1 Some Basic Concepts of Chemistry

1. If the true value for an experimental result is 6.23 and the results reported by three students X, Y and Z are :

X : 6.18 and 6.28

Y : 6.20 and 6.023

Z : 6.22 and 6.24

Which of the following option is correct?

(a) X precise, Y accurate, Z precise and accurate.

(b) X precise and accurate, Y not precise, Z precise

(c) Both X & Z precise & accurate, Y not precise.

(d) Both X & Y neither precise nor accurate, Z both precise and accurate.

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

Tricky

(a) conservation of mass

(b) multiple proportions

(c) constant composition

(d) constant volume

3. 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

(a) 1.568×10^3 (b) 1.568×10^4

(c) 15.68 (d) 3.136×10^4

4. The amount of zinc required to produce 224 mL of H_2 at STP on treatment with dil. H_2SO_4 will be

(a) 6.5 g (b) 0.65 g

(c) 65 g (d) 0.065 g

5. Assuming fully decomposed, the volume of CO_2 released at STP on heating 9.85 g of $BaCO_3$ (Atomic mass, Ba = 137) will be

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

6. The number of water molecules present in a drop of water (volume 0.0018 mL) density = 18 mL^{-1} at room temperature is

(a) 1.084×10^{18} (b) 6.023×10^{19}

(c) 4.84×10^{17} (d) 6.023×10^{23}

7. 1.44 g of titanium (At. mass = 48) reacted with excess of O_2 and produce x g of non stoichiometric compound $Ti_{1.44}O$. The value of x is:

Critical Thinking

(a) 2 (b) 1.77

(c) 1.44 (d) none of these

8. Silver oxide (Ag_2O) decomposes at temperature 300 °C yielding metallic silver and oxygen gas. A 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

9. A sample of AlF_3 contains 3.0×10^{24} F^- ions. The number of formula unit of this sample are

(a) 9×10^{24} (b) 3×10^{24}

(c) 0.75×10^{24} (d) 1.0×10^{24}

10. Dissolving 120 g of a compound of mol. wt. 60 in 1000 g of water gave a solution of density 1.12 g/ mL. The molarity of the solution is:

(a) 1.00 M (b) 2.00 M

(c) 2.50 M (d) 4.00 M

11. A mixture of O_2 and gas "Y" mol. mass 80 in the mole ratio a : b has a mean molecular mass 40. What would be mean molecular mass, if the gases are mixed in the ratio b : a under, identical conditions? (Assume that gases are non-reacting):

Toughnut

(a) 40 (b) 48 (c) 62 (d) 72

12. If 3.01×10^{20} molecules are removed from 98 mg of H_2SO_4, then the number of moles of H_2SO_4 left are

(a) 0.1×10^{-3} (b) 0.5×10^{-3}

(c) 1.66×10^{-3} (d) 9.95×10^{-2}

13. The number of molecules in 8.96 litre of a gas at 0 °C and 1 atm. pressure is approximately

(a) 6.023×10^{23} (b) 12.04×10^{23}

(c) 18.06×10^{23} (d) 24.08×10^{22}

14. The density of 3M solution of sodium chloride is 1.252 g mL^{-1}. The molality of the solution will be: (molar mass, NaCl = 585 g mol^{-1}) Tricky

(a) 2.60m (b) 2.18m (c) 2.79m (d) 3.00m

15. Indium (atomic mass = 114.82) has two naturally occurring isotopes, the predominant one form has isotopic mass 114.9041 and abundance of 95.72%. Which of the following isotopic mass is the most likely for the other isotope?

(a) 112.94 (b) 115.90

(c) 113.90 (d) 114.90

16. A compound contains 54.55 % carbon, 9.09% hydrogen , 36.36% oxygen. The empirical formula of this compound is:

(a) C_3H_5O (b) $C_4H_8O_2$

(c) $C_2H_4O_2$ (d) C_2H_4O

17. An organic compound whose empirical and molecular formula are same, contains 20% carbon, 6.7% hydrogen, 46.7% nitrogen and the rest oxygen. On heating it yields ammonia, leaving a solid residue. The solid residue gives a violet colour with dilute solution of alkaline copper sulphate. The organic compound is

Toughnut

(a) NH_2COONH_4 (b) $HCOONH_4$

(c) NH_2NHCHO (d) NH_2CONH_2

18. 10 mL of 2 M NaOH solution is added to 200 mL of 0.5 M of NaOH solution. What is the final concentration ?

(a) 0.57 M (b) 5.7 M

(c) 11.4 M (d) 1.14 M

19. Arrange the following in the order of increasing mass (atomic mass: O = 16, Cu = 63, N = 14)

Toughnut

I. one atom of oxygen

II. one atom of nitrogen

III. 1×10^{-10} mole of oxygen

IV. 1×10^{-10} mole of copper

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

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

20. The number of moles of oxygen in one litre of air containing 21% oxygen by volume, under standard conditions are

(a) 0.0093 mole (b) 0.21 mole

(c) 2.10 mole (d) 0.186 mole

21. The concentrated sulphuric acid that is peddled commercial is 95% H_2SO_4 by weight. If the density of this commercial acid is 1.834 g cm^{-3}, the molarity of this solution is

(a) 17.8 M (b) 12.0 M

(c) 10.5 M (d) 15.7 M

22. 9 moles of "D" and 14 moles of E are allowed to react in a closed vessel according to given reactions. Calculate number of moles of B formed in the end of reaction, if 4 moles of G are present in reaction vessel. (Percentage yield of reaction is mentioned in the reaction) Critical Thinking

Step-1 $3D + 4E \xrightarrow{80\%} 5C + A$

Step-2 $3C + 5G \xrightarrow{50\%} 6B + F$

(a) 2.4 (b) 30 (c) 4.8 (d) 1

23. A mixture of NH_4NO_3 and $(NH_4)_2HPO_4$ contain 30.40% mass per cent 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

24. The mass of N_2F_4 produced by the reaction of 2.0 g of NH_3 and 8.0 g of F_2 is 3.56 g. What is the per cent yield?

$$2NH_3 + 5F_2 \longrightarrow N_2F_4 \quad 6HF$$

(a) 79.0 (b) 71.2

(c) 84.6 (d) None of these

25. The ppm level of F^- in a 500 g sample of a tooth paste containing 0.2 g F^- is

(a) 400 (b) 1000 (c) 250 (d) 200

26. Two glucose solutions are mixed. One has a volume of 480 mL and a concentration of 1.50 M and the second has a volume of 520 mL and concentration 1.20 M. The molarity of final solution is

(a) 1.20 M (b) 1.50 M

(c) 1.34 M (d) 2.70 M

27. What is the volume of CO_2 liberated (in litres) at 1 atmosphere and 0 °C when 10 g of 100% pure calcium carbonate is treated with excess dilute sulphuric acid?
(Atomic mass Ca : 40, C : 12, O : 16)

(a) 0.224 (b) 2.24 (c) 22.4 (d) 224

28. Complete combustion of 0.858 g of compound X gives 2.64 g of CO_2 and 1.26 g of H_2O. The lowest molecular mass X can have:

(a) 43 g (b) 86 g (c) 129 g (d) 172 g

29. The impure 6 g of NaCl is dissolved in water and then treated with excess of silver nitrate solution. The mass of precipitate of silver chloride is found to be 14 g. The % purity of NaCl solution would be:

Toughnut

(a) 95% (b) 85% (c) 75% (d) 65%

30. How many of 0.1N HCl are required to react completely with 1 g mixture of Na_2CO_3 and $NaHCO_3$ containing equimolar amounts of two ?

(a) 157.7 mL (b) 15.77 mL
(c) 147.7 mL (d) 14.77 mL

31. 5 g of benzene on nitration gave 6.6 g of nitrobenzene. The theoretical yield of the nitrobenzene will be

(a) 4.5 g (b) 5.6 g (c) 8.09 g (d) 6.6 g

32. An aqueous solution of oxalic acid dihydrate contains its 6.3 g in 250 mL. The volume of 0.1 N NaOH required to completely neutralize 10 mL of this solution

(a) 4 mL (b) 20 mL (c) 2 mL (d) 40 mL

33. Choose the incorrect formula out of the four compounds for an element X below :

(a) X_2O_3 (b) X_2Cl_3
(c) $X_2(SO_4)_3$ (d) XPO_4

34. A gaseous compound of nitrogen and hydrogen contains 12.5% (by mass) of hydrogen. The density of the compound relative to hydrogen is 16. The molecular formula of the compound is:

(a) NH_2 (b) N_3H (c) NH_3 (d) N_2H_4

35. In an organic compound of molar mass 108 g mol^{-1} C, H and N atoms are present in 9 : 1 : 3.5 by mass. Molecular formula can be:

(a) $C_6H_8N_2$ (b) $C_7H_{10}N$
(c) $C_5H_6N_3$ (d) $C_4H_{18}N_3$

36. What is the empirical formula of vanadium oxide, if 2.74 g of the metal oxide contains 1.53 g of metal?

(a) V_2O_3 (b) VO (c) V_2O_5 (d) V_2O_7

37. 100 cm^3 of 0.1 N HCl is mixed with 100 cm^3 of 0.2 N NaOH solution. The resulting solution is

Tricky

(a) 0.1 N and the solution is basic
(b) 0.1 N and the solution is acidic
(c) 0.05 N and the solution is basic
(d) 0.05 N and the solution is acidic

38. On subjecting 10 mL mixture of N_2 and CO to repeated electro spark, 7 mL of O_2 was required for combustion. What was the mole percent of CO in the mixture? (All volumes were measured under identical conditions)

(a) 60 (b) 40 (c) 6 (d) 4

39. When burnt in air, 14.0 g mixture of carbon and sulphur gives a mixture of CO_2 and SO_2 in the volume ratio of 2:1, volume being measured at the same conditions of temperature and pressure moles of carbon in the mixture is

(a) 0.75 (b) 0.5 (c) 0.40 (d) 0.25

40. What is the molarity of SO_4^{2-} ion in aqueous solution that contain 34.2 ppm of $Al_2(SO_4)_3$? (Assume complete dissociation and density of solution 1g/mL)

Critical Thinking

(a) 3×10^{-4} M (b) 2×10^{-4} M
(c) 10^{-4} M (d) None of these

41. A transition metal *M* forms a volatile chloride which has a vapour density of 94.8. If it contains 74.75% of chlorine the formula of the metal chloride will be

(a) MCl_3 (b) MCl_2 (c) MCl_4 (d) MCl_5

42. 50 mL 10 N H_2SO_4, 25 mL 12 N HCl and 40 mL 5 N HNO_3 were mixed together and the volume of the mixture was made 1000 mL by adding water. The normality of the resultant solution will be

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

43. 250 mL of a sodium carbonate solution contains 2.65 g 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)

(a) 0.1 M (b) 0.01 M
(c) 0.001 M (d) 10^{-4} M

44. 3.92 g of ferrous ammonium sulphate crystals are dissolved in 100 mL of water. 20 mL of this solution requires 18 mL of potassium permaganate during titration for complete oxidation. The weight of $KMnO_4$ present in one litre of the solution of

(a) 3.47 g (b) 12.38 g
(c) 1.23 g (d) 34.76 g

45. 1.12 mL of a gas is produced at S.T.P. by the action of 4.12 mg of alcohol ROH with methyl magnesium Iodide. The molecular mass of alcohol is

(a) 16.0 (b) 41.2 (c) 82.4 (d) 156.0

46. How many moles of P_4 can be produced by reaction of 0.10 moles $Ca_5(PO_4)_3F$, 0.36 moles SiO_2 and 0.90 moles C according to the following reaction?

$$4\,Ca_5(PO_4)_3F \;\; 18\,SiO_2 \;\; 30\,C \longrightarrow 3P_4 \;\; 2CaF_2 \;\; 18CaSiO_3 \;\; 30\,CO$$

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

47. 1 mole of mixture of CO and CO_2 requires exactly 28 g KOH in solution for complete conversion of all the CO_2 into K_2CO_3. How much amount more of KOH will be required for conversion into K_2CO_3. If one mole of mixture is completely oxidized to CO_2

Critical Thinking

(a) 112 g (b) 84 g (c) 56 g (d) 28 g

48. 2.0 g of a sample contains mixture of SiO_2 and Fe_2O_3. On very strong heating, it leaves a residue weighing 1.96 g. The reaction responsible for loss of mass is given below.

$Fe_2O_3(s) \rightarrow Fe_3O_4(s) + O_2(g)$, (unbalance equation)

What is the percentage by mass of SiO_2 in original sample?

(a) 100% (b) 20% (c) 40% (d) 60%

49. 20 g of $CaCO_3$ on heating gave 8.8 g of CO_2 and 11.2 g of CaO. This is in accordance with

(a) The law of conservation of mass.
(b) The law of constant composition.
(c) The law of reciprocal proportion.
(d) None of these

50. If 224 mL of a triatomic gas has a mass of 1 g at 273K and 1 atmospheric pressure then the mass of one atom is

(a) 8.30×10^{-23} g (b) 2.08×10^{-23} g
(c) 5.53×10^{-23} g (d) 6.24×10^{-23} g

51. Specific volume of cylindrical virus particle is 6.02×10^{-2} cc/g. whose radius and length are 7 Å & 10 Å respectively.

If $N_A = 6.02 \times 10^{23} mol^{-1}$, find molecular weight of virus

Toughnut

(a) 3.08×10^3 kg/mol (b) 3.08×10^4 kg/mol
(c) 1.54×10^4 kg/mol (d) 15.4 kg/mol

52. 1.575 g of oxalic acid $(COOH)_2.xH_2O$ are dissolved in water and the volume made upto 250 mL. On titration 16.68 mL of this solution requires 25 mL of N/15 NaOH solution for complete neutralization, calculate x.

(a) 3 (b) 2 (c) 4 (d) 5

53. 2 g of a mixture of CO and CO_2 on reaction with excess I_2O_5 produced 2.54 g of I_2. What will be the mass % of CO_2 in the original mixture?

(a) 35 (b) 70 (c) 30 (d) 60

54. Which statement is false for the balanced equation given below?

$$CS_2 + 3O_2 \longrightarrow 2SO_2 + CO_2$$

(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

55. Number of moles of $KMnO_4$ required to oxidize one mole of $Fe(C_2O_4)$ in acidic medium is

Toughnut

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

56. 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

(a) 6 (b) 1 (c) 2 (d) 4

57. A 25.0 mm × 40.0 mm piece of gold foil is 0.25 mm thick. The density of gold is 19.32 g/cm^3. How many gold atoms are in the sheet? (Atomic weight : Au = 197.0)

Tricky

(a) 7.7×10^{23} (b) 1.5×10^{23}
(c) 4.3×10^{21} (d) 1.47×10^{22}

58. What volume of oxygen gas (O_2) measured at 0°C and 1 atm, is needed to burn completely 1L of propane gas (C_3H_8) measured under the same conditions ?

(a) 7L (b) 6L (c) 5L (d) 10L

59. 25.4 g of I_2 and 14.2 g of Cl_2 are made to react completely to yield a mixture of ICl and ICl_3. Calculate moles of ICl and ICl_3 formed

(a) 0.1, 0.1 (b) 0.2, 0.2
(c) 0.1, 0.2 (d) 0.2, 0.1

60. 10 moles SO_2 and 15 moles O_2 were allowed to react over a suitable catalyst. 8 moles of SO_3 were formed. The remaining moles of SO_2 and O_2 respectively are -
(a) 2 moles, 11 moles (b) 2 moles, 8 moles
(c) 4 moles, 5 moles (d) 8 moles, 2 moles

61. In the reaction

$$4NH_3(g) + 5O_2(g) \longrightarrow 4NO(g) \quad 6H_2O(l),$$

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 ammonia will be consumed
(d) all the oxygen will be consumed

62. An ideal gaseous mixture of ethane (C_2H_6) and ethene (C_2H_4) occupies 28 litre at 1 atm and 273 K. The mixture reacts completely with 128 g O_2 to produce CO_2 and H_2O. Mole fraction at C_2H_6 in the mixture is: Toughnut
(a) 0.6 (b) 0.4 (c) 0.5 (d) 0.8

63. Wood's metal contains 50.0% bismuth, 25.0% lead, 12.5% tin and 12.5% cadmium by mass. What is the mole fraction of tin?
(Atomic mass : Bi = 209, Pb = 207, Sn = 199, Cd = 112)
(a) 0.202 (b) 0.158 (c) 0.176 (d) 0.221

64. The mass of $BaCO_3$ produced when excess CO_2 is bubbled through a solution of 0.205 mol $Ba(OH)_2$ is :
(a) 81 g (b) 40.5 g
(c) 20.25 g (d) 162 g

65. Sulfuryl chloride (SO_2Cl_2) reacts with water to give a mixture of H_2SO_4 and HCl. How many moles of baryta would be required to neutralize the solution formed by adding 4 mole of SO_2Cl_2 to excess of water ?
(a) 1 (b) 2 (c) 3 (d) 4

66. 1 g mixture of equal number of mole of Li_2CO_3 and other metal carbonate (M_2CO_3) required 21.6 mL of 0.5 N HCl for complete neutralisation reaction. What is the approximate atomic mass of the other metal? Critical Thinking
(a) 25 (b) 23 (c) 51 (d) 118

67. When 2.5 g of a sample of Mohr's salt reacts completely with 50 mL of $\frac{N}{10}$ $KMnO_4$ solution. The % purity of the sample of Mohr's salt is:
(a) 78.4 (b) 70 (c) 37 (d) 40

68. If potassium chlorate is 80% pure, then 48 g of oxygen would be produced from (atomic mass of K = 39)
(a) 153.12 g of $KClO_3$ (b) 122.5 g of $KClO_3$
(c) 245 g of $KClO_3$ (d) 98 g of $KClO_3$

69. 12 g of Mg (atomic mass 24) will react completely with hydrochloric acid to give
(a) One mol of H_2
(b) 1/2 mol of H_2
(c) 2/3 mol of O_2
(d) both 1/2 mol of H_2 and 1/2 mol of O_2

70. 2.76 g of silver carbonate (at mass of Ag 108) on being heated strongly yield a residue weighing Tricky
(a) 2.16 g (b) 2.48 g
(c) 2.32 g (d) 2.64 g

Answer KEY

1	(d)	**8**	(c)	**15**	(a)	**22**	(a)	**29**	(a)	**36**	(c)	**43**	(c)	**50**	(c)	**57**	(d)	**64**	(b)
2	(c)	**9**	(d)	**16**	(d)	**23**	(a)	**30**	(a)	**37**	(c)	**44**	(a)	**51**	(d)	**58**	(c)	**65**	(b)
3	(b)	**10**	(b)	**17**	(d)	**24**	(d)	**31**	(c)	**38**	(a)	**45**	(c)	**52**	(b)	**59**	(a)	**66**	(d)
4	(b)	**11**	(d)	**18**	(a)	**25**	(a)	**32**	(d)	**39**	(b)	**46**	(a)	**53**	(c)	**60**	(a)	**67**	(a)
5	(a)	**12**	(b)	**19**	(a)	**26**	(c)	**33**	(b)	**40**	(a)	**47**	(b)	**54**	(d)	**61**	(d)	**68**	(a)
6	(b)	**13**	(d)	**20**	(a)	**27**	(b)	**34**	(d)	**41**	(c)	**48**	(c)	**55**	(b)	**62**	(b)	**69**	(b)
7	(b)	**14**	(c)	**21**	(a)	**28**	(a)	**35**	(a)	**42**	(b)	**49**	(a)	**56**	(d)	**63**	(c)	**70**	(a)

Hints & Solutions

1. **(d)** Both Y and X are neither precise nor accurate as the two values in each of them are not close. With respect to X & Y, the values of Z are close & agree with the true value. Hence, both precise & accurate.

2. **(c)** The H : O ratio in water is fixed, irrespective of its source. Hence it is law of constant composition.

3. **(b)** 0.5% by weight means if Mol. wt. is 100 then mass of Se is 0.5. If at least one atom of Se is present in the molecule then

$$\text{M. Wt} = \frac{100}{0.5} \times 78.4 \quad 1.568 \times 10^4$$

4. **(b)** $Zn \quad H_2SO_4 \longrightarrow ZnSO_4 \quad H_2$

65 g Zn gives 1 mole of $H_2 = 22400$ mL of H_2

224 mL of H_2 will be obtained from 0.65 g Zn.

5. **(a)** $BaCO_3 \longrightarrow BaO \quad CO_2$

192 g of $BaCO_3$ gives 1 mol of $CO_2 = 22.4$ L

9.85 g of $BaCO_3$ will give 0.05 mol of CO_2 which is equal to 1.12 litre.

6. **(b)** 0.0018 mL = 0.0018 g = 0.0001 mole of water

10^{-4} mole

$\therefore$ Number of water molecules

$= 6.023 \times 10^{23} \times 10^{-4} = 6.023 \times 10^{19}$

7. **(b)** $Ti + O_2 \longrightarrow Ti_{1.44}O$

$$\frac{1.44}{48}\text{mole} \quad \frac{x}{48 \;\; 1.44 \quad 16}\text{mole}$$

$$\therefore \quad \frac{1.44}{48} \quad \frac{1.44x}{48 \;\; 1.44 \quad 16}$$

$x = 1.77$ g

8. **(c)** Let mass of $Ag_2O = x$ g

$$Ag_2O \quad \longrightarrow \quad 2Ag + \frac{1}{2}O_2$$

xg

232 g $\qquad\qquad \frac{1}{2} \times 32 \quad 16$ g O_2

$$\frac{16}{232} \times x = 0.104 \Rightarrow x \quad 1.508 \text{ g}$$

$$\% \text{ of } Ag_2O = \frac{1.508}{1.6} \times 100 \quad 94.25\%$$

9. **(d)** An, AlF_3 the number of F is 3 for one AlF_3 molecule $3F^- \equiv 1$ formula unit of AlF_3

$$3.0 \times 10^{24}\, F^- \equiv \frac{1}{3} \times 3.0 \times 10^{24}\, AlF_3 \text{ units}$$

10. **(b)** Given

mass of solute (w) = 120 g

mass of solvent (w) = 1000 g

Mol. mass of solute = 60 g

density of solution = 1.12 g/ mL

From the given data,

Mass of solution = 1000 + 120 = 1120 g

$$\because \quad d \quad \frac{\text{Mol. mass}}{V} \text{ or } V \quad \frac{\text{Mol. mass}}{d}$$

Volume of solution $V \quad \frac{1120}{1.12} \quad 1000$ mL

or = 1 litre

$$\text{Now molarity (M)} = \frac{W}{\text{Mol. mass} \times V \text{ lit}}$$

$$= \frac{120}{60 \times 1} \quad 2M$$

11. **(d)** Let mole fraction of O_2 is x

$40 = 32 \times x + 80\,(1 - x)$

or $x = 5/6$

$$a : b = x : (1 - x) = \frac{5}{6} : \frac{1}{6}$$

When ratio is changed

$$M_{\text{mixture}} = 32 \times \frac{1}{60} + 80 \times \frac{5}{6} \quad 72$$

12. **(b)** Moles of H_2SO_4 in 98 mg of H_2SO_4

$$= \frac{1}{98} \times 0.098 \quad 0.001$$

Moles of H_2SO_4 removes

$$= \frac{3.01\times10^{20}}{6.02\times10^{23}} \quad 0.5\times10^{-3} \quad 0.0005$$

Moles of H_2SO_4 left

$= 0.001 - 0.0005 = 0.5 \times 10^{-3}$

13. (d) At S.T.P. 22.4 litre of gas contains 6.023×10^{23} molecules

$\therefore$ molecules in 8.96 litre of gas

$$= \frac{6.023\times10^{23}\times8.96}{22.4} \quad 24.08\times10^{22}$$

14. (c) The relation between molarity (M) and molality (m) is

$$d = M\left(\frac{1}{m} \quad \frac{M_2}{1000}\right),$$ M_2 = Mol. mass of solute

On putting value

$$1.252 = 3\left(\frac{1}{m} \quad \frac{58.5}{1000}\right)$$

on solving $m = 2.79$

15. (a) Let atomic weight of other isotope is M

$$114.82 \quad \frac{114.9041\times95.72 + M\times4.28}{100}$$

$M = 112.94$

16. (d)

C	54.55	54.55/12 = 4.5	4.5/2.27 = 2
H	9.09	9.09/1 = 9.09	9.09/2.27 = 4
O	36.36	36.36/16 = 2.27	2.27/2.27 = 1

Hence empirical formula of the compound = C_2H_4O

17. (d)

Element	Percentage	Atomic mass	Relative no. of atoms	Simplest ratio
C	20%	12	1.66	1
H	6.7%	1	6.7	4
N	46.7%	14	3.33	2
O	26.6%	16	1.66	1

Empirical formula = Molecular formula

$= CH_4N_2O$ or NH_2CONH_2

$$H_2NCONH_2 + H_2NCONH_2 \xrightarrow{\Delta}$$

$$H_2NCONHCONH_2 \quad NH_3$$

biuret,

When an aqueous solution of biuret is treated with dilute sodium hydroxide and a drop of copper sulphate, a violet colour is produced. This test is known as biuret test, and is characteristic of compounds having the group –CONH–

18. (a) From molarity equation

$M_1V_1 + M_2V_2 = MV_{(total)}$

$$2\times\frac{10}{1000} + 0.5\times\frac{200}{1000} = M\times\frac{210}{1000}$$

$120 = M \times 210$

$$M = \frac{120}{210} \quad 0.57\ M$$

19. (a) Mass of 6.023×10^{23} atoms of oxygen = 16 g

Mass of one atom of oxygen

$$= \frac{16}{6.023\times10^{23}} = 2.66\times10^{-23}\ g$$

Mass of 6.023×10^{23} atoms of nitrogen = 14 g

Mass of one atom of nitrogen

$$\frac{14}{6.023\times10^{23}} \quad 2.32\times10^{-23}\ g$$

Mass of 1 mole of oxygen = 16 g

Mass of 1×10^{-10} mole of oxygen $= 16 \times 10^{-10}$

Mass of 1 mole of copper = 63 g

Mass of 1×10^{-10} mole of copper $= 63 \times 1 \times 10^{-10}$

$= 63 \times 10^{-10}$

So, the order of increasing mass is II < I < III < IV.

20. (a) 21% of 1 litre is 0.21 litre.

22.4 litres = 1 mole at STP

$$\therefore 0.21 \text{ litre} = \frac{0.21}{22.4} \quad 0.0093 \text{ mol}$$

21. (a) 95% H_2SO_4 by weight means 100g H_2SO_4 solution contains 95g H_2SO_4 by mass.

Molar mass of H_2SO_4 = 98g mol^{-1}

$$\text{Moles in 95g} = \frac{95}{98} = 0.969 \text{ mole}$$

Volume of 100g H_2SO_4

$$\frac{\text{mass}}{\text{density}} \quad \frac{100g}{1.834g\ cm^{-3}}$$

$= 54.52\ cm^3 = 54.52 \times 10^{-3}\ L$

$$\text{Molarity} \quad \frac{\text{Moles of solute}}{\text{Volme of solute in L}}$$

$$\frac{0.969}{54.52\times10^{-3}} \quad 17.8\ \text{M}$$

22. (a) $3D + 4E \xrightarrow{80\%} 5C$ A

9 mole 14 mole $\frac{5}{3}\times9\times0.8$ 12 mole

$3C + 5G \xrightarrow{50\%} 6B$ F

12 mole 4 mole

Limiting Reagent is G

$\therefore$ Moles of B formed $= \frac{6}{5}\times4\times0.5$ 2.4

23. (a) Let wt. of NH_4NO_3 and $(NH_4)_2HPO_4$ are x and y gram respectively

$$\frac{\frac{x}{80}\times2\times14+\frac{y}{132}\times2\times14}{x \quad y}\times100 \quad 30.4$$

$\Rightarrow x : y = 2 : 1$

24. (d) $2NH_3 + 5F_2 \longrightarrow N_2F_4 + 6HF$

2×17 g NH_3 gives 66 g N_2F_4

2 g will give $-\frac{66}{34}\times2$ 3.88 g N_2F_4

$$\%\ \text{yield} = \frac{3.56}{3.88}\times100 \quad 91.75\%$$

25. (a) $$\text{ppm} = \frac{\text{wt. of solute}}{\text{wt. of solvent}}\times10^6$$

$$= \frac{0.2}{500}\times10^6 \quad 400$$

26. (c) $M_1V_1 + M_2V_2 = M_3V_3 \quad (V_3 = V_1 + V_2)$

$1.5\times480 + 1.2\times520 = M_3\times1000$

$M_3 = 1.34$ M

27. (b) $CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + H_2O + CO_2$

1 mol	100 g	22.4 litre
1 mol	10 g	2.24 litre

28. (a) Moles of C $= n_{CO_2} = \frac{2.64}{44}$ 0.06

$\Rightarrow$ mass of C = 0.72

Mole of H = 2 × Moles of H_2O =

$2\times\frac{1.26}{18} = 0.14 \Rightarrow$ mass of H 0.14

Compound does not contains oxygen.

So EF $\rightarrow C_{0.06}H_{0.14} \Rightarrow C_3H_{17}$

$\Rightarrow$ Lowest M.M. = 43

29. (a) The reaction that takes place is

$NaCl + AgNO_3 \longrightarrow AgCl\downarrow \quad NaNO_3$

$\therefore$ 143.5 g of AgCl is produced from 58.5 g NaCl

$\therefore$ 14 g of AgCl will be produced from

$\frac{58.5\times14}{143.5}$ 5.70 g NaCl

This is the amount of NaCl in common salt;

$$\%\ \text{purity} = \frac{5.70}{6}\times100 \quad 95\%$$

30. (a) Na_2CO_3 $NaHCO_3$

x $(1-x)$

$\frac{x}{106}$ $\frac{1-x}{84}$ given (moles are equal)

x = 0.557

$\frac{0.557}{53}$ $\frac{0.443}{84}$ $\frac{V\times0.1}{1000}$

V = 157.7 mL

31. (c) $C_6H_6 + HNO_3 \rightarrow C_6H_5NO_2 + H_2O$

78g 123g

Now since 78g of benzene on nitration give = 123g nitrobenzene

hence 5g of benzene on nitration give

$= \frac{123}{78}\times5$ 7.88g

nearest answer is (c) i.e. theoritical yield = 7.88 g

32. (d) Normality of oxalic acid solution

$\frac{6.3\times1000}{63\times250} = 0.4$ N

Now from

$N_1V_1 = N_2V_2$

$0.4\times10 = 0.1\times V_2$

$V_2 = 40$ mL

33. (b) $X_2O_3 \Rightarrow X^{3+}O^{2-}$

$X_2Cl_3 \Rightarrow X^{3+}Cl^{2-}$

$X_2(SO_4)_3 \Rightarrow X^{3+}SO_4^{2-}$

$XPO_4 \Rightarrow X^{3+}PO_4^{3-}$

Because Cl^{2-} does not exist. So, X_2Cl_3 is incorrect. The correct formula should be XCl_3.

34. (d) In an unknown compounds containing N and H

given % of H = 12.5%

$\therefore$ % of N = 100 – 12.5 = 87.5%

Element	Percentage	Atomic ratio	Simple ratio
H	12.5%	$\frac{12.5}{1}$ 12.5	$\frac{12.5}{6.25}$ 2
N	87.5	$\frac{87.5}{14}$ 6.25	$\frac{6.25}{6.25}$ 1

2 × vapour density = Mol. wt = mol wt.

= 16 × 2 = 32.

Molecular formula = n × empirical formula

mass n $\frac{32}{16} = 2$

$\therefore$ Molecular formula of the compound will be = $(NH_2)_2 = N_2H_4$

35. (a)

	C	H	N		
Moles	$\frac{9}{12}$	$\frac{1}{1}$	$\frac{3.5}{14}$	n	$\frac{108}{54}$ 2
	$\frac{3}{4}$:	1 :	$\frac{1}{4}$		
	3 :	4 :	1		

$\Rightarrow$ $C_3H_4N \Rightarrow$ M.F. = $(C_3H_4N)_n$

MF = $(C_3H_4N)_2 = C_6H_8N_2$

36. (c) Mass of oxide = Mass of metal + Mass of oxygen

$2.74 = 1.53 + W_{Oxygen} \Rightarrow W_{Oxygen} = 1.21$ g

Moles of V = $\frac{1.53}{51}$ 0.03

Moles of O = $\frac{1.21}{16}$ 0.075

$V_{0.03}O_{0.075}$

$VO_{2.5} \Rightarrow V_2O_5$

37. (c) Normality

= $\frac{N_1V_1 - N_2V_2}{V_1 \quad V_2}$ $\frac{0.2\times100 - 0.1\times100}{100 \quad 100}$

$\frac{10}{200}$ 0.05N NaOH

38. (a) $N_2 \quad O_2 \rightarrow 2NO$

a a 2a

$CO + \frac{1}{2}O_2 \rightarrow CO_2$

$(10-a) \quad \frac{(10-a)}{2} \quad (10-a)$

$a + \frac{(10-a)}{2} = 7$

$\therefore$ a = 4

volume of CO = 6 mL

Mole % of CO = $\frac{6\times100}{10} = 60$

39. (b) Let weight of C be x g, then S will be (14 – x)g

$\frac{x/12}{(14-x)/32} = \frac{2}{1}$

$\therefore$ x = 6 g ; Moles of C = $\frac{6}{12} = 0.5$

40. (a) $\frac{\text{mass of } Al_2(SO_4)_3}{\text{mass of water}} \times 10^6$ 34.2

1 litre solution contains 1000 g of water

$\Rightarrow$ In 1 litre solution, mass of

$Al_2(SO_4)_3$ $\frac{34.2\times1000}{10^6}$ 34.2 mg

molarity of

$Al_2(SO_4)_3$ $\frac{34.2\times10^{-3}}{342}$ M 10^{-4} M

$Al_2(SO_4)_3(aq) \longrightarrow 2Al^{3+}(aq) \quad 3SO_4^{2-}(aq)$

10^{-4} M $\quad 2\times10^{-4}$ M $\quad 3\times10^{-4}$ M

$\left[SO_4^{2-}\right] = 3\times10^{-4}$ M

41. (c) 74.75% of chlorine means 74.75g chlorine is present in 100g of metal chloride.

Weight of metal = 100g – 74.75g
= 25.25g

Equivalent weight

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

$$= \frac{25.25}{74.75} \times 35.5 = 12$$

Valency of metal

$$\frac{2 \times \text{V.D.}}{\text{Equivalent wt. of metal} \quad 35.5}$$

$$\frac{2 \times 94.8}{12 \quad 35.5} \quad 4$$

$\therefore$ Formula of compound = MCl_4

42. (b) $N \quad \frac{N_1V_1 \quad N_2V_2 \quad N_3V_3}{\text{Total volume}}$

$$\frac{50 \times 10 \quad 25 \times 12 \quad 40 \times 5}{1000} \quad 1N$$

43. (c) Molarity

$$= \frac{Wt \times 1000}{MW \times V} \quad \frac{2.65 \times 1000}{106 \times 250} \quad 0.1M$$

$M_1V_1 = M_2V_2$

$\therefore 10 \times 0.1 = 1000 \times M_2 = 0.001$ M

44. (a) Normality of ferrous amm. sulphate

$$= \frac{3.92 \times 1000}{392 \times 100} \quad 0.1 \text{ (Eq. wt of FAS is 392)}$$

$N_1V_1 = N_2V_2$

$20 \times 0.1 = 18 \times N_2 \qquad N_2 = 0.111$

1 g ev. of $KMnO_4 = 31.6$ g

0.111 g ev. of $KMnO_4 = 31.6 \times 0.111 = 3.5$ g.

45. (c) Let the alcohol be ROH and x its molecular weight

$$\underset{x\,g}{ROH} \quad CH_3MgI \rightarrow \underset{16\,g}{CH_4} \quad ROMgI$$

$\frac{4.12}{1000}$ g of alcohol will produce

$\frac{16}{x} \times \frac{4.12}{1000}$ g of methane

Methane actually obtained is = $\frac{16 \times 1.12}{22400}$ g

$$\therefore \frac{16 \times 4.12}{x \times 1000} \quad \frac{16 \times 1.12}{22400} = x = 82.4$$

46. (a) $4\underset{0.1}{Ca_5(PO_4)_3F} + \underset{0.36}{18SiO_2} + \underset{0.9}{30C} \xrightarrow{\text{L.R.}} 3P_4 \quad 2CaF_2$

$18CaSiO_3 \quad 30CO$

18 moles of SiO_2 gives 3 moles of P_4

0.36 moles of SiO_2 will give

$= \frac{3}{18} \times 0.36 \quad 0.06$ mole

47. (b) $CO \quad \frac{1}{2}O_2 \rightarrow CO_2$;

$CO_2 \quad 2KOH \rightarrow K_2CO_3 \quad H_2O$

Moles of KOH = $\frac{28}{56} = 0.50$

It corresponds to 0.25 mol of CO_2

Hence mol of CO = 1 – 0.25 = 0.75 $\equiv$ mole of CO_2 formed

Mol of KOH requred = 2 × 0.75 = 1.5

= 1.5 × 56 = 84 g

48. (c) $3Fe_2O_3\ s \rightarrow 2Fe_3O_4 \quad \frac{1}{2}O_2$

480 g Fe_2O_3 provide 16 g O_2. For loss of

$0.04\ g\ O_2 \rightarrow 0.04 \times \frac{480}{16} \quad 1.2\ g\ Fe_2O_3$

% by mass of $SiO_2 = \frac{0.8}{2.0} \times 100 \quad 40\%$

49. (a) $CaCO_3 \rightarrow CaO + CO_2$

20 g 8.8 g 11.2 g

mass of reactant = mass of products = 20g.

Hence the law of conservation of mass is obeyed.

50. (c) The conditions given are standard conditions

224 mL has mass = 1g ;

22400 mL will have mass = 100g. This is mol. wt of gas

6.023×10^{23} molecules have $3 \times 6.023 \times 10^{23}$ atoms since gas is triatomic

$\therefore$ weight of one atom

$$= \frac{100}{3\times6.023\times10^{23}} \quad 5.5\times10^{-23}\,g$$

51. (d) Specific volume (volume of 1 g) of cylindrical virus particle = 6.02×10^{-2} cc/g

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

Length of virus = 10×10^{-8} cm

Volume of virus =

$$\pi r^2 l \quad \frac{22}{7}\times(7\times10^{-8})^2\times10\times10^{-8}$$

$= 154 \times 10^{-23}$ cc

$$\text{Wt. of one virus particle} \quad \frac{\text{volume}}{\text{specific volume}}$$

$\therefore$ Mol. wt. of virus = Wt. of N_A particle

$$= \frac{154\times10^{-23}}{6.02\times10^{-2}}\times6.02\times10^{23} = 15400\ \text{g/mol}$$

$= 15.4$ kg/mol

52. (b) Meq of oxalic acid in 16.68 ml = Meq of NaOH

$$= 25 \times \frac{1}{15}$$

Meq of oxalic acid in 250 ml

$$= 25 \times \frac{1}{15} \times \frac{250}{16.68} = 24.98$$

$$\frac{1.575}{(90 \quad 18x)/2}\times1000 = 24.98$$

$\therefore \quad x = 2$

53. (c) $5CO \quad I_2O_5 \rightarrow 5CO_2 \quad I_2$

$$\text{Moles of } I_2O_5 = \frac{25.4}{254}$$

$= 0.01 \equiv 0.05$ moles of CO

Weight of CO = $0.05 \times 28 = 1.4$ g;

Weight of $CO_2 = 2 - 1.4 = 0.6$ g

$$\text{Hence \% of } CO_2 = \frac{0.6}{2} \times 100 = 30\%$$

54. (d) 3 molecules of O_2 = 1 molecules of CS_2

6 molecules of O_2 = 2 molecules of CS_2

55. (b) The required equation is

$$2KMnO_4 \quad 3H_2SO_4 \longrightarrow$$

$$K_2SO_4 \quad 2MnSO_4 \quad 3H_2O \quad \underset{\text{nascent oxygen}}{5\ O}$$

$$2Fe(C_2O_4) \quad 3H_2SO_4 \quad 3\ O \longrightarrow$$

$$Fe_2(SO_4)_3 \quad 2CO_2 \quad 3H_2O$$

O required for 1 mol. of $Fe(C_2O_4)$ is 1.5, 5 O are obtained from 2 moles of $KMnO_4$

$\therefore$ 1.5 [O] will be obtained from

$$= \frac{2}{5}\times1.5 \quad 0.6 \text{ moles of } KMnO_4.$$

56. (d) Weight of Iron in 67200

$$= \frac{0.33}{100}\times67200 \quad 221.76$$

Number of atoms of Iron

$$= \frac{221.76}{56} \quad 3.96 \equiv 4$$

57. (d) Volume of gold foil = $25 \times 40 \times 0.25$ mm^3

$= 250 \times 10^{-3}$ cm^3

Mass of gold foil = $19.32 \times 250 \times 10^{-3}$ g

$= 4.83$ g

$$\text{No. of gold atoms} = \frac{4.83}{197}\times N_A$$

$= 1.47 \times 10^{22}$

58. (c) Writing the equation of combustion of propane (C_3H_8), we get

$$\underset{1L}{\overset{1vol}{C_3H_8}} + \underset{5L}{\overset{5vol}{5O_2}} \rightarrow 3CO_2 \quad 4H_2O$$

From the above equation we find that we need 5 L of oxygen at NTP to completely burn 1 L of propane at N.T.P.

If we change the conditions for both the gases from N.T.P. to same conditions of temperature and pressure. The same results are obtained. i.e. 5 L is the correct answer.

59. (a)

$$I_2 + 2Cl_2 \longrightarrow ICl + ICl_3$$

No. of moles initially	$\frac{25.4}{254}$	$\frac{14.2}{71}$	0	0
	0.1	0.2	0	0
No. of moles after reaction	0	0	0.1	0.1

60. **(a)** $2SO_2 + O_2 \longrightarrow 2SO_3$

10 15 0

$10-2x$ $15-x$ $2x$

$\because 2x = 8 \quad x = 4$

Hence, remaining, $SO_2 = 10-8 = 2$ moles,

$O_2 = 15-4 = 11$ moles

61. **(d)**

$4NH_3(g) \quad 5O_2(g) \longrightarrow 4NO(g) \quad 6H_2O(l)$

	4 moles	5 moles	4 moles	6 moles
Given	1 Mole	1 Mole		
Reacting	0.8	1	0.8	1.2

All O_2 consumed being limiting reagent.

62. **(b)** $C_2H_6 + 3.5O_2 \longrightarrow 2CO_2 + 3H_2O$;

$C_2H_4 + 3O_2 \longrightarrow 2CO_2 + 2H_2O$

Let volume of ethane is x litre,

$22.4 \times 4 = 3.5x + 3(28-x)$

$\Rightarrow x = 11.2$ litre

at constant T and P, V n;

$\Rightarrow$ Mole fraction of C_2H_6 in mixture

$= \frac{11.2}{28} \quad 0.4$

63. **(c)** $X_{Sn} = \frac{12.5/119}{\frac{50}{209} \quad \frac{25}{207} \quad \frac{12.5}{119} \quad \frac{12.5}{112}} \quad 0.176$

64. **(b)** $\underset{1\,mol}{Ba(OH)_2} + CO_2 \longrightarrow \underset{1\,mol}{BaCO_3} \quad H_2O$

1 mol $Ba(OH)_2$ = 1 mol $BaCO_3$

$\therefore$ 0.205 mol $Ba(OH)_2 \equiv 0.205$ mol $BaCO_3$

Wt. of substance = No. of moles × Molecular mass= 0.205 × 197.3 = 40.5 g

65. **(b)** $SO_2Cl_2 + 2H_2O \rightarrow H_2SO_4 \quad 2HCl$

$H_2SO_4 \quad Ba(OH)_2 \rightarrow BaSO_4 \quad 2H_2O$

$2HCl \quad Ba(OH)_2 \rightarrow BaCl_2 \quad 2H_2O$

Total moles of $Ba(OH)_2$ required = 2

66. **(d)** Let x g of Li_2CO_3 and (1 – x) g of M_2CO_3 present in given mixture

2 × Total moles of carbonates = moles of HCl and

$2\times\left(\frac{x}{74} \quad \frac{1-x}{2M \quad 60}\right) \quad 21.6\times0.5\times10^{-3}$

$x = 0.20$

$\because \frac{x}{74} \quad \frac{1-x}{2M \quad 60}$

$M = 118$

67. **(a)** m-eq.$FeSO_4(NH_4)_2SO_4.6H_2O$ = m-eq. of $KMnO_4$ (n = 1)

$\frac{W}{392}\times1\times1000 = 0.1\times50$

Hence, % purity of Mohr's salt

$= \frac{1.96}{2.5}\times100 \quad 78.4\% \qquad W = 1.96$ g

68. **(a)** $\underset{\substack{2\times122.5g\\245}}{2KClO_3} \xrightarrow{heat} 2KCl \quad \underset{\substack{3\times32g\\96}}{3O_2}$

48 g of oxygen will be produced from 122.5 g of $KClO_3$

$\therefore$ Amount of 80% $KClO_3$ needed

$= \frac{100}{80}\times122.5 \quad 153.12$g

69. **(b)** $\underset{\substack{1\,mole\\ \frac{1}{2}\,mole}}{Mg} + 2HCl \rightarrow MgCl_2 + \underset{\substack{1\,mole\\ \frac{1}{2}\,mole\,(12g\ of\ Mg \quad \frac{1}{2}mol)}}{H_2}\uparrow$

70. **(a)** Decomposition of Ag_2CO_3 gives silver

$\underset{\substack{2\times276g\\2.76g}}{2Ag_2CO_3} \rightarrow \underset{\substack{4\times108g\\2.16g}}{4Ag} \quad 2CO_2 \quad O_2$