

Some Basic Concepts of Chemistry

1.3 Properties of Matter and their Measurement

1. The dimensions of pressure are the same as that of
 (a) force per unit volume
 (b) energy per unit volume
 (c) force (d) energy (1995)

1.4 Uncertainty in Measurement

2. Given the numbers : 161 cm, 0.161 cm, 0.0161 cm. The number of significant figures for the three numbers is
 (a) 3, 3 and 4 respectively
 (b) 3, 4 and 4 respectively
 (c) 3, 4 and 5 respectively
 (d) 3, 3 and 3 respectively. (1998)

1.5

Laws of Chemical Combinations

3. Equal masses of H_2 , O_2 and methane have been taken in a container of volume V at temperature $27^\circ C$ in identical conditions. The ratio of the volumes of gases H_2 : O_2 : methane would be
 (a) 16 : 1 : 2 (b) 8 : 1 : 2 (2014)
4. What volume of oxygen gas (O_2) measured at $0^\circ C$ and 1 atm, is needed to burn completely 1 L of propane gas (C_3H_8) measured under the same conditions?
 (a) 5 L (b) 10 L
 (c) 7 L (d) 6 L (2008)
5. 0.24 g of a volatile gas, upon vaporisation, gives 45 mL vapour at NTP. What will be the vapour density of the substance? (Density of $H_2 = 0.089$ g/L)
 (a) 95.93 (b) 59.93
 (c) 95.39 (d) 5.993 (1996)
6. The molecular weight of O_2 and SO_2 are 32 and 64 respectively. At $15^\circ C$ and 150 mmHg pressure, one litre of O_2 contains 'N' molecules. The number of molecules in two litres of SO_2 under the same conditions of temperature and pressure will be

- (a) $N/2$ (b) N
 (c) $2N$ (d) $4N$ (1990)
7. What is the weight of oxygen required for the complete combustion of 2.8 kg of ethylene?
 (a) 2.8 kg (b) 6.4 kg
 (c) 9.6 kg (d) 96 kg (1989)

1.7 Atomic and Molecular Masses

8. An element, X has the following isotopic composition :
 $^{200}X : 90\%$ $^{199}X : 8.0\%$ $^{202}X : 2.0\%$
 The weighted average atomic mass of the naturally occurring element X is closest to
 (a) 201 amu (b) 202 amu
 (c) 199 amu (d) 200 amu (2007)
9. Boron has two stable isotopes, $^{10}B(19\%)$ and $^{11}B(81\%)$. Calculate average at. wt. of boron in the periodic table.
 (a) 10.8 (b) 10.2
 (c) 11.2 (d) 10.0 (1990)

1.8 Mole Concept and Molar Masses

10. Which one of the followings has maximum number of atoms?
 (a) 1 g of $Ag(s)$ [Atomic mass of $Ag = 108$]
 (b) 1 g of $Mg(s)$ [Atomic mass of $Mg = 24$]
 (c) 1 g of $O_{2(g)}$ [Atomic mass of $O = 16$]
 (d) 1 g of $Li(s)$ [Atomic mass of $Li = 7$] (NEET 2020)
11. In which case is number of molecules of water maximum?
 (a) 18 mL of water
 (b) 0.18 g of water
 (c) 0.00224 L of water vapours at 1 atm and 273 K
 (d) 10^{-3} mol of water (NEET 2018)
12. Suppose the elements X and Y combine to form two compounds XY_2 and X_3Y_2 . When 0.1 mole of XY_2 weighs 10 g and 0.05 mole of X_3Y_2 weighs 9 g, the atomic weights of X and Y are

- (a) 40, 30 (b) 60, 40
(c) 20, 30 (d) 30, 20 (NEET-II 2016)
13. If Avogadro number N_A , is changed from $6.022 \times 10^{23} \text{ mol}^{-1}$ to $6.022 \times 10^{20} \text{ mol}^{-1}$, this would change
(a) the mass of one mole of carbon
(b) the ratio of chemical species to each other in a balanced equation
(c) the ratio of elements to each other in a compound
(d) the definition of mass in units of grams. (2015)
14. The number of water molecules is maximum in
(a) 1.8 gram of water
(b) 18 gram of water
(c) 18 moles of water
(d) 18 molecules of water. (2015)
15. A mixture of gases contains H_2 and O_2 gases in the ratio of 1 : 4 (w/w). What is the molar ratio of the two gases in the mixture?
(a) 16 : 1 (b) 2 : 1
(c) 1 : 4 (d) 4 : 1 (2015, Cancelled)
16. Which has the maximum number of molecules among the following?
(a) 44 g CO_2 (b) 48 g O_3
(c) 8 g H_2 (d) 64 g SO_2
(Mains 2011)
17. The number of atoms in 0.1 mol of a triatomic gas is ($N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$)
(a) 6.026×10^{22} (b) 1.806×10^{23}
(c) 3.600×10^{23} (d) 1.800×10^{22} (2010)
18. The maximum number of molecules is present in
(a) 15 L of H_2 gas at STP
(b) 5 L of N_2 gas at STP
(c) 0.5 g of H_2 gas
(d) 10 g of O_2 gas. (2004)
19. Which has maximum molecules?
(a) 7 g N_2 (b) 2 g H_2
(c) 16 g NO_2 (d) 16 g O_2 (2002)
20. Specific volume of cylindrical virus particle is $6.02 \times 10^{-2} \text{ cc/g}$ whose radius and length are 7 Å and 10 Å respectively. If $N_A = 6.02 \times 10^{23}$, find molecular weight of virus.
(a) 15.4 kg/mol (b) $1.54 \times 10^4 \text{ kg/mol}$
(c) $3.08 \times 10^4 \text{ kg/mol}$ (d) $3.08 \times 10^3 \text{ kg/mol}$
(2001)
21. The number of atoms in 4.25 g of NH_3 is approximately
(a) 4×10^{23} (b) 2×10^{23}
(c) 1×10^{23} (d) 6×10^{23} (1999)
22. Haemoglobin contains 0.334% of iron by weight. The molecular weight of haemoglobin is approximately 67200. The number of iron atoms (Atomic weight of Fe is 56) present in one molecule of haemoglobin is
(a) 4 (b) 6
(c) 3 (d) 2 (1998)
23. The number of moles of oxygen in one litre of air containing 21% oxygen by volume, under standard conditions, is
(a) 0.0093 mol (b) 2.10 mol
(c) 0.186 mol (d) 0.21 mol (1995)
24. The total number of valence electrons in 4.2 g of N_3^- ion is (N_A is the Avogadro's number)
(a) $2.1 N_A$ (b) $4.2 N_A$
(c) $1.6 N_A$ (d) $3.2 N_A$ (1994)
25. The number of gram molecules of oxygen in $6.02 \times 10^{24} \text{ CO}$ molecules is
(a) 10 g molecules (b) 5 g molecules
(c) 1 g molecule (d) 0.5 g molecules. (1990)
26. Ratio of C_p and C_v of a gas 'X' is 1.4. The number of atoms of the gas 'X' present in 11.2 litres of it at NTP will be
(a) 6.02×10^{23} (b) 1.2×10^{23}
(c) 3.01×10^{23} (d) 2.01×10^{23} (1989)
27. The number of oxygen atoms in 4.4 g of CO_2 is
(a) 1.2×10^{23} (b) 6×10^{22}
(c) 6×10^{23} (d) 12×10^{23} (1989)
28. 1 cc N_2O at NTP contains
(a) $\frac{1.8}{224} \times 10^{22}$ atoms
(b) $\frac{6.02}{22400} \times 10^{23}$ molecules
(c) $\frac{1.32}{224} \times 10^{23}$ electrons
(d) all of the above. (1988)

1.9 Percentage Composition

29. An organic compound contains carbon, hydrogen and oxygen. Its elemental analysis gave C, 38.71% and H, 9.67%. The empirical formula of the compound would be
(a) CHO (b) CH_4O
(c) CH_3O (d) CH_2O (2008)
30. Percentage of Se in peroxidase anhydrous enzyme is 0.5% by weight (at. wt. = 78.4) then minimum molecular weight of peroxidase anhydrous enzyme is
(a) 1.568×10^4 (b) 1.568×10^3
(c) 15.68 (d) 2.136×10^4 (2001)

31. Which of the following fertilizers has the highest nitrogen percentage?
 (a) Ammonium sulphate
 (b) Calcium cyanamide
 (c) Urea
 (d) Ammonium nitrate (1993)

1.10 Stoichiometry and Stoichiometric Calculations

32. The number of moles of hydrogen molecules required to produce 20 moles of ammonia through Haber's process is
 (a) 40 (b) 10
 (c) 20 (d) 30 (NEET 2019)
33. The density of 2 M aqueous solution of NaOH is 1.28 g/cm^3 . The molality of the solution is [Given that molecular mass of NaOH = 40 g mol^{-1}]
 (a) 1.20 m (b) 1.56 m
 (c) 1.67 m (d) 1.32 m (Odisha NEET 2019)
34. A mixture of 2.3 g formic acid and 4.5 g oxalic acid is treated with conc. H_2SO_4 . The evolved gaseous mixture is passed through KOH pellets. Weight (in g) of the remaining product at STP will be
 (a) 1.4 (b) 3.0
 (c) 2.8 (d) 4.4 (NEET 2018)
35. What is the mass of the precipitate formed when 50 mL of 16.9% solution of AgNO_3 is mixed with 50 mL of 5.8% NaCl solution?
 (Ag = 107.8, N = 14, O = 16, Na = 23, Cl = 35.5)
 (a) 3.5 g (b) 7 g
 (c) 14 g (d) 28 g (2015)
36. 20.0 g of a magnesium carbonate sample decomposes on heating to give carbon dioxide and 8.0 g magnesium oxide. What will be the percentage purity of magnesium carbonate in the sample? (At. wt. of Mg = 24)
 (a) 96 (b) 60
 (c) 84 (d) 75 (2015)
37. When 22.4 litres of $\text{H}_{2(g)}$ is mixed with 11.2 litres of $\text{Cl}_{2(g)}$, each at STP, the moles of $\text{HCl}_{(g)}$ formed is equal to
 (a) 1 mol of $\text{HCl}_{(g)}$ (b) 2 mol of $\text{HCl}_{(g)}$
 (c) 0.5 mol of $\text{HCl}_{(g)}$ (d) 1.5 mol of $\text{HCl}_{(g)}$ (2014)
38. 1.0 g of magnesium is burnt with 0.56 g O_2 in a closed vessel. Which reactant is left in excess and how much? (At. wt. Mg = 24, O = 16)
 (a) Mg, 0.16 g (b) O_2 , 0.16 g
 (c) Mg, 0.44 g (d) O_2 , 0.28 g (2014)
39. 6.02×10^{20} molecules of urea are present in 100 mL of its solution. The concentration of solution is
 (a) 0.001 M (b) 0.1 M
 (c) 0.02 M (d) 0.01 M (NEET 2013)
40. In an experiment it showed that 10 mL of 0.05 M solution of chloride required 10 mL of 0.1 M solution of AgNO_3 , which of the following will be the formula of the chloride (X stands for the symbol of the element other than chlorine)?
 (a) X_2Cl_2 (b) XCl_2
 (c) XCl_4 (d) X_2Cl (Karnataka NEET 2013)
41. 25.3 g of sodium carbonate, Na_2CO_3 is dissolved in enough water to make 250 mL of solution. If sodium carbonate dissociates completely, molar concentration of sodium ion, Na^+ and carbonate ions, CO_3^{2-} are respectively
 (Molar mass of $\text{Na}_2\text{CO}_3 = 106 \text{ g mol}^{-1}$)
 (a) 0.955 M and 1.910 M
 (b) 1.910 M and 0.955 M
 (c) 1.90 M and 1.910 M
 (d) 0.477 M and 0.477 M (2010)
42. 10 g of hydrogen and 64 g of oxygen were filled in a steel vessel and exploded. Amount of water produced in this reaction will be
 (a) 3 mol (b) 4 mol
 (c) 1 mol (d) 2 mol (2009)
43. How many moles of lead(II) chloride will be formed from a reaction between 6.5 g of PbO and 3.2 g HCl ?
 (a) 0.011 (b) 0.029
 (c) 0.044 (d) 0.333 (2008)
44. The mass of carbon anode consumed (giving only carbon dioxide) in the production of 270 kg of aluminium metal from bauxite by the Hall process is
 (a) 270 kg (b) 540 kg
 (c) 90 kg (d) 180 kg (Atomic mass : Al = 27) (2005)
45. Molarity of liquid HCl , if density of solution is 1.17 g/cc
 (a) 36.5 (b) 18.25
 (c) 32.05 (d) 42.10 (2001)
46. Volume of CO_2 obtained by the complete decomposition of 9.85 g of BaCO_3 is
 (a) 2.24 L (b) 1.12 L
 (c) 0.84 L (d) 0.56 L (2000)

47. In the reaction,
 $4\text{NH}_3(\text{g}) + 5\text{O}_2(\text{g}) \rightarrow 4\text{NO}(\text{g}) + 6\text{H}_2\text{O}(\text{l})$
 when 1 mole of ammonia and 1 mole of O_2 are made to react to completion
 (a) all the oxygen will be consumed
 (b) 1.0 mole of NO will be produced
 (c) 1.0 mole of H_2O is produced
 (d) all the ammonia will be consumed. (1998)
48. The amount of zinc required to produce 224 mL of H_2 at STP on treatment with dilute H_2SO_4 will be
 (a) 65 g (b) 0.065 g
 (c) 0.65 g (d) 6.5 g (1996)
49. At STP the density of CCl_4 vapour in g/L will be nearest to
 (a) 6.87 (b) 3.42
 (c) 10.26 (d) 4.57 (1988)

ANSWER KEY

1. (b) 2. (d) 3. (c) 4. (a) 5. (b) 6. (c) 7. (c) 8. (d) 9. (a) 10. (d)
 11. (a) 12. (a) 13. (a) 14. (c) 15. (d) 16. (c) 17. (b) 18. (a) 19. (b) 20. (a)
 21. (d) 22. (a) 23. (a) 24. (c) 25. (b) 26. (a) 27. (a) 28. (d) 29. (c) 30. (a)
 31. (c) 32. (d) 33. (c) 34. (c) 35. (b) 36. (c) 37. (a) 38. (a) 39. (d) 40. (b)
 41. (b) 42. (b) 43. (b) 44. (c) 45. (c) 46. (b) 47. (a) 48. (c) 49. (a)

Hints & Explanations

1. (b) : Pressure = $\frac{\text{Force}}{\text{Area}}$
 Therefore, dimensions of pressure = $\frac{\text{MLT}^{-2}}{\text{L}^2} = \text{ML}^{-1}\text{T}^{-2}$
 and dimensions of energy per unit volume
 $= \frac{\text{Energy}}{\text{Volume}} = \frac{\text{ML}^2\text{T}^{-2}}{\text{L}^3} = \text{ML}^{-1}\text{T}^{-2}$

2. (d) : Zeros placed left to the number are never significant, therefore the no. of significant figures for the numbers 161 cm, 0.161 cm and 0.0161 cm are same, i.e., 3.

3. (c) : According to Avogadro's hypothesis, ratio of the volumes of gases will be equal to the ratio of their no. of moles.

So, no. of moles = $\frac{\text{Mass}}{\text{Mol. mass}}$
 $n_{\text{H}_2} = \frac{w}{2}; n_{\text{O}_2} = \frac{w}{32}; n_{\text{CH}_4} = \frac{w}{16}$
 So, the ratio is $\frac{w}{2} : \frac{w}{32} : \frac{w}{16}$ or 16 : 1 : 2.

4. (a) : $\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$
 1 vol. 5 vol. 3 vol. 4 vol.

According to the above equation,

1 vol. or 1 litre of propane requires 5 vol. or 5 litres of O_2 to burn completely.

5. (b) : Weight of gas = 0.24 g,
 Volume of gas = 45 mL = 0.045 litre and density of H_2 = 0.089 g/L
 Weight of 45 mL of H_2 = density $\times$ volume
 $= 0.089 \times 0.045 = 4.005 \times 10^{-3}$ g

Therefore, vapour density

$$= \frac{\text{Weight of certain volume of substance}}{\text{Weight of same volume of hydrogen}} = \frac{0.24}{4.005 \times 10^{-3}} = 59.93$$

6. (c) : If 1 L of one gas contains N molecules, 2 L of any gas under the same conditions will contain $2N$ molecules.

7. (c) : $\text{C}_2\text{H}_4 + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 2\text{H}_2\text{O}$
 28 g 96 g

For complete combustion,

$$2.8 \text{ kg of } \text{C}_2\text{H}_4 \text{ requires } = \frac{96}{28} \times 2.8 \times 10^3 \text{ g} = 9.6 \times 10^3 \text{ g} = 9.6 \text{ kg of } \text{O}_2$$

8. (d) : Average isotopic mass of X

$$= \frac{200 \times 90 + 199 \times 8 + 202 \times 2}{90 + 8 + 2} = \frac{18000 + 1592 + 404}{100} = 199.96 \text{ amu} \approx 200 \text{ amu}$$

9. (a) : Average atomic mass = $\frac{19 \times 10 + 81 \times 11}{100} = 10.81$

10. (d) : 1 mole of substance = N_A atoms

$$108 \text{ g of Ag} = N_A \text{ atoms} \Rightarrow 1 \text{ g of Ag} = \frac{N_A}{108} \text{ atoms}$$

$$24 \text{ g of Mg} = N_A \text{ atoms} \Rightarrow 1 \text{ g of Mg} = \frac{N_A}{24} \text{ atoms}$$

$$32 \text{ g of } \text{O}_2 = N_A \text{ molecules} = 2 N_A \text{ atoms}$$

$$\Rightarrow 1 \text{ g of O} = \frac{N_A}{16} \text{ atoms}$$

$$7 \text{ g of Li} = N_A \text{ atoms} \Rightarrow 1 \text{ g of Li} = \frac{N_A}{7} \text{ atoms}$$

Therefore, 1 g of Li(s), has maximum number of atoms.

11. (a) : (a) Mass of water = $V \times d = 18 \times 1 = 18 \text{ g}$
Molecules of water = mole $\times N_A = \frac{18}{18} N_A = N_A$

(b) Molecules of water = mole $\times N_A = \frac{0.18}{18} N_A$

(c) Moles of water = $\frac{0.00224}{22.4} = 10^{-4}$

Molecules of water = mole $\times N_A = 10^{-4} N_A$

(d) Molecules of water = mole $\times N_A = 10^{-3} N_A$

12. (a) : Let atomic weight of element X is x and that of

element Y is y .

For XY , $n = \frac{\text{Mol. wt.}}{x + y}$

$$0.1 = \frac{10}{x + 2y} \Rightarrow x + 2y = \frac{10}{0.1} = 100 \quad \dots(i)$$

For X_3Y_2 , $n = \frac{\text{Mol. wt.}}{3x + 2y}$

$$0.05 = \frac{9}{3x + 2y} \Rightarrow 3x + 2y = \frac{9}{0.05} = 180 \quad \dots(ii)$$

On solving equations (i) and (ii), we get $x = 40$

$$40 + 2y = 100 \Rightarrow 2y = 60 \Rightarrow y = 30$$

13. (a) : Mass of 1 mol (6.022×10^{23} atoms) of carbon = 12 g

If Avogadro number is changed to 6.022×10^{20} atoms then mass of 1 mol of carbon

$$= \frac{12 \times 6.022 \times 10^{20}}{6.022 \times 10^{23}} = 12 \times 10^{-3} \text{ g}$$

14. (c) : 1.8 gram of water = $\frac{6.023 \times 10^{23}}{18} \times 1.8$
 $= 6.023 \times 10^{22}$ molecules

18 gram of water = 6.023×10^{23} molecules

18 moles of water = $18 \times 6.023 \times 10^{23}$ molecules

15. (d) : Number of moles of $H_2 = 1/2$

Number of moles of $O_2 = \frac{4}{32}$

Hence, molar ratio = $\frac{1}{2} : \frac{4}{32} = 4 : 1$

16. (c) : 8 g H_2 has 4 moles while the others has 1 mole each.

17. (b) : No. of atoms = $N_A \times \text{No. of moles} \times 3$
 $= 6.023 \times 10^{23} \times 0.1 \times 3 = 1.806 \times 10^{23}$

18. (a) : At STP, $22.4 \text{ L} = 6.023 \times 10^{23}$ molecules
 $15 \text{ L H} = \frac{6.023 \times 10^{23} \times 15}{22.4} = 4.033 \times 10^{23}$ molecules

$$5 \text{ L N}_2 = \frac{6.023 \times 10^{23} \times 5}{22.4} = 1.344 \times 10^{23} \text{ molecules}$$

$2 \text{ g H}_2 = 6.023 \times 10^{23}$ molecules

$$0.5 \text{ g H}_2 = \frac{6.023 \times 10^{23} \times 0.5}{2} = 1.505 \times 10^{23} \text{ molecules}$$

$32 \text{ g O}_2 = 6.023 \times 10^{23}$ molecules

$$10 \text{ g of O}_2 = \frac{6.023 \times 10^{23} \times 10}{32} = 1.882 \times 10^{23} \text{ molecules}$$

19. (b) : Number of molecules = moles $\times N_A$
Molecules of $N_2 = \frac{7}{14} N_A = 0.5 N_A$

Molecules of $H_2 = N_A$

Molecules of $NO_2 = \frac{16}{46} N_A = 0.35 N_A$

Molecules of $O_2 = \frac{16}{32} N = 0.5 N_A$

$\therefore$ 2 g H_2 (1 mole H_2) contains maximum molecules.

20. (a) : Specific volume (vol. of 1 g) of cylindrical virus particle = $6.02 \times 10^{-2} \text{ cc/g}$

Radius of virus, $r = 7 \text{ \AA} = 7 \times 10^{-8} \text{ cm}$

Volume of virus = $\pi r^2 l$

$$= \frac{22}{7} \times (7 \times 10^{-8})^2 \times 10 \times 10^{-8} = 154 \times 10^{-23} \text{ cc}$$

wt. of one virus particle = $\frac{\text{Volume (cc)}}{\text{Specific volume (cc/g)}}$
 $= \frac{154 \times 10^{-23}}{6.02 \times 10^{-2}} \text{ g}$

$\therefore$ Molecular wt. of virus = wt. of N particles
 $= \frac{154 \times 10^{-23}}{6.02 \times 10^{-2}} \times 6.02 \times 10^{23} \text{ g/mol}$
 $= 15400 \text{ g/mol} = 15.4 \text{ kg/mol}$

21. (d) : 17 g of $NH_3 = 4N_A$ atoms

$4.25 \text{ g of NH}_3 = \frac{4N_A}{17} \times 4.25 \text{ atoms}$
 $= N_A \text{ atoms} = 6 \times 10^{23} \text{ atoms}$

22. (a) : Quantity of iron in one molecule
 $= \frac{67200}{100} \times 0.334 = 224.45 \text{ amu}$

No. of iron atoms in one molecule of haemoglobin
 $= \frac{224.45}{56} = 4$

23. (a) : Volume of oxygen in one litre of air
 $= \frac{21}{100} \times 1000 = 210 \text{ mL}$

Therefore, no. of moles = $\frac{210}{22400} = 0.0093 \text{ mol}$

24. (c) : Each nitrogen atom has 5 valence electrons, therefore total number of valence electrons in N_3^- ion is 16. Since the molecular mass of N_3^- is 42, therefore total number of valence electrons in 4.2 g of N_3^- ion

$$= \frac{4.2}{42} \times 16 \times N_A = 1.6 N_A$$

25. (b) : Avogadro's no., $N_A = 6.02 \times 10^{23}$ molecules = 1 mole
 $\therefore 6.02 \times 10^{24}$ CO molecules = 10 moles CO
 = 10 g atoms of O = 5 g molecules of O_2

26. (a) : Here, $C_p/C_v = 1.4$, which shows that the gas is diatomic.

$$22.4 \text{ L at NTP} = 6.02 \times 10^{23} \text{ molecules}$$

$$\therefore 11.2 \text{ L at NTP} = 3.01 \times 10^{23} \text{ molecules}$$

Since gas is diatomic,

$$\therefore 11.2 \text{ L at NTP} = 2 \times 3.01 \times 10^{23} \text{ atoms} \\ = 6.02 \times 10^{23} \text{ atom}$$

27. (a) : 1 mol of $CO_2 = 44 \text{ g of } CO_2$

$$\therefore 4.4 \text{ g } CO_2 = 0.1 \text{ mol } CO_2 = 6 \times 10^{22} \text{ molecules} \\ [\text{Since, 1 mole } CO_2 = 6 \times 10^{23} \text{ molecules}] \\ = 2 \times 6 \times 10^{22} \text{ atoms of O} = 1.2 \times 10^{23} \text{ atoms of O}$$

28. (d) : As we know,

$$22400 \text{ cc of } N_2O \text{ contain } 6.02 \times 10^{23} \text{ molecules}$$

$$\therefore 1 \text{ cc of } N_2O \text{ contain } \frac{6.02 \times 10^{23}}{22400} \text{ molecules}$$

Since in N_2O molecule there are 3 atoms

$$\therefore 1 \text{ cc } N_2O = \frac{3 \times 6.02 \times 10^{23} \text{ atoms}}{22400} = \frac{1.8 \times 10^{22} \text{ atoms}}{224}$$

No. of electrons in a molecule of $N_2O = 7 + 7 + 8 = 22$

Hence, no. of electrons in 1 cc of N_2O

$$= \frac{6.02 \times 10^{23}}{22400} \times 22 \text{ electrons} = \frac{1.32}{224} \times 10^{23} \text{ electrons}$$

29. (c) :

Element	%	Atomic mass	Mole	Simple ratio
C	38.71	12	$\frac{38.71}{12} = 3.22$	$\frac{3.22}{3.22} = 1$
H	9.67	1	$\frac{9.67}{1} = 9.67$	$\frac{9.67}{3.22} = 3$
O	51.62	16	$\frac{51.62}{16} = 3.22$	$\frac{3.22}{3.22} = 1$

Hence, empirical formula of the compound would be CH_3O .

30. (a) : In peroxidase anhydrous enzyme, 0.5% Se is present means, 0.5 g Se is present in 100 g of enzyme. In a molecule of enzyme one Se atom must be present. Hence,

$$78.4 \text{ g Se will be present in } \frac{100}{0.5} \times 78.4 = 1.568 \times 10^4$$

$$\therefore \text{Minimum molecular weight of enzyme is } 1.568 \times 10^4.$$

31. (c) : Urea (NH_2CONH_2), % of N = $\frac{28}{60} \times 100 = 46.66\%$

Similarly, % of N in other compounds are :

$(NH_4)_2SO_4 = 21.2\%$; $CaCN_2 = 35.0\%$ and $NH_4NO_3 = 35.0\%$

32. (d) : Haber's process, $N_2 + 3H_2 \rightarrow 2NH_3$

2 moles of NH_3 are formed by 3 moles of H_2 .

$\therefore$ 20 moles of NH_3 will be formed by 30 moles of H_2 .

33. (c) : Density = 1.28 g/cc,

Conc. of solution = 2 M

Molar mass of NaOH = 40 g mol⁻¹

Volume of solution = 1 L = 1000 mL

Mass of solution = $d \times V = 1.28 \times 1000 = 1280 \text{ g}$

Mass of solute = $n \times \text{Molar mass} = 2 \times 40 = 80 \text{ g}$

Mass of solvent = $(1280 - 80) \text{ g} = 1200 \text{ g}$

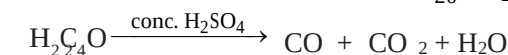
$$\text{Number of moles of solute} = \frac{80}{40} = 2$$

$$\therefore \text{Molality} = \frac{2 \times 1000}{1200} = 1.67 \text{ m}$$

34. (c) : $HCOOH \xrightarrow[\text{conc. } H_2SO_4]{\text{Dehydrating agent}} CO + H_2O$

$$n_i = \frac{2.3}{46} = \frac{1}{20} \quad \quad \quad \begin{matrix} 0 & 0 \\ \frac{1}{20} & \frac{1}{20} \end{matrix}$$

$$n_f = 0 \quad \quad \quad \begin{matrix} \frac{1}{20} & \frac{1}{20} \end{matrix}$$



$$n_i = \frac{4.5}{90} = \frac{1}{20} \quad \quad \quad \begin{matrix} 0 & 0 & 0 \end{matrix}$$

$$n_f = 0 \quad \quad \quad \begin{matrix} \frac{1}{20} & \frac{1}{20} & \frac{1}{20} \end{matrix}$$

H_2O gets absorbed by conc. H_2SO_4 . Gaseous mixture (containing CO and CO_2) when passed through KOH pellets, CO_2 gets absorbed.

$$\text{Moles of CO left (unabsorbed)} = \frac{1}{20} + \frac{1}{20} = \frac{1}{10}$$

$$\text{Mass of CO} = \text{moles} \times \text{molar mass} = \frac{1}{10} \times 28 = 2.8 \text{ g}$$

35. (b) : 16.9% solution of $AgNO_3$ means 16.9 g of $AgNO_3$ in 100 mL of solution.

= 8.45 g of $AgNO_3$ in 50 mL solution.

Similarly, 5.8 g of NaCl in 100 mL solution

$$= 2.9 \text{ g of NaCl in 50 mL solution.}$$

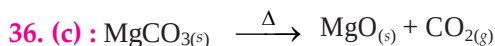
The reaction can be represented as :



$$\begin{matrix} \text{Initial} & 8.45/170 & 2.9/58.5 & 0 & 0 \\ \text{mole} & = 0.049 & = 0.049 & & \end{matrix}$$

$$\text{Final moles} \quad 0 \quad 0 \quad 0.049 \quad 0.049$$

$$\therefore \text{Mass of AgCl precipitated} = 0.049 \times 143.3 \\ = 7.02 \approx 7 \text{ g}$$

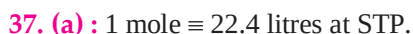


$$84 \text{ g of MgCO}_3 \equiv 40 \text{ g of MgO}$$

$$\therefore 20 \text{ g of MgCO}_3 \equiv \frac{40}{84} \times 20 = 9.52 \text{ g of MgO}$$

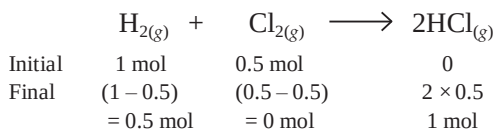
$$\text{Actual yield} = 8 \text{ g of MgO}$$

$$\therefore \% \text{ purity} = \frac{8}{9.52} \times 100 = 84\%$$



$$n_{\text{H}_2} = \frac{22.4}{22.4} = 1 \text{ mol}; n_{\text{Cl}_2} = \frac{11.2}{22.4} = 0.5 \text{ mol}$$

Reaction is as,

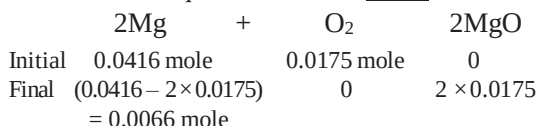


Here, Cl_2 is limiting reagent. So, 1 mole of $\text{HCl}_{(g)}$ is formed.

38. (a) : $n_{\text{Mg}} = \frac{1}{24} = 0.0416 \text{ moles}$

$$n_{\text{O}_2} = \frac{0.56}{32} = 0.0175 \text{ mole}$$

The balanced equation is



Here, O_2 is limiting reagent.

$$\therefore \text{Mass of Mg left in excess} = 0.0066 \times 24 = 0.16 \text{ g}$$

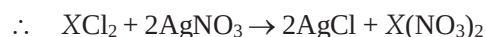
39. (d) : Moles of urea = $\frac{6.02 \times 10^{-23}}{6.02 \times 10^{-23}} = 0.001$

$$\text{Concentration of solution} = \frac{0.001}{100} \times 1000 = 0.01 \text{ M}$$

40. (b) : Millimoles of solution of chloride
 $= 0.05 \times 10 = 0.5$

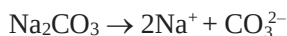
$$\text{Millimoles of AgNO}_3 \text{ solution} = 10 \times 0.1 = 1$$

So, the millimoles of AgNO_3 are double than the chloride solution.



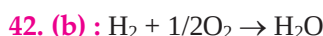
41. (b) : Given that molar mass of $\text{Na}_2\text{CO}_3 = 106 \text{ g}$
 $\frac{25.3 \times 1000}{106 \times 250} = 0.955 \text{ M}$

$$\therefore \text{Molarity of solution} = \frac{25.3 \times 1000}{106 \times 250} = 0.955 \text{ M}$$



$$\left[\text{Na}^+\right] = 2\left[\text{Na}_2\text{CO}_3\right] = 2 \times 0.955 = 1.910 \text{ M}$$

$$\left[\text{CO}_3^{2-}\right] = \left[\text{Na}_2\text{CO}_3\right] = 0.955 \text{ M}$$



2 g	16 g	18 g
1 mol	0.5 mol	1 mol

$$10 \text{ g of H}_2 = 5 \text{ mol and } 64 \text{ g of O}_2 = 2 \text{ mol}$$

$\therefore$ In this reaction, oxygen is the limiting reagent so amount of H_2O produced depends on the amount of O_2 .

Since 0.5 mol of O_2 gives 1 mol of H_2O

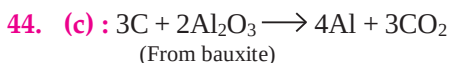
$\therefore$ 2 mol of O_2 will give 4 mol of H_2O



$$\frac{6.5}{224} \text{ mol} \quad \frac{3.2}{36.5} \text{ mol}$$

$$= 0.029 \text{ mol} = 0.087 \text{ mol}$$

Formation of moles of lead(II) chloride depends upon the no. of moles of PbO which acts as a limiting reagent here. So, no. of moles of PbCl_2 formed will be equal to the no. of moles of PbO i.e. 0.029.



4 moles of Al is produced by 3 moles of C.

1 mole of Al is produced by $\frac{3}{4}$ mole of C.

$$\frac{270 \times 1000}{27} = 10^4 \text{ moles of Al is produced by } \frac{3}{4} \times 10^4$$

moles of C.

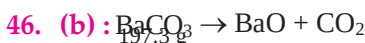
$$\text{Amount of carbon used} = \frac{3}{4} \times 10^4 \times 12 \text{ g}$$

$$= \frac{3}{4} \times 10 \times 12 \text{ kg} = 90 \text{ kg}$$



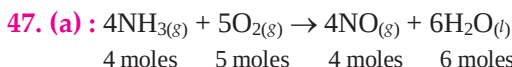
$\Rightarrow$ 1 cc. solution contains 1.17 g of HCl

$$\therefore \text{Molarity} = \frac{1.17 \times 1000}{36.5 \times 1} = 32.05$$



9.85 g	$\frac{22.4 \text{ L at N.T.P.}}{197.3 \times 9.85}$
	$= 1.118 \text{ L}$

$\Rightarrow$ 9.85 g of BaCO_3 will produce 1.118 L of CO_2 at N.T.P. on the complete decomposition.



$\Rightarrow$ 1 mole of NH_3 requires = $5/4 = 1.25$ mole of oxygen while 1 mole of O_2 requires = $4/5 = 0.8$ mole of NH_3 . Therefore, all oxygen will be consumed.



65 g	22400 mL
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Since 65 g of zinc reacts to liberate 22400 mL of H_2 at STP, therefore amount of zinc needed to produce 224 mL of H_2 at STP = $\frac{65}{22400} \times 224 = 0.65 \text{ g}$



$$\therefore \text{Density of CCl}_4 \text{ vapour} = \frac{154}{22.4} \text{ g L}^{-1} = 6.875 \text{ g L}^{-1}$$