Stoichiometry

1. **The law of multiple proportions is illustrated by**

   1) HBr, HI 2) H_2O, D_2O 3) CO, CO_2 4) CaO, MgO

2. **Nitrogen forms N_2O, NO, N_2O_3, NO_2 & N_2O_5 with oxygen, it illustrates the?**

   1) Law of definite proportions 2) Law of multiple proportions

   3) Law of reciprocal proportion 4) Law of conservation of mass

3. **A balanced chemical equation obeys**

   1) Law of multiple proportions 2) Law of definite proportions

   3) Law of reciprocal proportion 4) Law of conservation of mass

4. **In an experiment 10 g of $CaCO_3$ on heating gave 4.6 g of CaO & 2.24lt of CO_2 at STP. These results show the law of**

   1) Gay-Lussac's 2) Constant proportions

   3) Conservation of mass 4) Reciprocal proportions

5. **The percentage compositions of four hydrocarbons is given**

	I	II	III	IV	
% of C	**75**	**80**	**85.7**	**91.3**	
% of H	**25**	**20**	**14.3**	**8.7**	

   These data illustrate the law of

   1) Constant proportions 2) Reciprocal proportions

   3) Definite proportions 4) Multiple proportions

6. **In H_2 (g) + Cl_2 (g) $\rightarrow$ 2HCl (g) the ratio of volumes of H_2 Cl_2 & HCl gases is 1: 1: 2. These figures illustrate the law of**

   1) Multiple proportions 2) Combining Volumes

   3) Definite proportions 4) Reciprocal proportions

7. Law of reciprocal proportion was given by

1) Dalton 2) Ritcher 3) Proust 4) Lavoiser

8. The following data are avaiable

a) % of Mg in MgO and in $MgCl_2$ b) % if C in CO & CO_2

c) % of Cr in $K_2Cr_2O_7$ & K_2CrO_4 c) % of Cu isotopes in Cu Metal

The law of multiple proportions may be illustrated by data

1) a and b 2) b only 3) b & d 4) c only

9. Law of multiple proportions is given by the pair

1) SO2 & SO_3 2) H_2O & D_2O

3) NaCl & NaBr 4) MgO & $MgCl_2$

10. Percentage of copper & oxygen in samples of CuO obtained by different methods were found to be the same. This proves the law of

1) Constant proportions 2) Reciprocal proportions

3) Multiple proportions 4) None

11. Oxygen combines with the isotopes of carbon to form two samples of CO_2. This data illustrates the law of

1) Conservation of mass 2) Multiple proportions

3) Reciprocal proportions 4) None

12. In SO_2 & SO_3 the ratio of the weights of oxygen that combines with a fixed weight of sulphur is 2: 3. This illustrates the law of

1) Constant proportions 2) Conservation of mass

3) Multiple proportions 4) Reciprocal proportions

13. CO_2 was prepared by i) buring C in air and ii) The action of dil HC*l* on $MgCO_3$. In both casescarbon & oxygen combined in the ratio of 3: 8. These figures illustrate the law of

1) Constant proportions 2) Reciprocal proportions

3) Multiple proportions 4) Conservation of mass

14. A sample of $CaCO_3$ has Ca = 40%, C = 12% and 0 = 48% if the law of definite proportions is true then the mass of Ca in 4g of a sample of a $CaCO_3$ from another source will be

1) 0.16 g 2) 1.6 g 3) 16 g 4) 0.016 g

15. 1.0 g of an oxide of A contained 0.5 g of A. 4.0 g of another oxide of A contained 1.6 g of A. The data indicates the law of

1) Reciprocal proportions 2) Constant proportions

3) Conservation of energy 4) Multiple proportions

16. Which of the following data illustrates the law of conservation of mass?

1) 12 g of *C* is heated in vacuum & on cooling there is no change is mass.

2) 56 g of *CO* reacts with 32 g of oxygen to form 44 g of CO_2.

3) 1.70 g of $AgNO_3$ reacts with 100 ml 0.1 M HC*l* to produce 1.435 g of AgC*l* & 0.63 g of HNO_3.

4) None

17. 'H' combines with 'O' to form H_2O in which 16 g oxygen combines with 2g of hydrogen. 'H' also combines with carbon to form CH_4 in which 2g of 'H' combine with 6g of carbon if 'C' & 'O' combine together then they will do so in the ratio of

1) 6: 18 2) 6: 16 3) 1: 2 4) 12: 24

18. SO_2 contains 5% S, H_2S contains 5.8% H_2 while H_2O contains 11.12 % of H_2. These figures illustrate the law of

1) Conservation of mass
2) Reciprocal proportions
3) Definite proportions
4) Multiple proportions

19. The percentage of hydrogen in water & Hydrogen peroxide are respectively 11.2% and 5.94%. This illustrates the law of

1) Conservation of mass
2) Multiple proportions
3) Constant composition
4) Reciprocal proportions

20. 4.4 g of an oxide of nitrogen gives 2.2 litres of nitrogen and 60g of another oxide of nitrogen gives 22.4 litres of nitrogen at NTP. The data shows

1) Law of conservation of mass
2) Law of multiple proportions
3) Law of constant proportions
4) Law of gaseous volumes

21. Law of difinite proportions does not apply to nitrogen oxide because

1) Mass number of nitrogen is not constant
2) Atomic weight of oxygen is variable
3) Equivalent weight of nitrogen is variable
4) Molecular weight of nitrogen is not fixed

22. Which one illustrates the law of reciprocal proportions?

1) CS_2, CO_2, SO_2
2) PH_3, P_2O_3, P_2O_5
3) N_2O_3, N_2O_4, N_2O_5
4) NaCl, NaBr, NaI

23. 1.5 g of hydrocarbon on combustion in excess of oxygen produces 4.4 g of CO_2 and 2.7 g of H_2O. The data illustrates the law of

1) Definite composition
2) Conservation of mass
3) Multiple proportions
4) Reciprocal proportions

24. If Law of conservation of mass was to hold true then 20.8 g of $BaCl_2$ on reaction with 9.8 g of H_2SO_4 will produce 7.3 g of HCl and $BaSO_4$ equal to

1) 25.5 g 2) 23.3 g 3) 11.65 g 4) 30.6 g

25. Law of reciprocal proportions can be used to determine

1) Atomic weights of a gas 2) Equivalent heights

3) Molecular weights of gases 4) None of these

26. Which of the following statement is correct?

1) There is no difference between precision and accuracy.

2) A good precision always means good accuracy.

3) Accuracy means that all measured values of an experiment are close to the actual value.

4) A measurement may have good accuracy but poor precision.

27. The number of significant figures in 0.0024 are

1) Two 2) Three 3) Four 4) Five

28. The number of significant figures in 96500 are

1) Three 2) Four

3) Five 4) Can be any of these

29. The number of significant figures in Avogadro's number (N_0) 6.023×10^{23} is

1) Three 2) Four 3) Five 4) Twenty Four

30. 1.00025 has how many significant figures?

1) 5 2) 3 3) 4 4) 6

31. The gram atomic weight of Silver is reported as 108.000gm. The number of significant figures in it is

1) 6 2) 3 3) 5 4) 4

32. The number of significant figures in the charge of electron i.e. 1.602×10^{-19} Coulmbs

1) 1 2) 2 3) 3 4) 4

33) 0.414 has how many significant figures?

1) 1 2) 2 3) 3 4) 4

34. The correctly reported answer of the addition of 3.829, 1.3 and 7.24 will have significant figures

1) Two 2) Three 3) Four 4) Five

35. The correctly reported answer of the addition of 154.21, 6.142 and 23 will be

1) 183.352 2) 183.35

3) 183.4 4) 183

36. The correctly reported difference of 16.4215 and 6.01 will have significant figures equal to

1) Three 2) Four 3) Five 4) Six

37. After rounding 6.235 and 6.225 to three significant figures, we will have their answers respectively as

1) 6.23, 6.22 2) 6.24, 6.123 3) 6.23, 6.23 4) 6.24, 6.22

38. The actual product of 4.327 and 2.8 is 12.1156. The correctly reported answer will be

1) 12 2) 12.1 3) 12.12 4) 12.116

39. On dividing 0.46 by 15.374, the actual answer is 0.029236. The correctly reported answer will be

1) 0.02923 2) 0.029 3) 0.029236 4) 0.02924

40. Two students x and y report the length of a pen as 12.0cm and 12.00cm respectively. Which of the following statements is correct?

1) Both are equally accurate

2) x is more accurate than y

3) y is more accurate than x

4) None of these

41. In which of the following numbers all zeros are significant?

1) 0.00004 2) 0.0060 3) 20.000 4) 0.800

42. The number of significant figures in the value of Plank's constant is (6.625×10^{-34}Js.)

1) Four 2) Five 3) Three 4) Thirty four

43)21.4g sample of ethyl alcohol contains 0.004g of water. The amount of pure ethyl alcohol (to the proper number of significant figures) is:

1) 21.396 g 2) 21.40g 3) 21.4g 4) 21.3 g

44. The number of significant figures in 5 are

1) Five 2) Infinite number 3) Zero 4) One

45. The Rydberg's constant is $1.0973731 \times 10^{7}m^{-1}$. It can be expressed to three significant figures as:

1) $1.0974\times10^{7}m^{-1}$ 2) $1.09\times10^{7}m^{-1}$ 3) $1.10\times10^{7}m^{-1}$ 4) $1.10^{7}m^{-1}$

KEY

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

Empirical and Molecular Formula

Percent composition

The composition of pure chemical compound is always fixed according to law of definite proportions.

The weight in grams of an element present in 100 grams of its compound is called weight percent of that element.

Weight percent of an element in a compound = $\frac{\text{Weight of element in one mole of the compound}}{\text{Gram molecular weight of compound}} \times 100$

Eg. The weight percent of oxygen in NaOH is

Solution: Weight percent of oxygen = (16/40) x100=40%

"Empirical formula of a compound is the simplest formula showing the relative number of atoms of different elements present in one molecule of the compound"

"Molecular formula represents the actual number of atoms of different elements present in one molecule of the compound."

For certain compounds the molecular formula and the empirical formula may be one and the same.

E.g.: Compound	**Empirical formula**	**Molecular formula**
Methane	**CH_4**	**CH_4**
Water	**H_2O**	**H_2O**

The molecular formula of a compound may be same as empirical formula or whole number multiple of it. Thus,

The molecular formula = $(\text{empirical formula}) \times n$ Where n is an integer 1, 2, 3 ... etc.

If the vapour density of the substance is known, its molecular weight can be calculated by using the equation.

2 x Vapour density = Molecular weight.

The difference between empirical and molecular formula illustrated with some examples in

Compound	**Empirical formula**	**n**	**Molecular formula**
Benzene	**CH**	**6**	**C_6H_6**
Butane	**C_2H_5**	**2**	**C_4H_{10}**
Ethane	**CH_3**	**2**	**C_2H_6**
Acetic acid	**CH_2O**	**2**	**$C_2H_4O_2$**
Glucose	**CH_2O**	**6**	**$C_6H_{12}O_6$**

Calculation of the empirical formula

Empirical formula can be determined from the mass percentages of various elements present in a compound.

The sequence of steps in the determination of empirical formula is:

1) The weight percentage (or weight) of each constituent element is taken or to be calculated.

2) The percent weight of each constituent is to be divided with its atomic weight to get relative number of atoms of each element.

3) The simplest whole number ratio of the values of step (2) is to be obtained. This may be done by dividing all values with the smallest among them. If it is not a whole number, then multiply them with a suitable integer to get whole number ratio.

4) The simplest atomic ratio obtained in (3) represents empirical formula.

Eg. The percentage composition of an organic compound is given below. Calculate the emperical formula

C = 70.59; H = 5.88; O = 23.53

Solution: **Percentage of the elements present**

Carbon **Hydrogen** **oxygen**.

70.59 5.88 23.53

Dividing the percentage compositions by the respective atomic weights of the elements

70.59/12= 5.88 5.88/1 = 5.88 23.53/16= 1.47

Dividing equal value in step 2 by the smallest number among them to get simple atomic ratio

5.88/1.47= 4 5.88/1.47= 4 1.47/1.47= 1

The ratio of atoms present in the molecule

C : H: O

4 : 4: 1

The empirical formula of the compound = C_4H_4O

STOICHIOMETRY

1. **A compound made of two elements A & B are found to contain 25% A (atomic mass 12.5) and 75% B (atomic mass 37.5) The simplest formula of the counpound is**

   1) AB 2) AB_2 3) AB_3 4) A_3B

   Ans:1

   A B

   25/12.5 =2 75/37.5=2

   Therefore simple ratio is 1:1, E, F is AB

2. **On analysis a certain compound was found to contain iodine and oxygen in the ratio of 254 g of iodine (atomic mass 127) and 80g oxygen. The formula of the compound**

   1) IO 2) I_2O_4 3) I_5O_3 4) I_2O_5

   Ans: 4. No, of mole atoms Iodine= 254/127 =2

   No, of mole atoms Oxygen=80/16 =5, Simple ratio is 2: 5, formula is I_2O_5.

3. **The weight percentage of oxygen in NaOH is**

   1) 40 2) 60 3) 8 4)10

   Ans: 1, Wt% of O= (16/40) X100=40%

4. **60 g of a compound on analysis gave 24 g 'C', 4g 'H' & 32 g 'O'. The empirical formula of the compound is**

   1) $C_2H_4O_2$ 2) $C_2H_2O_2$ 3) CH_2O_2 4) CH_2O

   Ans: 4, No. of mole atoms of C=24/12 =2, of H=4/1=4 and of O=32/16 =2

   Thus simple ratio is 1:2:1 and EF is CH_2O

5. Caffine contains 28.9% by mass of nitrogen. If molecular mass of caffine is 194, then the number of nitrogen atoms present in one molecule of caffine is

1) 3 2) 4 3) 5 4) 6

Ans: 2, 100 g of caffeine contains 28.9 gm of N

194g of caffeine contains (194/100) X28.9 =56.06g of N =56.06/14 =4

6. A phosphorus oxide has 43.6 % phosporus. The empirical formula of the compound is

1) P_2O_5 2) P_2O_3 3) P_4O_6 4) PO_2

Ans: 1

	P	O
	43.6/31 =1.4	100-43.6=56.4/16 =3.52
	1.4/1.4=1	3.52/1.4= 5/2

Simple ratio is 1:5/2 =2:5

7. Two elements X (at.wt = 75) and Y (at.wt = 16) combine to give compound having 75.8% X. The compound is

1) XY 2) X_2Y 3) X_2Y_2 4) X_2Y_3

Ans: 4

	X	Y
	75.8/75 =1.01	100-75.8=24.2/16 =1.5
	1.01/1.01=1	1.5/1.01= 3/2

Simple ratio is 1:3/2 =2:3

8. Atomic weight of a metal M is 56. The empirical formula of its oxide containing 70% of M is

1) MO_2 2) M_2O_3 3) M_3O_2 4) MO_4

Ans: 2

	M	O
	(70/56)=5/4	(30/16)=15/8

Simple ratio is 5/4:15/8 =1: 3/2 =2:3, E.F= M_2O_3

9. A certain compound has the molecular formula X_4O_6. If the compound contains 56.2% of X. Then the atomic mass of X is

1) 48 a.m.u 2) 30.8 a.m.u

3) 42 a.m.u 4) 62.0 a.m.u

Ans: 2 1mole X_4O_6 contains 96gm of O

Given 56.2gm X combines with 43.8gm O

Wt of X that combines with 96gm O =(96/43.8)X56.2 =123.18

Atomic mass of X=123.18/4 =30.79amu

10. An organic compound containing C, H & O has a vapour density 83. The molecular formula of the compound is

1) $C_6H_3O_2$ 2) $C_5H_6O_2$

3) $C_8H_6O_4$ 4) $C_8H_{10}O_3$

Ans: 3 Molecular wt= 2 X VD=2X83=166.

Molecular wt of $C_8H_6O_4$ =166

11. A carbon compound contains 80% carbon & 20% hydrogen. Its molecular formula is likely

1) C_2H_4 2) C_2H_6 3) C_3H_8 4) C_4H_{10}

Ans: 2 C =80/12 =6.66, H: 20/1=20

Simple ratio of C: H= (6.66/6.66): (20/6.66) = 1:3 $\therefore$ E.F=CH_3

12.

List - I	**List - II (Empirical formula)**
A) Glucose	**1) BNH_2**
B) Oxalic acid	**2) CH_2O**
C) Inorganic benzene	**3) CH**
D) Hydrogen peroxide	**4) CHO_2**
The correct match is	**5) HO**

	A	B	C	D
1)	3	5	2	4
2)	2	4	1	5
3)	1	3	2	4
4)	4	2	1	3

Ans: 2

13.

List - I	**List - II**
A) CH_4	**1) 90% C**
B) C_2H_6	**2) 75% C**
C) C_2H_4	**3) 80 % C**
D) C_3H_4	**4) 85.7% C**
	5) 60% C

	A	B	C	D
1)	2	3	4	1
2)	5	1	2	4
3)	3	2	4	1
4)	2	1	5	3

Ans: 1 %wt of C = (wt of C/molar mass of compound) X100

14. 4 g of a hydrocarbon on complete combustion gives 12.571 g of CO_2. The compound may be

i) C_2H_4 ii) CH_4 iii) C_3H_8 iv) C_4H_8

1) i only 2) ii only 3) ii & iii only 4) i & iv only

Ans: 4 %c = $\frac{wtofCO_2 \times 12 \times 100}{WtofOrganic.compound \times 44} = \frac{12X12.571x100}{4X44}$ =85.7%

H=100-85.7=14.3

C= (85.7/12)=7.14 , H= (14.3/1)=14.3

Simple ratio of C and H = (7.14/7, 14): (14.3/7.14)= 1:2 ∴ E.F=CH_2.

15. Assertion (A): Empirical formula of glucose & acetic acid is CH_2O.

Reason (R): The percentage composition of elements is same in both.

1) Both A and R are true, and R is correct explanation of A.

2) Both A and R are true, and R is not correct explanation of A.

3) A is true, but R is false.

4) Both A and R are false.

Ans: 1

16. An alkane has C/H ratio (by mass) of 5.1428. Its molecular formula is

1) C_5H_{12} 2) C_6H_{14} 3) C_8H_{18} 4) C_7H_{16}

Ans: 2 C_6H_{14} contains 72gm of C and 14 gm of H. C/H =72/14 =5.14

17. An organic compound is found to contain C = 54.5%, 0 = 36.4% and H = 9.1% by mass. Its empirial formula is

1) CH_2O 2) CHO_2 3) C_2H_4O 4) C_3H_8O

Ans: 3, C=54.5/12= 4.54, H=9.1/1=9.1 and O= 36.4/16 =2.27

Simple ratio = (4.54/2.27): 9.1/2.27):2.27/2.27)= 2:4:1 $\therefore$ E.F= C_2H_4O

18. The empirical formula of a compound is CH_2O. Its molecular weight is

120. The molecular formula of the compound is

1) CH_2O 2) $C_2H_4O_2$ 3) $C_3H_6O_3$ 4) $C_4H_8O_4$

Ans: 4 Empirical formula weight =12+2+16=30, n = 120/30 =4

The molecular formula = E.FXn= $(CH_2O)_4$

19. In a compound C, H & N atoms are present in 9: 1: 3.5 by weight. Molecular weight of compound is 108. Molecular formula of the compound is

1) $C_2H_6N_2$ 2) C_3H_4N 3) $C_6H_8N_2$ 4) $C_9H_{12}N_3$

Ans: 2, C: H: N = (9/12): (1/1): (3.5/14) = ¾: 1: ¼= 3:4:1. EF = C_3H_4N

20. 0.36 g of an organic compound on complete combustion gives 1.1 g of CO_2 and 0.54g of H_2O, then percentage composition of Carbon & Hydrogen respectively in the compound are

1) 60, 40 2) 77.8, 22.2 3) 75, 25 4) 83.33, 16.67

Ans: 4, %C = (12X1.1X100/44X0.36) =83.33%

%H = (2X0.54X100/18X0.36)= 16.67%

21. 0.2 g of an Organic compound on complete combustion liberates 56.CC of nitrogen at STP, then percentage composition of Nitogen in the compound is

1) 70 2) 35 3) 17.5 4) 8.75

Ans: 2, %N = (vol. of N_2 in c.c at STP)/8w = (56/8) x0.2=35%

22. A hydrocarbon contains 10% hydrogen, and then the hydrocarbon may be

A) Alkane B) Alkene C) Alkyne

1) Only C 2) A or B 3) B or C 4) A or B or C

Ans: 1.

Mole atoms of C =90/12= 7.5

Mole atoms of H =10/1=10

Simple ratio of C and H= (7, 5/7.5): (10/7.5) =1:4/3=3:4. $\therefore$ E.F= C_3H_4

Hence it is an alkyne.

23. The empirical formula of an organic compound is CH_2O, its vapour density is 45, then its molecular formula is

1) C_2H_5O 2) $C_3H_6O_3$ 3) $C_2H_4O_2$ 4) $C_4H_3O_4$

Ans: 2, Empirical formula weight =12+2+16=30, Molecular wt=2X V.D=2X45=90, n = 90/30 =4

The molecular formula =E. FXn= ($CH_2O)_3$

24. 0.2 mole of an alkane on combustion gives 26.4g CO_2 gas then molecular formula of alkane is

1) C_3H_8 2) C_4H_{10} 3) C_2H_6 4) CH_4

Ans: 1,

0.2 moles give 26.4gm CO_2

Thus 1mole gives 26.4/0.2 =132gm= 132/44 =3 moles CO_2.

$\therefore$ Alkane has 3 carbon atoms. $\therefore$ Formula is C_3H_8

25. 0.5 g of an organic compound on complete combustion produces 0.44g CO_2. The percentage of carbon in the compound is

1) 48% 2) 12% 3) 60% 4) 24%

Ans: 4,

%C = (12X0.44X100)/44X0.5=24%