Ordinary Thinking

Objective Questions

Significant figures, Units for measurement, Matter and Separation of mixture

1. One fermi is **[Haryana CEET 1994; DPMT 2004]**
(a) $10^{-13}\ cm$ (b) $10^{-15}\ cm$
(c) $10^{-10}\ cm$ (d) $10^{-12}\ cm$

2. A picometre is written as
(a) $10^{-9}\ m$ (b) $10^{-10}\ m$
(c) $10^{-11}\ m$ (d) $10^{-12}\ m$

3. One atmosphere is equal to
(a) 101.325 K *pa* (b) 1013.25 *K pa*
(c) $10^5\ Nm$ (d) None of these

4. Dimensions of pressure are same as that of **[CBSE PMT 1995]**
(a) Energy (b) Force
(c) Energy per unit volume (d) Force per unit volume

5. The prefix 10^{18} is **[Kerala MEE 2002]**
(a) Giga (b) Nano
(c) Mega (d) Exa

6. Given the numbers : 161*cm*, 0.161*cm*, 0.0161 *cm*. The number of significant figures for the three numbers are **[CBSE PMT 1998]**
(a) 3, 4 and 5 respectively (b) 3, 3 and 3 respectively
(c) 3, 3 and 4 respectively (d) 3, 4 and 4 respectively

7. Significant figures in 0.00051 are
(a) 5 (b) 3
(c) 2 (d) 4

8. Which of the following halogen can be purified by sublimation
(a) F_2 (b) Cl_2
(c) Br_2 (d) I_2

9. Difference in density is the basis of **[Kerala MEE 2002]**
(a) Ultrafiltration (b) Molecular sieving
(c) Gravity Separation (d) Molecular attraction

10. Which of the following elements of matter would best convey that there is life on earth
(a) Oxygen (b) Hydrogen
(c) Carbon (d) Iron

11. The compound which is added to table salt for maintaining proper health is
(a) KCl (b) KBr
(c) NaI (d) $MgBr_2$

12. Which of the following contains only one element
(a) Marble (b) Diamond
(c) Glass (d) Sand

13. In known elements, the maximum number is of **[CPMT 1985]**
(a) Metals (b) Non-metals
(c) Metalloids (d) None of these

14. Which one of the following is not an element
(a) Diamond (b) Graphite
(c) Silica (d) Ozone

15. A mixture of $ZnCl_2$ and $PbCl_2$ can be separated by **[AFMC 1989]**
(a) Distillation (b) Crystallization
(c) Sublimation (d) Adding aceitic acid

16. A mixture of methyl alcohol and acetone can be separated by
(a) Distillation
(b) Fractional distillation
(c) Steam distillation
(d) Distillation under reduced pressure

17. In the final answer of the expression $\frac{(29.2-20.2)(1.79\times10^5)}{1.37}$. The number of significant figures is **[CBSE PMT 1994]**
(a) 1 (b) 2
(c) 3 (d) 4

18. 81.4 *g* sample of ethyl alcohol contains 0.002 *g* of water. The amount of pure ethyl alcohol to the proper number of significant figures is
(a) 81.398 *g* (b) 71.40 *g*
(c) 91.4 *g* (d) 81 *g*

19. The unit $J\ Pa^{-1}$ is equivalent to
(a) m^3 (b) cm^3
(c) dm^3 (d) None of these

20. From the following masses, the one which is expressed nearest to the milligram is
(a) 16 *g* (b) 16.4 *g*
(c) 16.428 *g* (d) 16.4284 *g*
[Manipal PMT 2001]

21. The number of significant figures in 6.02×10^{23} is
(a) 23 (b) 3
(c) 4 (d) 26

22. The prefix zepto stands for **[DPMT 2004]**
(a) 10^9 (b) 10^{-12}
(c) 10^{-15} (d) 10^{-21}

23. The significant figures in 3400 are **[BHU 2004]**
(a) 2 (b) 5
(c) 6 (d) 4

24. The number of significant figures in 6.0023 are **[Pb.CET 2001]**
(a) 5 (b) 4
(c) 3 (d) 1

25. Given $P=0.0030m$, $Q=2.40m$, $R=3000m$, Significant figures in P, Q and R are respectively **[Pb. CET 2002]**
(a) 2, 2, 1 (b) 2, 3, 4
(c) 4, 2, 1 (d) 4, 2, 3

26. The number of significant figures in 60.0001 is **[Pb. CET 2000]**

(a) 5 (b) 6

(c) 3 (d) 2

27. A sample was weighted using two different balances. The result's were (i) 3.929 *g* (ii) 4.0 *g*. How would the weight of the sample be reported

(a) 3.929 *g* (b) 3 *g*

(c) 3.9 *g* (d) 3.93 *g*

Laws of chemical combination

1. Which of the following pairs of substances illustrate the law of multiple proportions **[CPMT 1972, 78]**

(a) CO and CO_2 (b) H_2O and D_2O

(c) $NaCl$ and $NaBr$ (d) MgO and $Mg(OH)_2$

2. 1.0 *g* of an oxide of *A* contained 0.5 *g* of *A*. 4.0 *g* of another oxide of *A* contained 1.6 *g* of *A*. The data indicate the law of

(a) Reciprocal proportions (b) Constant proportions

(c) Conservation of energy (d) Multiple proportions

3. Among the following pairs of compounds, the one that illustrates the law of multiple proportions is

(a) NH_3 and NCl_3 (b) H_2S and SO_2

(c) CuO and Cu_2O (d) CS_2 and $FeSO_4$

4. The percentage of copper and oxygen in samples of CuO obtained by different methods were found to be the same. This illustrates the law of **[AMU 1982, 92]**

(a) Constant proportions (b) Conservation of mass

(c) Multiple proportions (d) Reciprocal proportions

5. Two samples of lead oxide were separately reduced to metallic lead by heating in a current of hydrogen. The weight of lead from one oxide was half the weight of lead obtained from the other oxide. The data illustrates **[AMU 1983]**

(a) Law of reciprocal proportions

(b) Law of constant proportions

(c) Law of multiple proportions

(d) Law of equivalent proportions

6. Chemical equation is balanced according to the law of **[AMU 1984]**

(a) Multiple proportion (b) Reciprocal proportion

(c) Conservation of mass (d) Definite proportions

7. Avogadro number is

(a) Number of atoms in one gram of element

(b) Number of millilitres which one mole of a gaseous substances occupies at NTP

(c) Number of molecules present in one gram molecular mass of a substance

(d) All of these

8. Different propartions of oxygen in the various oxides of nitrogen prove the **[MP PMT 1985]**

(a) Equivalent proportion (b) Multiple proportion

(c) Constant proportion (d) Conservation of matter

9. Two elements *X* and *Y* have atomic weights of 14 and 16. They form a series of compounds *A*, *B*, *C*, *D* and *E* in which the same amount of element *X*, *Y* is present in the ratio 1 : 2 : 3 : 4 : 5. If the compound *A* has 28 parts by weight of *X* and 16 parts by weight of *Y*, then the compound of *C* will have 28 parts weight of *X* and **[NCERT 1971]**

(a) 32 parts by weight of *Y* (b) 48 parts by weight of *Y*

(c) 64 parts by weight of *Y* (d) 80 parts by weight of *Y*

10. Carbon and oxygen combine to form two oxides, carbon monoxide and carbon dioxide in which the ratio of the weights of carbon and oxygen is respectively 12 : 16 and 12 : 32. These figures illustrate the

(a) Law of multiple proportions

(b) Law of reciprocal proportions

(c) Law of conservation of mass

(d) Law of constant proportions

11. A sample of calcium carbonate $(CaCO_3)$ has the following percentage composition : *Ca* = 40%; *C* = 12%; *O* = 48%

If the law of constant proportions is true, then the weight of calcium in 4 *g* of a sample of calcium carbonate obtained from another source will be

(a) 0.016 *g* (b) 0.16 *g*

(c) 1.6 *g* (d) 16 *g*

12. *n g* of substance *X* reacts with *m g* of substance *Y* to form *p g* of substance *R* and *q g* of substance *S*. This reaction can be represented as, $X + Y = R + S$. The relation which can be established in the amounts of the reactants and the products will be

(a) $n - m = p - q$ (b) $n + m = p + q$

(c) $n = m$ (d) $p = q$

13. Which of the following is the best example of law of conservation of mass **[NCERT 1975]**

(a) 12 *g* of carbon combines with 32 *g* of oxygen to form 44 *g* of CO_2

(b) When 12 *g* of carbon is heated in a vacuum there is no change in mass

(c) A sample of air increases in volume when heated at constant pressure but its mass remains unaltered

(d) The weight of a piece of platinum is the same before and after heating in air

14. The law of multiple proportions is illustrated by the two compounds **[NCERT 1972]**

(a) Sodium chloride and sodium bromide

(b) Ordinary water and heavy water

(c) Caustic soda and caustic potash

(d) Sulphur dioxide and sulphur trioxide

15. In compound *A*, 1.00 *g* nitrogen unites with 0.57 *g* oxygen. In compound *B*, 2.00 *g* nitrogen combines with 2.24 *g* oxygen. In compound *C*, 3.00 *g* nitrogen combines with 5.11 *g* oxygen. These results obey the following law **[CPMT 1971]**

(a) Law of constant proportion

(b) Law of multiple proportion

(c) Law of reciprocal proportion

(d) Dalton's law of partial pressure

16. Hydrogen combines with oxygen to form H_2O in which 16 *g* of oxygen combine with 2 *g* of hydrogen. Hydrogen also combines with carbon to form CH_4 in which 2 *g* of hydrogen combine with 6 *g* of carbon. If carbon and oxygen combine together then they will do show in the ratio of
(a) 6 : 16 or 12 : 32 (b) 6 : 18
(c) 1 : 2 (d) 12 : 24

17. 2 *g* of hydrogen combine with 16 *g* of oxygen to form water and with 6 *g* of carbon to form methane. In carbon dioxide 12 *g* of carbon are combined with 32 *g* of oxygen. These figures illustrate the law of
(a) Multiple proportions (b) Constant proportions
(c) Reciprocal proportions (d) Conservation of mass

18. An element forms two oxides containing respectively 53.33 and 36.36 percent of oxygen. These figures illustrate the law of
(a) Conservation of mass (b) Constant proportions
(c) Reciprocal proportions (d) Multiple proportions

19. After a chemical reaction, the total mass of reactants and products **[MP PMT 1989]**
(a) Is always increased (b) Is always decreased
(c) Is not changed (d) Is always less or more

20. A sample of pure carbon dioxide, irrespective of its source contains 27.27% carbon and 72.73% oxygen. The data support **[AIIMS 1992]**
(a) Law of constant composition
(b) Law of conservation of mass
(c) Law of reciprocal proportions
(d) Law of multiple proportions

21. The law of definite proportions is not applicable to nitrogen oxide because **[EAMCET 1981]**
(a) Nitrogen atomic weight is not constant
(b) Nitrogen molecular weight is variable
(c) Nitrogen equivalent weight is variable
(d) Oxygen atomic weight is variable

22. Which one of the following pairs of compounds illustrates the law of multiple proportion **[EAMCET 1989]**
(a) H_2O, Na_2O (b) MgO, Na_2O
(c) Na_2O, BaO (d) $SnCl_2, SnCl_4$

Atomic, Molecular and Equivalent masses

1. Which property of an element is always a whole number **[MP PMT 1986]**
(a) Atomic weight (b) Equivalent weight
(c) Atomic number (d) Atomic volume

2. Which one of the following properties of an element is not variable **[Bihar MADT 1981]**
(a) Valency (b) Atomic weight
(c) Equivalent weight (d) All of these

3. The modern atomic weight scale is based on **[MP PMT 2002]**
(a) C^{12} (b) O^{16}
(c) H^1 (d) C^{13}

4. 1 *amu* is equal to
(a) $\frac{1}{12}$ of $C-12$ (b) $\frac{1}{14}$ of O - 16
(c) $1g$ of H_2 (d) 1.66×10^{-23} kg

5. Sulphur forms the chlorides S_2Cl_2 and SCl_2. The equivalent mass of sulphur in SCl_2 is **[EAMCET 1985; Pb. CET 2001]**
(a) 8 *g*/mole (b) 16 *g*/mole
(c) 64.8 *g*/mole (d) 32 *g*/mole

6. The sulphate of a metal M contains 9.87% of *M*. This sulphate is isomorphous with $ZnSO_4.7H_2O$. The atomic weight of *M* is **[IIT 1991]**
(a) 40.3 (b) 36.3
(c) 24.3 (d) 11.3

7. When 100 *ml* of 1 *M* $NaOH$ solution and 10 ml of 10 *N* H_2SO_4 solution are mixed together, the resulting solution will be **[DPMT 1982]**
(a) Alkaline (b) Acidic
(c) Strongly acidic (d) Neutral

8. In chemical scale, the relative mass of the isotopic mixture of oxygen atoms (O^{16}, O^{17}, O^{18}) is assumed to be equal to **[Bihar MADT 1981]**
(a) 16.002 (b) 16.00
(c) 17.00 (d) 11.00

9. For preparing 0.1 *N* solution of a compound from its impure sample of which the percentage purity is known, the weight of the substance required will be **[MP PET 1996]**
(a) More than the theoretical weight
(b) Less than the theoretical weight
(c) Same as the theoretical weight
(d) None of these

10. 1 mol of CH_4 contains
(a) 6.02×10^{23} atoms of *H*
(b) 4 *g* atom of Hydrogen
(c) 1.81×10^{23} molecules of CH_4
(d) 3.0 *g* of carbon

11. In the reaction $2Na_2S_2O_3 + I_2 \rightarrow Na_2S_4O_6 + 2NaI$, the equivalent weight of $Na_2S_2O_3$ (mol. wt. = *M*) is equal to
(a) M (b) $M/2$
(c) $M/3$ (d) $M/4$

12. When potassium permanganate is titrated against ferrous ammonium sulphate, the equivalent weight of potassium permanganate is **[CPMT 1988]**
(a) Molecular weight /10 (b) Molecular weight /5
(c) Molecular weight /2 (d) Molecular weight

13. Boron has two stable isotopes, ^{10}B (19%) and ^{11}B (81%). The atomic mass that should appear for boron in the periodic table is **[CBSE PMT 1990]**
(a) 10.8 (b) 10.2
(c) 11.2 (d) 10.0

14. What is the concentration of nitrate ions if equal volumes of 0.1 $M\ AgNO_3$ and 0.1 $M\ NaCl$ are mixed together **[CPMT 1983; NCERT 1985]**

(a) 0.1 M (b) 0.2 M
(c) 0.05 M (d) 0.25 M

15. Total number of atoms represented by the compound $CuSO_4.5H_2O$ is **[BHU 2005]**

(a) 27 (b) 21
(c) 5 (d) 8

16. 74.5 g of a metallic chloride contain 35.5 g of chlorine. The equivalent weight of the metal is **[CPMT 1986]**

(a) 19.5 (b) 35.5
(c) 39.0 (d) 78.0

17. 7.5 grams of a gas occupy 5.8 litres of volume at STP the gas is

(a) NO (b) N_2O
(c) CO (d) CO_2

18. The number of atoms in 4.25 g of NH_3 is approximately **[CBSE PMT 1999; MH CET 2003]**

(a) 1×10^{23} (b) 2×10^{23}
(c) 4×10^{23} (d) 6×10^{23}

19. One litre of a gas at STP weight 1.16 g it can possible be **[AMU 1992]**

(a) C_2H_2 (b) CO
(c) O_2 (d) CH_4

20. The vapour density of a gas is 11.2. The volume occupied by 11.2 g of the gas at ATP will be **[Bihar CET 1995]**

(a) 11.2 L (b) 22.4 L
(c) 1 L (d) 44.8 L

21. Equivalent weight of crystalline oxalic acid is **[MP PMT 1995]**

(a) 30 (b) 63
(c) 53 (d) 45

22. The equivalent weight of an element is 4. Its chloride has a V.D 59.25. Then the valency of the element is **[BHU 1997]**

(a) 4 (b) 3
(c) 2 (d) 1

23. 1.25 g of a solid dibasic acid is completely neutralised by 25 ml of 0.25 molar $Ba(OH)_2$ solution. Molecular mass of the acid is

(a) 100 (b) 150
(c) 120 (d) 200

24. The oxide of a metal has 32% oxygen. Its equivalent weight would be **[MP PMT 1985]**

(a) 34 (b) 32
(c) 17 (d) 8

25. The mass of a molecule of water is **[Bihar CEE 1995]**

(a) $3\times10^{-26}\ kg$ (b) $3\times10^{-25}\ kg$
(c) $1.5\times10^{-26}\ kg$ (d) $2.5\times10^{-26}\ kg$

26. 1.24 gm P is present in 2.2 gm

(a) P_4S_3 (b) P_2S_2
(c) PS_2 (d) P_2S_4

27. The atomic weights of two elements A and B are 40 and 80 respectively. If x g of A contains y atoms, how many atoms are present in $2x$ g of B

(a) $\frac{y}{2}$ (b) $\frac{y}{4}$
(c) y (d) $2y$

28. Assuming fully decomposed, the volume of CO_2 released at STP on heating 9.85g of $BaCO_3$ (Atomic mass of Ba=137) will be **[CBSE PMT 2000]**

(a) 0.84 L (b) 2.24 L
(c) 4.06 L (d) 1.12 L

29. If N_A is Avogadro's number then number of valence electrons in 4.2 g of nitride ions (N^{3-})

(a) 2.4 N_A (b) 4.2 N_A
(c) 1.6 N_A (d) 3.2 N_A

30. The weight of 1×10^{22} molecules of $CuSO_4.5H_2O$ is **[IIT 1991]**

(a) 41.59 g (b) 415.9 g
(c) 4.159 g (d) None of these

31. Rearrange the following (I to IV) in the order of increasing masses and choose the correct answer from (a), (b), (c) and (d) (Atomic mass: N=14, O=16, Cu=63).

I. 1 molecule of oxygen
II. 1 atom of nitrogen
III. 1×10^{-10} g molecular weight of oxygen
IV. 1×10^{-10} g atomic weight of copper

(a) II<I<III<IV (b) IV<III<II<I
(c) II<III<I<IV (d) III<IV<I<II

32. 1.520 g of the hydroxide of a metal on ignition gave 0.995 gm of oxide. The equivalent weight of metal is **[DPMT 1984]**

(a) 1.520 (b) 0.995
(c) 19.00 (d) 9.00

33. How much coulomb charge is present on 1g ion of N^{3-}

(a) 5.2×10^{6} Couloumb (b) 2.894×10^{5} Couloumb
(c) 6.6×10^{6} Couloumb (d) 8.2×10^{6} Couloumb

34. Ratio of C_p and C_v of a gas X is 1.4, the number of atom of the gas 'X' present in 11.2 litres of it at NTP will be **[CBSE 1999]**

(a) 6.02×10^{23} (b) 1.2×10^{23}
(c) 3.01×10^{23} (d) 2.01×10^{23}

35. If we consider that 1/6, in place of 1/12, mass of carbon atom is taken to be the relative atomic mass unit, the mass of one mole of a substance will **[AIEEE 2005]**

(a) Decrease twice
(b) Increase two fold
(c) Remain unchanged
(d) Be a function of the molecular mass of the substance

36. What should be the equivalent weight of phosphorous acid, if P=31; O=16; H=1
(a) 82 (b) 41
(c) 20.5 (d) None of these

37. The number of molecule at NTP in 1 *ml* of an ideal gas will be
(a) 6×10^{23} (b) 2.69×10^{19}
(c) 2.69×10^{23} (d) None of these

38. The specific heat of a metal is 0.16 its approximate atomic weight would be
(a) 32 (b) 16
(c) 40 (d) 64

39. The weight of a molecule of the compound $C_{60}H_{122}$ is **[AIIMS 2000]**
(a) 1.4×10^{-21} g (b) 1.09×10^{-21} g
(c) 5.025×10^{23} g (d) 16.023×10^{23} g

40. What is the weight of oxygen required for the complete combustion of 2.8 *kg* of ethylene **[CBSE PMT 1989]**
(a) 2.8 *kg* (b) 6.4 *kg*
(c) 9.6 *kg* (d) 96 *kg*

41. What volume of NH_3 gas at STP would be needed to prepare 100*ml* of 2.5 molal (2.5m) ammonium hydroxide solution
(a) 0.056 litres (b) 0.56 litres
(c) 5.6 litres (d) 11.2 litres

42. If the density of water is 1 $g\ cm^{-3}$ then the volume occupied by one molecule of water is approximately **[Pb. PMT 2004]**
(a) 18 cm^3 (b) 22400 cm^3
(c) $6.02\times10^{-23}\ cm^3$ (d) $3.0\times10^{-23}\ cm^3$

43. Caffeine has a molecular weight of 194. If it contains 28.9% by mass of nitrogen, number of atoms of nitrogen in one molecule of caffeine is
(a) 4 (b) 6
(c) 2 (d) 3

44. A 400 *mg* iron capsule contains 100 mg of ferrous fumarate, $(CHCOO)_2Fe$. The percentage of iron pasent in it is approximately
(a) 33% (b) 25%
(c) 14% (d) 8%

45. The element whose a atom has mass of 10.86×10^{-26} *kg* is
(a) Boron (b) Calcium
(c) Silver (d) Zinc

46. The number of gram atoms of oxygen present in 0.3 gram mole of $(COOH)_2.2H_2O$ is
(a) 0.6 (b) 1.8
(c) 1.2 (d) 3.6

47. A gaseous mixture contains CH_4 and C_2H_6 in equimolecular proportion. The weight of 2.24 litres of this mixture at NTP is
(a) 4.6 *g* (b) 1.6 *g*
(c) 2.3 *g* (d) 23 *g*

48. Vapour density of a metal chloride is 66. Its oxide contains 53% metal. The atomic weight of the metal is **[Bihar MADT 1982]**
(a) 21 (b) 54
(c) 27.06 (d) 2.086

49. One gram of hydrogen is found to combine with 80*g* of bromine one gram of calcium valency=2 combines with 4*g* of bromine the equivalent weight of calcium is
(a) 10 (b) 20
(c) 40 (d) 80

50. The equivalent weight of $MnSO_4$ is half its molecular weight when it is converted to **[IIT 1988; CPMT 1994]**
(a) Mn_2O_3 (b) MnO_2
(c) MnO_4 (d) MnO_4^{2-}

51. 100 *mL* of PH_3 on decomposition produced phosphorus and hydrogen. The change in volume is **[MNR 1986]**
(a) 50 *mL* increase (b) 500 *mL* decrease
(c) 900 *mL* decrease (d) Nil.

52. 12*g* of *Mg* (at. mass 24) on reacting completely with acid gives hydrogen gas, the volume of which at STP would be **[CPMT 1978]**
(a) 22.4 *L* (b) 11.2 *L*
(c) 44.8 *L* (d) 6.1 *L*

53. Which of the following has least mass **[Pb. PET 1985]**
(a) 2 *g* atom of nitrogen (b) 3×10^{23} atoms of *C*
(c) 1 mole of *S* (d) 7.0 *g* of *Ag*

54. How many mole of helium gas occupy 22.4 *L* at 0^oC at 1 atm. pressure **[Kurukshetra CEE 1992; CET 1992]**
(a) 0.11 (b) 0.90
(c) 1.0 (d) 1.11

55. Volume of a gas at STP is 1.12×10^{-7} cc. Calculate the number of molecules in it **[BHU 1997]**
(a) 3.01×10^{20} (b) 3.01×10^{12}
(c) 3.01×10^{23} (d) 3.01×10^{24}

56. 4.4 *g* of an unknown gas occupies 2.24*L* of volume at standard temperature and pressure. The gas may be **[MP PMT 1995]**
(a) Carbon dioxide (b) Carbon monoxide
(c) Oxygen (d) Sulphur dioxide

57. The number of moles of oxygen in 1 *L* of air containing 21% oxygen by volume, in standard conditions, is **[CBSE PMT 1995; Pb. PMT 2004]**
(a) 0.186 *mol* (b) 0.21 *mol*
(c) 2.10 *mol* (d) 0.0093 *mol*

58. The number of molecules in 8.96 *L* of a gas at 0^oC and 1 atmosphere pressure is approximately **[BHU 1993]**
(a) 6.02×10^{23} (b) 12.04×10^{23}
(c) 18.06×10^{23} (d) 24.08×10^{22}

59. The equivalent weight of a metal is 9 and vapour density of its chloride is 59.25. The atomic weight of metal is **[Pb. CET 2002]**

(a) 23.9 (b) 27.3

(c) 36.3 (d) 48.3

60. The molecular weight of a gas is 45. Its density at STP is **[Pb. PMT 2004]**

(a) 22.4 (b) 11.2

(c) 5.7 (d) 2.0

61. Equivalent weight of a bivalent metal is 37.2. The molecular weight of its chloride is **[MH CET 2003]**

(a) 412.2 (b) 216

(c) 145.4 (d) 108.2

62. On reduction with hydrogen, 3.6 g of an oxide of metal left 3.2 g of metal. If the vapour density of metal is 32, the simplest formula of the oxide would be **[DPMT 2004]**

(a) MO (b) M_2O_3

(c) M_2O (d) M_2O_5

63. The number of molecules in 4.25 *g* of ammonia are **[Pb. CET 2000]**

(a) 0.5×10^{23} (b) 1.5×10^{23}

(c) 3.5×10^{23} (d) 1.8×10^{32}

The mole concept

1. Which one of the following pairs of gases contains the same number of molecules **[EAMCET 1987]**

(a) 16 *g* of O_2 and 14 *g* of N_2

(b) 8 *g* of O_2 and 22 *g* of CO_2

(c) 28 *g* of N_2 and 22 *g* of CO_2

(d) 32 *g* of O_2 and 32 *g* of N_2

2. Number of *gm* of oxygen in 32.2 *g* $Na_2SO_4.10H_2O$ is **[Haryana PMT 2000]**

(a) 20.8 (b) 22.4

(c) 2.24 (d) 2.08

3. 250 *ml* of a sodium carbonate solution contains 2.65 grams of Na_2CO_3. If 10 *ml* of this solution is diluted to one litre, what is the concentration of the resultant solution (mol. wt. of Na_2CO_3 =106) **[EAMCET 2001]**

(a) 0.1 *M* (b) 0.001 *M*

(c) 0.01 *M* (d) 10^{-4} *M*

4. A molar solution is one that contains one mole of a solute in **[IIT 1986]**

(a) 1000 *g* of the solvent (b) One litre of the solvent

(c) One litre of the solution (d) 22.4 litres of the solution

5. The number of oxygen atoms in 4.4 *g* of CO_2 is approx. **[CBSE PMT 1990]**

(a) 1.2×10^{23} (b) 6×10^{22}

(c) 6×10^{23} (d) 12×10^{23}

6. The volume occupied by 4.4 *g* of CO_2 at STP is **[AFMC 1997, 2004; Pb. CET 1997, 2002]**

(a) 22.4 *L* (b) 2.24 *L*

(c) 0.224 *L* (d) 0.1 *L*

7. The number of water molecules present in a drop of water (volume 0.0018 *ml*) at room temperature is **[DCE 2000]**

(a) 6.023×10^{19} (b) 1.084×10^{18}

(c) 4.84×10^{17} (d) 6.023×10^{23}

8. One mole of calcium phosphide on reaction with excess of water gives **[IIT 1999]**

(a) One mole of phosphine

(b) Two moles of phosphoric acid

(c) Two moles of phosphine

(d) One mole of phosphorus pentoxide

9. 19.7 *kg* of gold was recovered from a smuggler. How many atoms of gold were recovered (*Au* =197) **[Pb. CET 1985]**

(a) 100 (b) 6.02×10^{23}

(c) 6.02×10^{24} (d) 6.02×10^{25}

10. The total number of protons in 10 *g* of calcium carbonate is ($N_0 = 6.023 \times 10^{23}$)

(a) 1.5057×10^{24} (b) 2.0478×10^{24}

(c) 3.0115×10^{24} (d) 4.0956×10^{24}

11. The number of molecules in 16 *g* of methane is

(a) 3.0×10^{23} (b) 6.02×10^{23}

(c) $\frac{16}{6.02} \times 10^{23}$ (d) $\frac{16}{3.0} \times 10^{23}$

12. Number of molecules in 100 *ml* of each of O_2, NH_3 and CO_2 at STP are **[Bihar MADT 1985]**

(a) In the order $CO_2 < O_2 < NH_3$

(b) In the order $NH_3 < O_2 < CO_2$

(c) The same

(d) $NH_3 = CO_2 < O_2$

13. The molecular weight of hydrogen peroxide is 34. What is the unit of molecular weight **[MP PMT 1986]**

(a) *g* (b) *mol*

(c) $g\,mol^{-1}$ (d) $mol\,g^{-1}$

14. The number of water molecules in 1 litre of water is **[EAMCET 1990]**

(a) 18 (b) 18×1000

(c) N_A (d) $55.55\ N_A$

15. The number of electrons in a mole of hydrogen molecule is **[CPMT 1987]**

(a) 6.02×10^{23} (b) 12.046×10^{23}

(c) 3.0115×10^{23} (d) Indefinite

16. The numbers of moles of $BaCO_3$ which contain 1.5 moles of oxygen atoms is **[EAMCET 1991]**

(a) 0.5 (b) 1

(c) 3 (d) 6.02×10^{23}

17. Which of the following is Loschmidt number

(a) 6×10^{23} (b) 2.69×10^{19}

(c) 3×10^{23} (d) None of these

18. How many molecules are present in one gram of hydrogen **[AIIMS 1982]**

(a) 6.02×10^{23} (b) 3.01×10^{23}

(c) 2.5×10^{23} (d) 1.5×10^{23}

19. The total number of gm-molecules of SO_2Cl_2 in $13.5g$ of sulphuryl chloride is **[CPMT 1992]**

(a) 0.1 (b) 0.2

(c) 0.3 (d) 0.4

20. The largest number of molecules is in **[BHU 1997]**

(a) $34g$ of water (b) $28g$ of CO_2

(c) $46g$ of CH_3OH (d) $54g$ of N_2O_5

21. The number of moles of sodium oxide in $620g$ of it is **[BHU 1992]**

(a) 1 mol (b) 10 moles

(c) 18 moles (d) 100 moles

22. $2g$ of oxygen contains number of atoms equal to that in **[BHU 1992]**

(a) $0.5g$ of hydrogen (b) $4g$ of sulphur

(c) $7g$ of nitrogen (d) $2.3g$ of sodium

23. Molarity of liquid HCl with density equal to $1.17g/cc$ is **[CBSE PMT 2001]**

(a) 36.5 (b) 18.25

(c) 32.05 (d) 4.65

24. How many atoms are contained in one mole of sucrose $(C_{12}H_{22}O_{11})$ **[Pb. PMT 2002]**

(a) $45\times6.02\times10^{23}$ atoms/mole

(b) $5\times6.62\times10^{23}$ atoms/mole

(c) $5\times6.02\times10^{23}$ atoms/mole

(d) None of these

25. The number of molecules of CO_2 present in 44g of CO_2 is **[BCECE 2005]**

(a) 6.0×10^{23} (b) 3×10^{23}

(c) 12×10^{23} (d) 3×10^{10}

26. A sample of phosphorus trichloride (PCl_3) contains 1.4 moles of the substance. How many atoms are there in the sample **[Kerala PMT 2004]**

(a) 4 (b) 5.6

(c) 8.431×10^{23} (d) 3.372×10^{24}

(e) 2.409×10^{24}

27. The number of sodium atoms in 2 moles of sodium ferrocyanide is **[BHU 2004]**

(a) 12×10^{23} (b) 26×10^{23}

(c) 34×10^{23} (d) 48×10^{23}

Percentage composition & Molecular formula

1. The percentage of oxygen in $NaOH$ is **[CPMT 1979]**

(a) 40 (b) 60

(c) 8 (d) 10

2. The percentage of nitrogen in urea is about **[KCET 2001]**

(a) 46 (b) 85

(c) 18 (d) 28

3. If two compounds have the same empirical formula but different molecular formula, they must have **[MP PMT 1986]**

(a) Different percentage composition

(b) Different molecular weights

(c) Same viscosity

(d) Same vapour density

4. A compound (80 g) on analysis gave C = 24 g, H = 4 g, O = 32 g. Its empirical formula is **[CPMT 1981]**

(a) $C_2H_2O_2$ (b) C_2H_2O

(c) CH_2O_2 (d) CH_2O

5. The empirical formula of a compound is CH_2O. 0.0835 moles of the compound contains 1.0 g of hydrogen. Molecular formula of the compound is

(a) $C_2H_{12}O_6$ (b) $C_5H_{10}O_5$

(c) $C_4H_8O_8$ (d) $C_3H_6O_3$

6. The empirical formula of an acid is CH_2O_2, the probable molecular formula of acid may be **[AFMC 2000]**

(a) CH_2O (b) CH_2O_2

(c) $C_2H_4O_2$ (d) $C_3H_6O_4$

7. In which of the following pairs of compounds the ratio of C, H and O is same

(a) Acetic acid and methyl alcohol

(b) Glucose and acetic acid

(c) Fructose and sucrose

(d) All of these

Chemical stoichiometry

1. How much of $NaOH$ is required to neutralise 1500 cm^3 of 0.1 $N\ HCl$ $(Na = 23)$ **[KCET 2001]**

(a) 40 g (b) 4 g

(c) 6 g (d) 60 g

2. How much water should be added to 200 c.c of semi normal solution of $NaOH$ to make it exactly deci normal **[AFMC 1983]**

(a) 200 cc (b) 400 cc

(c) 800 cc (d) 600 cc

3. 2.76 g of silver carbonate on being strongly heated yield a residue weighing **[Pb. CET 2003]**

(a) 2.16 g (b) 2.48 g

(c) 2.64 g (d) 2.32 g

4. In the reaction, $4NH_3(g)+5O_2(g)\rightarrow 4NO(g)+6H_2O(g)$, When 1 mole of ammonia and 1 mole of O_2 are made to react to completion

(a) 1.0 mole of H_2O is produced

(b) 1.0 mole of NO will be produced

(c) All the oxygen will be consumed

(d) All the ammonia will be consumed

5. Haemoglobin contains 0.33% of iron by weight. The molecular weight of haemoglobin is approximately 67200. The number of iron atoms (At. wt. of *Fe* = 56) present in one molecule of haemoglobin is **[CBSE PMT 1998]**

(a) 6 (b) 1

(c) 4 (d) 2

6. What quantity of ammonium sulphate is necessary for the production of NH_3 gas sufficient to neutralize a solution containing 292 *g* of HCl? [HCl=36.5; $(NH_4)_2SO_4$ =132; NH_3 =17] **[CPMT 1992]**

(a) 272 *g* (b) 403 *g*

(c) 528 *g* (d) 1056 *g*

7. The percentage of P_2O_5 in diammonium hydrogen phosphate $(NH_4)_2HPO_4$ is **[CPMT 1992]**

(a) 23.48 (b) 46.96

(c) 53.78 (d) 71.00

8. If $1\frac{1}{2}$ moles of oxygen combine with *Al* to form Al_2O_3 the weight of *Al* used in the reaction is (*Al*=27) **[EAMCET 1980]**

(a) 27 *g* (b) 54 *g*

(c) 49.5 *g* (d) 31 *g*

9. The percentage of *Se* in peroxidase anhydrous enzyme is 0.5% by weight (atomic weight=78.4). Then minimum molecular weight of peroxidase anhydrous enzyme is

[CBSE PMT 2001]

(a) 1.568×10^4 (b) 1.568×10^3

(c) 15.68 (d) 3.136×10^4

10. H_2 evolved at STP on complete reaction of 27 *g* of Aluminium with excess of aqueous $NaOH$ would be

[CPMT 1991]

(a) 22.4 (b) 44.8

(c) 67.2 (d) 33.6 *litres*

11. What is the % of H_2O in $Fe(CNS)_3.3H_2O$

(a) 45 (b) 30

(c) 19 (d) 25

12. What weight of SO_2 can be made by burning sulphur in 5.0 moles of oxygen

(a) 640 *grams* (b) 160 *grams*

(c) 80 *grams* (d) 320 *grams*

13. What is the normality of a 1 *M* solution of H_3PO_4

[AIIMS 1982]

(a) 0.5 *N* (b) 1.0 *N*

(c) 2.0 *N* (d) 3.0 *N*

14. Normality of 2*M* sulphuric acid is **[AIIMS 1992]**

(a) 2*N* (b) 4*N*

(c) $\frac{N}{2}$ (d) $\frac{N}{4}$

15. How many *g* of a dibasic acid (Mol. wt. = 200) should be present in 100 *ml* of its aqueous solution to give decinormal strength **[AIIMS 1992]**

(a) 1 *g* (b) 2 *g*

(c) 10 *g* (d) 20 *g*

16. The solution of sulphuric acid contains 80% by weight H_2SO_4. Specific gravity of this solution is 1.71. Its normality is about **[CBSE 1991]**

(a) 18.0 (b) 27.9

(c) 1.0 (d) 10.0

17. Mohr's salt is dissolved in dil. H_2SO_4 instead of distilled water to

(a) Enhance the rate of dissolution

(b) Prevent cationic hydrolysis

(c) Increase the rate of ionisation

(d) Increase its reducing strength

18. Acidified potassium permanganate solution is decolourised by

(a) Bleaching powder (b) White vitriol

(c) Mohr's salt (d) Microcosmic salt

19. Approximate atomic weight of an element is 26.89. If its equivalent weight is 8.9, the exact atomic weight of element would be **[DPMT 1984]**

(a) 26.89 (b) 8.9

(c) 17.8 (d) 26.7

20. Vapour density of a gas is 22. What is its molecular mass

[AFMC 2000]

(a) 33 (b) 22

(c) 44 (d) 11

21. Equivalent weight of $KMnO_4$ acting as an oxidant in acidic medium is **[CPMT 1990; MP PET 1999]**

(a) The same as its molecular weight

(b) Half of its molecular weight

(c) One-third of its molecular weight

(d) One-fifth of its molecular weight

22. 0.16 *g* of dibasic acid required 25 *ml* of decinormal *NaOH* solution for complete neutralisation. The molecular weight of the acid will be **[CPMT 1989]**

(a) 32 (b) 64

(c) 128 (d) 256

23. To neutralise 20 *ml* of $M/10$ sodium hydroxide, the volume of $M/20$ hydrochloric acid required is **[Andhra MBBS 1980]**

(a) 10 *ml* (b) 15 *ml*
(c) 20 *ml* (d) 40 *ml*

24. Hydrochloric acid solutions *A* and *B* have concentration of 0.5 *N* and 0.1 *N* respectively. The volume of solutions *A* and *B* required to make 2 *litres* of 0.2 *N* hydrochloric are **[KCET 1993]**

(a) 0.5 *l* of *A* + 1.5 *l* of *B*
(b) 1.5 *l* of *A* + 0.5 *l* of *B*
(c) 1.0 *l* of *A* + 1.0 *l* of *B*
(d) 0.75 *l* of *A* + 1.25 *l* of *B*

25. 5 *ml* of *N HCl*, 20 *ml* of $N/2\ H_2SO_4$ and 30 *ml* of $N/3\ HNO_3$ are mixed together and volume made to one *litre*. The normality of the resulting solution is **[MNR 1991]**

(a) $N/5$ (b) $N/10$
(c) $N/20$ (d) $N/40$

26. Under similar conditions of pressure and temperature, 40 *ml* of slightly moist hydrogen chloride gas is mixed with 20 *ml* of ammonia gas, the final volume of gas at the same temperature and pressure will be **[CBSE PMT 1993]**

(a) 100 *ml* (b) 20 *ml*
(c) 40 *ml* (d) 60 *ml*

27. $KMnO_4$ reacts with oxalic acid according to the equation, $2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$, here 20 *ml* of 0.1 *M* $KMnO_4$ is equivalent to **[CBSE PMT 1996]**

(a) 20 *ml* of 0.5 *M* $H_2C_2O_4$ (b) 50 *ml* of 0.1 *M* $H_2C_2O_4$
(c) 50 *ml* of 0.5 *M* $H_2C_2O_4$ (d) 20 *ml* of 0.1 *M* $H_2C_2O_4$

28. In order to prepare one *litre* normal solution of $KMnO_4$, how many *grams* of $KMnO_4$ are required if the solution is used in acidic medium for oxidation **[MP PET 2002]**

(a) 158 *g* (b) 31.6 *g*
(c) 790 *g* (d) 62 *g*

29. What is the concentration of nitrate ions if equal volumes of 0.1 *M* $AgNO_3$ and 0.1 *M NaCl* are mixed together **[NCERT 1981; CPMT 1983]**

(a) 0.1 *N* (b) 0.2 *M*
(c) 0.05 *M* (d) 0.25 *M*

30. 30 *ml* of acid solution is neutralized by 15 *ml* of a 0.2 *N* base. The strength of acid solution is **[CPMT 1986]**

(a) 0.1 *N* (b) 0.15 *N*
(c) 0.3 *N* (d) 0.4 *N*

31. A solution containing Na_2CO_3 and *NaOH* requires 300 *ml* of 0.1 *N HCl* using phenolpthalein as an indicator. Methyl orange is then added to the above titrated solution when a further 25 *ml* of 0.2 *N HCl* is required. The amount of *NaOH* present in solution is $(NaOH = 40, Na_2CO_3 = 106)$ **[CPMT 1992]**

(a) 0.6 *g* (b) 1.0 *g*
(c) 1.5 *g* (d) 2.0 *g*

32. In the preceeding question, the amount of Na_2CO_3 present in the solution is **[CPMT 1992]**

(a) 2.650 *g* (b) 1.060 *g*
(c) 0.530 *g* (d) 0.265 *g*

33. How many *ml* of 1 (*M*) H_2SO_4 is required to neutralise 10 *ml* of 1 (*M*) *NaOH* solution **[MP PET 1998; MNR 1982; MP PMT 1987]**

(a) 2.5 (b) 5.0
(c) 10.0 (d) 20.0

34. Which of the following cannot give iodometric titrations **[AIIMS 1997]**

(a) Fe^{3+} (b) Cu^{2+}
(c) Pb^{2+} (d) Ag^+

35. $KMnO_4$ reacts with ferrous ammonium sulphate according to the equation $MnO_4^- + 5Fe^{2+} + 8H^+ \rightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$, here 10 *ml* of 0.1 *M* $KMnO_4$ is equivalent to **[CPMT 1999]**

(a) 20 *ml* of 0.1 *M* $FeSO_4$
(b) 30 *ml* of 0.1 *M* $FeSO_4$
(c) 40 *ml* of 0.1 *M* $FeSO_4$
(d) 50 *ml* of 0.1 *M* $FeSO_4$

36. $Ca(OH)_2 + H_3PO_4 \rightarrow CaHPO_4 + 2H_2O$ the equivalent weight of H_3PO_4 in the above reaction is **[Pb. PMT 2004]**

(a) 21 (b) 27
(c) 38 (d) 49

37. The mass of $BaCO_3$ produced when excess CO_2 is bubbled through a solution of 0.205 mol $Ba(OH)_2$ is **[UPSEAT 2004]**

(a) 81 *g* (b) 40.5 *g*
(c) 20.25 *g* (d) 162 *g*

38. The amount of water that should be added to 500 *ml* of 0.5 *N* solution of *NaOH* to give a concentration of 10 *mg* per *ml* is

(a) 100 (b) 200
(c) 250 (d) 500

39. Number of moles of $KMnO_4$ required to oxidize one mole of $Fe(C_2O_4)$ in acidic medium is **[Haryana CEE 1996]**

(a) 0.6 (b) 0.167
(c) 0.2 (d) 0.4

40. A hydrocarbon contains 86% carbon, 488ml of the hydrocarbon weight 1.68 *g* at STP. Then the hydrocarbon is an

(a) Alkane (b) Alkene

(c) Alkyne (d) Arene

41. The ratio of amounts of H_2S needed to precipitate all the metal ions from 100 *ml* of 1 *M* $AgNO_3$ and 100 *ml* of 1 *M* $CuSO_4$ will be

(a) 1:1 (b) 1:2

(c) 2:1 (d) None of these

42. An electric discharge is passed through a mixture containing 50 *c.c.* of O_2 and 50 *c.c.* of H_2. The volume of the gases formed (i) at room temperature and (ii) at 110^{0}C will be

(a) (i) 25 *c.c.* (ii) 50 *c.c.* (b) (i) 50 *c.c.* (ii) 75 *c.c.*

(c) (i) 25 *c.c.* (ii) 75 *c.c.* (d) (i) 75 *c.c.* (ii) 75 *c.c.*

43. 100 *ml* of 0.1 *N* hypo decolourised iodine by the addition of *x g* of crystalline copper sulphate to excess of *KI*. The value of '*x*' is (molecular wt. of $CuSO_4.5H_2O$ is 250)

(a) 5.0 *g* (b) 1.25 *g*

(c) 2.5 *g* (d) 4 *g*

44. How many grams of caustic potash required to completely neutralise 12.6 *gm* HNO_3

(a) 22.4 *KOH* (b) 1.01 *KOH*

(c) 6.02 *KOH* (d) 11.2 *KOH*

45. If isobutane and n-butane are present in a gas, then how much oxygen should be required for complete combustion of 5 *kg* of this gas

(a) 17.9 *kg* (b) 9 *kg*

(c) 27 *kg* (d) 1.8 *kg*

46. 16.8 *litre* gas containing H_2 and O_2 is formed at NTP on electrolysis of water. What should be the weight of electrolysed water

(a) 5 *g* (b) 9 *g*

(c) 10 *g* (d) 12 *g*

47. On electrical decomposition of 150 *ml* dry and pure O_2, 10% of O_2 gets changed to *O*, then the volume of gaseous mixture after reaction and volume of remaining gas left after passing in turpentine oil will be

(a) 145 *ml* (b) 149 *ml*

(c) 128 *ml* (d) 125 *ml*

48. What should be the weight of 50% *HCl* which reacts with 100 *g* of limestone

(a) 50% pure (b) 25% pure

(c) 10% pure (d) 8% pure

49. What should be the weight and moles of *AgCl* precipitate obtained on adding 500ml of 0.20 *M* *HCl* in 30 *g* of $AgNO_3$ solution? ($AgNO_3 = 170$)

(a) 14.35 *g* (b) 15 *g*

(c) 18 *g* (d) 19 *g*

50. A solution of 10 *ml* $\frac{M}{10} FeSO_4$ was titrated with $KMnO_4$ solution in acidic medium. The amount of $KMnO_4$ used will be **[CPMT 1984]**

(a) 5 *ml* of 0.1 *M* (b) 10 *ml* of 1.1 *M*

(c) 10 *ml* of 0.5 *M* (d) 10 *ml* of 0.02 *M*

51. 1.12 *ml* of a gas is produced at STP by the action of 4.12 *mg* of alcohol, with methyl magnesium iodide. The molecular mass of alcohol is **[Roorkee 1992; IIT 1993]**

(a) 16.0 (b) 41.2

(c) 82.4 (d) 156.0

52. The simplest formula of a compound containing 50% of element X (atomic mass 10) and 50% of element *Y* (atomic mass 20) is **[Roorkee 1994]**

(a) XY (b) X_2Y

(c) XY_3 (d) X_2Y_3

53. A compound contains atoms of three elements in *A*, *B* and *C*. If the oxidation number of *A* is +2, *B* is +5 and that of *C* is – 2, the possible formula of the compound is **[CBSE PMT 2000]**

(a) $A_3(BC_4)_2$

(b) $A_3(B_4C)_2$

(c) ABC_2

(d) $A_2(BC_3)_2$

54. What will be the volume of CO_2 at NTP obtained on heating 10 grams of (90% pure) limestone **[Pb. CET 2001]**

(a) 22.4 *litre*

(b) 2.016 *litre*

(c) 2.24 *litre*

(d) 20.16 *litre*

55. The ratio of the molar amounts of H_2S needed to precipitate the metal ions from $20mL$ each of $1M\ Cd(NO_3)_2$ and $0.5M\ CuSO_4$ is **[CPMT 1997]**

(a) 1 : 1

(b) 2 : 1

(c) 1 : 2

(d) Indefinite

56. 12*g* of *Mg* (at. mass 24) will react completely with acid to give **[MNR 1985]**

(a) One mole of H_2

(b) 1/2 mole of H_2

(c) 2/3 mole of O_2

(d) Both 1/2 mol of H_2 and 1/2 mol of O_2

57. 1.5 *mol* of O_2 combine with Mg to form oxide MgO. The mass of Mg (at. mass 24) that has combined is

[KCET 2001]

(a) 72 *g* (b) 36 *g*

(c) 48 *g* (d) 24 *g*

58. 100 *g* $CaCO_3$ reacts with 1*litre* 1 *N HCl*. On completion of reaction how much weight of CO_2 will be obtain

[Kerala CET 2005]

(a) 5.5 *g* (b) 11 *g*

(c) 22 *g* (d) 33 *g*

(e) 44 *g*

Critical Thinking

Objective Questions

1. Mixture of sand and sulphur may best be separated by **[Kerala CET 2001]**

(a) Fractional crystallisation from aqueous solution

(b) Magnetic method

(c) Fractional distillation

(d) Dissolving in CS_2 and filtering

2. Irrespective of the source, pure sample of water always yields 88.89% mass of oxygen and 11.11% mass of hydrogen. This is explained by the law of **[Kerala CEE 2002]**

(a) Conservation of mass (b) Constant composition

(c) Multiple proportions (d) Constant volume

3. Zinc sulphate contains 22.65% of zinc and 43.9% of water of crystallization. If the law of constant proportions is true, then the weight of zinc required to produce 20 *g* of the crystals will be

(a) 45.3 *g* (b) 4.53 *g*

(c) 0.453 *g* (d) 453 *g*

4. 10 dm^3 of N_2 gas and 10 dm^3 of gas *X* at the same temperature contain the same number of molecules. The gas *X* is

(a) CO (b) CO_2

(c) H_2 (d) NO

5. The molar heat capacity of water at constant pressure is 75 $JK^{-1}\ mol^{-1}$. When 1.0 *kJ* of heat is supplied to 100 *g* of water which is free to expand, the increases in temperature of water is

(a) 6.6 *K* (b) 1.2 *K*

(c) 2.4 *K* (d) 4.8 *K*

6. A compound possesses 8% sulphur by mass. The least molecular mass is **[AIIMS 2002]**

(a) 200 (b) 400

(c) 155 (d) 355

7. Which of the following contains maximum number of atoms **[JIPMER 2000]**

(a) 6.023×10^{21} molecules of CO_2

(b) 22.4 *L* of CO_2 at STP

(c) 0.44 *g* of CO_2

(d) None of these

8. In a mole of water vapour at STP, the volume actually occupied or taken by the molecules (i.e., Avogadro's No. × Volume of one molecule) is **[Kerala EEE 2000]**

(a) Zero

(b) Less than 1% of 22.4 litres

(c) About 10% of the volume of container

(d) 1% to 2% of 22.4 litres

(e) Between 2% to 5% of 22.4 litres

9. If 10^{21} molecules are removed from 200*mg* of CO_2, then the number of moles of CO_2 left are **[IIT 1983]**

(a) 2.85×10^{-3} (b) 28.8×10^{-3}

(c) 0.288×10^{-3} (d) 1.68×10^{-2}

10. The set of numerical coefficient that balances the equation $K_2CrO_4 + HCl \rightarrow K_2Cr_2O_7 + KCl + H_2O$ is

[Kerala CEE 2001]

(a) 1, 1, 2, 2, 1 (b) 2, 2, 1, 1, 1

(c) 2, 1, 1, 2, 1 (d) 2, 2, 1, 2, 1

11. One litre hard water contains 12.00 *mg* Mg^{2+} milli equivalent of washing soda required to remove its hardness is

(a) 1 (b) 12.15

(c) 1×10^{-3} (d) 12.15×10^{-3}

12. In standardization of $Na_2S_2O_3$ using $K_2Cr_2O_7$ by iodometry, the equivalent weight of $K_2Cr_2O_7$ is **[IIT 2000]**

(a) $MW/2$ (b) $MW/3$

(c) $MW/6$ (d) $MW/1$

13. 3.92 *g* of ferrous ammonium sulphate crystals are dissolved in 100 *ml* of water, 20 *ml* of this solution requires 18 *ml* of $KMnO_4$ during titration for complete oxidation. The weight of $KMnO_4$ present in one *litre* of the solution is

[Tamilnadu CET 2002]

(a) 3.476 *g* (b) 12.38 *g*

(c) 34.76 *g* (d) 1.238 *g*

14. A 100 *ml* solution of 0.1 *n HCl* was titrated with 0.2 *N NaOH* solution. The titration was discontinued after adding 30 *ml* of *NaOH* solution. The remaining titration was completed by adding 0.25 *N KOH* solution. The volume of *KOH* required for completing the titration is **[DCE 1999]**

(a) 70 *ml* **[CBSE PMT 2003]** (b) 32 *ml*

(c) 35 *ml* (d) 16 *ml*

15. What volume of Hydrogen gas, at 273 *K* and 1 atm pressure will be consumed in obtaining 21.6 *g* of elemental boron (atomic mass = 10.8) from the reduction of boron trichloride by Hydrogen **[AIEEE 2003]**

(a) 22.4 *L* (b) 89.6 *L*

(c) 67.2 *L* (d) 44.8 *L*

16. The mass of 112 cm^3 of CH_4 gas at STP is

[Karnataka CET 2001]

(a) 0.16 g (b) 0.8 g

(c) 0.08 g (d) 1.6 g

17. Complete combustion of 0.858 g of compound X gives 2.63 g of CO_2 and 1.28 g of H_2O. The lowest molecular mass X can have **[Kerala MEE 2000]**

(a) 43 g (b) 86 g

(c) 129 g (d) 172 g

18. In the following reaction, which choice has value twice that of the equivalent mass of the oxidising agent

$SO_2 + H_2O \longrightarrow 3S + 2H_2O$ **[DPMT 2000]**

(a) 64 (b) 32

(c) 16 (d) 48

Assertion & Reason

For AIIMS Aspirants

Read the assertion and reason carefully to mark the correct option out of the options given below :

(a) *If both assertion and reason are true and the reason is the correct explanation of the assertion.*

(b) *If both assertion and reason are true but reason is not the correct explanation of the assertion.*

(c) *If assertion is true but reason is false.*

(d) *If the assertion and reason both are false.*

(e) *If assertion is false but reason is true.*

1. Assertion : Volume of a gas is inversely proportional to the number of moles of a gas.

Reason : The ratio by volume of gaseous reactants and products is in agreement with their mole ratio. **[AIIMS 1995]**

2. Assertion : Molecular weight of oxygen is 16.

Reason : Atomic weight of oxygen is 16. **[AIIMS 1996]**

3. Assertion : Atoms can neither be created nor destroyed.

Reason : Under similar condition of temperature and pressure, equal volume of gases does not contain equal number of atoms. **[AIIMS 1994,2002]**

4. Assertion : One mole of SO_2 contains double the number of molecules present in one mole of O_2.

Reason : Molecular weight of SO_2 is double to that of O_2.

5. Assertion : 1.231 has three significant figures.

Reason : All numbers right to the decimal point are significant.

6. Assertion : 22.4 L of N_2 at NTP and 5.6 L O_2 at NTP contain equal number of molecules.

Reason : Under similar conditions of temperature and pressure all gases contain equal number of molecules.

7. Assertion : One atomic mass unit (amu) is mass of an atom equal to exactly one-twelfth the mass of a carbon-12 atom.

Reason : Carbon-12 isotope was selected as standard.

8. Assertion : Molecular mass of A is $\frac{M}{4}$ if the molecular mass of B is M.

Reason : Vapour density of A four times that of B.

9. Assertion : Pure water obtained from different sources such as, river, well, spring, sea etc. always contains hydrogen and oxygen combined in the ratio $1:8$ by mass.

Reason : A chemical compound always contains elements combined together in same proportion by mass, it was discovered by French chemist, Joseph Proust (1799).

10. Assertion : As mole is the basic chemical unit, the concentration of the dissolved solute is usually specified in terms of number of moles of solute.

Reason : The total number of molecules of reactants involved in a balanced chemical equation is known as molecularity of the reaction.

11. Assertion : A certain element X, forms three binary compounds with chlorine containing 59.68%,68.95% and 74.75% chlorine respectively. These data illustrate the law of multiple proportions.

Reason : According to law of multiple proportions, the relative amounts of an element combining with some fixed amount of a second element in a series of compounds are the ratios of small whole numbers.

12. Assertion : Equivalent weight of Cu in CuO is 63.6 and in Cu_2O 31.8.

Reason : Equivalent weight of an element $= \frac{\text{Atomic weight of the element}}{\text{Valency of the element}}$

13. Assertion : Mass spectrometer is used for the determination of isotopes.

Reason : Isotopes are the atoms of same element differing in mass numbers.

14. Assertion : Gases combine in simple ratio of their volume but, not always.

Reason : Gases deviate from ideal behaviour.

15. Assertion : Isomorphous substances form crystals of same shape and can grow in saturated solution of each other.

Reason : They have similar constitution and chemical formulae.

16. Assertion : Atomicity of oxygen is 2.

Reason : 1 mole of an element contains 6.023×10^{23} atoms.

17. Assertion : 1 amu equals to $1.66\times10^{-24}\ g$.

Reason : $1.66\times10^{-24}\ g$ equals to $\frac{1}{12}th$ of mass of a C^{12} atom.

Answers

Significant figures, Units for measurement, Matter and Separation of mixture

1	a	2	d	3	a	4	c	5	d
6	b	7	c	8	d	9	c	10	c
11	c	12	b	13	a	14	c	15	b
16	b	17	b	18	a	19	a	20	c
21	b	22	d	23	a	24	a	25	b
26	b	27	d						

Laws of chemical combination

1	a	2	d	3	c	4	a	5	c
6	c	7	c	8	b	9	b	10	a
11	c	12	b	13	a	14	d	15	b
16	a	17	c	18	d	19	c	20	a
21	c	22	d						

Atomic, Molecular and Equivalent masses

1	c	2	b	3	a	4	a	5	b
6	c	7	d	8	b	9	a	10	b
11	a	12	b	13	a	14	c	15	b
16	c	17	a	18	d	19	a	20	a
21	b	22	b	23	d	24	c	25	a
26	a	27	c	28	d	29	a	30	c
31	a	32	d	33	b	34	a	35	c
36	b	37	b	38	c	39	a	40	b
41	c	42	d	43	a	44	d	45	d
46	b	47	c	48	c	49	b	50	b
51	a	52	b	53	b	54	c	55	b
56	a	57	d	58	d	59	a	60	d
61	c	62	d	63	b				

The mole concept

1	a	2	b	3	b	4	c	5	a
6	b	7	a	8	c	9	d	10	c
11	b	12	c	13	c	14	d	15	a
16	a	17	b	18	b	19	a	20	a
21	b	22	b	23	c	24	a	25	a
26	c	27	d						

Percentage composition & Molecular formula

1	a	2	a	3	b	4	d	5	a
6	b	7	b						

Chemical stoichiometry

1	c	2	c	3	a	4	c	5	c
6	c	7	c	8	b	9	a	10	d
11	c	12	d	13	d	14	b	15	a
16	b	17	b	18	c	19	d	20	c
21	d	22	c	23	d	24	a	25	d
26	b	27	b	28	b	29	c	30	a
31	b	32	c	33	b	34	c	35	d
36	d	37	b	38	d	39	a	40	b
41	b	42	c	43	c	44	d	45	a
46	b	47	a	48	a	49	a	50	d
51	c	52	b	53	a	54	b	55	b
56	b	57	a	58	c				

Critical Thinking Questions

1	d	2	b	3	b	4	a	5	c
6	b	7	b	8	b	9	a	10	d
11	a	12	c	13	a	14	d	15	c
16	c	17	a	18	b				

Assertion & Reason

1	e	2	e	3	c	4	e	5	d
6	d	7	a	8	c	9	a	10	b
11	a	12	e	13	e	14	a	15	a
16	b	17	a						

Answers and Solutions

Significant figures, Units of measurement, Matter and Separation of mixture

4. (c) Pressure $= \frac{\text{Force}}{\text{Area}} = \frac{[MLT^{-2}]}{[L^2]} = [ML^{-1}T^{-2}]$

Energy per unit volume $= \frac{[ML^2T^{-2}]}{[L^3]} = [ML^{-1}T^{-2}]$

17. (b) $\frac{(29.2-20.2)(1.79\times10^5)}{1.37} = \frac{9.0\times1.79\times10^5}{1.37}$

Least precise terms *i.e.*, 9.0 has only two significant figures. Hence, final answer will have two significant figures.

18. (a) Pure ethyl alcohol $= 81.4 - 0.002 = 81.398$.

19. (a) JPa^{-1}; Unit of work is *Joule* and unit of pressure is *Pascal*.

Dimension of *Joule i.e.* work $= F\times L = MLT^{-2}\times L$

$= [ML^2T^{-2}]$

$\frac{1}{Pa} = \frac{1}{\text{Pressure}} = \frac{1}{\frac{F}{A}} = \frac{1\times A}{F} = [MLT^{-1}]$

So, $JPa^{-1} = [ML^2T^2] = [L^2\times L] = [L^3]$.

22. (d) 1 zepto $= 10^{-21}$

23. (a) As we know that all non zero unit are significant number. Therefore significant figure is 2.

24. (a) Number of significant figures in 6.0023 are 5 because all the zeroes stand between two non zero digit are counted towards significant figures.

25. (b) Given $P = 0.0030m$, $Q = 2.40m$ & $R = 3000m$ In $P(0.0030)$ initial zeros after the decimal point are not significant. Therefore, significant figures in $P(0.0030)$ are 2. Similarly in $Q(2.40)$ significant figures are 3 as in this case final zero is significant. In $R = (3000)$ all the zeroes are significant hence, in R significant figures are 4.

26. (b) All the zeroes between two non zero digit are significatn. Hence in 60.0001 significant figures is 6.

27. (d) Round off the digit at 2nd position of decimal 3.929 = 3.93.

Laws of chemical combination

12. (b) $\underset{ng}{X} + \underset{mg}{Y} \rightleftharpoons \underset{pg}{R} + \underset{qg}{S}$

$n + m = p + q$ by low of conservation of mass.

Atomic, Molecular and Equivalent masses

5. (b) The atomic weight of sulphur =32

In SCl_2 valency of sulphur =2

So equivalent mass of sulphur $= \frac{32}{2} = 16$.

6. (c) As the given sulphate is isomorphous with $ZnSO_4.7H_2O$ its formula would be $MSO_4.7H_2O$ .m is the atomic weight of M, molecular weight of $MSO_4.7H_2O$

$= m + 32 + 64 + 126 = m + 222$

Hence % of $M = \frac{m}{m+222}\times100 = 9.87$ (given) or

$100m = 9.87m + 222\times9.87$ or $90.13m = 222\times9.87$

or $m = \frac{222\times9.87}{90.13} = 24.3$.

7. (d) For $NaOH$, $M = N$

$N_1V_1 = 100ml \times 1N = 100ml(N)$

For H_2SO_4, $N_2V_2 = 10ml \times 10N = 100ml(N)$

Hence, $N_1V_1 = N_2V_2$.

10. (b) 1 mole of CH_4 contains 4 mole of hydrogen atom *i.e.* $4g$ atom of hydrogen.

11. (a) $\overset{+2}{Na_2SO_3} + I_2 \rightarrow \overset{+2.5}{Na_2S_4O_6} + NaI$

$n = 2 \times 0.5 = 1$

$E = \frac{M}{n-\text{factor}} = \frac{M}{1} = M$

12. (b) $E = \frac{M}{5}$

13. (a) Atomic mass $= \frac{10 \times 19 + 81 \times 11}{100} = \frac{190 + 891}{100} = \frac{1081}{100}$

$= 10.81$

14. (c) $0.1M$ $AgNO_3$ will react with $0.1M$ $NaCl$ to form $0.1M\ NaNO_3$. But as the volume doubled, conc. of $NO_3^- = \frac{0.1}{2} = 0.05M$.

16. (c) wt. of metallic chloride $= 74.5$

wt. of chlorine $= 35.5$

$\therefore$ wt. of metal $= 74.5 - 35.5 = 39$

Equivalent weight of metal $= \frac{\text{weight of metal}}{\text{weight of chlorine}} \times 35.5$

$= \frac{39}{35.5} \times 35.5 = 39$

17. (a) $\because$ $5.8L$ of gas has mass $= 7.5gm$

$\therefore 22.4L$ " " " $= \frac{7.5}{5.8} \times 22.4 = 28.96$

So molecular weight = 29

So, molecular formula of compound is NO

18. (d) $\because$ $17gm$ NH_3 contains 6×10^{23} molecules of NH_3

$\therefore$ $4.25gm$ NH_3 contains $= \frac{6 \times 10^{23}}{17} \times 4.25$

$\therefore$ No. of atoms $= \frac{6 \times 10^{23} \times 4.25}{17} \times 4 = 6 \times 10^{23}$.

19. (a) $\because$ $1L$ of gas at S.T.P. weight $1.16g$

$\therefore$ $22.4\ L$ of gas at S.T.P. weight $= 22.4 \times 1.16$

$= 25.984 \approx 26$

This molecular weight indicates that given compound is C_2H_2.

20. (a) Molecular weight $= 2 \times V.D = 2 \times 11.2 = 22.4$

$\because$ $22.4gm$ of gas occupies $22.4L$ at S.T.P.

$\therefore$ $11.2gm$ of gas occupies $\frac{22.4}{22.4} \times 11.2 = 11.2L$.

21. (b) Equivalent weight $= \frac{\text{Molecular weight}}{\text{Valency}}$

Molecular weight of $\begin{matrix} COOH \\ | \\ COOH \end{matrix} \cdot 2H_2O = \frac{126}{2} = 63$.

22. (b) Valency of the element $= \frac{2 \times V.D}{E + 35.5} = \frac{2 \times 59.25}{4 + 35.5}$

$= \frac{118.50}{39.5} = 3$.

23. (d) Molarity $= \frac{W(gm) \times 1000}{V(ml) \times \text{molecular weight}}$

$0.25 = \frac{1.25 \times 1000}{25 \times \text{molecular weight}}$

$\therefore$ Molecular weight $= \frac{1.25 \times 1000}{0.25 \times 25} = 200$.

24. (c) Let weight of metal oxide = $100gm$

Weight of oxygen = $32gm$

$\therefore$ weight of metal $= 100 - 32 = 68gm$

Equivalent weight of oxide $= \frac{\text{wt. of metal}}{\text{wt. of oxygen}} \times 8$

$= \frac{68}{32} \times 8 = 17$.

25. (a) 6×10^{23} molecules has mass $= 18gm$

1 molecules has mass $= \frac{18}{6 \times 10^{23}} = 3 \times 10^{-23} gm$

$= 3 \times 10^{-26} kg$.

26. (a) Choice (a) is P_4S_3

$\because$ $\frac{31 \times 4}{(124)} gm$ P is present in $220gm$ P_4S_3

$\therefore$ $1.24gm$ P is present in $= \frac{220}{124} \times 1.24 = 2.2gm$

27. (c) Number of moles of $A = \frac{x}{40}$

Number of atoms of $A = \frac{x}{40} \times \text{Avogadro no.} = y$ (say)

Or $x = \frac{40y}{\text{Avogadro no.}}$

Number of moles of $B = \frac{2x}{80}$

Number of atoms of B

$= \frac{2x}{80} \times \text{Av.no.} = \frac{2}{80} \times \frac{40y}{\text{Av.no.}} \times \text{Av.no.} = y$

28. (d) $BaCO_3 \rightarrow BaO + CO_2 \uparrow$

Molecular weight of $BaCO_3 = 137 + 12 + 3 \times 16 = 197$

$\because$ $197gm$ produces $22.4L$ at S.T.P.

$\therefore$ $9.85gm$ produces $\frac{22.4}{197} \times 9.85 = 1.12L$ at S.T.P.

29. (a) $14\ gm$ N^{3-} ions have $= 8N_A$ valence electrons

4.2gm of N^{3-} ions have $= \frac{8N_A \times 4.2}{14} = 2.4 N_A$

30. (c) [$\because$ Molecular weight of $CuSO_4.5H_2O$

$= 63.5 + 32 + 64 + 90 = 249.5$]

6×10^{23} molecules has weight $= 249.5 gm$

1×10^{22} molecules has weight $= \frac{249.5 \times 1 \times 10^{22}}{6 \times 10^{23}}$

$= 41.58 \times 10^{-1}$

$= 4.158$

31. (a) (I) 1 molecule of oxygen

$\because$ 6×10^{23} molecule has mass $= 32 gm$

$\therefore$ 1 molecule of O_2 has mass $= \frac{32}{6 \times 10^{23}}$

$= 5.3 \times 10^{-23} gm$

(II) 1 atom of nitrogen

$\because$ $2 \times 6 \times 10^{23}$ atoms of N_2 has mass = 28gm

$\therefore$ 1 atom of N_2 has mass $= \frac{28}{2 \times 6 \times 10^{23}}$

$= 2.3 \times 10^{-23} gm$

(III) $1 \times 10^{-10} g$ molecular weight of oxygen

g atomic weight $= 2 \times 1 \times 10^{-10} = 2 \times 10^{-10} g$

(IV) $1 \times 10^{-10} g$ atomic weight of copper

So, order of increasing masses $II < I < III < IV$.

32. (d) $\frac{\text{wt.of metal hydroxide}}{\text{wt.of metal oxide}} = \frac{EM + EOH^-}{EM + EO^-}$

$= \frac{1.520}{0.995} = \frac{x + 17}{x + 8}$

$= 1.520x + 1.520 \times 8 = 0.995x + 0.995 \times 17$

$1.520x + 12.160 = 0.995x + 16.915$

or $0.525x = 4.755$

$x = \frac{4.755}{0.525} = 9$.

33. (b) One ion carries $3 \times 1.6 \times 10^{-19}$ *coulomb*

Then 1 gm ion N^{3-} (1 mole) carries

$= 3 \times 1.6 \times 10^{-19} \times 6.02 \times 10^{23}$

$= 2.89 \times 10^5$ *coulomb*

34. (a) $\frac{C_P}{C_V} = 1.4$ so, given gas is diatomic

11.2L $= 3.01 \times 10^{23}$ molecules

$\therefore$ No. of atoms $= 3.01 \times 10^{23} \times 2 = 6.023 \times 10^{23}$ *atoms*

36. (b) The acid is dibasic.

Molecular weight of $H_3PO_3 = 3 + 31 + 48 = 82$

$\therefore$ Equivalent weight $= \frac{\text{Molecularweight}}{\text{Basicity}} = \frac{82}{2} = 41$.

37. (b) $\because$ 22400 ml at NTP has 6.023×10^{23} molecule

$\therefore$ 1 ml at NTP has $= \frac{6.023 \times 10^{23}}{22400}$

$= 0.0002688 \times 10^{23} = 2.69 \times 10^{19}$.

38. (c) Sp. heat × atomic wt.= 6.4

0.16 × atomic wt.= 6.4

Atomic wt. $= \frac{6.4}{0.16} = 40$.

39. (a) Molecular weight of $C_{60}H_{122} = 12 \times 60 + 122 \times 1$

$= 720 + 122 = 842$

$\because$ 6×10^{23} molecule $C_{60}H_{122}$ has mass = 842gm

$\therefore$ 1 molecule $C_{60}H_{122}$ has mass $\frac{842}{6 \times 10^{23}}$

$= 140.333 \times 10^{-23} gm = 1.4 \times 10^{-21} gm$.

40. (b) $C_2H_4 + 2O_2 \rightarrow 2CO_2 + 2H_2O$

$\because$ 28gm C_2H_4 requires 64gm oxygen

$\therefore$ 2.8×10^3 gm C_2H_4 requires $= \frac{64}{28} \times 2.8 \times 10^3 gm$

$= 6.4 \times 10^3 gm$ = 6.4kg.

41. (c) 2.5 molal NH_4OH means 2.5 moles of NH_3 in 1000g H_2O (1000cc of solution)

Hence, 100cc solution of NH_3 requires = 0.25 mole

$= 0.25 \times 22.4L = 5.6L$.

42. (d) $d = \frac{M}{V}$; $1 = \frac{M}{V}$ or $M = V$; 18gm = 18ml

6×10^{23} molecule of water has volume =18cc

1 molecule of water has volume $= \frac{18}{6 \times 10^{23}}$

$= 3 \times 10^{-23} cm^3$.

43. (a) 100gm caffeine has 28.9gm nitrogen

194gm caffeine has $= \frac{28.9}{100} \times 194 = 56.06 gm$

$\therefore$ No. of atoms in caffeine $= \frac{56.06}{14} \approx 4$.

44. (d) Molecular weight of $(CHCOO)_2Fe = 170$

Fe present in 100mg of $(CHCOO)_2Fe$

$= \frac{56}{170} \times 100mg = 32.9mg$

This is present in 400mg of capsule

% of Fe in capsule $= \frac{32.9}{400} \times 100 = 8.2$.

45. (d) 1 atom has mass $= 10.86 \times 10^{-26} kg$

$= 10.86 \times 10^{-23}\,gm$

6.023×10^{23} atoms has mass

$= 10.86 \times 10^{-23} \times 6.023 \times 10^{23} = 65.40\,gm$

This is the atomic weight of *Zn*.

46. (b) $\because$ 1mole $(COOH)_2 \,.\, 2H_2O$ has 96*gm* oxygen

$\therefore$ 0.3 mole $(COOH)_2 \,.\, 2H_2O$ has $96 \times 0.3 = 28.8\,gm$

$\therefore$ No. of gram atoms of oxygen $= \frac{28.8}{16} = 1.8$.

47. (c) Equimolecular proportion means both gases occupied equal volume $= \frac{2.24}{2} = 1.12L$

For CH_4:

22.4*L* CH_4 has mass $= 16gm$

1.12*L* CH_4 has mass $= \frac{16}{22.4} \times 1.12 = 0.8gm$.

For C_2H_6

22.4*L* C_2H_6 has mass = 30*gm*

1.12*L* C_2H_6 has mass $= \frac{30}{22.4} \times 1.12 = \frac{3.0}{2}gm = 1.5gm$

Total mass $= 1.5gm + 0.8gm = 2.3gm$.

48. (c) Let wt. of metal oxide = 100*gm*

wt. of metal = 53*gm*

wt. of oxygen = 47*gm*

Equivalent weight of oxygen $= \frac{\text{wt. of metal}}{\text{wt. of oxygen}} \times 8$

$= \frac{53}{47} \times 8 = 9.02$

Valency $= \frac{2 \times V.D}{E + 35.5} = \frac{2 \times 66}{9 + 35.5} = \frac{132}{44.5} = 2.96 \approx 3$

$\therefore$ Atomic weight $= \text{Equivalent weight} \times \text{Valency}$

$= 9.02 \times 3 = 27.06$

49. (b) One gram of hydrogen combines with 80*gm* of bromine.

So, equivalent weight of bromine = 80*gm*

$\because$ 4*gm* of bromine combines with 1*gm* of *Ca*

$\therefore$ 80*gm* of bromine combines with $= \frac{1}{4} \times 80 = 20$.

50. (b) $\overset{+2}{Mn}SO_4 \rightarrow \overset{+4}{Mn}O_2$

Change of valency $= 4 - 2 = 2$

$\therefore$ Equivalent weight $= \frac{M}{2}$.

51. (a) $\underset{100ml}{\underset{2ml}{2PH_3}} \rightarrow \underset{\text{(solid)}}{2P} + \underset{150ml}{\underset{3ml}{3H_2}}$

Increase in volume $= 150ml - 100ml = 50ml$ increase.

52. (b) $Mg + 2HCl \rightarrow MgCl_2 + H_2$

$\because$ 24*g* *Mg* evolves 22.4*L* H_2 at STP

$\therefore$ 12*g* *Mg* evolves H_2 at STP $\frac{22.4}{24} \times 12$

=11.2*L* at STP.

53. (b) (a) 2*gm* atom of nitrogen = 28*gm*

(b) 6×10^{23} atoms of *C* has mass $= 12gm$

3×10^{23} atoms of *C* has mass $= \frac{12 \times 3 \times 10^{23}}{6 \times 10^{23}} = 6gm$

(c) 1mole of *S* has mass = 32*gm*

(d) 7.0*gm* of *Ag*

So, lowest mass = 6*gm* of *C*.

54. (c) 1mole of any gas at STP occupies 22.4*L*.

55. (b) $\because$ 22400*cc* of gas at STP has 6×10^{23} molecules

$\therefore$ 1.12 $\times 10^{-7}$ of gas at STP has $\frac{6 \times 10^{23} \times 1.12 \times 10^{-7}}{22400}$

$= .03 \times 10^{14} = 3 \times 10^{12}$.

56. (a) $\because$ 2.24*L* of gas has mass = 4.4*gm*

$\therefore$ 22.4*L* of gas has mass $= \frac{4.4}{2.24} \times 22.4 = 44$

So given gas is CO_2 because CO_2 has molecular mass=44.

57. (d) 1*L* of air =210*cc* O_2

22400*cc* = 1 mole

$210\,cc = \frac{1}{22400} \times 210 = 0.0093$.

58. (d) $\because$ 22.4*L* of a gas at STP has no. of molecules

$= 6.023 \times 10^{23}$

$\therefore$ 8.96*L* of a gas at STP has no. of molecules

$= \frac{6.02 \times 10^{23} \times 8.96}{22.4} = 2.408 \times 10^{23} = 24.08 \times 10^{22}$.

59. (a) Given equivalent weight of metal = 9

Vapour density of metal chloride = 59.25

$\therefore$ molecular weight of metal chloride

$= 2 \times V.D = 2 \times 59.25 = 118.5$

$\therefore$ valency of metal

$= \frac{\text{molecular weight of metal chloride}}{\text{equivalnet weight of metal} + 35.5}$

Valency of metal $= \frac{118.5}{9 + 35.5} = \frac{118.5}{44.5} = 2.66$

Therefore atomic weight of the metal

=equivalent weight × valency

$= 9 \times 2.66 = 23.9$

60. (d) The density of gas $= \frac{\text{molecular wt. of metal}}{\text{volume}}$

$= \frac{45}{22.4} = 2\,gm\,litre^{-1}$

61. (c) Equivalent weight of bivalent metal = 37.2

$\therefore$ Atomic weight of metal $= 37.2 \times 2 = 74.4$

$\therefore$ Formula of chloride $= MCl_2$

Hence, molecular weight of chloride

$(MCl_2) = 74.4 + 2 \times 35.5 = 145.4$

62. (c) As we know that

Equivalent weight $= \frac{\text{weight of metal}}{\text{weight of oxygen}} \times 8$

$$= \frac{32}{0.4} \times 8 = 64$$

Vapour density $= \frac{\text{mol. wt}}{2}$

Mol. wt $= 2 \times V.D = 2 \times 32 = 64$

As we know that $n = \frac{\text{mol. wt}}{\text{eq. wt}} = \frac{64}{64} = 1$

Suppose, the formula of metal oxide be M_2O_n. Hence the formula of metal oxide $= M_2O$.

63. (b) Molecular weight of NH_3 is 17

According to the mole concept

17 gm NH_3 has molecules $= 6.02 \times 10^{23}$

$\therefore$ 1 gm NH_3 has molecules $= \frac{6.02 \times 10^{23}}{17}$

$\therefore$ 4.25 gm NH_3 has molecules

$$= \frac{6.02 \times 10^{23} \times 4.25}{17} = 1.5 \times 10^{23} \text{ molecule}$$

The mole concept

1. (a) 16g O_2 has no. of moles $= \frac{16}{32} = \frac{1}{2}$

14g N_2 has no. of moles $= \frac{14}{28} = \frac{1}{2}$

No. of moles are same, so no. of molecules are same.

2. (b) $Na_2SO_4 . 10H_2O = 2 \times 23 + 32 + 4 \times 16 + 10 \times 18$

$= 46 + 32 + 64 + 180 = 322gm$

322gm $Na_2SO_4.10H_2O$ contains = 224 gm oxygen

32.2gm $Na_2SO_4.10H_2O$ contains

$$= \frac{32.2 \times 224}{322} = 22.4 \text{ gm}$$

3. (b) Molarity $= \frac{W(gm) \times 1000}{\text{molecular wt.} \times V(ml.)}$

$$= \frac{2.65 \times 1000}{106 \times 250} = 0.1M$$

10 ml of this solution is diluted to 1000 ml $N_1V_1 = N_2V_2$

$10 \times 0.1 = 1000 \times x$

$x = \frac{0.1 \times 10}{1000} = 0.001M$.

4. (c) According to definition of molar solution $\rightarrow$ A molar solution is one that contains one mole of a solute in one litre of the solution.

5. (a) 44g of CO_2 has $2 \times 6 \times 10^{23}$ atoms of oxygen

4.4g of CO_2 has $= \frac{12 \times 10^{23}}{44} \times 4.4$

$= 1.2 \times 10^{23}$ atoms.

6. (b) 44g CO_2 occupies 22.4L at STP

4.4g CO_2 occupies $= \frac{22.4}{44} \times 4.4 = 2.24L$.

7. (a) Density $= \frac{\text{Mass}}{\text{Volume}}$; $1 = \frac{g}{ml}$ or $g = ml$

0.0018ml = 0.0018gm

No. of moles $= \frac{\text{weight}}{\text{Molecular weight}} = \frac{0.0018}{18} = 1 \times 10^{-4}$

$\therefore$ No. of water molecules $= 6.023 \times 10^{23} \times 1 \times 10^{-4}$

$= 6.023 \times 10^{19}$.

8. (c) $Ca_3P_2 + 6H_2O \rightarrow 2PH_3 + 3Ca(OH)_2$

9. (d) Amount of gold $= 19.7kg = 19.7 \times 1000gm = 19700gm$

No. of moles $= \frac{19700}{197} = 100$

$\therefore$ No. of atoms $= 100 \times 6.023 \times 10^{23}$

$= 6.023 \times 10^{25}$ atoms.

10. (c) $\because$ 100gm $CaCO_3 = 6.023 \times 10^{23}$ molecules

$\therefore$ 10gm $CaCO_3 = \frac{6.023 \times 10^{23}}{100} \times 10$

$= 6.023 \times 10^{22}$ molecule

1 molecule of $CaCO_3$ = 50 protons

6.023×10^{22} molecule of $CaCO_3 = 50 \times 6.023 \times 10^{22}$

$= 3.0115 \times 10^{24}$

11. (b) 16gm of CH_4 = 1mole $= 6.023 \times 10^{23}$ molecules.

12. (c) According to avogadro's hypothesis equal volumes of all gases under similar conditions of temperature and pressure contains equal no. of molecules.

14. (d) $d = \frac{M}{V}$ (d = density, M = mass, V = volume)

Since $d = 1$

So, $M = V$

18gm = 18ml

18ml = N_A molecules (N_A = avogadro's no.)

1000ml $= \frac{N_A}{18} \times 1000 = 55555 N_A$

15. (a) This is fact.

16. (a) $\because$ 3 moles of oxygen is that in 1 mole of $BaCO_3$

$\therefore$ 1.5 moles of oxygen is that in mole of $BaCO_3$

$$= \frac{1}{3} \times 1.5 = \frac{1}{2} = 0.5.$$

17. (b) The no. of molecules present in 1ml of gas at STP is known as Laschmidt number.

22400ml of gas has total no. of molecules

$= 6.023 \times 10^{23}$

1ml of gas has total no. of molecules $= \frac{6.023\times10^{23}}{22400}$

$= 2.69\times10^{19}$.

18. (b) $\because$ 2gm of hydrogen $= 6.02\times10^{23}$ molecules

$\therefore$ 1gm of hydrogen

$= \frac{6.02\times10^{23}}{2} = 3.01\times10^{23}$ molecule.

19. (a) Molecular weight of SO_2Cl_2

$= 32+32+2\times35.5$ = 135gm

$\because$ 135 gm of SO_2Cl_2 = 1gm molecule

$\therefore$ 13.5gm of SO_2Cl_2 $= \frac{1}{135}\times13.5 = 0.1$.

20. (a) (a) 34gm of water

$\because$ 18gm H_2O = 6.023×10^{23} molecule

$\therefore$ 34gm H_2O = $\frac{6.023\times10^{23}}{18}\times34$

$= 11.37\times10^{23}$ mole

(b) 28gm of CO_2

$\because$ 44gm $CO_2 = 6\times10^{23}$ molecules

$\therefore$ 28gm CO_2 $= \frac{6\times10^{23}}{44}\times28 = 3.8\times10^{23}$

(c) 46gm of CH_3OH

$\because$ 32gm $CH_3OH = 6\times10^{23}$ molecules

$\therefore$ 46gm $CH_3OH = \frac{6\times10^{23}}{32}\times46 = 8.625\times10^{23}$

(d) $\because$ 108gm of $N_2O_5 = 6\times10^{23}$ molecules

$\therefore$ 54gm of $N_2O_5 = \frac{6\times10^{23}}{108}\times54 = 3\times10^{23}$ molecules.

21. (b) Sodium oxide $\rightarrow Na_2O$

Molecular weight = 46 +16 = 62

62gm of Na_2O = 1 mole

620gm of Na_2O = 10 mole.

22. (b) 2gm of oxygen contains atom $= \frac{2}{16} = \frac{1}{8}$ mole

also 4g of sulphur $= \frac{4}{32} = \frac{1}{8}$ mole.

23. (c) Molarity = mole/litre

$\because$ 1cc contains 1.17gm

$\therefore$ 1000cc contains 1170gm $\frac{1170gm}{\text{Mol.wt.}}$

$= \frac{1170}{36.5} = 32.05 mole/litre$ (Mol. wt. of HCl=36.5)

24. (a) 1 mole of sucrose contains 6.023×10^{23} molecules

$\because$ 1 molecule of sucrose has 45 atoms

$\therefore$ 6.023×10^{23} molecule of sucrose has

$45\times6.023\times10^{23}$ atoms/mole

25. (a) wt of $CO_2 = 44$

mol wt of $CO_2 = 44$

No. of molecule $= \frac{\text{wt.of } CO_2}{mol\ wt\ of\ CO_2}\times6.02\times10^{23}$

$= \frac{44}{44}\times6.02\times10^{23} = 6.02\times10^{23}$

26. (c) No. of atoms in one molecule

= no. of moles $\times 6.022\times10^{23}$

$= 1.4\times6.022\times10^{23} = 8.432\times10^{23}$

27. (d) As we know that four sodium atom are present in sodium ferrocyanide $[Na_4Fe(CN)_6]$

Hence, number of Na atoms = No. of moles × number of atom × Avogadro's number

$2\times4\times6.023\times10^{23} = 48\times10^{23}$

Percentage composition & Molecular formula

1. (a) $\because$ 40gm $NaOH$ contains 16gm of oxygen

$\therefore$ 100gm of $NaOH$ contains $\frac{16}{40}\times100$ =40% oxygen.

2. (a) Urea- $NH_2-CO-NH_2$

$\because$ 60gm of urea contains 28gm of nitrogen

$\therefore$ 100gm of urea contains $\frac{28}{60}\times100 = 46.66$.

3. (b) Based on facts.

4. (d) $C = 24gm$, $H = 4gm$, $O = 32gm$

So, Molecular formula $= C_2H_4O_2$

So, Empirical formula $= CH_2O$

(Simplest formula).

5. (a) $\because$ 0.0835 mole of compound contains 1gm of hydrogen

$\therefore$ 1gm mole of compound contain = $\frac{1}{0.0835} = 11.97$

=12gm of hydrogen.

12 gm of H_2 is present in $C_2H_{12}O_6$

6. (b) Empirical formula of an acid is CH_2O_2

$(\text{Empirical formula})_n$ = Molecular formula

n = whole no. multiple *i.e.* 1,2,3,4.............

If $n = 1$ molecular formula CH_2O_2.

7. (b) Glucose - $C_6H_{12}O_6$

Ratio of C, H and $O = 1:2:1$

In acetic acid $CH_3-\overset{\displaystyle O}{\overset{\|}{C}}-O-H$

Ratio of C, H and O $1:2:1$.

Chemical stoichiometry

1. (c) $N = \frac{W(gm)\times1000}{V\times\text{Eq.wt.}}$

1500ml of 0.1N HCl = 150ml (N)

$1 = \frac{W(gm)\times 1000}{150\times 40}$, $W(gm) = \frac{150\times 40}{1000} = 6gm$.

2. (c) $N_1V_1 = N_2V_2$; $\frac{1}{2}\times 200 = \frac{1}{10}\times V_2$; $V_2 = 1000ml$

Volume of water added $= 1000 - 200 = 800ml$.

3. (a) $2Ag_2CO_3 \xrightarrow{\Delta} 4Ag + 2CO_2 + O_2$

$2\times 276\ gm \qquad 4\times 108\ gm$

$\because$ $2\times 276 gm$ of Ag_2CO_3 gives $4\times 108\ gm$

$\therefore$ $1 gm$ of Ag_2CO_3 gives $= \frac{4\times 108}{2\times 276}$

$\therefore$ $2.76\ gm$ of Ag_2CO_3 gives

$\frac{4\times 108\times 2.76}{2\times 276} = 2.16\ gm$

4. (c)

$$4NH_{3(g)} + 5O_{2(g)} \rightarrow 4NO_{(g)} + 6H_2O_{(g)}$$

$t = 0 \quad 1 \quad 1 \quad 0 \quad 0$

$t = t \quad 1-4x \quad 1-5x \quad 4x \quad 6x$

Oxygen is limiting reagent

So, $X = \frac{1}{5} = 0.2$ all oxygen consumed

Left $NH_3 = 1 - 4\times 0.2 = 0.2$.

5. (c) $\because$ $100 gm$ Hb contain $= 0.33 gm$ Fe

$\therefore$ $67200 gm$ $Hb = \frac{67200\times 0.33}{100} gm\ Fe$

gm atom of $Fe = \frac{672\times 0.33}{56} = 4$.

6. (c) $\underset{132}{(NH_4)_2SO_4} \equiv 2NH_3 \equiv \underset{2(36.5)=73\ gm}{2HCl}$

$73\,g\,HCl \equiv 132\,g(NH_4)_2SO_4$

$292\,g\,HCl = 528\,g(NH_4)_2SO_4$

7. (c) $\underset{2(36+1+31+64)=264}{2(NH_4)_2HPO_4} \equiv \underset{62+80=142}{P_2O_5}$

% of $P_2O_5 = \frac{\text{wt.of } P_2O_5}{\text{wt of salt}}\times 100$

$= \frac{142}{264}\times 100 = 53.78\%$.

8. (b) $2Al + \frac{3}{2}O_2 \rightarrow Al_2O_3$

According to equation $\frac{3}{2}$ mole of O_2 combines with 2 mole Al.

2 mole $Al = 54gm$

9. (a) $0.5gm$ Se $\rightarrow$ $100gm$ peroxidase anhydrous enzyme

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

Minimum m.w. $\rightarrow$ molecule at least contain one selenium.

10. (d) $H_2O + \underset{27\ gm}{Al} + NaOH \rightarrow NaAlO_2 + \underset{\frac{3}{2}\times 22.4=33.6\,L}{\frac{3}{2}H_2}$

11. (c) In $Fe(CNS)_3.3H_2O$

% of $H_2O = \frac{3\times 18}{284}\times 100 = 19\%$.

12. (d) $5S + 5O_2 \rightarrow 5SO_2$; $5\ O_2 \equiv 5\ SO_2$; $5\times 64 = 320gm$.

13. (d) H_3PO_4 is tribasic so $N = 3M = 3\times 1 = 3$.

14. (b) H_2SO_4 is dibasic $N = 2M = 2\times 2 = 4$.

15. (a) For Dibasic acid $E = \frac{M}{2} = \frac{200}{2} = 100$

$N = \frac{W\times 1000}{E\times V(\text{in } ml)}$

$\frac{1}{10} = \frac{W\times 1000}{100\times 100} = W = 1gm$.

16. (b) $N = \frac{10\times \text{sp.gr. of the solution}\times \text{wt.\% of solute}\times \text{Mol.wt.}}{\text{Molecular wt. of solute}\times \text{Eq.wt.}}$

$N = \frac{10\times 1.71\times 80\times 98}{98\times 49} = 27.9$

18. (c) $2KMnO_4 + 3H_2SO_4 \rightarrow$

$K_2SO_4 + 2MnSO_4 + 3H_2O + [O]$

$2FeSO_4 + H_2SO_4 + [O] \rightarrow Fe_2(SO_4)_3 + H_2O]\times 5$
[Mohr–salt]

$2KMnO_4 + 10FeSO_4 + 8H_2SO_4 \rightarrow$

$K_2SO_4 + 2MnSO_4 + 5Fe_2(SO_4)_3 + 8H_2O$

Mohr-salt reducing agent $KMnO_4/H^+ \rightarrow$ oxidising agent

19. (d) Atomic weight = Equivalent weight × Valency

$= 8.9\times 3 = 26.7\left(\text{Valency} = \frac{26.89}{8.9} \approx 3\right)$.

20. (c) $MW = 2\times V.D. = 2\times 22 = 44$.

21. (d) $2\overset{+7}{KMnO_4} + 3H_2SO_4 \rightarrow K_2SO_4 + 2\overset{+2}{MnSO_4} + 3H_2O + 5[O]$

Change by 5

$\text{Eq.wt.} = \frac{\text{Mol.wt.}}{5}$

22. (c) Dibasic acid $NaOH$; $N_1V_1 = N_2V_2$

$\frac{W}{E}\times 1000 = \frac{1}{10}\times 25$; $\frac{0.16}{E}\times 1000 = \frac{25}{10}$

$M = 2\times E = 2\times 64 = 128$.

23. (d) $NaOH \qquad HCl$

$N_1V_1 = N_2V_2$; $20\times \frac{1}{10} = \frac{1}{20}\times V$; $V = 40ml$.

24. (a) $NV = N_1V_1 + N_2V_2$

$0.2\times 2 = 0.5x + 0.1(2-x)$

$0.4 = 0.5x + 0.2 - 0.1x$

$0.2 = 0.4x$

$x = \frac{1}{2}L = 0.5L$

25. (d) $NV = N_1V_1 + N_2V_2 + N_3V_3$

$N \times 1000 = 1 \times 5 + \frac{1}{2} \times 20 + \frac{1}{3} \times 30 = 5 + 10 + 10 = 25$

$N = 0.025 = \frac{N}{40}$.

26. (b) $NH_{3(g)} + HCl_{(g)} \rightarrow NH_4Cl_{(s)}$

$t = 0$	$20ml$	$40ml$	0
$t = t$	0	$20\ ml$	solid

Final volume = $20\ ml$.

27. (b) $KMnO_4$ Oxalic acid

$\frac{M_1V_1}{n_1} = \frac{M_2V_2}{n_2}$; $\frac{20 \times 0.1}{2} = \frac{M_2V_2}{5}$; $M_2V_2 = 5$.

28. (b) Acidic medium $E = \frac{M}{5} = \frac{158}{5} = 31.6gm$.

29. (c) 0.1 M $AgNO_3$ will react with 0.1 M $NaCl$ to form 0.1 M $NaNO_3$. But as the volume is doubled, conc. of $NO_3^- = \frac{0.1}{2} = 0.05\,M$

30. (a) Acid base

$N_1V_1 = N_2V_2$; $N_1 \times 30 = 0.2 \times 15$; $N_1 = 0.1N$

31. (b) (I) Phenopthalein indicate partial neutralisation of $Na_2CO_3 \rightarrow NaHCO_3$

Meq. of Na_2CO_3 + Meq. of $NaOH$ = Meq. of HCl

$\frac{W}{E} \times 1000 + \frac{W}{E} \times 1000 = NV$

(Suppose $Na_2CO_3 = a\,gm$, $NaOH = b\ gm$)

$\frac{a}{106} \times 1000 + \frac{b}{40} \times 1000 = 300 \times 0.1$ .....(1)

(II) Methyl orange indicate complete neutralisation

HCl HCl

$N_1V_1 = N_2V_2$, $25 \times 0.2 = 0.1 \times V_2$ so $V_2 = 50ml$ excess

$\therefore \frac{a}{53} \times 1000 + \frac{b}{40} \times 1000 = 350 \times 0.1$ .....(2)

From (1) and (2) b =1gm.

32. (c) From solution of (31)

From equation (1)

$a = Na_2CO_3 = 0.53gm$.

33. (b) $(H_2SO_4)\frac{M_1V_1}{n_1} = \frac{M_2V_2}{n_2}(NaOH)$

$\frac{1 \times V_1}{1} = \frac{1 \times 10}{2}$; $V_1 = 5ml$.

34. (c) Atom in highest oxidation state can oxidize iodide to liberate I_2 which is volumetrically measured by iodometric titration using hypo.

$2I^- \rightarrow I_2$

$Pb^{+2} \rightarrow$ Lowest oxidation state can not oxidise iodide to I_2.

35. (d) $KMnO_4$ = Mohr salt

$\frac{M_1V_1}{n_1} = \frac{M_2V_2}{n_2}$; $\frac{0.1 \times 10}{1} = \frac{M_2V_2}{5}$; $M_2V_2 = 5$.

36. (d) The equivalent weight of $H_3PO_4 = \frac{\text{molecular weight}}{2}$

$\because$ mole wt of H_3PO_4 = 3 + 31 + 64 = 98

$\therefore \frac{98}{2} = 49$

37. (b) $Ba(OH)_2 + CO_2 \rightarrow BaCO_3 + H_2O$

Atomic wt. of $BaCO_3$ = $137 + 12 + 16 \times 3$ = 197

No. of mole $= \frac{\text{wt.of substance}}{\text{mol wt.}}$

$\because$ 1 mole of $Ba(OH)_2$ gives 1 mole of $BaCO_3$

$\therefore$ 205 mole of $Ba(OH)_2$ will give .205 mole of $BaCO_3$

$\therefore$ wt. of 0.205 mole of $BaCO_3$ will be

$.205 \times 197 = 40.385gm \approx 40.5\ gm$

38. (d) $N_1 = 0.5N \rightarrow 10mg$ per mL

$N_2 = \frac{10 \times 10^{-3}gm}{40 \times 1} \times 1000$ =0.25N

$V_1 = 500ml$, $V_2 = ?$

$N_1V_1 = N_2V_2$; $0.5 \times 500 = 0.25 \times V_2$

$V_2 = 1000mL$ final volume water added = 1000 – 500 = 500mL.

39. (a) eq. of $KMnO_4$ = eq. of $Fe(C_2O_4)$

$x \times 5 = 1 \times 3$

$x = 0.6$

40. (b)

Element	At.wt.	Mole	Ratio	Empirical formula
C =86%	12	7.1	1	CH_2
H =14%	1	14	2	Beleongs to alkene C_nH_{2n}

41. (b) $AgNO_3 \equiv 2Ag^+ + \underset{(H_2S)}{S^{2-}} \rightarrow Ag_2S$

$\because$ 2 mole $\rightarrow$ 1 mole [100×1 =100 millimole]

$\therefore$ 100 miliimole $\rightarrow$ 50 millimole H_2S required

$CuSO_4 \equiv Cu^{+2} + \underset{(H_2S)}{S^{2-}} \rightarrow CuS$

$\because$ 1 mole $\rightarrow$ 1 mole [100×1=100 millimole]

$\therefore$ 100 millimole $\rightarrow$ 100 millimole H_2S required

Ratio $\frac{50}{100} = \frac{1}{2}$.

42. (c) At room temperature $2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(l)}$

t =0	50ml	50ml	0
$t = t$	50 – 2x =0	50 – x	2x
		25$gases$	(50)liquid

In this case H_2 is limiting reagent

x = 25ml

At 110°C $2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(g)}$ $V_{gas} = 75ml$

$t = t$	0	25ml	50ml

43. (c) $\overset{+2}{CuSO_4} + 2KI \rightarrow K_2SO_4 + \overset{+2}{CuI_2}$; $\quad 2\overset{+2}{CuI_2} \rightarrow \overset{+1}{CuI_2} + I_2$

$I_2 + 2Na_2S_2O_3 \rightarrow 2NaI + Na_2S_4O_6$

Eq. wt. Of $CuSO_4.5H_2O = \text{Mol.wt.} = 250$

100 ml of 0.1 N hypo ≡ 100 ml of 0.1 N $CuSO_4.5H_2O$

$= \frac{250 \times 0.1 \times 100}{100} = 2.5\, gm$

44. (d) $HNO_3 + KOH \rightarrow KNO_3 + H_2O$

$\frac{12.6}{63} = 0.2$ mole; $HNO_3 \equiv KOH$

0.2 mole ≡ 0.2 mole

$0.2 \times 56 = 11.2 gm$.

45. (a) Isobutane and n-butane $[C_4H_{10}]$ have same molecular formula; $C_4H_{10} + \frac{13}{2}O_2 \rightarrow 4CO_2 + 5H_2O$

For 58gm of C_4H_{10} 208 gm O_2 is required then for 5 kg of

C_4H_{10} $O_2 = \frac{5 \times 208}{58} = 17.9\, kg$

46. (b) $n = \frac{16.8}{22.4} = 0.75$ mole of H_2 and O_2

$2H_2O \rightarrow \underset{2:1}{2H_2 + O_2}$ $\quad 0.75 < \begin{matrix} 0.25 \\ 0.25 \end{matrix} \begin{matrix} O_2 \\ H_2 \end{matrix}$

2 mole H_2 – 2 mole H_2O

0.5 mole H_2 – 0.5 mole H_2O = 9gm.

47. (a) ∵ 3ml (O) → 1ml O_3

30ml (O) → 10ml O_3

$x = \frac{150 \times 10}{100} = 15ml$

V of O_2 + V of $O_3 = 135 + 10 = 145ml$

Turpentine oil absorb ozone.

48. (a) 50% HCl itself means 50gm HCl react with 100gm sample

% Purity $= \frac{50}{100} \times 100 = 50\%$.

49. (a) $AgNO_3 + HCl \rightarrow AgCl + HNO_3$

$\frac{30}{170}$ $\quad \frac{500 \times 0.2}{1000}$

t = 0 0.176 mole 0.1 mole limiting =14.345gm

t = t 0.076 mole 0 0.1mole

50. (d) $KMnO_4$ $\quad FeSO_4$

$\frac{M_1V_1}{n_1} = \frac{M_2V_2}{n_2}$; $M_1V_1 = \frac{n_1}{n_2}M_2V_2$

$= \frac{2}{10} \times 10 \times \frac{1}{10} = \frac{1}{5} = 0.2$

For (d), $M_1V_1 = 0.02 \times 10 = \frac{1}{5}$

51. (c) $\underset{1\text{ mol.}}{ROH} + CH_3MgI \rightarrow \underset{1\text{ mol}=22400\ cc}{CH_4} + Mg\!<\!\begin{matrix} OR \\ I \end{matrix}$

1.12 mL is obtained from 4.12 mg

∴ 22400 mL will be obtained from

$\frac{4.12}{1.12} \times 22400\, mg = 84.2\, g$

52. (b)

Element	%(a)	At.wt.(b)	a/b	Ratio
X	50	10	5	2
Y	50	20	2.5	1

Simplest formula $= X_2Y$

53. (a) $A_3(BC_4)_2 = 3 \times 2 + [5 + (-2 \times 4)]_2 = 0$.

54. (b) $\underset{10gm}{CaCO_3} \rightarrow CaO + CO_2$

90% pure 9gm $= \frac{9}{100}$ mole

$CaCO_3 \equiv CO_2 = 0.09$ mole

At NTP Vol. $CO_2 = 0.09 \times 22.4 = 2.016L$.

55. (b) $Cd^{+2} + S^{2-} \rightarrow CdS$

20×1= 20

$Cu^{+2} + S^{2-} \rightarrow CuS$

20×0.5 =10

Ratio = 2 : 1

56. (b) $Mg^{+2} \equiv H_2$

$n = \frac{12gm}{24gm} = \frac{1}{2}$ mole of H_2

57. (a) $\underset{1\text{mole}}{Mg} + \underset{0.5\text{mole}}{\frac{1}{2}O_2} \rightarrow MgO$

0.5 mole of oxygen react with 1 mole of Mg

1.5 mole of oxygen react with $\frac{1.5}{0.5} = 3$ mole

$24 \times 3 = 72gm$.

58. (c) $\underset{100\,g}{CaCO_3} + \underset{2N}{2HCl} \rightarrow CaCl_2 + \underset{44\ g}{CO_2} + H_2O$

100 g $CaCO_3$ with 2 N HCl gives 44 g CO_2

100 g $CaCO_3$ with 1 N HCl gives 22 g CO_2

Critical Thinking Questions

2. (b) H_2O contains H and O in a fixed ratio by mass. It illustrates the law of constant composition.

3. (b) 100 g of $ZnSO_4$ crystals are obtained from =22.65g Zn

1g of $ZnSO_4$ crystals will be obtained from $= \frac{22.65}{100}\, g$ Zn

20 g of $ZnSO_4$ crystals obtained from $= \frac{22.65}{100} \times 20 = 4.53\, g$

4. (a) If same volume is occupied by the gas, the no. of molecules are same, so no. of moles are same.

1 mole of N_2 gas $= 2 \times 14 = 28gm$

1 mole of CO gas $=12+16=28gm$

5. (c) Heat capacity of water per gram $=\frac{75}{18}=4.17$

$Q = mST$

$1000=100\times4.17\times t$

$t=\frac{1000}{100\times4.17}=2.4\,K$.

6. (b) ∵ $8gm$ sulphur is present in $100gm$ of substance

∴ $32gm$ sulphur will present $=\frac{100}{8}\times32=400$.

7. (b) (a) 6.023×10^{23} molecules of CO_2

No. of atoms $=3\times6.023\times10^{21}=18.069\times10^{21}$ atoms

(b) $22.4L$ of CO_2

No. of atoms $=6.023\times10^{23}\times3=18.069\times10^{23}$ atoms

(c) $0.44gm$ of CO_2

No. of moles $=\frac{0.44}{44}=\frac{1}{100}\times6.023\times10^{23}$ moles

$=6.023\times10^{21}$ moles $=3\times6.023\times10^{21}$ atoms

18.069×10^{21} atoms

8. (b) It is about $22.4L$.

9. (a) $200mg$ of CO_2 = $200\times10^{-3}=0.2gm$

$44gm$ of CO_2 = 6×10^{23} molecules

$0.2gm$ of CO_2 = $\frac{6\times10^{23}}{44}\times0.2=0.0272\times10^{23}$

$=2.72\times10^{21}$ molecule

Now 10^{21} molecule are removed.

So remaining molecules $=2.72\times10^{21}-10^{21}$

$=10^{21}(2.72-1)=1.72\times10^{21}$ molecules

Now, 6.023×10^{23} molecules = 1mole

1.72×10^{21} molecules $=\frac{1\times1.72\times10^{21}}{6.023\times10^{23}}=0.285\times10^{-2}$

$=2.85\times10^{-3}$.

10. (d) $2K_2Cr_2O_4+2HCl\rightarrow K_2Cr_2O_7+2KCl+H_2O$

11. (a) Meq of Mg^{+2} ≡ Meq of washing soda

$\frac{W}{E}\times1000=Mg^{+2}$; $EW=\frac{24}{2}=12$

$\frac{12\times10^{-3}}{12}\times1000=1$.

12. (c) $\underset{+12/\text{two atom}}{K_2Cr_2O_7}+4H_2SO_4\rightarrow K_2SO_4+\underset{+6/\text{two atom}}{Cr_2(SO_4)_3}+4H_2O+3[O]$

Change by 6

$\text{Eq.wt.}=\frac{\text{Mol.wt.}}{6}$

13. (a) $KMnO_4$ = Mohr salt

$\frac{M_1V_1}{1}=\frac{M_2V_2}{5}=\left[\frac{W}{M\times V}\times1000\right]\times\frac{V_2}{5}$

$\left[\frac{W\times1000}{58\times1000}\right]\times18=\frac{3.92\times1000}{392\times1000}\times\frac{20}{5}$ W=3.476gm/L.

14. (d) Volume m of HCl neutralised by $NaOH$ = (Caustic soda) = V_1

$N_1V_1=N_2V_2$; $0.1\times V_1=0.2\times30$; $V_1=60ml$

V total (HCl) = $100ml$

V_1 = $60ml$

$40ml$

$40ml$ 0.1N HCl is now neutralised by KOH (0.25N) →

(HCl) $N_1V_1=N_2V_2$ (KOH)

$0.1\times40=0.25\times V_2$; $V_2=16ml$.

15. (c) $BCl_3+3[H]\rightarrow B+3HCl$

$BCl_3+\frac{3}{2}H_2\rightarrow B+3HCl$; $B=\frac{21.6}{10.8}=2$ mole

$B\equiv\frac{3}{2}H_2$

1mole $\equiv\frac{3}{2}$ mole ; 2 mole – 3 mole

$V=3\times22.4=67.2L$.

16. (c) $n=\frac{W}{M}=\frac{V}{22400}$; $\frac{W}{16}=\frac{112}{22400}$; $W=0.08gm$.

17. (a) $\%C=\frac{12}{44}\times\frac{W_{CO_2}}{W}\times100=\frac{12}{44}\times\frac{2.63}{0.858}\times100=83.6\%$

$\%H=\frac{2}{18}\times\frac{W_{H_2O}}{W}\times100=\frac{2}{18}\times\frac{1.28}{.858}\times100=16.4\%$

	%(a)	At.wt.(b)	a/b	Ratio	
C	83.6	12	6.96	1	× 3
H	16.4	1	16.4	2.3	7

$C_3H_7=12\times3+7=43gm$.

18. (b) $\underset{+4}{SO_2}+2H_2O\rightarrow\underset{0}{S}+2H_2O_2$

$EW=\frac{M}{4}=\frac{64}{4}=16$; Twice $16\times2=32$

Assertion & Reason

1. (e) We know that from the reaction $H_2+Cl_2\rightarrow2HCl$ that the ratio of the volume of gaseous reactants and products is in agreement with their molar ratio. The ratio of $H_2:Cl_2:HCl$ volumes is $1:1:2$ which is the same as their molar ratio. Thus volume of gas is directly related to the number of moles. Therefore, the assertion is false but reason is true.

2. (e) We know that molecular weight of substance is calculated by adding the atomic weight of atoms present in one molecules. We also know that molecular weight of oxygen (O_2)=2x (Atomic weight of oxygen) $=2\times16=32\,a.m.u.$ Atomic

weight of oxygen is 16, because it is 16 times heavier than1/12th of carbon atom. Therefore assertion is false but reason is true.

3. (c) According to Dalton's atomic theory atoms can neither be created nor destroyed and according to berzelius hypothesis, under similar condition of temperature and pressure equal volumes of all gases contain equal no. of atom. Therefore assertion is true but reason is false.

4. (e) One mole of any substance corresponding to 6.023×10^{23} entities is respective of its weight.

Molecular weight of $SO_2 = 32 + 2 \times 16 = 64 gm$.

Molecular weight of $O_2 = 16 \times 2 = 32 gm$.

$\therefore$ Molecular weight of SO_2 is double to that of O_2.

5. (d) 1.231 has four significant figures all no. from left to right are counted, starting with the first digit that is not zero for calculating the no. of significant figure.

6. (d) Molar volume (at NTP) = 22.4L

Now 22.4L of N_2 = volume occupied by one mole of $N_2 = 28 gm = 6.023 \times 10^{23}$ molecules.

Similarly, $O_2 = 2 \times 16 = 32 gm$,

$32 gm = 6.023 \times 10^{23}$ molecules = 22.4L

$\therefore$ $22.4L = 6.023 \times 10^{23}$ or $5.6L = \frac{6.023 \times 10^{23} \times 5.6}{22.4}$

$= \frac{1}{4} \times 6.023 \times 10^{23}$

According to avagadro's hypothesis equal volume of all gases contain equal no. of molecules under similar condition of temperature and pressure.

7. (a) For universally accepted atomic mass unit in 1961, C-12 was selected as standard. However the new symbol used is 'u' (unified mass) in place of amu.

8. (c) Vapour density of $B = \frac{M}{2}$,

Vapour density of $A = 4 \times \frac{M}{4} = 2M$

Molecular mass of $A = 2 \times 2M = 4M$.

9. (a) Pure water always contains hydrogen and oxygen in the ratio $1:8$ by mass. This is in accordance with the law of constant composition.

10. (b) The number of moles of a solute present in litre of solution is known is as molarity (M).

The total no. of molecules of reactants present in a balanced chemical equation is known as molecularity. For example,

$PCl_5 \rightarrow PCl_3 + Cl_2$ (Unimolecular)

$2HCl \rightarrow H_2 + I_2$ (Bimolecular)

$\therefore$ Molarity and molecularity are used in different sense.

11. (a) Both assertion and reason are true and reason is the correct explanation of assertion.

12. (e) Equivalent wt. of Cu in $CuO = \frac{63.6}{2} = \frac{\text{At.wt.}}{\text{Valency}}$ =31.8

Equivalent wt. of Cu in $Cu_2O = \frac{63.6}{1}$ =63.6

(Valency of Cu =1).

13. (e) Mass spectrometer is the instrument used for the determination of accurate atomic mass and the relative abundance of the isotopes.

14. (a) Both assertion and reason are true and reason is the correct explanation of assertion.

15. (a) Example of isomorphous compounds are K_2SO_3, K_2CrO_4, K_2SeO_4 (valency of S, Cr, Se = 6) and $ZnSO_4 . 7H_2O$, $MgSO_4 . 7H_2O$, $FeSO_4 . 7H_2O$ (valency of Zn, Mg, Fe =2).

16. (b) No. of atoms present in a molecules of a gaseous element is called atomicity.

For example, O_2 has two atoms and hence its atomicity is 2.

17. (a) 12gm of C-12 contain 6.023×10^{23} atom

$\therefore$ $\frac{12}{6.023} \times 10^{-23} = 1.66 \times 10^{-24}$.

Chemical Arithmetic

SET Self Evaluation Test - 1

1. A mixture of sand and iodine can be separated by **[Kerala CEE 2002]**
   (a) Crystallisation (b) Sublimation
   (c) Distillation (d) Fractional distillation

2. The element similar to carbon is
   (a) Mg (b) Mn
   (c) Sn (d) Po

2. The law of multiple proportions was proposed by **[IIT 1992]**
   (a) Lavoisier (b) Dalton
   (c) Proust (d) Gay-Lussac

4. 1 L of N_2 combines with 3 L of H_2 to form $2L$ of NH_3 under the same conditions. This illustrates the
   (a) Law of constant composition
   (b) Law of multiple proportions
   (c) Law of reciprocal proportions
   (d) Gay-Lussac's law of gaseous volumes

5. One sample of atmospheric air is found to have 0.03% of carbon dioxide and another sample 0.04%. This is evidence that
   (a) The law of constant composition is not always true
   (b) The law of multiple proportions is true
   (c) Air is a compound
   (d) Air is a mixture

6. One part of an element A combines with two parts of another B. Six parts of the element C combine with four parts of the element B. if A and C combine together the ratio of their weights will be governed by **[AMU 1984]**
   (a) Law of definite proportion
   (b) Law of multiple proportion
   (c) Law of reciprocal proportion
   (d) Law of conservation of mass

7. The maximum amount of $BaSO_4$ precipitated on mixing equal volumes of $BaCl_2$ (0.5 M) with H_2SO_4 (1M) will correspond to **[AIIMS 1997]**
   (a) 0.5 M (b) 1.0 M
   (c) 1.5 M (d) 2.0 M

8. Crystals of which pair are isomorphous **[MP PMT 1985]**
   (a) $ZnSO_4, SnSO_4$ (b) $MgSO_4, CaSO_4$
   (c) $ZnSO_4, MgSO_4$ (d) $PbSO_4, NiSO_4$

9. M is the molecular weight of $KMnO_4$. The equivalent weight of $KMnO_4$ when it is converted into K_2MnO_4 is
   (a) M (b) $M/3$
   (c) $M/5$ (d) $M/7$

10. An aqueous solution of 6.3 g of oxalic acid dihydrate is made up of to 250 ml. The volume of 0.1 N $NaOH$ required to completely neutralise 10 ml of this solution is **[IIT 2001]**
    (a) 40 ml (b) 20 ml
    (c) 10 ml (d) 4 ml

11. The normality of orthophosphoric acid having purity of 70% by weight and specific gravity 1.54 would be **[CPMT 1992]**
    (a) 11N (b) 22N
    (c) 33N (d) 44N

12. The equivalent weight of phosphoric acid (H_3PO_4) in the reaction, $NaOH + H_3PO_4 \rightarrow NaH_2PO_4 + H_2O$ is **[AIIMS 1999; BHU 2005]**
    (a) 25 (b) 49
    (c) 59 (d) 98

13. Volume of 0.6 M $NaOH$ required to neutralize $30\ cm^3$ of 0.4 M HCl is **[KCET 1995]**
    (a) $30\ cm^3$ (b) $20\ cm^3$
    (c) $50\ cm^3$ (d) $45\ cm^3$

14. One mole of potassium dichromate completely oxidises the following number of moles of ferrous sulphate in acidic medium **[MP PET 1998]**
    (a) 1 (b) 3
    (c) 5 (d) 6

15. The number of equivalents of $Na_2S_2O_3$ required for the volumetric estimation of one equivalent of Cu^{2+} is **[Kerala MEE 2000]**
    (a) 1 (b) 2
    (c) 3/2 (d) 3

AS Answers and Solutions

(SET -1)

1. (b) Iodine shows sublimation and hence volatalizes on heating, the vapour condenses on cooling to give pure iodine.

2. (c) Carbon and tin both are same group elements so have similarities in properties.

3. (b) Law of multiple proportions was proposed by Dalton and verified by Berzelius.

4. (d) Gay-Lussac's law : The volumes of the reacting gases and those of the gaseous products bear the simple ratio (also called the law of gaseous volumes).

5. (d)

6. (c) The weights of two elements combining with a fixed amount of the third element will bear the same ratio(or simple multiple of it) in which they themselves react.

7. (a) $BaCl_2 + H_2SO_4 \rightarrow BaSO_4 + 2HCl$

One mole of $BaCl_2$ reacts with one mole of H_2SO_4. Hence 0.5 mole will react with 0.5 mole of H_2SO_4 *i.e.* $BaCl_2$ is the limiting reagent.

8. (c) Isomorphous substance molecules contain the same number of atoms bonded in similar fashion.

9. (a) $K\overset{+7}{Mn}O_4 \rightarrow K_2\overset{+6}{Mn}O_4$

Change in 0.5 per atom $= 7 - 6 = 1$

$\therefore$ Equivalent weight of $KMnO_4$

$$= \frac{\text{Molecular weight of } KMnO_4}{\text{Change of 0.5 per atom}} = \frac{M}{1} = M.$$

10. (a) Oxalic acid $\quad NaOH$

$$N_1V_1 = N_2V_2$$

$$\left[\frac{W}{E} \times \frac{1000}{V}\right] \times V_1 = N_2V_2$$

$$\frac{6.3}{63} \times \frac{1000}{250} \times 10 = 0.1 \times V \quad V = 40 ml.$$

11. (a) 70% by weight $70gm\ H_3PO_4 \rightarrow 100gm$ solution/sample

$$V = \frac{W}{d} = \frac{100}{1.54} \quad N = \frac{70 \times 1000}{98 \times 100/1.54} = 11N.$$

12. (d) $\underset{}{NaOH} + \underset{(PO_4^{-3})}{H_3PO_4} \rightarrow \underset{(NaPO_4^{-2})}{NaH_2PO_4}$

$$EW = \frac{MW}{\text{no. of ionisable} H^+} = \frac{98}{1}.$$

13. (b) $NaOH \quad HCl$

$N_1V_1 = N_2V_2$; $0.6 \times V_1 = 0.4 \times 30$; $V_1 = 20 ml$.

14. (d) $\underset{n=6}{Cr_2O_7^{--}} \rightarrow Cr^{3+}$; $\underset{n=1}{Fe^{++}} \rightarrow Fe^{+++}$

eq. of $K_2Cr_2O_7$ = eq. of $FeSO_4$

$$1 \times 6 = x \times 1$$

15. (b) $Cu^{2+} + 2I^- \rightarrow CuI_2 \quad 2CuI_2 \rightarrow Cu_2I_2 + I_2$

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