CHAPTER 1

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 and3 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 °C in identical conditions. The ratio of the volumes of gases $H_2 : O_2 :$ methane would be
   (b) 16 : 8 : 1
   (c) 16 : 1: 2 (d) 8 : 1 : 2 *(2014)*
4. What volume of oxygen gas (O_2) measured at 0°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°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) 2 *N* (d) 4 *N* *(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 6.022×10^{23} mol^{-1} to 6.022×10^{20} 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 ($N_A = 6.02 \times 10^{23}$ 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 6.02×10^{-2} 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) 1.54×10^4 kg/mol
(c) 3.08×10^4 kg/mol (d) 3.08×10^3 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 6.02×10^{24} 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 $H_{2(g)}$ is mixed with 11.2 litres of $Cl_{2(g)}$, each at STP, the moles of $HCl_{(g)}$ formed is equal to
(a) 1 mol of $HCl_{(g)}$ (b) 2 mol of $HCl_{(g)}$
(c) 0.5 mol of $HCl_{(g)}$ (d) 1.5 mol of $HCl_{(g)}$
(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 Na_2CO_3 = 106 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 is
(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,
$4NH_{3(g)} + 5O_{2(g)} \rightarrow 4NO_{(g)} + 6H_2O_{(l)}$
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 $= \frac{MLT^{-2}}{L^2} = ML^{-1}T^{-2}$

and dimensions of energy per unit volume

$$= \frac{\text{Energy}}{\text{Volume}} = \frac{ML^2T^{-2}}{L^3} = ML^{-1}T^{-2}$$

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 $= \frac{\text{Mass}}{\text{Mol. mass}}$

$n_{H_2} = \frac{w}{2}$; $n_{O_2} = \frac{w}{32}$; $n_{CH_4} = \frac{w}{16}$

So, the ratio is $\frac{w}{2} : \frac{w}{32} : \frac{w}{16}$ or 16 : 1 : 2.

4. (a) : $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$
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 × 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) : $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$
28 g 96 g

For complete combustion,
2.8 kg of C_2H_4 requires $= \frac{96}{28} \times 2.8 \times 10^3$ g
$= 9.6 \times 10^3$ g = 9.6 kg of 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 g of Ag = N_A atoms ⇒ 1 g of Ag $= \frac{N_A}{108}$ atoms

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

32 g of O_2 = N_A molecules = 2 N_A atoms

⇒ 1 g of $O_2 = \frac{N_A}{16}$ atoms

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

Therefore, 1 g of $Li_{(s)}$, has maximum number of atoms.

11. (a) : (a) Mass of water = $V \times d = 18 \times 1 = 18$ g

Molecules of water = mole × $N_A = \frac{18}{18} N_A = N_A$

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

$= 10^{-2} N_A$

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

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

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

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

For XY, $n = \frac{w}{\text{Mol. wt.}}$

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

For X_3Y_2, $n = \frac{w}{\text{Mol. wt.}}$

$0.05 = \frac{9}{3x + 2y} \Rightarrow 3x + 2y = \frac{9}{0.05} = 180$ ...(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

$= \frac{12 \times 6.022 \times 10^{20}}{6.022 \times 10^{23}} = 12 \times 10^{-3}$ 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 × No. of moles × 3

$= 6.023 \times 10^{23} \times 0.1 \times 3 = 1.806 \times 10^{23}$

18. (a) : At STP, 22.4 L = 6.023×10^{23} molecules

15 L $H_2 = \frac{6.023 \times 10^{23} \times 15}{22.4} = 4.033 \times 10^{23}$ molecules

5 L $N_2 = \frac{6.023 \times 10^{23} \times 5}{22.4} = 1.344 \times 10^{23}$ molecules

2 g $H_2 = 6.023 \times 10^{23}$ molecules

0.5 g $H_2 = \frac{6.023 \times 10^{23} \times 0.5}{2} = 1.505 \times 10^{23}$ molecules

32 g $O_2 = 6.023 \times 10^{23}$ molecules

10 g of $O_2 = \frac{6.023 \times 10^{23} \times 10}{32} = 1.882 \times 10^{23}$ molecules

19. (b) : Number of molecules = moles × 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 $O_2 = \frac{16}{32} N_A = 0.5\, N_A$

∴ 2 g H_2 (1 mole H_2) contains maximum molecules.

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

Radius of virus, r = 7 Å = 7×10^{-8} cm

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

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

wt. of one virus particle $= \frac{\text{Volume (cc)}}{\text{Specific volume (cc/g)}}$

$= \frac{154 \times 10^{-23}}{6.02 \times 10^{-2}}$ g

∴ Molecular wt. of virus = wt. of N_A particles

$= \frac{154 \times 10^{-23}}{6.02 \times 10^{-2}} \times 6.02 \times 10^{23}$ g/mol

= 15400 g/mol = 15.4 kg/mol

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

4.25 g of $NH_3 = \frac{4N_A}{17} \times 4.25$ atoms

$= N_A$ atoms $= 6 \times 10^{23}$ atoms

22. (a) : Quantity of iron in one molecule

$= \frac{67200}{100} \times 0.334 = 224.45$ 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

$= \frac{21}{100} \times 1000 = 210$ mL

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

∴ 6.02×10^{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 L at NTP = 6.02×10^{23} molecules

∴ 11.2 L at NTP = 3.01×10^{23} molecules

Since gas is diatomic,

∴ 11.2 L at NTP = $2 \times 3.01 \times 10^{23}$ atoms

= 6.02×10^{23} atom

27. (a) : 1 mol of CO_2 = 44 g of CO_2

∴ 4.4 g CO_2 = 0.1 mol CO_2 = 6×10^{22} molecules

[Since, 1 mole $CO_2 = 6 \times 10^{23}$ molecules]

= $2 \times 6 \times 10^{22}$ atoms of O = 1.2×10^{23} atoms of O

28. (d) : As we know,

22400 cc of N_2O contain 6.02×10^{23} molecules

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

Since in N_2O molecule there are 3 atoms

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

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

∴ Minimum molecular weight of enzyme is 1.568×10^4.

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.

∴ 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 × 1000 = 1280 g

Mass of solute = n × Molar mass = 2 × 40 = 80 g

Mass of solvent = (1280 – 80) g = 1200 g

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

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

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

$n_i = \frac{2.3}{46} = \frac{1}{20}$ 0   0

$n_f = 0$ $\frac{1}{20}$ $\frac{1}{20}$

$H_2C_2O_4 \xrightarrow{\text{conc. } H_2SO_4} CO + CO_2 + H_2O$

$n_i = \frac{4.5}{90} = \frac{1}{20}$ 0   0   0

$n_f = 0$ $\frac{1}{20}$ $\frac{1}{20}$ $\frac{1}{20}$

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.

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

Mass of CO = moles × molar mass = $\frac{1}{10} \times 28 = 2.8$ 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 g of NaCl in 50 mL solution.

The reaction can be represented as :

	$AgNO_3$ +	NaCl ⟶	AgCl↓ +	$NaNO_3$
Initial mole	8.45/170 = 0.049	2.9/58.5 = 0.049	0	0
Final moles	0	0	0.049	0.049

∴ Mass of AgCl precipitated = 0.049 × 143.3

= 7.02 ≈ 7 g

36. (c) : $MgCO_{3(s)} \xrightarrow{\Delta} MgO_{(s)} + CO_{2(g)}$

84 g of $MgCO_3 \equiv$ 40 g of MgO (84 g, 40 g)

$\therefore$ 20 g of $MgCO_3 \equiv \frac{40}{84} \times 20 = 9.52$ g of MgO

Actual yield = 8 g of MgO

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

37. (a) : 1 mole $\equiv$ 22.4 litres at STP.

$n_{H_2} = \frac{22.4}{22.4} = 1$ mol; $n_{Cl_2} = \frac{11.2}{22.4} = 0.5$ mol

Reaction is as,

	$H_{2(g)}$	+ $Cl_{2(g)}$	$\longrightarrow 2HCl_{(g)}$
Initial	1 mol	0.5 mol	0
Final	(1 – 0.5) = 0.5 mol	(0.5 – 0.5) = 0 mol	2 × 0.5 1 mol

Here, Cl_2 is limiting reagent. So, 1 mole of $HCl_{(g)}$ is formed.

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

$n_{O_2} = \frac{0.56}{32} = 0.0175$ mole

The balanced equation is

	2Mg	+ O_2	$\longrightarrow$ 2MgO
Initial	0.0416 mole	0.0175 mole	0
Final	(0.0416 – 2 × 0.0175) = 0.0066 mole	0	2 × 0.0175

Here, O_2 is limiting reagent.

$\therefore$ Mass of Mg left in excess = 0.0066 × 24 = 0.16 g

39. (d) : Moles of urea $= \frac{6.02 \times 10^{20}}{6.02 \times 10^{23}} = 0.001$

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

40. (b) : Millimoles of solution of chloride
= 0.05 × 10 = 0.5

Millimoles of $AgNO_3$ solution = 10 × 0.1 = 1

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

$\therefore$ $XCl_2 + 2AgNO_3 \rightarrow 2AgCl + X(NO_3)_2$

41. (b) : Given that molar mass of Na_2CO_3 = 106 g

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

$Na_2CO_3 \rightarrow 2Na^+ + CO_3^{2-}$

$[Na^+] = 2[Na_2CO_3] = 2 \times 0.955 = 1.910$ M

$[CO_3^{2-}] = [Na_2CO_3] = 0.955$ M

42. (b) : $H_2 + 1/2O_2 \rightarrow H_2O$

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

10 g of H_2 = 5 mol and 64 g of O_2 = 2 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

43. (b) : $PbO + 2HCl \rightarrow PbCl_2 + H_2O$

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

= 0.029 mol = 0.087 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.

44. (c) : $3C + 2Al_2O_3 \longrightarrow 4Al + 3CO_2$
(From bauxite)

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

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

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

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

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

45. (c) : Density = 1.17 g/cc.

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

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

46. (b) : $BaCO_3 \rightarrow BaO + CO_2$

197.3 g — 22.4 L at N.T.P.

9.85 g — $\frac{22.4}{197.3} \times 9.85$ = 1.118 L

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

47. (a) : $4NH_{3(g)} + 5O_{2(g)} \rightarrow 4NO_{(g)} + 6H_2O_{(l)}$

4 moles 5 moles 4 moles 6 moles

$\Rightarrow$ 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.

48. (c) : $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$

65 g — 22400 mL

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 $= \frac{65}{22400} \times 224 = 0.65$ g

49. (a) : Weight of 1 mol of CCl_4 vapour
= 12 + 4 × 35.5 = 154 g

$\therefore$ Density of CCl_4 vapour $= \frac{154}{22.4}$ g L^{-1} = 6.875 g L^{-1}