CHEMISTRY STOICHIOMETRY Used for mcqs chapter wise XII
Used for mcqs chapter wise XI

Level – 1

1. If water sample are taken from sea, rivers or lake, they will be found to contain hydrogen and oxygen in the approximate ratio of 1:8. This indicates the law of:
   a) Multiple proportion  b) Definite proportion  c) Reciprocal proportions  d) None of these

2. Hydrogen and oxygen combine to form H₂O₂ and H₂O containing 5.93 % and 11.2 % hydrogen respectively. The data illustrates:
   a) law of conservation of mass  b) law of constant proportion  c) law of reciprocal proportion  d) law of multiple proportion

3. One of the following combinations illustrate law of reciprocal proportions:
   a) N₂O₃, N₂O₄, N₂O₅  b) NaCl, NaBr, NaI  c) CS₂, CO₂, SO₂  d) PH₃, P₂O₃, P₂O₅

4. All the substances listed below are fertilizers that contribute nitrogen to the soil. Which of these is the richest source of nitrogen on a mass percentage basis?
   a) Urea, (NH₂)₂CO  b) Ammonium nitrate, NH₄NO₃  c) Nitric oxide, NO  d) Ammonia, NH₃

5. Cisplatin, an anticancer drug, has the molecular formula Pt(NH₃)₂Cl₂. What is the mass (in gram) of one molecule?
   (Atomic weights : Pt = 195, H = 1.0, N = 14, Cl = 35.5)
   a) 4.98 × 10⁻²¹  b) 4.98 × 10⁻²²  c) 6.55 × 10⁻²¹  d) 3.85 × 10⁻²²

6. Aspirin has the formula C₉H₈O₄. How many atoms of oxygen are there in a table spoon weighing 360 mg?
   a) 1.204 × 10²³  b) 1.08 × 10²²  c) 1.204 × 10²⁴  d) 4.81 × 10²³

7. 20 g of an ideal gas contains only atoms of S & O occupies 5.6 L at NTP. What is the mol. wt. of gas?
   a) 64  b) 80  c) 96  d) None of these

8. A sample of ammonium phosphate, (NH₄)₃PO₄ contains 6 moles of hydrogen atoms. The number of moles of oxygen atoms in the sample is:
   a) 1  b) 2  c) 4  d) 6

9. Total number of moles of oxygen atoms in 3 litre O₃(g) at 27°C and 8.21 atm are:
   a) 3  b) 2  c) 1  d) None of these

10. 3.011 × 10²² atoms of an element weight 1.15 gm. The atomic mass of the element is:
    a) 10  b) 2.3  c) 35.5  d) 23

11. One atom of an element x weigh 6.643 × 10⁻²¹ g. Number of moles of atom in 20 kg is:
    a) 4  b) 40  c) 100  d) 500

12. Mass of one atom of the element A is 3.9854 ×10⁻²³g. How many atoms are contained in 1 g of the element?
    a) 2.509 × 10²³  b) 6.022 × 10²³  c) 12.044 ×10²³  d) None of these

13. Which of the following contains the largest mass of hydrogen atoms?
    a) 5.0 moles C₂H₆O₄  b) 1.1 moles C₃H₆O₃  c) 1.5 moles C₆H₅O₆  d) 4.0 moles C₂H₄O₂

14. Which has minimum number of atoms of oxygen?
    a) 10 mL H₂O(ℓ)  b) 0.1 mole of V₂O₅  c) 12 gm O₃(ℓ)  d) 12.044 ×10²² molecules of CO₂
15. Rearrange the following (I to IV) in the order of increasing masses:
I) 0.5 mole of O₃  II) 0.5 gm atom of oxygen
III) 3.011 ×10^{23} molecules of O₂  IV) 5.6 litre of CO₂ at STP
a) II < IV < III < I  b) II < I < IV < III  c) IV < II < III < I  d) I < II < III < IV

16. The total no. of neutrons present in 54 mL H₂O(l) are:
a) 3Nₐ  b) 30Nₐ  c) 24Nₐ  d) None of these

17. Total no. of electrons present in 48 g Mg^{2+} are: Nₐ is the avogadro's number
a) 24Nₐ  b) 2Nₐ  c) 20Nₐ  d) None of these

18. The number of neutrons in 5 g of D₂O (D is \(^2\)H) are:
a) 0.25Nₐ  b) 2.5Nₐ  c) 1.1Nₐ  d) None of these

19. It is known that atom contain protons, neutrons and electrons. If the mass of neutron is assumed to half of its original value whereas that of proton is assumed to be twice of its original value then the atomic mass of \(^{14}\)C will be:
a) same  b) 14.28 % less  c) 14.28 % more  d) 28.56 less

20. The hydrated salt Na₂CO₃ . xH₂O undergoes 63 % loss in mass on heating and becomes anhydrous. The value of x is:
a) 10  b) 12  c) 8  d) 18

21. A 6.85 g sample of the hydrate Sr(OH)₂ . xH₂O is dried in an oven to give 3.13 g of anhydrous Sr(OH)₂. What is the value of x ? (Atomic weights : Sr = 87.60, O = 15.0, H = 1.0)
a) 8  b) 12  c) 10  d) 6

22. What percentage of oxygen is present in the compound CaCO₃.3Ca₃(PO₄)₂ ?
a) 23.3 %  b) 45.36 %  c) 41.94 %  d) 17.08 %

23. One mole of element X has 0.444 times the mass of one mole of element Y. One average atom of element X has 2.96 times the mass of one atom of \(^{12}\)C. What is the atomic weight of Y?
a) 80  b) 15.77  c) 46.67  d) 40.0

24. A given sample of pure compound contains 9.81 gm of Zn, 1.8 × 10^{23} atoms of chromium and 0.60 mole of oxygen atoms. What is the simplest formula ?
a) ZnCr₃O₇  b) ZnCr₂O₄  c) ZnCrO₄  d) ZnCrO₆

25. The formula of an acid is HXO₂. The mass of 0.0242 moles of the acid is 1.657 g. What is the atomic weight of X ?
a) 35.5  b) 28.1  c) 128  d) 19.0

26. What is the empirical formula of vanadium oxide, if 2.74 g of the metal oxide contains 1.53 g of metal ?
a) V₂O₃  b) VO  c) V₂O₅  d) V²O₇

27. Determine the empirical formula of Kelvar, used in making bullet proof vests, is 70.6 % C, 4.2 % H, 11.8 % N and 13.4 % O:
a) C₇H₆NO₂  b) C₇H₆N₂O  c) C₇H₆NO  d) C₇H₅NO

28. Dieldrin, an insecticide, contains C, H, Cl & O. Combustion of 29.72 mg of Dieldrin gave 41.21 mg CO₂ and 5.63 mg of H₂O. In a separate analysis 25.31 mg of Dieldrin was converted into 57.13 mg AgCl. What is the empirical formula of Dieldrin?
a) C₆H₄Cl₃O  b) C₆H₄ClO  c) C₁₂H₆Cl₆  d) C₆H₄Cl₃O₂
29. A gaseous compound is composed of 85.7 % by mass carbon and 14.3 % by mass hydrogen. It’s density is 2.28 g/litre at 300 K and 1.0 atm pressure. Determine the molecular formula of the compound: a) C₂H₂  b) C₂H₄  c) C₄H₈  d) C₄H₁₀

30. If average molecular wt. of air is 29, then assuming N₂ & O₂ gases are there which options are correct regarding composition of air: i) 75 % by mass of N₂  ii) 75 % by moles N₂  iii) 72.41 % by mass of N₂ a) only (i) is correct  b) only (ii) is correct c) both (ii) and (iii) are correct  d) both (i) and (ii) are correct

31. Density of dry air containing only N₂ & O₂ is 1.15 g/L at 740 mm and 300 K. What is % composition of N₂ by weight in the air? a) 78 %  b) 75.5 %  c) 72.91 %  d) 72.75 %

32. A gaseous mixture of H₂ and CO₂ gas contains 66 mass % of CO₂. The vapour density of the mixture is: a) 6.1  b) 5.4  c) 2.7  d) 10.8

33. The vapour density of a mixture containing NO₂ and N₂O₄ is 27.6. The mole fraction of N₂O₄ in the mixture is: a) 0.1  b) 0.2  c) 0.5  d) 0.8

34. Adipic acid, a compound used in making nylon, is 43.8 % oxygen. There are four oxygen atoms per molecule. What is the molecular weight of hexamethylenediamine? a) 36  b) 116  c) 292  d) 146

35. Average atomic mass of magnesium is 24.31 a.m.u. This magnesium is composed of 79 mole % of ²⁴Mg and remaining 21 mole % of ²⁵Mg & ²⁶Mg. Calculate mole % of ²⁶Mg. a) 10  b) 11  c) 15  d) 16

36. Indium (atomic weight = 114.82) has two naturally occurring isotopes, the predominant one form has isotopic weight 114.9041 and abundance of 95.72 %. Which of the following isotopic weights is the most likely for the other isotope? a) 112.94  b) 115.90  c) 113.90  d) 114.90

37. Suppose two elements X & Y combine to form two compounds XY₂ & X₂Y₃ when 0.05 mole of XY₂ weighs 5 g while 3.011 x 10²³ molecules of X₂Y₃ weighs 85 g. The atomic masses of X & Y are respectively: a) 20,30  b) 30,40  c) 40,30  d) 80,60

38. 44 g of a sample on complete combustion gives 88 gm CO₂ and 36 gm of H₂O. The molecular formula of the compound may be: a) C₄H₆  b) C₃H₅O  c) C₂H₄O  d) C₃H₆O

39. 40 milligram diatomic volatile substance (X₂) is converted to vapour that displaced 4.92 mL of air at 1 atm and 300 K. Atomic weight of element X is nearly: a) 400  b) 240  c) 200  d) 100

40. A mixture of O₂ and gas “Y” (mol. wt. 80) in the mole ratio a : b has a mean molecular weight 40. What would be mean molecular weight, if the gases are mixed in the ratio b : a under identical conditions ? (gases are non-reacting): a) 40  b) 48  c) 62  d) 72

41. Two element X (at. mass = 75) and Y (at. mass = 16) combine to give a compound having 75.8 % of X. The formula of the compound is: a) XY  b) X₂Y  c) X₂Y₂  d) X₂Y₃

42. A sample of phosphorus that weighs 12.4 g exerts a pressure 8 atm in a 0.821 litre closed vessel at 527°C. The molecular formula of the phosphorus vapour is: a) P₂  b) P₄  c) P₆  d) P₈
43. Manganese forms non-stoichiometric oxides having the general formula $MNO_x$. The value of $x$ for the compound that analyzed 64 % Mn:
   a) 1.16   b) 1.83   c) 2   d) 1.93

44. 1.44 gram of titanium (Ti) reacted with excess of $O_2$ and produce $x$ gram of non-stoichiometric compound $Ti_{1.44}O$. The value of $x$ is:
   a) 2   b) 1.77   c) 1.44   d) none of these

45. A 25.0 mm × 40.0 mm piece of gold foil is 0.25 mm thick. The density of gold is 19.32 g/cm³. How many gold atoms are in the sheet? (Atomic weight : Au = 197.0)
   a) $7.7 \times 10^{23}$   b) $1.5 \times 10^{23}$   c) $4.3 \times 10^{21}$   d) $1.47 \times 10^{22}$

46. Balance the following equation and choose the quantity which is the sum of the coefficients of the products:
   $\ldots \ldots \text{CS}_2 + \ldots \ldots \text{Cl}_2 \rightarrow \text{CCl}_4 + \ldots \ldots \text{S}_2\text{Cl}_2$
   a) 16   b) 13   c) 18   d) 12

47. Balance the following equation and choose the quantity which is the sum of the coefficients of reactants and products:
   $\ldots \ldots \text{PtCl}_2 + \ldots \ldots \text{XeF}_2 \rightarrow \text{PtF}_6 + \ldots \ldots \text{Cl}_2 + \ldots \ldots \text{Xe}$
   a) 16   b) 13   c) 18   d) 12

48. Which statement is false for the balanced equation given below?
   $\text{CS}_2 + 3\text{O}_2 \rightarrow 2\text{SO}_2 + \text{CO}_2$
   a) One mole of CS$_2$ will produce one mole of CO$_2$
   b) The reaction of 16 g of oxygen produces 7.33 g of CO$_2$
   c) The reaction of one mole of O$_2$ will produce 2/3 mole of SO$_2$
   d) Six molecules of oxygen requires three molecules of CS$_2$

49. Which of the following setups is correct to calculate the weight (in g) of KClO$_3$ produced from the reaction of 0.150 moles of Cl$_2$?
   $3\text{Cl}_2 + 6\text{KOH} \rightarrow 5\text{KCl} + \text{KClO}_3 + 3\text{H}_2\text{O}$
   a) 0.150 moles Cl$_2$ × 1 mole KClO$_3$/3 moles Cl$_2$ × 122.5 g/1 mole KClO$_3$
   b) 0.150 moles Cl$_2$ × 1 mole KClO$_3$/3 moles Cl$_2$ × 1 mole KClO$_3$/122.5 g
   c) 0.150 moles Cl$_2$ × 3 moles Cl$_2$/1 mole KClO$_3$ × 122.5 g/1 mole KClO$_3$
   d) 0.150 moles Cl$_2$ × 3 moles Cl$_2$/1 mole KClO$_3$ × 122.5 g/122.5 g

50. 2.0 g sample contain mixture of SiO$_2$ & Fe$_2$O$_3$, on very strong heating leave a residue weighing 1.96 g. The reaction responsible for loss of weight is
   $\text{Fe}_2\text{O}_3(s) \rightarrow \text{Fe}_3\text{O}_4(s) + \text{O}_2(g)$
   What is the percentage by mass of SiO$_2$ in original sample?
   a) 10 %   b) 20 %   c) 40 %   d) 60 %

51. What volume of air at STP containing 21 % of oxygen by volume is required to completely burn sulphur (S$_8$) present in 200 g of sample, which contains 20 % inert material which does not burn. Sulphur burns according to the reaction $\frac{1}{8} \text{S}_8(s) + \text{O}_2(g) \rightarrow \text{SO}_2(g)$
   a) 23.52 litre   b) 320 litre   c) 112 litre   d) 533.33 litre

52. For the reaction, $2\text{Fe(NO}_3)_2 + 3\text{Na}_2\text{CO}_3 \rightarrow \text{Fe}_2(\text{CO}_3)_3 + 6\text{NaNO}_3$ Initially if 2.5 mole of Fe(NO$_3)_2$ and 3.6 mole of Na$_2$CO$_3$ is taken. If 6.3 mole of NaNO$_3$ is obtained then % yield of given reaction is:
   a) 50 %   b) 84 %   c) 87.5 %   d) 100 %
53. How many moles of P4 can be produced by reaction of 0.10 moles Ca5(PO4)3F, 0.36 moles SiO2 & 0.90 moles C according to the following reaction?

\[ 4\text{Ca}_5(\text{PO}_4)_3\text{F} + 18\text{SiO}_2 + 30 \text{ C} \rightarrow 3\text{P}_4 + 2\text{CaF}_2 + 18\text{CaSiO}_3 + 30 \text{ CO} \]

a) 0.060  b) 0.030  c) 0.045  d) 0.075

54. Some older emergency oxygen masks containing potassium superoxide, KO2 which reacts with CO2 and water in exhaled air to produce oxygen according to the given equation. If a person exhales 0.667 g of CO2 per minute, how many grams of KO2 are consumed in 5.0 minutes?

\[ 4\text{KO}_2 + 2\text{H}_2\text{O} + 4\text{CO}_2 \rightarrow 4\text{KHCO}_3 + 3\text{O}_2 \]

a) 10.7  b) 0.0757  c) 1.07  d) 5.38

55. The mass of N2F4 produced by the reaction of 2.0 g of NH3 and 8.0 g of F2 is 3.56 g. What is the percent yield?

\[ 2\text{NH}_3 + 5\text{F}_2 \rightarrow \text{N}_2\text{F}_4 + 6\text{HF} \]

a) 79.0  b) 71.2  c) 84.6  d) None of these

56. Phosphoric acid (H3PO4) prepared in a two step process.

1) \( \text{P}_4 + 5\text{O}_2 \rightarrow \text{P}_4\text{O}_{10} \)

2) \( \text{P}_4\text{O}_{10} + 6\text{H}_2\text{O} \rightarrow 4\text{H}_3\text{PO}_4 \)

We allow 62 g of phosphorus to react with excess oxygen which from P4O10 in 85 % yield. In the step (2) reaction 90 % yield of H3PO4 is obtained. Produced mass of H3PO4 is:

a) 37.485 g  b) 149.949 g  c) 125.47 g  d) 564.48 g

57. 0.8 mole of a mixture of CO and CO2 requires exactly 40 gram of NaOH in solution for complete conversion of all the CO2 into Na2CO3. How many moles more of NaOH would it require for conversion into Na2CO3, if the mixture (0.8 mole) is completely oxidised to CO2?

a) 0.2  b) 0.6  c) 1  d) 1.5

58. Silver oxide (Ag2O) decomposes at temperature 300°C yielding metallic silver and oxygen gas. 1.60 g sample of impure silver oxide yields 0.104 g of oxygen gas. What is the per cent by mass of the silver oxide in the sample?

a) 5.9  b) 47.125  c) 94.25  d) 88.2

59. What is the molar mass of diacidic organic Lewis base, if 12 g of chloroplatinate salt on ignition produced 5 gm residue? Atomic weight of Pt = 195, Cl = 35.5

a) 52  b) 58  c) 88  d) one of these

60. One gram of the silver salt of an organic dibasic acid yields, on strong heating, 0.5934 g of silver. If the weight percentage of carbon in it 8 times the weight percentage of hydrogen and one-half the weight percentage of oxygen, determine the molecular formula of the acid.

a) C3H6O4  b) C4H6O6  c) C2H6O2  d) C5H10O5

61. 0.607 g of a silver salt of tribasic organic acid was quantitatively reduced to 0.37 g of pure Ag. What is the mol. wt. of the acid? [Ag = 108]

a) 207  b) 210  c) 531  d) 324

62. An ideal gaseous mixture of ethane (C2H6) and ethene (C2H4) occupies 28 litre at STP. The mixture reacts completely with 128 g O2 to produce CO2 and H2O. Mole fraction at C2H6 in the mixture is:

a) 0.6  b) 0.4  c) 0.5  d) 0.8

63. 20 mL of a mixture of CO & H2 were mixed with excess of O2 and exploded and cooled. There was a volume contraction of 18 mL. All volume measurements corresponds to room temperature (27°C) and one atmospheric pressure. Determine the volume ratio V1 : V2 of CO & H2 in the original mixture.

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

64. The percentage by volume of C3H8 in a gaseous mixture of C3H8, CH4 & CO is 20. When 100 mL of the mixture is burnt in excess of O2, the volume of CO2 produced is:

a) 90 mL  b) 160 mL  c) 140 mL  d) none of these
65. 40 mL gaseous mixture of CO, CH₄ and Ne was exploded with 10 mL of oxygen. On cooling, the gases occupied 36.5 mL. After treatment with KOH the volume reduced by 9 mL and again on treatment with alkaline pyrogallol, the volume further reduced. Percentage of CH₄ in the original mixture is:
   a) 22.5  b) 77.5  c) 7.5  d) 15

66. A gaseous mixture of propane and butane of volume 3 litre on complete combustion produces 11.0 litre CO₂ under standard conditions of temperature and pressure. The ratio of volume of butane to propane is:
   a) 1 : 2  b) 2 : 1  c) 3 : 2  d) 3 : 1

67. Fluoxymesterone, C₂₀H₂₉FO₃, is an anabolic steroid. A solution is prepared by dissolving 10.0 mg of the steroid in 500 mL of water, 1.0 mL portion of this solution is diluted to a final volume of 1.00 L. What is the resulting molarity?
   a) 1.19×10⁻¹⁰  b) 1.19×10⁻⁷  c) 5.95×10⁻⁸  d) 2.38×10⁻¹¹

68. The lead nitrate, Pb(NO₃)₂, in 25 mL of a 0.15 M solution reacts with all of the aluminium sulphate, Al₂(SO₄)₃, in 20 mL of solution. What is the molar concentration of the Al₂(SO₄)₃?
   a) 6.25×10⁻² M  b) 2.421×10⁻² M  c) 0.1875 M  d) None of these

69. Concentrated HNO₃ is 63 % HNO₃ by mass and has density of 1.4 g/mL. How many millilitres of this solution are required to prepare 250 mL of a 1.20 M HNO₃ solution?
   a) 18.0  b) 21.42  c) 20.0  d) 14.21

70. Wood’s metal contains 50.0 % bismuth, 25.0 % lead, 12.5 % tin and 12.5 % cadmium by weight. What is the mole fraction of tin? (Atomic weights : Bi = 209, Pb = 207, Sn = 119, Cd = 112)
   a) 0.202  b) 0.158  c) 0.176  d) 0.221

71. The density of a 56.0 % by weight aqueous solution of 1-propanol (CH₃CH₂CH₂OH) is 0.8975 g/cm³. What is the mole fraction of the compound?
   a) 0.292  b) 0.227  c) 0.241  d) 0.276

72. Three solutions X,Y,Z of HCl are mixed to produce 100 mL of a 0.1 M solution. The molarities of X,Y & Z are 0.07 M, 0.12 M and 0.15 M respectively. What respective volumes of X,Y & Z should be mixed?
   a) 50 mL, 25 mL, 25 mL  b) 20 mL, 60 mL, 20 mL  c) 40 mL, 30 mL, 30 mL  d) 55 mL, 20 mL, 25 mL

73. What is the molarity of SO₄²⁻ ion in aqueous solution that contain 34.2 ppm of Al₂(SO₄)₃? (Assume complete dissociation and density of solution 1 g/mL)
   a) 3×10⁻⁴ M  b) 2×10⁻⁴ M  c) 10⁻⁴ M  d) None of these

74. 50 mL of 20.8 % (w/V) BaCl₂(aq) and 100 mL of 9.8 % (w/V) H₂SO₄(aq) solutions are mixed. Molarity of Cl⁻ ions in the resulting solution is: (At. wt. of Ba = 137)
   a) 0.333 M  b) 0.666 M  c) 0.1 M  d) 1.33 M

75. The relation between molarity (M) and molality (m) is given by:
   (ρ = density of solution, Mₛ = molecular weight of solute)
   a) m = \frac{1000M}{1000\rho - Mₛ}  b) m = \frac{1000\rho M}{1000\rho - MMₛ}  c) m = \frac{1000MMₛ}{1000\rho - MMₛ}  d) m = \frac{1000M}{1000\rho - MMₛ}

76. Molarity and molality of a solution of an liquid (mol. wt. = 50) in aqueous solution is 9 and 10 respectively. What is the density of solution?
   a) 1 g/cc  b) 0.95 g/cc  c) 1.05 g/cc  d) 1.35 g/cc

77. An aqueous solution of ethanol has density 1.025 g/mL and it is 2M. What is the molality of this solution?
   a) 1.79  b) 2.143  c) 1.951  d) None of these
78. 0.2 mole of HCl and 0.2 mole of barium chloride were dissolved in water to produce a 500 mL solution. The molarity of the Cl\(^-\) ions is:
   a) 0.06 M   b) 0.09 M   c) 1.2 M   d) 0.80 M

79. Calculate the mass of anhydrous HCl in 10 mL of concentrated HCl (density = 1.2 g/mL) solution having 37% HCl by weight.
   a) 4.44 g   b) 4.44 mg   c) 4.44 \times 10^{-3} g   d) 0.444 \mu g

80. 100 mL of 10% NaOH (w/V) is added to 100 mL of 10% HCl (w/V). The resultant solution becomes:
   a) alkaline   b) strongly alkaline   c) acid   d) neutral

81. Calculate the molality of 1 L solution of 80% H\(_2\)SO\(_4\) (w/V), given that the density of the solution is 1.80 g mL\(^{-1}\).
   a) 9.18   b) 8.6   c) 1.02   d) 10.8

82. How many millilitres of 0.1 M H\(_2\)SO\(_4\) must be added to 50 mL of 0.1 M NaOH to give a solution that has a concentration of 0.05 M in H\(_2\)SO\(_4\)?
   a) 400 mL   b) 200 mL   c) 100 mL   d) None of these

83. 1 M HCl and 2 M HCl are mixed in volume ratio of 4:1. What is the final molarity of HCl solution?
   a) 1.5   b) 1   c) 1.2   d) 1.8

84. 342 gm of 20% by mass of Ba(OH)\(_2\) solution (sp. gr. 0.57) is reacted with 1200 mL of 2M HNO\(_3\). If the final density is same as pure water then molarity of the ion in resulting solution by nature of the above solution is identified, is:
   a) 0.25 M   b) 0.5 M   c) 0.888 M   d) None of these

85. 100 mL of H\(_2\)SO\(_4\) solution having molarity 1 M and density 1.5 g/mL is mixed with 400 mL of water. Calculate final molarity of H\(_2\)SO\(_4\) solution, if final density is 1.25 g/mL:
   a) 4.4 M   b) 0.145 M   c) 0.52 M   d) 0.227 M

86. What volume of HCl solution of density 1.2 g/cm\(^3\) and containing 36.5% by weight HCl, must be allowed to react with zinc (Zn) in order to liberate 4.0 g of hydrogen?
   a) 333.33 mL   b) 500 mL   c) 614.66 mL   d) None of these

87. A bottle of an aqueous H\(_2\)O\(_2\) solution is labelled as ‘28 V’ H\(_2\)O\(_2\) and the density of the solution in g/mL is 1.25. Choose the correct option:
   a) Molality of H\(_2\)O\(_2\) solution is 2   b) Molarity of H\(_2\)O\(_2\) solution is 5   c) Molality of H\(_2\)O\(_2\) solution is 2.15   d) None of these

88. The impure 6 g of NaCl dissolved in water and then treated with excess of silver nitrate solution. The weight of precipitate of silver chloride is found to be 14 g. The % purity of NaCl solution would be:
   a) 95%   b) 85%   c) 75%   d) 65%

89. 10 L of hard water required 5.6 g of lime for removing hardness. Hence temporary hardness in ppm of CaCO\(_3\) is:
   a) 1000   b) 2000   c) 100   d) 1

90. A sample of peanut oil weighing 2 g is added to 25 mL of 0.40 M KOH. After saponification is complete, 8.5 mL of 0.28 M H\(_2\)SO\(_4\) is needed to neutralize excess of KOH. The saponification number of peanut oil is:
   a) 146.72   b) 223.44   c) 98.9   d) None of these

91. Al\(_2\)(SO\(_4\))\(_3\) solution of 1 molar concentration is present in 1 litre solution of 2.684 g/cc. How many moles of BaSO\(_4\) would be precipitated on adding BaCl\(_2\) in excess?
   a) 2 moles   b) 3 moles   c) 6 moles   d) 12 moles

92. A certain public water supply contains 0.10 ppb (part per billion) of chloroform (CHCl\(_3\)). How many molecules of CHCl\(_3\) would be obtained in 0.478 mL drop of this water?
   a) \(4 \times 10^{-3} \times N_A\)   b) \(10^{-3} \times N_A\)   c) \(4 \times 10^{-10} \times N_A\)   d) None of these
93. 1 L of pond water contains 20 mg of Ca\(^{2+}\) and 12 mg of Mg\(^{2+}\) ions. What is the volume of a 2N Na\(_2\)CO\(_3\) solution required to soften 5000L of pond water? 
   a) 500 L  
   b) 50 L  
   c) 5 L  
   d) None of these

94. One litre of a sample of hard water contain 4.44 mg CaCl\(_2\) and 1.9 mg of MgCl\(_2\). What is the total hardness in terms of ppm of CaCO\(_3\)? 
   a) 2 ppm  
   b) 3 ppm  
   c) 4 ppm  
   d) 6 ppm

95. Phosphorous has the oxidation state of +1 in: 
   a) Orthophosphoric acid  
   b) Phosphorous acid  
   c) Hypophosphorous  
   d) Metaphosphoric acid

96. The oxidation states of Cl in CaOCl\(_2\) (bleaching powder) is/are: 
   a) +1 only  
   b) −1 only  
   c) +1 & −1  
   d) None of these

97. The oxidation number of sulphur in S\(_8\), S\(_2\)F\(_2\), H\(_2\)S, H\(_2\)SO\(_4\), and respectively are: 
   a) 0, +1, −2 & 6  
   b) +2, 0, +2 & 6  
   c) 0, +1, +2 & 4  
   d) −2, 0, +2 & 6

98. Fe shows an oxidation state of +1 in: 
   a) Fe(CO)\(_5\)  
   b) [Fe(H\(_2\)O)\(_5\)NO]SO\(_4\)  
   c) Fe\(_3\)[Fe(CN)\(_6\)]\(_3\)  
   d) FeCl\(_4\)

99. When SO\(_2\) is passed into an acidified potassium dichromate solution, the oxidation numbers of sulphur and chromium in the final products respectively are: 
   a) +6, +6  
   b) +6, +3  
   c) 0, +3  
   d) +2, +3

100. The oxidation states of S-atoms in Caro’s and Marshall’s acids are: 
   a) +3, +3  
   b) +3, −3  
   c) −3, +5  
   d) −5, +3

101. The oxidation number states of S-atoms in Caro’s and Marshall’s acids are: 
   a) +6, +6  
   b) +6, +4  
   c) +6, −6  
   d) +4, +6

102. In Fe(II) – MnO\(_4\)\(^−\) titration, HNO\(_3\) is not used because: 
   a) it oxidises Mn\(^{2+}\)  
   b) it reduces MnO\(_4\)\(^−\)  
   c) it oxidises Fe\(^{2+}\)  
   d) it reduces Fe\(^{3+}\) formed

103. 0.1 mole \(H_3PO_4\) is completely neutralized by 5.6 g KOH then the true statement is: 
   a) \(x = 3\) and given acid is dibasic  
   b) \(x = 4\) and given acid has no P-H linkage  
   c) \(x = 2\) and given acid does not form acid salt  
   d) all of these

104. When potassium permanganate is titrated against ferrous ammonium sulphate in acidic medium, the equivalent weight of potassium permanganate is: 
   a) \(\frac{3}{molecular\ weight}\)  
   b) \(\frac{5}{molecular\ weight}\)  
   c) \(\frac{2}{molecular\ weight}\)  
   d) \(\frac{10}{molecular\ weight}\)

105. 2 mole of N\(_2\)H\(_4\) loses 16 mole of electron is being converted to a new compound X. Assuming that all of the N appears in the new compound. What is the oxidation state of ‘N’ in X? 
   a) −1  
   b) −2  
   c) +2  
   d) +4

106. Equivalent weight of Fe\(_2\) in the half reaction, Fe\(_2\)\(→\)Fe\(_2\)O\(_3\) + SO\(_2\) is: 
   a) M/10  
   b) M/11  
   c) M/6  
   d) M/1

107. The equivalent weight of HCl in the given reaction is: 
   \(K_2Cr_2O_7 + 14HCl → 2KCl + 2CrCl_3 + 3Cl_2 + H_2O\) 
   a) 16.25  
   b) 36.5  
   c) 73  
   d) 85.1

108. Equivalent weight of H\(_3\)PO\(_4\) when it disproportionate into PH\(_3\) and H\(_3\)PO\(_3\) is: 
   a) M  
   b) M/2  
   c) M/4  
   d) 3M/4
In the following reaction, \( \text{As}_2\text{S}_3 + \text{H}^+ + \text{NO}_3^- \rightarrow \text{NO} + \text{H}_2\text{O} + \text{AsO}_4^{3-} + \text{SO}_4^{2-} \) the equivalent weight of \( \text{As}_2\text{S}_4 \) is related to its molecular weight by:

a) \( \frac{M}{2} \)  

b) \( \frac{M}{4} \)  

c) \( \frac{M}{24} \)  

d) \( \frac{M}{28} \)

\( 6 \times 10^{-3} \) mole \( \text{K}_2\text{Cr}_2\text{O}_7 \) reacts completely with \( 9 \times 10^{-3} \) mole \( \text{X}^{n+} \) to give \( \text{XO}_4^{2-} \) & \( \text{Cr}^{3+} \). The value of \( n \) is:

a) 1  

c) 3  

d) None of these

When \( \text{BrO}_3^- \) ion reacts with \( \text{Br}^- \) in acid medium, \( \text{Br}_2 \) is liberated. The equivalent weight of \( \text{Br}_2 \) in this reaction is:

a) \( \frac{5M}{8} \)  

b) \( \frac{5M}{3} \)  

c) \( \frac{3M}{5} \)  

d) \( \frac{4M}{6} \)

Decreasing order (first having highest and then others following it) of mass of pure \( \text{NaOH} \) in each of the aqueous solution:

i) 50 g of 40 % (w/W) \( \text{NaOH} \)  

ii) 50 mL of 50 % (w/V) \( \text{NaOH} \) [\( \text{d}_{\text{soln}} = 1.2 \text{ g/mL} \)]  

iii) 50 g of 15 M \( \text{NaOH} \) [\( \text{d}_{\text{soln}} = 1 \text{ g/mL} \)]

a) i, ii, iii  

b) ii, iii, i  

c) ii, iii, i  

d) ii, i, iii

If \( m_A \) gram of a metal \( A \) displaces \( m_B \) gram of another metal \( B \) from its salt solution and if the equivalent weights are \( E_A \) & \( E_B \) respectively then equivalent weight of \( A \) can be expressed as:

a) \( E_A = \frac{m_A \times E_B}{m_B} \)  

b) \( E_A = \frac{m_B \times E_A}{E_B} \)  

c) \( E_A = \frac{m_B \times E_B}{m_A} \)  

d) \( E_A = \sqrt{\frac{m_A \times E_B}{m_B}} \)

For the redox reaction, \( \text{MnO}_4^- + \text{C}_2\text{O}_4^{2-} + \text{H}^+ \rightarrow \text{Mn}^{2+} + \text{CO}_2 + \text{H}_2\text{O} \) the correct coefficients of the reactants for the balanced reaction are respectively \( \text{MnO}_4^-, \text{C}_2\text{O}_4^{2-}, \text{H}^+ \):

a) 2,5,16  

b) 16,3,12  

c) 15,16,12  

d) 2,16,5

In a chemical reaction, \( \text{K}_2\text{Cr}_2\text{O}_7 + x \text{H}_2\text{SO}_4 + y\text{SO}_2 \rightarrow \text{K}_2\text{SO}_4 + \text{Cr}_2(\text{SO}_4)_3 + z\text{H}_2\text{O} \); the value of \( x, y \) & \( z \) respectively are:

a) \( x = 1, y = 3, z = 1 \)  

b) \( x = 4, y = 1, z = 4 \)  

c) \( x = 3, y = 2, z = 1 \)  

d) \( x = 2, y = 2, z = 1 \)

Hydrazine reacts with \( \text{KIO}_3 \) in presence of \( \text{HCl} \) as \( \text{N}_2\text{H}_4 + \text{IO}_3^- + 2\text{H}^+ + \text{Cl}^- \rightarrow \text{ICI} + \text{N}_2 + 3\text{H}_2\text{O} \). The equivalent masses of \( \text{N}_2\text{H}_4 \) & \( \text{KIO}_3 \) respectively are:

a) 8 & 53.5  

b) 16 & 53.5  

c) 8 & 35.6  

d) 8 & 87

What will be the normality of a solution obtained by mixing 0.45 N and 0.60 N \( \text{NaOH} \) in the ratio 2 : 1 by volume?

a) 0.4 N  

b) 0.5 N  

c) 1.05 N  

d) 0.15 N

A 3.4 g sample of \( \text{H}_2\text{O}_2 \) solution containing \( x \%) \( \text{H}_2\text{O}_2 \) by mass requires \( x mL \) of a \( \text{KMnO}_4 \) solution for complete oxidation under acidic condition. The molarity of \( \text{KMnO}_4 \) solution is:

a) \( 1 \)  

b) 0.5  

c) 0.4  

d) 0.2

What volume of \( \text{O}_2 \) \( \text{gig} \) measured at STP will be formed by action of 100 mL of 0.5 N \( \text{KMnO}_4 \) on hydrogen peroxide in an acid solution? The skeleton equation for the reaction is \( \text{KMnO}_4 + \text{H}_2\text{SO}_4 + \text{H}_2\text{O}_2 \rightarrow \text{K}_2\text{SO}_4 + \text{MnSO}_4 + \text{O}_2 + \text{H}_2\text{O} \)

a) 0.12 litre  

b) 0.028 litre  

c) 0.56 litre  

d) 1.12 litre

A sample of 1.0 g of solid \( \text{Fe}_2\text{O}_3 \) of 80 % purity is dissolved in a moderately concentrated \( \text{HCl} \) solution which is reduced by zinc dust. The resulting solution required 16.7 mL of a 0.1 M solution of the oxidant. Calculate the number of electrons taken up by the oxidant.

a) 2  

b) 4  

c) 6  

d) 5
121. KMnO₄ reacts with oxalic acid according to the equation:

\[ 2\text{MnO}_4^- + 5\text{C}_2\text{O}_4^{2-} + 16\ H^+ \rightarrow 2\text{Mn}^{2+} + 10\text{CO}_2 + 8\text{H}_2\text{O} \]

Here, 20 mL of 0.1 M KMnO₄ is equivalent to:

a) 120 mL of 0.25 M H₂C₂O₄  
b) 150 mL of 0.10 M H₂C₂O₄  
c) 25 mL of 0.20 M H₂C₂O₄  
d) 50 mL of 0.20 M H₂C₂O₄

122. Ratio of moles of Fe(II) oxidised by equal volumes of equimolar KMnO₄ & K₂Cr₂O₇ solution in acidic medium will be:

a) 5 : 3  
b) 1 : 1  
c) 1 : 2  
d) 5 : 6

123. The weight of a mixture containing HCl and H₂SO₄ is 0.1 g. On treatment with an excess of an AgNO₃ solution, reacted with this acid mixture gives 0.1435 g of AgCl. Weight % of the H₂SO₄ is mixture is:

a) 36.5  
b) 63.5  
c) 50  
d) None of these

124. A solution of Na₂S₂O₃ is standardized iodometrically against 0.167 g of KBrO₃. This process requires 50 mL of the Na₂S₂O₃ solution. What is the normality of the Na₂S₂O₃?

\[ \text{mol wt KBrO}_3 = 167 \]

a) 0.2 N  
b) 0.12 N  
c) 0.72 N  
d) 0.02 N

125. 0.80 g of impure (NH₄)₂SO₄ was boiled with 100 mL of a 0.2 N NaOH solution till all the NH₃(g) evolved. The remaining solution was diluted to 250 mL. 25 mL of this solution was neutralized using 5 mL of a 0.2 N H₂SO₄ solution. The percentage purity of the (NH₄)₂SO₄ sample is:

a) 82.5  
b) 72.5  
c) 62.5  
d) 17.5

126. The NH₃ evolved due to complete conversion of N from 1.12 g sample of protein was absorbed in 45 mL of 0.4 N HNO₃. The excess acid required 20 mL of 0.1 N NaOH. The % N in the sample is:

a) 8  
b) 16  
c) 20  
d) 25

127. Find out % of oxalate ion in a given sample of an alkali metal oxalate salt, 0.30 g of it is dissolved in 100 mL water required 90 mL of centimolar KMnO₄ solution in acidic medium.

a) 66 %  
b) 55 %  
c) 44 %  
d) 6.6 %

128. 320 mg of a sample of magnesium having a coating of its oxide required 20 mL of 0.1 M hydrochloric acid for the complete neutralization of the latter. The composition of the sample is:

a) 87.5 % Mg and 12.5 % MgO  
b) 12.5 % Mg and 87.5 % MgO  
c) 80 % Mg and 20 % MgO  
d) 20 % Mg and 80 % MgO

129. The concentration of bivalent lead ions in a sample of polluted water that also contains nitrate ions is determined by adding solid sodium sulphate (M = 142) to exactly 500 mL water. Calculate the molarity of lead ions if 0.355 g of sodium sulphate was needed for complete precipitation of lead ions as sulphate.

a) 1.25 \times 10^{-3} \text{M}  
b) 2.5 \times 10^{-3} \text{M}  
c) 5 \times 10^{-3} \text{M}  
d) None of these

130. What volume of HNO₃ (sp. gravity 1.05 g mL⁻¹ containing 12.6 (w/) of HNO₃) that reduce into NO is required to oxidize iron 1 g FeSO₄·7H₂O in acid medium is?

a) 70 mL  
b) 0.57 mL  
c) 80 mL  
d) 0.65 mL

131. The total volume of 0.1 M KMnO₄ solution that are needed to oxidize 100 mg each of ferrous oxalate and ferrous sulphate in a mixture in acidic medium is:

a) 1.096 mL  
b) 1.32 mL  
c) 5.48 mL  
d) none of these

132. When 2.5 g of a sample of Mohr’s salt reacts completely with 50 mL of \( \frac{N}{10} \) KMnO₄ solution. The % purity of the sample of Mohr’s salt is:

a) 78.4  
b) 70  
c) 37  
d) 40

133. 4 mole of a mixture of Mohr’s salt and Fe₂(SO₄)₃ requires 500 mL of 1 M K₂Cr₂O₇ for complete oxidation in acidic medium. The mole % of the Mohr’s salt in the mixture is:

a) 25  
b) 50  
c) 60  
d) 75
134. The equivalent weight of a metal is double than of oxygen. How many times is the weight of its oxide greater than the weight of the metal?
   a) 1.5    b) 2    c) 3    d) 4

135. A metal oxide has the formula \( \text{X}_2\text{O}_3 \). It can be reduced by hydrogen to give free metal and water. 0.1596 g of metal oxide requires 6 mg of hydrogen for complete reduction. The atomic weight of the metal (in amu) is:
   a) 15.58    b) 15.8    c) 5.58    d) 55.8

136. In the mixture of \( (\text{NaHCO}_3 + \text{Na}_2\text{CO}_3) \), volume of HCl required is \( x \) mL with phenolphthalein indicator and \( y \) mL with methyl orange indicator in the same titration. Hence, volume of HCl for complete reaction of \( \text{Na}_2\text{CO}_3 \) is:
   a) \( 2x \)    b) \( y \)    c) \( x/2 \)    d) \( y - x \)

137. 0.1 g of a solution containing \( \text{Na}_2\text{CO}_3 \) & \( \text{NaHCO}_3 \) requires 10 mL of 0.1 N HCl for neutralization using phenolphthalein as an indicator. wt. % of \( \text{Na}_2\text{CO}_3 \) is:
   a) 25    b) 32    c) 50    d) None of these

138. A mixture of \( \text{NaOH} \) and \( \text{Na}_2\text{CO}_3 \) required 25 mL of 0.1 M HCl using phenolphthalein as the indicator. However, the same amount of the mixture required 30 mL of 0.1 M HCl when methyl orange was used as the indicator. The molar ratio of \( \text{NaOH} \) and \( \text{Na}_2\text{CO}_3 \) in the mixture was:
   a) 2 : 1    b) 1 : 2    c) 4 : 1    d) 1 : 4

139. 100 mL solution of \( \text{NaOH} \) and \( \text{Na}_2\text{CO}_3 \) was first titrated with \( \text{N}/10 \) HCl in presence of HPh, 17.5 mL is required to end point. After this MeOH was added and 2.5 mL of same HCl is required. The amount of \( \text{NaOH} \) in mixture is:
   a) 0.06 g per 100 mL    b) 0.06 g per 200 mL    c) 0.05 g per 100 mL    d) 0.012 g per 200 mL

140. 1 gram of a sample of \( \text{CaCO}_3 \) was strongly heated and the \( \text{CO}_2 \) liberated was absorbed in 100 mL of 0.5 M NaOH. Assuming 90 % purity for the sample. How much mL of 0.5 M HCl would be required to react with the solution of the alkali and \( \text{Na}_2\text{CO}_3 \) to reach the phenolphthalein end point?
   a) 73 mL    b) 41 mL    c) 82 mL    d) 100 mL

141. A sample of pure sodium carbonate 0.318 g is dissolved in water and titrated with HCl solution. A volume of 60 mL is required to reach the methyl orange end point. Calculate the molarity of the acid.
   a) 0.1 M    b) 0.2 M    c) 0.4 M    d) None of these

142. Calculate the mass of anhydrous oxalic acid, which can be oxidised to \( \text{CO}_2 \) by 100 mL of an \( \text{MnO}_4^- \) solution, 10 mL of which is capable of oxidizing 50 mL of 1N \( \Gamma^- \) to \( \text{I}_2 \).
   a) 45 g    b) 22.5 g    c) 30 g    d) 12.25 g

143. A mixture of \( \text{NaHC}_2\text{O}_4 \) & \( \text{KHC}_2\text{O}_4\cdot\text{H}_2\text{C}_2\text{O}_4 \) required equal volumes of 0.2 N \( \text{KMnO}_4 \) and 0.12 N \( \text{NaOH} \) separately. What is the molar ratio of \( \text{NaHC}_2\text{O}_4 \) & \( \text{KMnO}_4\cdot\text{H}_2\text{C}_2\text{O}_4 \) in the mixture.
   a) 6 : 1    b) 1 : 6    c) 1 : 3    d) 3 : 1

144. If \( a \) g is the mass of \( \text{NaHC}_2\text{O}_4 \) required to neutralize 100 mL of 0.2 M \( \text{NaOH} \) and \( b \) g that required to reduce 100 mL of 0.02 M \( \text{KMnO}_4 \) in acidic medium, then:
   a) \( a = b \)    b) \( 2a = b \)    c) \( a = 2b \)    d) None of these

145. 2 mole, equimolar mixture of \( \text{Na}_2\text{C}_2\text{O}_4 \) & \( \text{H}_2\text{C}_2\text{O}_4 \) required \( V_1 \) L of 0.1 M \( \text{KMnO}_4 \) in acidic medium for complete oxidation. The same amount of the mixture required \( V_2 \) L of 0.1 M \( \text{NaOH} \) for neutralization. The ratio of \( V_1 \) to \( V_2 \) is:
   a) 1 : 2    b) 2 : 1    c) 4 : 5    d) 5 : 4

146. A mixture containing 0.05 mole of \( \text{K}_2\text{Cr}_2\text{O}_7 \) and 0.02 mole of \( \text{KMnO}_4 \) was treated with excess of \( \text{KI} \) in acidic medium. The liberated iodine required 1.0 L of \( \text{Na}_2\text{S}_2\text{O}_3 \) solution for titration. Concentration of \( \text{Na}_2\text{S}_2\text{O}_3 \) solution was:
   a) 0.40 mol L\(^{-1}\)    b) 0.20 mol L\(^{-1}\)    c) 0.25 mol L\(^{-1}\)    d) 0.30 mol L\(^{-1}\)
147. 25 mL of 2N HCl, 50 mL of 4N HNO₃ and x mL of 2 M H₂SO₄ are mixed together and the total volume is made up to 1L after dilution. 50 mL of this acid mixture completely reacted with 25 mL of a 1N Na₂CO₃ solution. The value of x is:

a) 250 mL  

b) 62.5 mL  

c) 100 mL  

d) None of these

148. In an iodometric estimation, the following reactions occur

\[
2\text{Cu}^{2+} + 4\text{I}^\text{−} \rightarrow \text{Cu}_2\text{I}_2 + \text{I}_2; \quad \text{I}_2 + 2\text{Na}_2\text{S}_2\text{O}_3 \rightarrow 2\text{NaI} + \text{Na}_2\text{S}_4\text{O}_6
\]

0.12 mole of CuSO₄ was added to excess of KI solution and the liberated iodine required 120 mL of hypo. The molarity of hypo solution was:

a) 2  

b) 0.20  

c) 0.1  

d) 1.0

149. 1 g mixture of equal number of mole of Li₂CO₃ and other metal carbonate required 10.99 mL of 0.5 N HCl for complete neutralization reaction. What is the approximate atomic weight of the other metal?

a) 25  

b) 23  

c) 24  

d) 39

150. 32 g of a sample of FeSO₄.7H₂O were dissolved in dilute sulphuric acid and water and its volume was made up to 1 litre. 25 mL of this solution required 20 mL of 0.02 M KMnO₄ solution for complete oxidation. Calculate the weight % of FeSO₄.7H₂O in the sample.

a) 34.75  

b) 69.5  

c) 89.5  

d) None of these

Level – 2

1. A mixture of NH₄NO₃ and (NH₄)₂HPO₄ contain 30.40 % mass percent of nitrogen. What is the mass ratio of the two components in the mixture?

a) 2 : 1  

b) 1 : 2  

c) 3 : 4  

d) 4 : 1

2. What value of 75 % alcohol by weight (d = 0.80 g/cm³) must be used to prepare 150 cm³ of 30 % alcohol by weight (d = 0.90 g/cm³) ?

a) 67.5 mL  

b) 56.25 mL  

c) 44.44 mL  

d) None of these

3. Calculate the number of millilitres of NH₃(aq) solution (d = 0.986 g/mL) contain 2.5 % by weight NH₃ which will be required to precipitate iron as Fe(OH)₃ in a 0.8 g sample that contains 50 % Fe₂O₃.

a) 0.344 mL  

b) 3.44 mL  

c) 17.24 mL  

d) 10.34 mL

4. In the preparation of iron from haematite (Fe₂O₃) by the reaction with carbon Fe₂O₃ + C \rightarrow Fe + CO₂. How much 80 % pure iron could be produced from 120 kg of 90 % pure Fe₂O₃ ?

a) 94.5 kg  

b) 60.48 kg  

c) 116.66 kg  

d) 120 kg

5. A mineral consists of an equimolar mixture of the carbonates of two bivalent metals. One metal is present to the extent of 12.5 % by weight. 2.8 g of the mineral on heating lost 1.32 g of CO₂. What is the % by weight of the other metal?

a) 87.5  

b) 35.71  

c) 65.11  

d) 23.21

6. 6.2 g of a sample containing Na₃CO₃, NaHCO₃ and non-volatile inert impurity on gentle heating loses 5 % of its weight due to reaction 2NaHCO₃ \rightarrow Na₂CO₃ + H₂O + CO₂. Residue is dissolved in water an formed 100 mL solution and its 10 mL portion requires 7.5 mL of 0.2 M aqueous solution of BaCl₂ for complete precipitation of carbonates. Determine weight (in gram) of Na₂CO₃ in the original sample.

a) 1.59  

b) 1.06  

c) 0.53  

d) None of these

7. Nitric acid can be produced NH₃ in three steps process

I) 4NH₃(g) + 5O₂(g) \rightarrow 4NO(g) + 6H₂O(g)  

II) 2NO(g) + O₂(g) \rightarrow 2NO₂(g)  

III) 3NO₂(g) + H₂O(l) \rightarrow 2HNO₃(aq) + NO(g)  

% yield of I, II, & III are respectively 50 %, 60 % & 80 % respectively the what volume of NH₃(g) at STP required to produced 1575 kg of HNO₃.

a) 156.25  

b) 350 L  

c) 3500 L  

d) None of these
8. 1 M NaOH solution was slowly added into 1000 mL of 183.75 g impure H₂SO₄ solution and the following plot was obtained. The percentage purity of H₂SO₄ sample and slope of the curve respectively are:
   a) 75%, -1/3  
   b) 80%, -1/2  
   c) 80%, -1  
   d) None of these

9. MnO₂ on ignition converts into Mn₃O₄. A sample of pyrolusite having 75 % MnO₂, 20 % inert impurities and rest water is ignited in air to constant weight. What is the percentage of Mn in the ignited sample?
   a) 24.6 %  
   b) 37 %  
   c) 55.24 %  
   d) 74.05 %

10. A 1.0 g sample of a pure organic compound containing chlorine is fused with Na₂O₂ to convert chlorine to NaCl. The sample is then dissolved in water, and the chloride precipitated with AgNO₃, giving 1.96 of AgCl. If the molecular weight of organic compound is 147, how many chlorine atoms does each molecule contain?
   a) 1  
   b) 2  
   c) 3  
   d) 4

11. A 0.60 g sample consisting of only CaC₂O₄ & MgC₂O₄ is heated at 500°C, converting the two salts of CaCO₃ and MgCO₃. The sample then weighs 0.465 g. If the sample had been heated to 900°C, where the products are CaO & MgO, what would the mixture of oxides have weighed?
   a) 0.12 g  
   b) 0.21 g  
   c) 0.252 g  
   d) 0.3 g

12. A metal M forms the sulphate M₂(SO₄)₃. A 0.596 gram sample of the sulphate reacts with excess BaCl₂ to give 1.220 g BaSO₄. What is the atomic weight of M?
   (Atomic weights : S = 32, Ba = 137.3)
   a) 26.9  
   b) 69.7  
   c) 55.8  
   d) 23

13. Urea (H₂NCONH₂) is manufactured by passing CO₂(g) through ammonia solution followed by crystallization. CO₂ for the above reaction is prepared by combustion of hydrocarbon. If combustion of 236 kg of a saturated hydrocarbon (C₇H₁₄ + 2) produces as much CO₂ as required for production of 999.6 kg urea then molecular formula of hydrocarbon is:
   a) C₁₀H₁₂  
   b) C₁₂H₂₆  
   c) C₁₃H₂₈  
   d) C₈H₁₈

14. 11.6 g of an organic compound having formula CₙH₂₄ + 2 is burnt in excess of O₂ initially taken in a 22.41 litre steel vessel. Before reaction the gaseous mixture was at 273 K with pressure reading 2 atm. After complete combustion and loss of considerable amount of heat, the mixture of product and excess of O₂ has a temperature of 546 K and 4.6 atm pressure. The formula of organic compound is:
   a) C₂H₆  
   b) C₃H₈  
   c) C₅H₁₂  
   d) C₄H₁₀

15. H₂O₂ → I₂ + 2KOH

150 mL of H₂O₂ sample was divided into two parts. First part was treated with KI and formed KOH required 200 mL of M/2 H₂SO₄ for neutralization. Other part was treated with KMnO₄ yielding 6.74 litre of O₂ at STP. Using % yield indicated find volume strength of H₂O₂ sample used.
   a) 5.04  
   b) 10.08  
   c) 3.96  
   d) 33.6
16. RH$_2$ (ion exchange resin) can replace Ca$^{2+}$ ions in hard water as RH$_2$ + Ca$^{2+}$ $\rightarrow$ RCa + 2H$. If 1 L of hard water after passing through RH$_2$ has pH = 3 then hardness in parts per million of Ca$^{2+}$ is:
   a) 20  b) 10  c) 40  d) 100

17. 100 cm$^3$ of a solution of an acid (Molar mass = 98) containing 29.4 g of the acid per litre were completely neutralized by 90.0 cm$^3$ of aq. NaOH containing 20 g of NaOH per 500 cm$^3$. The basicity of the acid is:
   a) 3  b) 2  c) 1  d) data insufficient

18. 20 mL of 0.1 M solution of compound Na$_2$CO$_3$,NaHCO$_3$.2H$_2$O is titrated against 0.05 M HCl, x mL of HCl is used when phenolphthalein is used as an indicator and y mL of HCl is used when methyl orange is the indicator in two separate titrations. Hence (y – x) is:
   a) 40 mL  b) 80 mL  c) 120 mL  d) none of these

19. SO$_2$Cl$_2$ (sulphuryl chloride) reacts with water to given a mixture of H$_2$SO$_4$ and HCl. What volume of 0.2 M Ba(OH)$_2$ is needed to completely neutralize 25 mL of 0.2 M SO$_2$Cl$_2$ solution:
   a) 25 mL  b) 50 mL  c) 100 mL  d) 200 mL

20. A sample containing HAsO$_2$ (mol.wt. = 108) and weighing 3.78 g is dissolved and diluted to 250 mL in a volumetric flask. A 50 mL sample (aliquot) is withdrawn with a pipet and titrated with 35 mL of 0.05 M solution of I$_2$. Calculate the percentage HAsO$_2$ in the sample.
   a) 25 %  b) 20 %  c) 10 %  d) none of these

21. A mixture of FeO & Fe$_2$O$_3$ is completely reacted with 100 mL of 0.25 M acidified KMnO$_4$ solution. The resultant solution was then titrated with Zn dust which converted Fe$^{3+}$ of the solution to Fe$^{2+}$. The Fe$^{2+}$ required 1000 mL of 0.10 M K$_2$Cr$_2$O$_7$ solution. Find out the weight % Fe$_2$O$_3$ in the mixture.
   a) 80.85  b) 19.15  c) 50  d) 89.41

22. To a 10 mL, 1M aqueous solution of Br$_2$, excess of NaOH is added so that all Br$_2$ is disproportional to Br$^-$ and BrO$_3^-$. The resulting solution is free from Br$^-$, by extraction and excess of OH$^-$ neutralized by acidifying the solution. The resulting solution is sufficient to react with 2g of impure CaC$_2$O$_4$ (M = 128 g/mol) sample. The % purity of oxalate sample is:
   a) 85.3 %  b) 12.5 %  c) 90 %  d) 64 %

23. 0.10 g of a sample containing CuCO$_3$ and some inert impurity was dissolved in dilute sulphuric acid and volume made up to 50 mL. This solution was added into 50 mL of 0.04 M KI solution where copper precipitates as CuI & I$^-$ is oxidized into I$_3^-$. A 10 mL portion of this solution is taken for analysis, filtered and made up free I$_3^-$ and then treated with excess of acidic permanganate solution. Liberated iodine required 20 mL of 2.5 mM sodium thiosulphate solution to reach the end point. Determine weight percentage of CuCO$_3$ in the original sample.
   a) 7.41  b) 74.1  c) 61.75  d) none of these

24. 1 mole of equimolar mixture of ferric oxalate and ferrous oxalate will require x mole of KMnO$_4$ in acidic medium for complete oxidation, x is:
   a) 0.5 mole  b) 0.9 mole  c) 1.2 mole  d) 4.5 mole

25. 5 g sample contain only Na$_2$CO$_3$ and Na$_3$SO$_4$. This sample is dissolved and the volume made up to 250 mL, 25 mL of this solution neutralizes 20 mL of 0.1 M H$_2$SO$_4$.
   Calculate the % of Na$_3$SO$_4$ in the sample:
   a) 42.4  b) 57.6  c) 36.2  d) none of these

26. An impure sample of sodium oxalate (Na$_2$C$_2$O$_4$) weighing 0.20 g is dissolved in aqueous solution of H$_2$SO$_4$ and solution is titrated at 70°C, requiring 45 mL of 0.02 M KMnO$_4$ solution. The end point is overrum, and back titration in carried out with 10 mL of 0.1 M oxalic acid solution. Find the % purity of Na$_2$C$_2$O$_4$ in sample:
   a) 75  b) 83.75  c) 90.25  d) none of these
27. 0.5 g mixture of $K_2Cr_2O_7$ & KMnO$_4$ was treated with excess of KI in acidic medium. Iodine liberated required 150 cm$^3$ of 0.10 N solution of thiosulphate solution for titration. Find the percentage of $K_2Cr_2O_7$ in the mixture:
   a) 14.64   b) 34.2   c) 65.69   d) 50

28. A 150 mL of solution of I$_2$ is divided into two unequal parts. I part reacts with hypo solution in acidic medium. 15 mL of 0.4 M hypo was consumed. Il part was added with 100 mL of 0.3 M NaOH solution. Residual base required 10 mL of 0.3 M H$_2$SO$_4$ solution for complete neutralization. What was the initial concentration of I$_2$?
   a) 0.08 M   b) 0.1 M   c) 0.2 M   d) None of these

29. A mixture of H$_2$SO$_4$ & H$_2$C$_2$O$_4$ (oxalic acid) and some inert impurity weighing 3.185 g was dissolved in water and the solution made up to 1 litre, 10 mL of this solution required 3 mL of 0.1 N Na$_2$SO$_4$ for complete neutralization. In another experiment 100 mL of the same solution in hot condition required 4 mL of 0.02 M KMnO$_4$ solution for complete reaction. The wt. % of H$_2$SO$_4$ in the mixture was:
   a) 40   b) 50   c) 60   d) 80

30. 0.80 g of sample of impure potassium dichromate was dissolved in water and made up to 500 mL solution. 25 mL of this solution treated with excess of KI in acidic medium and I$_2$ liberated required 24 mL of a sodium thiosulphate solution. 30 mL of this sodium thiosulphate solution required 15 mL of N/20 solution of pure potassium dichromate. What was the percentage of $K_2Cr_2O_7$ in given sample?
   a) 73.5 %   b) 75.3 %   c) 36.75 %   d) none of these

Level – 3

Passage:-1

Oleum is considered as a solution of SO$_3$ in H$_2$SO$_4$, which is obtained by passing SO$_3$ in solution of H$_2$SO$_4$. When 100 g sample of oleum is diluted with desired weight of H$_2$O then the total mass of H$_2$SO$_4$ obtained after dilution is known as % labeling in oleum.

For example, a oleum bottle labeled as ‘109 % H$_2$SO$_4$’ means the 109 g total mass of pure H$_2$SO$_4$ will be formed when 100 g of oleum is diluted by 9 g of H$_2$O which combines with all the free SO$_3$ present in oleum to form
H$_2$SO$_4$ as SO$_3$ + H$_2$O $\rightarrow$ H$_2$SO$_4$.

1. What is the % of free SO$_3$ in an oleum that is labeled as ‘104.5 % H$_2$SO$_4$’?
   a) 10   b) 20   c) 40   d) None of these

2. 9.0 g water is added into oleum sample labeled as “112 % “ H$_2$SO$_4$ then the amount of free SO$_3$ remaining in the solution is:
   a) 14.93 L at STP   b) 7.46 L at STP   c) 3.73 L at STP   d) 112 L at STP

3. If excess water is added into a bottle sample labeled as “112 % H$_2$SO$_4”, and is reacted with 5.3 g Na$_2$CO$_3$, then find the volume of CO$_2$ evolved at 1 atm pressure and 300 K temperature after the completion of the reaction:
   a) 2.46 L   b) 24.6 L   c) 1.23 L   d) 12.3 L

4. 1g of oleum sample is diluted with water. The solution required 54 mL of 0.4 N NaOH for complete neutralization. The % of free SO$_3$ in the sample is:
   a) 74   b) 26   c) 20   d) None of these

Passage:-2

The strength of H$_2$O$_2$ is expressed in several ways like molarity, normality, % (w/V), volume strength, etc. The strength of “10 V” means 1 volume of H$_2$O$_2$ on decomposition gives 10 volumes of oxygen at STP or 1 litre of H$_2$O$_2$ gives 10 litre of O$_2$ at STP. The decomposition of H$_2$O$_2$ is shown as under: H$_2$O$_2$$_{(aq)}$ $\rightarrow$ H$_2$O$_{(l)}$ + $\frac{1}{2}$ O$_2$$_{(g)}$.

H$_2$O$_2$ can acts as oxidising as well as reducing agent, as oxidizing agent H$_2$O$_2$ converted into H$_2$O and as reducing agent H$_2$O$_2$ converted into O$_2$, both cases it’s n-factor is 2. ∴ Normality of H$_2$O$_2$ solution = 2 × Molarity of H$_2$O$_2$ solution.
1. What is the molarity of “11.2 V” of H₂O₂?
   a) 1 M    b) 2 M    c) 5.6 M    d) 11.2 M
2. What is the percentage strength (% w/V) of “112.2 V” H₂O₂?
   a) 1.7    b) 3.4    c) 34    d) none of these
3. 20 mL of H₂O₂ solution is reacted with 80 mL of 0.05 M KMnO₄ in acidic medium then what is the volume strength of H₂O₂?
   a) 2.8    b) 5.6    c) 11.2    d) none of these
4. 40 g Ba(MnO₄)₂ (mol. wt. = 375) sample containing some inert impurities in acidic medium is completely reacted with 25 mL of “33.6 V” of H₂O₂. What is the percentage purity of the sample?
   a) 28.12 %    b) 70.31 %    c) 85 %    d) none of these

Passage- 3

A water is said to be a soft water if it produces sufficient foam with the soap and water that does not produce foam with soap is known as hard water. Hardness has been classified into two types (i) Temporary hardness (ii) Permanent hardness. Temporary hardness is due to presence of calcium and magnesium bicarbonate. It is simply removed by boiling as

\[ \text{Ca(HCO}_3\text{)} \rightarrow \text{CaCO}_3 \downarrow + \text{CO}_2 \uparrow + \text{H}_2\text{O} \]

\[ \text{Mg(HCO}_3\text{)} \rightarrow \text{MgCO}_3 \downarrow + \text{CO}_2 \uparrow + \text{H}_2\text{O} \]

Temporary hardness can also be removed by addition of slaked lime, Ca(OH)₂

\[ \text{Ca(HCO}_3\text{)} + \text{Ca(OH)}_2 \rightarrow 2\text{CaCO}_3 \downarrow + 2\text{H}_2\text{O} \]

Permanent hardness is due to presence of sulphate and chlorides of Ca, Mg, etc. It is removed by washing soda as

\[ \text{CaSO}_4 + \text{Na}_2\text{CO}_3 \rightarrow \text{CaCO}_3 \downarrow + 2\text{NaCl} \]

\[ \text{CaSO}_4 + \text{Na}_2\text{CO}_3 \rightarrow \text{CaCO}_3 \downarrow + \text{Na}_2\text{SO}_4 \]

Permanent hardness also removed by ion exchange resin process as

\[ 2\text{RH} + \text{Ca}^{2+} \rightarrow \text{R}_2\text{Ca} + 2\text{H}^+ \]

\[ 2\text{ROH} + \text{SO}_4^{2-} \rightarrow \text{R}_2\text{SO}_4 + 2\text{OH}^- \]

The degree of hardness of water is measured in terms of ppm of CaCO₃. 100 ppm means 100 g of CaCO₃ is present in 10⁶ g of H₂O. If any water contain 120 ppm of MgSO₄ its hardness in terms of CaCO₃ = 100 ppm.

1. One litre of a sample of hard water (d = 1g/mL) contains 136 mg of CaSO₄ and 190 mg of MgCl₂. What is the total hardness of water in terms of CaCO₃?
   a) 100 ppm    b) 200 ppm    c) 300 ppm    d) none of these
2. What is the weight of Ca(OH)₂ required for 10 litre of water remove temporary hardness of 100 ppm due to Ca(HCO₃)₂?
   a) 1.62 g    b) 0.74 g    c) 7.4 g    d) none of these
3. A 200 g sample of hard water is passed through the column of cation exchange resin, in which H⁺ is exchanged by Ca²⁺. The outlet water of column required 50 mL of 0.1 M NaOH for complete neutralization. What is the hardness of Ca²⁺ ion in ppm?
   a) 250 ppm    b) 500 ppm    c) 750 ppm    d) 1000 ppm

Passage- 4

Equivalent weight = \( \frac{\text{Molecular weight}}{\text{Atomic weight}} \)
\( n - \text{factor} \)

n-factor is very important in redox as well as non-redox reactions. With the help of n-factor we can predicts the molar ratio of the reactant species taking part in reactions. The reciprocal of n-factor’s ratio of the reactants is the molar ratio of the reactants.

In general n-factor of acid/base is number of moles of H⁺/OH⁻ furnished per mole of acid/base. n-factor of a reactant is no. of moles of electrons lost or gained per mole of reactant.
Example 1:
1. In acidic medium: KMnO₄ (n = 5) → Mn²⁺
2. In basic medium: KMnO₄ (n = 3) → Mn²⁺
3. In neutral medium: KMnO₄ (n = 1) → Mn⁶⁺

Example 2: FeC₂O₄ → Fe³⁺ + 2CO₂
Total no. of moles of e⁻ lost by 1 mole of FeC₂O₄
= 1 + 1×2 ⇒ 3
∴ n-factor of FeC₂O₄ = 3

1. n-factor of Ba(MnO₄)₂ in acidic medium is:
   a) 2       b) 6       c) 10       d) none of these

2. For the reaction, H₃PO₂ + NaOH → NaH₂PO₂ + H₂O. What is the equivalent weight of H₃PO₂? (mol.wt.is M)
   a) M       b) M/2      c) M/3      d) none of these

3. For the reaction, Fe₀.₉₅ O (molar mass : M) → Fe₂O₃. What is the eq. wt of Fe₀.₉₅ O?
   a) M       b) M/0.85   c) M/0.95   d) none of these

4. In the reaction, xVO + yFe₂O₃ → FeO + V₂O₅. What is the value of x & y respectively?
   a) 1,1      b) 2,3      c) 3,2      d) none of these

One or More Answers IS/ARE CORRECT

1. 1 g atom of nitrogen represents:
   a) 6.02 × 10²³ N₂ molecules       b) 22.4 litre of N₂ at N.T.P.
   c) 11.2 litre of N₂ at N.T.P       d) 14 g of nitrogen

2. 1 g molecule of V₂O₅ contains:
   a) 5 mole of oxygen atom           b) 2 mole of V atom
   c) 1 mole of oxygen atom           d) 2.5 mole of oxygen atom

3. Select dimensionless quantity (ies):
   a) vapour density                  b) molality     c) specific gravity    d) mass fraction

4. Which of the following concentration terms is affected by a change in temperature?
   a) molarity                        b) molality     c) normality            d) specific gravity

5. Which of the following statements regarding the compound AₓBᵧ is/are correct?
   a) 1 mole of AₓBᵧ contains 1 mole of A and 1 mole of B
   b) 1 equivalent of AₓBᵧ contains 1 equivalent of A and 1 equivalent of B
   c) 1 mole of AₓBᵧ contains x moles of A & Y moles of B
   d) equivalent weight of AₓBᵧ = equivalent weight of A + equivalent weight of B

6. 1 mole of Ba(OH)₂ will exactly neutralize:
   a) 0.5 mole HCl                     b) 1 mole of H₂SO₄
   c) 1 mole of H₃PO₃                  d) 2 mole of H₃PO₂

7. The pair of species having different percentage (mass) of carbon is:
   a) CH₃COOH & C₆H₁₂O₆                b) CH₃COOH & C₂H₅OH
   c) HCOOCH₃ & HCOOH                  d) C₂H₅OH & CH₃OCH₃
8. 30 mL of CH₃OH (d = 0.8 g/cm³) is mixed with 60 mL of C₂H₅OH (d = 0.92 g/cm³) at 25°C to form a solution of density 0.88 g/cm³. Select the correct option:
   a) molarity and molality of resulting solution are 6.33 & 13.59 respectively
   b) the mole fraction of solute and molality are 0.385 & 13.59 respectively
   c) molarity and % change in volume are 13.59 and zero respectively
   d) mole fraction of solvent and molality are 0.615 and 13.59 respectively

9. Which of the following is/are correct for 17 g/L of H₂O₂ solution?
   a) volume strengths is 5.6 at 273 K and 1 atm
   b) molarity of solution is 0.5 M
   c) 1 mL of this solution gives 2.8 mL O₂ at 273 K and 2 atm
   d) the normality of solution is 2 M

10. Solution containing 23 g HCOOH is/are:
    a) 46 g of 70 % \( \frac{w}{v} \) HCOOH (\( d_{\text{solution}} = 1.40 \text{ g/mL} \))
    b) 50 g of 10 M HCOOH (\( d_{\text{solution}} = 1 \text{ g/mL} \))
    c) 50 g of 25 % \( \frac{w}{w} \) HCOOH
    d) 46 g of 5 M HCOOH (\( d_{\text{solution}} = 1 \text{ g/mL} \))

11. A sample of H₂O₂ solution labeled as “28 volume” has density of 26.5 g/L. Mark the correct options representing concentration of same solution in other units:
    a) \( M_{H_2O_2} = 2.5 \)
    b) \( \% \frac{w}{v} = 17 \)
    c) Mole fraction of H₂O₂ = 0.2
    d) \( m_{H_2O_2} = 13.88 \)

12. A mixture of 100 mL of CO, CO₂ & O₂ was sparked. When the resulting gaseous mixture was passed through KOH solution, contraction in volume was found to be 80 mL, the composition of initial mixture may be (in the same order):
   a) 30 mL, 60 mL 10 mL   b) 30 mL, 50 mL, 20 mL   c) 50 mL, 30 mL, 20 mL   d) 20 mL 70 mL, 10 mL

13. If 1 mole of H₃PO₄ is reacted with 1 mole of X(OH)₂ as: H₃PO₄ + X(OH)₂ → XHPO₄ + 2H₂O then:
    a) the equivalent weight of base is \( \frac{\text{mol wt.}}{2} \)
    b) the eq. wt. of H₃PO₄ is \( \frac{98}{3} \)
    c) the resulting solution is required 1 mole NaOH for complete neutralization
    d) 1 mole of X(OH)₂ more required for complete neutralization of XHPO₄

14. Dichromate ion in acidic medium oxidizes stannous ion as:
    \( xSn^{2+} + yCr_2O_7^{2-} + zH^+ \rightarrow aSn^{4+} + bCr^{3+} + cH_2O \)
    a) the value of \( x : y \) is 1 : 3
    b) the value of \( x + y + z \) is 18
    c) \( a : b \) is 3 : 2
    d) the value of \( z - c \) is 7

15. When a equimolar mixture of Cu₂S and CuS is titrated with Ba(MnO₄)₂ in acidic medium, the final product’s contains Cu²⁺, SO₂ & Mn²⁺. If the mol. wt. of Cu₂S, CuS & Ba(MnO₄)₂ are \( M_1, M_2 \) & \( M_3 \) respectively then:
    a) eq. wt. of Cu₂S is \( \frac{M_1}{8} \)
b) eq wt. of CuS is $\frac{M_z}{6}$

c) eq. wt. of Ba(MnO₄)₂ is $\frac{M_3}{5}$

d) Cu₂S and Cus both have same equivalents in mixture

**Match The Column**

Column – I & Column – II contains four entries each. Entries of Column – I are to be matched with some entries of Column – II. One or more than one entries of Column – I may have the matching with the same entries of Column – II.

1. **Column – I**

<table>
<thead>
<tr>
<th>Column – I</th>
<th>Column – II</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) 0.5 mole of SO₂(g)</td>
<td>P) Occupy 11.2 L at STP</td>
</tr>
<tr>
<td>B) 1 g of H₂(g)</td>
<td>Q) Weighs 24 g</td>
</tr>
<tr>
<td>C) 0.5 mole of O₃(g)</td>
<td>R) Total no. of atoms = $1.5 \times N_A$</td>
</tr>
<tr>
<td>D) 1g molecule of O₂(g)</td>
<td>S) Weighs 32 g</td>
</tr>
</tbody>
</table>

2. **Column – I**

<table>
<thead>
<tr>
<th>Isotope – II</th>
<th>% composition of heavier isotope</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) (z - 1)</td>
<td>P) 25 % by moles</td>
</tr>
<tr>
<td>B) (z + 1)</td>
<td>Q) 50% by moles</td>
</tr>
<tr>
<td>C) z</td>
<td>R) % by mass dependent on z</td>
</tr>
<tr>
<td>D) (z - 1)</td>
<td>S) 75% by mass</td>
</tr>
</tbody>
</table>

3. **Column – I**

<table>
<thead>
<tr>
<th>Column – I</th>
<th>Column – II</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) When Bi₂S₃ converted into Bi⁵⁺ &amp; S</td>
<td>P) 18</td>
</tr>
<tr>
<td>B) When Al₂(Cr₂O₇)₃ reduced into Cr³⁺ in acidic medium.</td>
<td>Q) 11</td>
</tr>
<tr>
<td>C) When FeS₂ converted into Fe₃O₄ &amp; SO₂</td>
<td>R) 2</td>
</tr>
<tr>
<td>D) When Mn(NO₃)₂ converted into MnO₂⁻⁻ &amp; NO</td>
<td>S) 10</td>
</tr>
</tbody>
</table>

4. **Column – I**

<table>
<thead>
<tr>
<th>Column – I</th>
<th>Column – II</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) Eq. wt. = $\frac{Molecular\ weight}{33}$</td>
<td>P) When CrI₃ oxidizes into Cr₂O₇⁻⁻ &amp; IO₄⁻</td>
</tr>
<tr>
<td>B) Eq. wt. = $\frac{Molecular\ weight}{27}$</td>
<td>Q) When Fe(SCN)₂ oxidises into Fe³⁺, SO₄²⁻, CO₃⁻⁻ &amp; NO₃⁻</td>
</tr>
<tr>
<td>C) Eq. wt. = $\frac{Molecular\ weight}{28}$</td>
<td>R) When NH₄SCN oxidizes into SO₄²⁻, CO₃⁻⁻ &amp; NO₃⁻</td>
</tr>
<tr>
<td>D) Eq. wt. = $\frac{Molecular\ weight}{24}$</td>
<td>S) When As₂S₃ oxidizes into AsO₃⁻ &amp; SO₄²⁻</td>
</tr>
</tbody>
</table>

5. **Column – I**

<table>
<thead>
<tr>
<th>Column – I</th>
<th>Column – II</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) $P_2H_4 \rightarrow PH_3 + P_4H_2$</td>
<td>P) $E = \frac{3M}{4}$</td>
</tr>
<tr>
<td>B) $I_2 \rightarrow I^- + IO_3^-$</td>
<td>Q) $E = \frac{3M}{5}$</td>
</tr>
<tr>
<td>C) $MnO_4^- + Mn^{2+} + H_2O \rightarrow Mn_3O_4 + H^+$</td>
<td>R) $E = \frac{15M}{26}$</td>
</tr>
<tr>
<td>D) $H_3PO_2 \rightarrow PH_3 + H_3PO_3$</td>
<td>S) $E = \frac{5M}{6}$</td>
</tr>
</tbody>
</table>
6. A sample of raw material contain NaNO₃ also contains NaIO₃. The NaIO₃ can be used as a source of iodine, produced in the following reaction:

\[ IO_3^- + HSO_3^- \rightarrow I^- + SO_4^{2-} \quad \ldots(1) \]

\[ I^- + IO_3^- \rightarrow I_2 + H_2O \quad \ldots(2) \]

One litre of sample solution containing 396 g of NaIO₃ is treated with stoichiometric quantity of NaHSO₃. Now a substantial amount of same solution is added to reaction mixture to bring about the reaction (2).

**Column – I** | **Column – II**
--- | ---
A) n - factor of IO₃⁻ in reaction (2) | P) 6
B) Number of moles of HSO₃⁻ used in reaction (1) | Q) 1.2
C) Moles of I₂ produced | R) 2
D) Equivalents of IO₃⁻ used in reaction | (2) S) 2

** Assertion – Reason Type Questions**

Each question contains STATEMENT – 1 (Assertion) and STATEMENT – 2 (Reason). Examine the statements carefully and mark the correct answer according to the instructions given below

A) If both the statement are TRUE & STATEMENT-2 is the correct explanation of STATEMENT-1
B) If both the statement are TRUE but STATEMENT-2 is not the correct explanation of STATEMENT-1
C) If STATEMENT -1 is TRUE & STATEMENT-2 is FALSE
D) If STATEMENT -1 is FALSE & STATEMENT-2 is TRUE

1. STATEMENT-1 : Specific gravity is dimensionless.
   STATEMENT-2 : Specific gravity is density of a substance measured w.r.t. density of water at 4°C.

2. STATEMENT-1 : Molarity of pure water is 55.55 M at 298 K.
   STATEMENT-2 : Molarity is temperature dependent.

3. STATEMENT-1 : Gram molecular weight of O₂ is 32.
   STATEMENT-2 : Relative atomic weight of oxygen is 32 a.m.u

4. STATEMENT-1 : The oxidation state of S in H₂SO₄ is 6
   STATEMENT-2 : Max. oxidation state of S is 6 because the max. oxidation state of an element is it’s no. of valence electron.

5. STATEMENT-1 : 0.1 M H₃PO₃(aq) solution has normality equal to 0.3 N when completely reacted with NaOH.
   STATEMENT-2 : H₃PO₃ is a dibasic acid.

6. STATEMENT-1 : MnO₂ can act as an oxidizing agent as well as reducing agent.
   STATEMENT-2 : Oxidation state of Mn lies between highest and lowest oxidation state.

7. STATEMENT-1 : Equivalent volume of H₂ is 11.2 L at STP.
   STATEMENT-2 : 1/2 mole H₂ has produced when 1 mole of H⁺(aq) accepted 1 mole of e⁻.

8. STATEMENT-1 : For the reaction, Na₂CO₃ + HCl → NaCl + NaHCO₃, the suitable indicator is phenolphthalein.
   STATEMENT-2 : Phenolphthalein provide it’s colour in acidic medium.

9. STATEMENT-1 : [Fe(CN)₆]⁴⁻ → Fe³⁺ + CO₂ + NO₃⁻, the equivalent weight of reactant is 3.74.
   STATEMENT-2 : Equivalent weight of reactant = \(\frac{Mol.\ wt.}{61}\).

10. STATEMENT-1 : In the balanced redox reaction,
    \(xAs_2S_3 + yNO_3^- + 4H_2O \rightarrow aAsO_4^{3-} + bNO + cSO_4^{2-} + 8H^+\)
    The n-factor of As₂S₃ and NO₃⁻ is 28 and 3 respectively.
    STATEMENT-2 : Molar ratio is reciprocal of n – factor’s ratio so \(x : y\) is 3 : 28.
ANSWERS STOICHIOMETRY

Level – 1

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Level – 3

- Passage – 1  1. b  2. c  3. c  4. b
- Passage – 2  1. a  2. b  3. b  4. b
- Passage – 3  1. c  2. b  3. b
- Passage – 4  1. c  2. a  3. c  4. b

- One or More Answers is/are correct

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- Match the Column

|   1. A → P,R,S ;  B → P ;  C→ P,Q,R ;  D → S |
|------|------|------|------|
|  2. A → P,R ;  B → Q,R ;  C→ Q,S ;  D → Q,R |
|  3. A → S ;  B → P ;  C→ Q ;  D → R |
|  4. A → Q ;  B → P ;  C→ S ;  D → R |
|  5. A → S ;  B → Q ;  C→ R ;  D → P |
|  6. A → S ;  B → P ;  C→ Q ;  D → R |

- Assertion – Reason Type Questions

|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|