solute}}{\text{vol}^{\text{m}} \text{ of sol}^{\text{n}} \text{(in L)}}$$

$$= \frac{4.5\times1000}{90\times250}$$

$$= 2 \times 10^{-1} \text{ M}$$

31. Answer (8)

$$C_xH_y(g) + \left(x + \frac{y}{4}\right)O_2(g) \rightarrow xCO_2(g) + \frac{y}{2}H_2O(l)$$

$$x + \frac{y}{4} = 6$$

x = 4

y = 8

32. Answer (2)

$$C_xH_yO_z + O_2 \rightarrow xCO_2 + \frac{y}{2}H_2O$$

2.64 g of CO_2 contains 0.72 g C.

1.08 g of H_2O contains 0.12 g H.

$\therefore$ mass of oxygen present = 1.80 – (0.72 +0.12) = 0.96 g

$$\% \text{ of O} = \frac{0.96}{1.80}\times100 = 53.33\ \%$$

33. Answer (8)

No. of significant figures in 50000.020×10^{-3} = 8

34. Answer (13)

Mass of Na^+ in 50 mL = 70 × 50 mg

$$\text{Millimoles of } NaNO_3 = \frac{70\times50}{23}$$

$$\text{Mass of } NaNO_3 = \frac{70\times50\times85\times10^{-3}}{23}$$

$$= 12.9 \simeq 13 \text{ g}$$

35. Answer (9)

$$\text{Molality} = \frac{\text{Moles of solute}}{\text{Mass of solvent (in kg)}}$$

6.50 molal solution of KOH means

6.50 moles of KOH in 1000 g of water (solvent)

364 g of KOH in 1364 g of solution

$$\text{Volume of solution} = \frac{\text{Mass of solution(g)}}{\text{density of solution (g mL}^{-1})}$$

$$= \frac{1364}{1.89}$$

$$\text{Molarity} = \frac{\text{Moles of solute}}{\text{Volume of solution (in L)}} = \frac{6.50\times1.89}{1364\times10^{-3}} = 9.00\ \text{M}$$

36. Answer (3)

Weight of H = $\frac{210}{18} \times 2 = 23.333$ g (in 750 g compound)

% of H = $\frac{23.333}{750} \times 100$

= 3.111

$\approx$ 3

37. Answer (525)

$3Pb(NO_3)_2 + Cr_2(SO_4)_3 \rightarrow 3PbSO_4 \downarrow + 2Cr(NO_3)_3$

m.moles of $Pb(NO_3)_2$ = 35 × 0.15 = 5.25 m.moles

m.moles of $Cr_2(SO_4)_3$ = 20 × 0.12 = 2.4 m.moles

$\therefore$ $Pb(NO_3)_2$ is limiting reagent.

m.moles of $PbSO_4$ formed = 5.25 m.moles

= 525 × 10^{-5} moles

38. Answer (1)

Volume of Cl_2 at STP = 20 mL

Moles of chlorine gas = $\frac{20}{22400}$

Molecules of Cl_2 gas = $\frac{20}{22400} \times 6.023 \times 10^{23}$

Atoms of Cl = $2 \times \frac{20}{22400} \times 6.023 \times 10^{23}$

$\approx 1 \times 10^{23}$

39. Answer (18)

$C_2H_6 + \frac{7}{2}O_2 \rightarrow 2CO_2 + 3H_2O$

Number of moles of ethane = $\frac{3}{30}$ = 0.1

Number of moles of water = 3 × 0.1 = 0.3

$\therefore$ Number of molecules of water

= 6.023 × 10^{23} × 0.3

= 18.069 × 10^{22}

$\approx$ 18 × 10^{22}

40. Answer (226)

NaOH	+ HCl	$\rightarrow$ NaCl	+ H_2O
125 m mol	500 m mol	-	-
-	375 m mol	125 m mol	-

Number of unreacted molecules of

HCl = 375 × 10^{-3} × 6.022 × 10^{23}

= 2258.25 × 10^{20}

= 225.825 × 10^{21}

$\approx$ 226 × 10^{21}

41. Answer (4)

Concentration of glucose in blood = 0.72 g/L

= $\frac{0.72}{180} = 4 \times 10^{-3}$ molar

42. Answer (464)

$2C_4H_{10}(g) + 13O_2(g) \longrightarrow 8CO_2(g) + 10H_2O(l)$

116 g	180 g
46.4 g	72.0 g

So, the amount of butane required is 464 × 10^{-1} g for the production of 72.0 g of H_2O.

43. Answer (3)

The number of significant figures in 0.00340 is three.

44. Answer (5)

Given, density of water = 1 g cm^{-3}

density of NaOH solution = 1.2 g cm^{-3}

mass of 1 L solution = 1200 g

mass of 1 L solvent = 1000 g

mass of solute = 200 g

molality = $\frac{200 \times 1000}{40 \times 1000} = 5$ m

45. Answer (3)

Molar mass of KCl = 39 + 35.5

= 74.5 g mol^{-1}

Density of solution = 1.20 g ml^{-1}

Mass of solution = 1000 + 3.3 × 74.5

= 1245.85 g

Voume of solution $= \frac{1245.85}{1.2}$ ml

$= 1038.20$ ml

Molarity $= \frac{3.3 \times 1000}{1038.20} = 3.17$ mol/l $\simeq 3$

46. Answer (50)

Mole $= \frac{\text{Given mass}}{\text{Molar mass}}$

$= \frac{3.45}{23} = 0.15$ mol of Na^+

Each mole of Na_3PO_4 has 3 mole of Na^+. So 0.15 mole of Na^+ is present in $\frac{0.15}{3}$ mole of Na_3PO_4.

Molarity $= \frac{0.15 \times 1000}{3 \times 100} = 0.5$ mol L^{-1}

Molarity $= 50 \times 10^{-2}$ mol L^{-1}

47. Answer (19)

$$C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$$

Moles initial	$\frac{100}{44}$	$\frac{1000}{32}$	–	–
Moles final	–	$\frac{1000}{32} - \frac{100 \times 5}{44}$	$\frac{300}{44}$	$\frac{400}{44}$

Mole fraction of CO_2 $= \frac{\frac{300}{44}}{19.89 + 6.81 + 9.09}$

$= 19.02$

$\therefore$ x = 19

48. Answer (20)

Molar mass of oxalic acid $H_2C_2O_4 \cdot 2H_2O = 126$ g/mol

$\text{Molarity} = \frac{\text{Number of moles of solute}}{\text{Vol. of solution (in L)}}$

$= \frac{6.3 \times 1000}{126 \times 250}$

$= 0.2$ molar

49. Answer (13)

$$Na_2O + H_2O \rightarrow 2NaOH$$

Moles $\frac{20}{23 \times 2 + 16}$ $= \frac{2 \times 20}{(23 \times 2 + 16)}$

Molarity $= \frac{0.645 \times 1000}{500}$

$= 1.290$ M

$= 12.90 \times 10^{-1}$ M

$\simeq 13 \times 10^{-1}$ M

50. Answer (64)

$M = \frac{\text{moles of solute}}{\text{volume of solution in L}}$

$M = \frac{80}{249.54 \times 5} \approx 64 \times 10^{-3}$ mol L^{-1}

51. Answer (2)

Moles $= \frac{\text{Number of atom}}{\text{Avogadro's number}}$

Moles $= \frac{\text{Given mass}}{\text{Molar mass}}$

$\frac{8}{23} = \frac{\text{Number of atoms}}{6.02 \times 10^{23}}$

Number of atoms $= 2 \times 10^{23}$

52. Answer (3)

$C_{15}H_{30} + \frac{45}{2}O_2 \rightarrow 15CO_2 + 15H_2O$

One litre of fuel has a mass $(0.756) \times 1000$ g.

$\therefore$ moles of $C_{15}H_{30} = \frac{756}{210}$

Moles of O_2 required $= \frac{45}{2} \times \frac{756}{210}$

Mass of O_2 required $= \frac{45}{2} \times \frac{756}{210} \times 32$ g $= 2592$ g

Mass of CO_2 formed $= 15 \times \frac{756}{210} \times 44 = 2376$ g

53. Answer (5418)

Molar mass of $C_7H_5N_3O_6$ = 227 g/mol

681 g of $C_7H_5N_3O_6$ = 3 mol

$\therefore$ 681 g of $C_7H_5N_3O_6$ has 9 mole of N.

= 54.18×10^{23} N atoms

= 5418×10^{21}

54. Answer (25)

0.3% glycine means

100 g protein 'A' contains 0.3 g glycine.

Since, molar mass of glycine is 75

75 g glycine will be present in $\frac{100}{0.3} \times 75$ g protein

Minimum molar mass of protein A is 25×10^3 g/mol

55. Answer (3)

$$\text{Molarity} = \frac{35}{(36.5) \times \frac{100}{1.46}} \times 1000 = 14.0 \text{ M}$$

56. Answer (143)

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

wt. of $CH_4 = 100$ g

wt. of $O_2 = 208$ g $\qquad n_{O_2} = \frac{208}{32}$

In this reaction O_2 is limiting reagent

2 moles of $O_2 \longrightarrow$ 1 mole of CO_2

1 mole of $O_2 \longrightarrow \frac{1}{2}$ mole of CO_2

$\frac{208}{32}$ mole of $O_2 \longrightarrow \frac{208}{32} \times \frac{1}{2}$ mole of CO_2

$\longrightarrow \frac{208}{32} \times \frac{1}{2} \times 44$ gm of CO_2

$\longrightarrow$ 143 gm of CO_2

57. Answer (225)

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

1 mol $CH_4 \longrightarrow$ 2 mole H_2O

36 gm $H_2O \longrightarrow$ 1 mole CH_4

81 gm $H_2O \longrightarrow \frac{1}{36} \times 81$ mole CH_4

$\longrightarrow$ 2.25 mole

$\longrightarrow 225 \times 10^{-2}$

58. Answer (1)

Density = 'x' gm ml^{-1}

$\therefore$ molality, $m = \frac{5 \times 1000}{[x(1000) - 372.5]} = 7.96$

$\simeq 8$ m (Assuming x = 1)

$\therefore \Delta T_f = iK_fm$

Assuming complete dissociation of salt (100%)

(i = 2)

$\Delta T_f = 2 \times 1.86 \times 8 \simeq 29.76$

Hence, the solution does not freeze at –21°C. This means that molality of the solution won't change as $x \geq 1$.

Statement (II) is also correct as molality is mass dependent and hence, does not change with temperature. However, as solvents are not mentioned, statement (I) can also be incorrect.

59. Answer (2)

Mole of A_2B = moles of AB_3

$$\frac{W}{2A + B} = \frac{W}{A + 3B}$$

A + 3B = 2A + B

2B = A

Atomic weight of A is 2 times that of B.

60. Answer (4)

Element	%mass	Moles	Whole number ratio
C	74	6.17	5
H	8.7	8.7	7
N	17.3	1.236	1

Empirical Formula = C_5H_7N

Empirical formula mass = 81 g

$n \times 81 = 162$

$n = 2$

Hence molecular formula is $C_{10}H_{14}N_2$

61. Answer (2)

$$\frac{0.02858 \times 0.112}{0.5702} = .00561$$

Answer expressed in 3 significant figures.

62. Answer (46)

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

Since H_2 is in excess and 20 L of ammonia gas is produced.

Hence, 2 moles $NH_3 \equiv 1$ mole N_2 $\quad (v \propto n)$

20 L $NH_3 \equiv 10$ L N_2

Volume of N_2 left = 56 – 10 = 46 L

63. Answer (24)

In 2L $\rightarrow$ 96 mg of Mg

$$\text{Number of atoms of Mg} = \frac{96 \times 10^{-3}}{24} \times N_A$$

$$= 4 \times 10^{-3} \times 6 \times 10^{23}$$

$$= 24 \times 10^{20}$$

64. Answer (54)

m moles of $HNO_3 = 800 \times 0.5$

Moles of $HNO_3 = 400 \times 10^{-3} = 0.4$ moles

Weight of $HNO_3 = 0.4 \times 63$ g = 25.2 g

Remaining acid = 25.2 – 11.5 = 13.7 g

$$M = \frac{13.7 \times 1000}{400 \times 63}$$

$$= \frac{137}{252} = 0.54$$

$$= 54 \times 10^{-2}$$

65. Answer (3)

According to the question,

100 g of haemoglobin contains 0.34 g of iron

3.3 g of haemoglobin contains $\frac{0.34}{100} \times 3.3$ g of iron

$$\text{moles of Fe} = \frac{0.34 \times 3.3}{100 \times 56} = \frac{N}{N_A}$$

$$N = \frac{0.34 \times 3.3 \times 6.022 \times 10^{23}}{100 \times 56} = 1.21 \times 10^{20}$$

66. Answer (2)

$$\underset{n_{moles}=1}{X} + \underset{1}{Y} + \underset{.05}{3Z} \rightleftharpoons xyz_3$$

$$\text{Limiting reagent is Z} = \frac{.05}{3} = .016$$

3 moles of Z $\rightarrow$ 1 mole of XYZ_3

.05 mole of Z $\rightarrow \frac{1}{3} \times .05$ mole of XYZ_3

M.wt. of XYZ_3 = 10 + 20 +90

= 120 amu

$$\text{Wt. of } XYZ_3 = \frac{.05}{3} \times 120$$

= 2 g

67. Answer (46)

$$\% \text{ of H} = \frac{2}{18} \times \frac{\text{wt. of } H_2O}{\text{wt. of organic compound}} \times 100$$

$$= \frac{2}{18} \times \frac{0.4428}{0.492} \times 100$$

$$= 0.11 \times 0.9 \times 100$$

$$= .099 \times 100 = 9.9$$

$$\% \text{ of C} = \frac{12}{44} \times \frac{0.7938}{0.492} \times 100$$

$$= 0.27 \times 1.61 \times 100$$

$$= 43.47$$

% Oxygen = 100 – (43.47 + 9.9)

= 100 – 53.37

$\simeq 46$

68. Answer (25)

$$H_2SO_4 + 2NaOH \longrightarrow Na_2SO_4 + 2H_2O$$

at intial	0.4 mole	0.2 mole	–
	0.3	0	0.1

Molarity of $Na_2SO_4 = \frac{0.1}{4} = 0.025$ M

= 25 millimolar.

69. Answer (3)

$$\underset{20\text{ g}}{N_{2(g)}} + \underset{5\text{ g}}{3H_{2(g)}} \rightleftharpoons 2NH_{3(g)}$$

Ideally 28 g N_2 reacts with 6 g H_2 limiting reagent is N_2

$\therefore$ Amount of NH_3 formed on reacting 20 g N_2 is,

$= \frac{34 \times 20}{28} = 24.28$ g

= 1.42 moles

70. Answer (3)

$$4HNO_3(l) + 3KCl(s) \longrightarrow Cl_2(g) + NOCl(g) + 2H_2O(g) + 3KNO_3(s)$$

$\because$ 110 g of $KNO_3 \Rightarrow$ moles of $KNO_3 = \frac{110}{101}$

= 1.089 mol

As, 4 mole of HNO_3 produces 3 mol of KNO_3.

Hence, the moles of HNO_3 required to produce 1.089 moles of $KNO_3 = \frac{4}{3} \times 1.089 = 1.452$ mol

Hence, mass of HNO_3 required is 1.452 × 63

= 91.5 g (approx.)

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