# Chapter 1. Some Basic Concepts of Chemistry

1. 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)*

2. 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)*

3. If Avogadro number $N_A$, is changed from $6.022 \times 10^{23}$ mol$^{-1}$ to $6.022 \times 10^{20}$ 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)*

4. 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)*

5. 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)*

6. 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
   (a) 8 : 16 : 1 (b) 16 : 8 : 1
   (c) 16 : 1 : 2 (d) 8 : 1 : 2 *(2014)*

7. When 22.4 litres of $H_{2(g)}$ is mixed with 11.2 litres of $Cl_{2(g)}$, each at S.T.P, 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)*

8. 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)*

9. $6.02 \times 10^{20}$ 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)*

10. 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)*

11. 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)*

12. The number of atoms in 0.1 mol of a triatomic gas is ($N_A = 6.02 \times 10^{23}$ mol$^{-1}$)
    (a) $6.026 \times 10^{22}$ (b) $1.806 \times 10^{23}$
    (c) $3.600 \times 10^{23}$ (d) $1.800 \times 10^{22}$
    *(2010)*

**13.** 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)*

**14.** 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)*

**15.** 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)*

**16.** 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)*

**17.** 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)*

**18.** 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)*

**19.** 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)*

**20.** 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)*

**21.** 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) $1.568 \times 10^4$ (b) $1.568 \times 10^3$
(c) 15.68 (d) $2.136 \times 10^4$ *(2001)*

**22.** 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)*

**23.** Specific volume of cylindrical virus particle is $6.02 \times 10^{-2}$ 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) $1.54 \times 10^4$ kg/mol
(c) $3.08 \times 10^4$ kg/mol (d) $3.08 \times 10^3$ kg/mol *(2001)*

**24.** In quantitative analysis of second group in laboratory, $H_2S$ gas is passed in acidic medium for precipitation. When $Cu^{2+}$ and $Cd^{2+}$ react with KCN, then for product, true statement is
(a) $K_2[Cu(CN)_4]$ more soluble
(b) $K_2[Cd(CN)_4]$ less stable
(c) $K_3[Cu(CN)_2]$ less stable
(d) $K_2[Cd(CN)_3]$ more stable. *(2000)*

**25.** 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)*

**26.** Oxidation numbers of $A$, $B$, $C$ are +2, +5 and –2 respectively. Possible formula of compound is
(a) $A_2(BC_2)_2$ (b) $A_3(BC_4)_2$
(c) $A_2(BC_3)_2$ (d) $A_3(B_2C)_2$ *(2000)*

**27.** The number of atoms in 4.25 g of $NH_3$ is approximately
(a) $4 \times 10^{23}$ (b) $2 \times 20^{23}$
(c) $1 \times 10^{23}$ (d) $6 \times 10^{23}$ *(1999)*

**28.** 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)*

**29.** 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)*

**30.** 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)*

**31.** Among the following which one is not paramagnetic? [Atomic numbers; Be = 4, Ne = 10, As = 33, Cl = 17]
(a) $Ne^{2+}$ (b) $Be^+$ (c) $Cl^-$ (d) $As^+$ *(1998)*

**32.** 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)
(a) 95.93 (b) 59.93 (c) 95.39 (d) 5.993 (1996)

**33.** 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)*

**34.** 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)*

**35.** 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)*

**36.** 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)*

**37.** A 5 molar solution of $H_2SO_4$ is diluted from 1 litre to a volume of 10 litres, the normality of the solution will be
(a) 1 N (b) 0.1 N
(c) 5 N (d) 0.5 N *(1991)*

**38.** The number of gram molecules of oxygen in $6.02 \times 10^{24}$ CO molecules is
(a) 10 g molecules (b) 5 g molecules
(c) 1 g molecules (d) 0.5 g molecules. *(1990)*

**39.** 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)*

**40.** 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)*

**41.** A metal oxide has the formula $Z_2O_3$. It can be reduced by hydrogen to give free metal and water. 0.1596 g of the metal oxide requires 6 mg of hydrogen for complete reduction. The atomic weight of the metal is
(a) 27.9 (b) 159.6
(c) 79.8 (d) 55.8 *(1989)*

**42.** 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) $6.02 \times 10^{23}$ (b) $1.2 \times 10^{23}$
(c) $3.01 \times 10^{23}$ (d) $2.01 \times 10^{23}$ *(1989)*

**43.** 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)*

**44.** The number of oxygen atoms in 4.4 g of $CO_2$ is
(a) $1.2 \times 10^{23}$ (b) $6 \times 10^{22}$
(c) $6 \times 10^{23}$ (d) $12 \times 10^{23}$ *(1989)*

**45.** At S.T.P. 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)*

**46.** One litre hard water contains 12.00 mg $Mg^{2+}$. Milli-equivalents of washing soda required to remove its hardness is
(a) 1 (b) 12.16
(c) $1 \times 10^{-3}$ (d) $12.16 \times 10^{-3}$
*(1988)*

**47.** 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 the above. *(1988)*

**Answer Key**

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

# EXPLANATIONS

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

For $XY_2$, $n = \frac{w}{\text{Mol. wt.}}$

$0.1 = \frac{10}{x+2y} \Rightarrow x + 2y = \frac{10}{0.1} = 100$ ...(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 $y = 30$

$x + 2(30) = 100 \Rightarrow x = 100 - 60 = 40$

**2. (b) :** 16.9% solution of $AgNO_3$ means 16.9 g of $AgNO_3$ in 100 mL of solution.
16.9 g of $AgNO_3$ in 100 mL solution ≡ 8.45 g of $AgNO_3$ in 50 mL solution.
Similarly, 5.8% 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 $= 0.049 \times 143.3$
$= 7.02 \approx 7$ g

**3. (a) :** Mass of 1 mol ($6.022 \times 10^{23}$ atoms) of carbon = 12 g
If Avogadro number is changed to $6.022 \times 10^{20}$ atoms then mass of 1 mol of carbon

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

**4. (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 $= 6.023 \times 10^{23}$ molecules
18 moles of water $= 18 \times 6.023 \times 10^{23}$ molecules

**5. (d) :** Number of moles of $H_2 = \frac{1}{2}$

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

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

**6. (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.

**7. (a) :** 1 mole ≡ 22.4 litres at S.T.P.

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

Reaction is as,

| | $H_{2(g)}$ + | $Cl_{2(g)}$ ⟶ | $2HCl_{(g)}$ |
|---|---|---|---|
| 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.

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

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

The balanced equation is

| | Mg + | $\frac{1}{2}O_2$ ⟶ | MgO |
|---|---|---|---|
| Initial | 0.0416 moles | 0.0175 moles | 0 |
| Final | (0.0416 – 2 × 0.0175) = 0.0066 moles | 0 | 2 × 0.0175 |

($O_2$ is limiting reagent.)

∴ Mass of Mg left in excess $= 0.0066 \times 24 = 0.16$ g

**9. (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

**10. (b) :** Millimoles of solution of chloride $= 0.05 \times 10 = 0.5$
Millimoles of $AgNO_3$ solution $= 10 \times 0.1 = 1$
So, the millimoles of $AgNO_3$ are double than the chloride solution.
∴ $XCl_2 + 2AgNO_3 \rightarrow 2AgCl + X(NO_3)_2$

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

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

**13. (b) :** Given that molar mass of $Na_2CO_3 = 106$ g

∴ Molarity of solution $= \frac{25.3 \times 1000}{106 \times 250}$
$= 0.9547\text{ M} = 0.955\text{ M}$

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

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

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

**14. (b) :** $\underset{\substack{2\,g\\1\,mol}}{H_2} + \underset{\substack{16\,g\\0.5}}{1/2O_2} \rightarrow \underset{\substack{18\,g\\1\,mol}}{H_2O}$

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 that of $O_2$.

Since 0.5 mol of $O_2$ gives 1 mol $H_2O$

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

**15. (a) :** $\underset{1\,vol.}{C_3H_8} + \underset{5\,vol.}{5O_2} \longrightarrow \underset{3\,vol.}{3CO_2} + \underset{4\,vol.}{4H_2O}$ (balanced equation)

According to the above equation

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

**16. (b) :** $\underset{n\,mol}{PbO} + \underset{2n\,mol}{2HCl} \rightarrow \underset{n\,mol}{PbCl_2} + H_2O$

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

0.029 mol $\quad$ 0.087 mol

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

**17. (c) :**

| Element | % | Atomic mass | mole ratio | 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 $CH_3O$.

**18. (d) :** Average isotopic mass of *X*

$$= \frac{200 \times 90 + 199 \times 8 + 202 \times 2}{90 + 8 + 2}$$

$$= \frac{18000 + 1592 + 404}{100} = 199.96 \text{ a.m.u.} \approx 200 \text{ a.m.u.}$$

**19. (a) :** At STP, 22.4 L $H_2 = 6.023 \times 10^{23}$ molecules

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

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

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

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

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

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

**20. (b) :** 1 mole of any element contain $6.023 \times 10^{23}$ number of molecules.

1 g mole of $O_2$ = 32 g $O_2$

$\Rightarrow$ 16 g of $O_2$ = 0.5 g mole $O_2$

1 g mole of $N_2$ = 28 g $N_2$

$\Rightarrow$ 7 g $N_2$ = 0.25 g mole $N_2$

1 g mole of $H_2$ = 2 g $H_2$

$\Rightarrow$ 2 g $H_2$ = 1.0 g mole $H_2$

1 g mole $NO_2 = 14 + 16 \times 2 = 46$

$\Rightarrow$ 16 g of $NO_2$ = 0.35 mole $NO_2$

2 g $H_2$ (1 g mole $H_2$) contain maximum molecules.

**21. (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

$$\frac{100}{0.5} \times 78.4 = 1.568 \times 10^4$$

**22. (c) :** Density = 1.17 g/cc.

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

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

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

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

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

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

wt. of one virus particle $= \frac{\text{Volume}}{\text{Specific volume}}$

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

$\therefore$ Molecular wt. of virus = wt. of $N_A$ particle

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

= 15400 g/mol = 15.4 kg/mol

**24. (c) :** $K_3[Cu(CN)_2] = 3(+1) + x + 2(-1) = 0$

$\Rightarrow x = -1$

As the oxidation no. of 'Cu' is –1 (–ve), so this complex is unstable and is not formed.

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

197·34 g $\rightarrow$ 22·4 L at N.T.P.

$$9{\cdot}85 \text{ g} \rightarrow \frac{22{\cdot}4}{197{\cdot}34} \times 9{\cdot}85 = 1{\cdot}118 \text{ L}$$

$\Rightarrow$ 9·85 g $BaCO_3$ will produce 1.118 L $CO_2$ at N.T.P. on the complete decomposition.

**26. (b) :** In $A_3(BC_4)_2$, $(+2)\times 3 + 2[+5 + 4(-2)]$
$\Rightarrow \ +6 + 10 - 16 = 0$
Hence in the compound $A_3(BC_4)_2$, the oxidation no. of '$A$', '$B$' and '$C$' are +2, +5 and –2 respectively.

**27. (d) :** No. of molecules in 4.25 g $NH_3$

$$= \frac{4.25}{17}\times 6.023\times 10^{23} = 2.5\times 6.023\times 10^{22}$$

Number of atoms in 4.25 g $NH_3$

$$= 4\times 2.5\times 6.023\times 10^{22} = 6.023\times 10^{23}$$

**28. (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

**29. (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

$$= \frac{224.45}{56} = 4$$

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

$\Rightarrow$ 1 mole of $NH_3$ requires $= \frac{5}{4} = 1.25$ mole of oxygen

while 1 mole of $O_2$ requires $= \frac{4}{5} = 0.8$ mole of $NH_3$.
As there is 1 mole of $NH_3$ and 1 mole of $O_2$, so all oxygen will be consumed.

**31. (c) :** $Ne^{2+}(8) \Rightarrow 1s^2 2s^2 2p_x^2 2p_y^1 2p_z^1$
$Be^+(3) \Rightarrow 1s^2 2s^1$
$Cl^-(18) \Rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6$
$As^+(32) \Rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p_x^1 4p_y^1$
$Cl^-$ is not paramagnetic , as it has no unpaired electron.

**32. (b) :** Weight of gas = 0.24 g, Volume of gas = 45 mL = 0.045 litre and density of $H_2$ = 0.089.
We know that weight of 45 mL of $H_2$ = Density × Volume = 0.089 × 0.045 = $4.005\times 10^{-3}$ g
Therefore vapour density

$$= \frac{\text{Weight of certain volume of substance}}{\text{Weight of same volume of hydrogen}}$$

$$= \frac{0.24}{4.005\times 10^{-3}} = 59.93$$

**33. (c) :** $\underset{(65\text{ g})}{Zn} + \underset{(22400\text{ mL})}{H_2SO_4} \rightarrow ZnSO_4 + H_2$
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

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

**34. (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

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

**35. (a) :** Volume of oxygen in one litre of air

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

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

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

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

**37. (a) :** 5M $H_2SO_4$ = 10N $H_2SO_4$
$N_1V_1 = N_2V_2 \Rightarrow 10\times 1 = N_2\times 10 \Rightarrow N_2 = 1N$

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

**39. (a) :** Average atomic mass

$$= \frac{19\times 10 + 81\times 11}{100} = 10.81$$

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

**41. (d) :** $Z_2O_3 + 3H_2 \rightarrow 2Z + 3H_2O$
Valency of metal in $Z_2O_3$ = 3
0.1596 g of $Z_2O_3$ react with 6 mg of $H_2$.
[1 mg = 0.001 g = $10^{-3}$g]

$\therefore$ 1 g of $H_2$ react with $= \frac{0.1596}{0.006} = 26.6$ g of $Z_2O_3$

$\therefore$ Eq. wt. of $Z_2O_3$ = 26.6
Now, Eq. wt. of $Z$ + Eq. wt. of O = Eq. wt. of $Z$ + 8 = 26.6
$\Rightarrow$ Eq. wt. of $Z$ = 26.6 – 8 = 18.6
$\therefore$ At. wt. of $Z$ = 18.6 × 3 = 55.8

$$\left[\text{Eq. wt} = \frac{\text{Atomic wt.}}{\text{Valency of metal}}\right]$$

**42. (a) :** Here, $C_p/C_V$ = 1.4, which shows that the gas is diatomic.
22.4 L at NTP = $6.02\times 10^{23}$ molecules

$\therefore$ 11.2 L at NTP = $3.01 \times 10^{23}$ molecules
Since gas is diatomic.
$\therefore$ 11.2 L at NTP = $6.02 \times 10^{23}$ atom

**43.** **(c) :** $\underset{28\text{ g}}{C_2H_4} + \underset{96\text{ g}}{3O_2} \rightarrow 2CO_2 + 2H_2O$

$$2.8 \text{ kg } C_2H_4 = \frac{96\text{ g}}{28\text{ g}} \times 2.8 \text{ kg}$$

$$= \frac{96}{28} \times 2.8 \times 10^3 g = 9.6 \times 10^3 \text{ g} = 9.6 \text{ kg}$$

**44.** **(a) :** 1 mol of $CO_2$ = 44 g of $CO_2$
$\therefore$ 4·4 g $CO_2$ = 0.1 mol $CO_2$ = $6 \times 10^{22}$ molecules
[Since, 1 mole $CO_2$ = $6 \times 10^{23}$ molecules]
= $2 \times 6 \times 10^{22}$ atoms of O = $1.2 \times 10^{23}$ atoms of O

**45.** **(a) :** 1 mol $CCl_4$ vapour = $12 + 4 \times 35.5$
= 154 g = 22.4 L

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

$$= 6.875 \text{ g L}^{-1}$$

**46.** **(a) :** $\underset{1\text{g eq.}}{Mg^{2+}} + \underset{1\text{g eq.}}{Na_2CO_3} \rightarrow MgCO_3 + 2Na^+$
1g eq. of $Mg^{2+}$ = 12g of $Mg^{2+}$ = 12000 mg
Now, 1000 millieq. of $Na_2CO_3$ = 12000 mg of $Mg^{2+}$
$\therefore$ 1 millieq. of $Na_2CO_3$ = 12 mg of $Mg^{2+}$

**47.** **(d) :** As we know,
22400 cc of $N_2O$ contain $6.02 \times 10^{23}$ molecules

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

Since in $N_2O$ molecule there are 3 atoms

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

$$= \frac{1.8 \times 10^{22}}{224} \text{ atoms}$$

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

$$\text{Hence, no. of electrons } = \frac{6.02 \times 10^{23}}{22400} \times 22 \text{ electrons}$$

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