



MEGA LECTURE

Chapter

1

BASIC CONCEPTS

Formula of mass spectrograph:

(The formula for mass charge ratio for mass spectrograph is $m/e = \frac{H^2 r^2}{2E}$ where 'H' is the strength of magnetic field, E is strength of electrical field and r is the radius of curvature of positive ion.

EQUATIONS TO SOLVE THE NUMERICALS

(1) Empirical and Molecular Formula

- (i) Average atomic mass of an element

$$= \frac{\text{Sum of multiplication of isotopic mass and relative abundance}}{100}$$
- (ii) % composition of an element in a compound

$$= \frac{\text{Mass of element} \times 100}{\text{Mass of the compound}}$$
- (iii) The % of C, H and O in an organic compound is determined by combustion analysis. The formulas are as follows: (Faisalabad 2013)
- % of carbon = $\frac{\text{Mass of CO}_2}{\text{Mass of organic compound}} \times \frac{12 \times 100}{44}$
- % of hydrogen = $\frac{\text{Mass of H}_2\text{O}}{\text{Mass of organic compound}} \times \frac{2 \times 100}{18}$
- % of oxygen = $100 - (\% \text{ of C} + \% \text{ of H})$
- (iv) Molecular formula = $n(\text{empirical formula})$

$$n = \frac{\text{Molar mass}}{\text{Empirical formula mass}}$$

(2) Concept of Mole and Avogadro's Number

- (i) 1 gram atom of an element = $\frac{\text{Mass of element}}{\text{Atomic mass}}$
- (ii) 1 gram molecular mass of a compound = $\frac{\text{Mass of the compound}}{\text{Molar mass}}$
- (iii) 1 gram formula mass = $\frac{\text{Mass of the ionic compound}}{\text{Formula mass}}$

- (iv) 1 gram ion = $\frac{\text{Mass of the ion}}{\text{Ionic mass}}$
- (v) Number of atoms of an element = Number of gram atoms $\times N_A$
- (vi) Number of molecules of a compound = Number of gram mole $\times N_A$
- (vii) Number of formula units in an ionic compound =
Number of gram formula $\times N_A$
- (viii) Number of ions = Number of gram ions $\times N_A$
- (ix) Number of atoms of an element = $\frac{\text{Mass of element} \times N_A}{\text{Atomic mass}}$
- (x) Number of molecules of a compound = $\frac{\text{Mass of compound} \times N_A}{\text{Molar mass}}$
- (xi) Number of formula units in an ionic compound
= $\frac{\text{Mass of the ionic compound}}{\text{Formula mass}} \times N_A$
- (xii) Number of ions = $\frac{\text{Mass of the ions}}{\text{Ionic mass}} \times N_A$
- (xiii) Number of atoms of an element in a molecule
= Number of molecules \times number of atoms of that element in molecule.
- (xiv) Volume of a gas at S.T.P. = Number of moles of gas $\times 22.414 \text{ dm}^3$
- (xv) % yield = $\frac{\text{Actual yield}}{\text{Theoretical yield}} \times 100$

METHODS TO SOLVE THE NUMERICAL PROBLEMS

(1) Determination of average atomic mass of an element from the % relative abundance and isotopic masses

The % relative abundance of each isotope is multiplied with isotopic mass. These factors are added up for all the isotopes and divided by 100.

(2) Determination of % of an element in a compound

The mass of that element in the compound is divided by the molar mass of the compound and multiplied by 100.

(3) Determination of empirical formula

The % of each element is divided by the atomic mass to get the mole ratios. The mole ratios are divided by the smallest value to get the atomic ratios. If the atomic ratios are whole numbers, then well and good, otherwise multiply with a suitable digit to get the whole numbers. These whole numbers give the empirical formula.

(4) Determination of molecular formula from empirical formula

For this purpose, we should know the molar mass of the compound. Molar mass is divided by empirical formula mass to get the 'n' factor.

n is multiplied with empirical formula to get the molecular formula.

(5) Calculation of mole of a substance

Number of moles of elements are obtained by dividing the mass of the element with atomic mass.

In case of molecular compounds, the mass of the substance is divided by molar mass to get the number of moles of the compound.

(6) Calculation of number of atoms

To calculate the number of atoms of an element, divide the mass of the element by atomic mass and multiply with N_A .

(7) Stoichiometric calculation the number of molecules

To calculate the number of molecules of a compound divide mass of the compound by molar mass and multiply with N_A .

(8) Stoichiometric calculations

In stoichiometric calculations, the mass of the given substance is converted into number of moles. These moles are compared with the moles of that substance whose amount is required. For the purpose of comparison, we take the help of balanced chemical equation.

(9) Calculation of limiting reagent

To calculate the limiting reagent, we first of all calculate the number of moles of all the reactants whose masses are given. These number of moles are compared with number of moles of the required substance. That substance among the reactants, which gives lesser number of moles of the required product is the limiting reagent. The less number of moles of the required product is multiplied by molar mass to get its mass.

(10) Calculation of % yield

In order to calculate the % yield of a chemical reaction we need the actual yield. This is mostly given in the numerical. The theoretical yield is calculated from the balanced chemical equation according to the disciplines of stoichiometry.

TABLES

Natural abundance of some common isotopes

Element	Relative abundances in %	
Hydrogen	$^1_1\text{H} = 99.985$	$^2_1\text{H} = 0.015$
Carbon	$^{12}_6\text{C} = 98.893$	$^{13}_6\text{C} = 1.107$
Nitrogen	$^{14}_7\text{N} = 99.634$	$^{15}_7\text{N} = 0.366$
Oxygen	$^{16}_8\text{O} = 99.759$	$^{17}_8\text{O} = 0.037, ^{18}_8\text{O} = 0.204$
Sulphur	$^{32}_{16}\text{S} = 95.0$	$^{33}_{16}\text{S} = 0.76, ^{34}_{16}\text{S} = 4.22, ^{36}_{16}\text{S} = 0.014$
Fluorine	$^{19}_9\text{F} = 100$	
Chlorine	$^{35}_{17}\text{Cl} = 75.53$	$^{37}_{17}\text{Cl} = 24.47$
Bromine	$^{79}_{35}\text{Br} = 50.54$	$^{81}_{35}\text{Br} = 49.49$
Iodine	$^{127}_{53}\text{I} = 100$	

Atomic masses and abundances of several naturally occurring isotopes

Isotope	Mass number	% natural abundance	Relative atomic mass	Average atomic mass of elements
H - 1	1	99.985	1.007825	1.00794
H - 2	2	0.015	2.0140	
C - 12	12	98.893	12 (by definition)	12.011
C - 13	13	1.10		
O - 16	16	99.759	15.994915	15.9994
O - 17	17	0.038	16.999131	
O - 18	18	0.200	17.999160	
Cu - 63	63	69.17	62.939598	63.546
Cu - 65	65	30.83	64.927793	
Cs - 133	133	100	132.905329	132.905
Ur - 235	235	0.720	235.043924	238.0289
Ur - 238	238	99.280	238.050784	

DEFINITIONS

(May be used in short questions with examples)

1. % yield:

That yield which is obtained by dividing the actual yield with theoretical yield and multiplying with 100 is called % yield. It is calculated for knowing the efficiency of a chemical reaction. Formula; $\% \text{ yield} = \frac{\text{Actual yield}}{\text{Theoretical yield}} \times 100$

2. Actual yield:

The actual amount of the product which is obtained in a chemical reaction is called actual yield. It is an experimental quantity and is mostly less than the theoretical yield. Theoretical yield is calculated from the balanced chemical reaction. We take the help of stoichiometry for calculating theoretical yield.

3. Atom:

The smallest particle of an element which may or may not exist independently is called an atom. The atoms of O, Cu and Au are made up of protons, neutrons and electrons. No doubt, other fundamental particles are also there.

4. Atomic-mass-unit:

It is the mass of 1/12th of one atom of carbon with lightest isotope C - 12. Its value is 1.661×10^{-24} kg. It is calculated with help of Avogadro's number.

5. Average atomic mass:

It is the average of atomic masses of all the isotopes of an element. Every isotope has its own atomic mass. The average atomic mass is a fractional quantity.

6. Avogadro's number:

(Lahore 2014, Sahiwal 2014)

It is the number of atoms, molecules, formula units or ions present in one mole of the element, a compound, or an ionic substance is called Avogadro's number. Its value is 6.02×10^{23} .

Formula applied:

$$\text{Average At. mass} = \frac{(\text{mass of Ne}^{20} \times \% \text{ abundance}) + (\text{mass of Ne}^{21} \times \% \text{ abundance}) + (\text{mass of Ne}^{22} \times \% \text{ abundance})}{100}$$

Putting the values

$$\begin{aligned} \text{Average atomic mass of Neon} &= \frac{20 \times 90.92 + 21 \times 0.26 + 22 \times 8.82}{100} \\ &= \frac{1818.4 + 5.46 + 194.04}{100} \\ &= \frac{2017.9}{100} = \boxed{20.18 \text{ a.m.u}} \text{ Ans.} \end{aligned}$$

Therefore the average atomic mass of neon is 20.18 a.m.u

7. Branches of chemistry:

Some important branches of chemistry are as follows:

- (i) Physical chemistry
- (ii) Inorganic chemistry
- (iii) Organic chemistry
- (iv) Analytical chemistry
- (v) Bio-Chemistry
- (vi) Applied chemistry or Industrial chemistry

The average atomic mass of three isotopes of Ne is as follows.

8. Chemistry:

That branch of science which deals with the structure of matter, composition of matter, changes of matter and laws and principles which govern these changes is called chemistry.

9. Empirical formula:

Lahore (2007)

That formula of a substance which gives the simple ratio of the elements present in the molecule of a substance. The empirical formula of H_2O_2 is HO, of Na_2O_2 is NaO and of $\text{C}_6\text{H}_{12}\text{O}_6$ is $\text{C}_1\text{H}_2\text{O}_1$.

10. Gram atom:

The atomic mass of an element expressed in grams is called the gram atom of an element. 12 g of carbon, 56 g of Fe and 238 g of U are gram atoms of carbon, iron and uranium respectively.

11. Gram formula:

(Gujranwala 2009)

The formula mass of an ionic substance expressed in grams is called as gram formula of the substance. 58.5 g of NaCl is gram formula of NaCl. It is not its molecular formula. NaCl does not have molecules.

12. Gram ion:

The ionic mass of an ionic substance expressed in grams is called as gram ion. 17 g is gram ion of OH^\ominus . Similarly 96 g is g ion of SO_4^{2-} .

13. Gram molar mass:

(Bahawalpur 2008, Gujranwala 2009)

The molar mass of a substance expressed in grams is called gram molar mass. 342 g is gram molar mass of glucose. 98 g is gram molar mass of H_2SO_4 .

14. Heteronuclear diatomic molecule:

(D.G. Khan 2011)

A molecule having two different atoms of two elements is called heteronuclear diatomic molecule. H - Cl, H - Br, H - I, CO - NO etc are heteronuclear diatomic molecules.

15. Homonuclear diatomic molecule: (D.G. Khan 2011)

A molecule which is consisted of two atoms and both are same is called homonuclear diatomic molecule. H_2 , O_2 , N_2 , Cl_2 , Br_2 , I_2 etc are homonuclear diatomic molecules.

16. Ion: (Sarg. 2011)

A positively or negatively charged atom or group of atoms is called an ion. For example H^+ , SO_4^{2-} , OH^- , CO_3^{2-} etc. are various ions.

17. Isobars:

Those atoms which have the same mass numbers but different atomic numbers.

${}^{36}_{16}S$ and ${}^{36}_{18}Ar$ are isobars of each other.

18. Isoelectronic species:

Those species i.e., atoms, ions or molecules which have the same number of electrons are called isoelectronic species. Na^+ , Mg^{2+} , Al^{3+} , Si^{4+} are isoelectronic species. Similarly C^{-4} , N^{-3} , O^{-2} and F^{-1} are isoelectronic to each other.

19. Isotones:

Atoms of the element having same number of neutrons are called isotones. ${}^{14}_6C$ and ${}^{15}_7N$ have both 8 neutrons and are isotones to each other.

20. Isotopes:

The atoms of an element which have same atomic number, but different mass numbers are called isotopes. ${}^{16}_8O$, ${}^{17}_8O$, ${}^{18}_8O$ are isotopes of oxygen.

21. Limiting reactant:

That reactant which is present in lesser amount and controls the amount of the products formed is called limiting reactant. It is finished earlier.

22. Macromolecule:

Molecules of high molar masses usually more than 10,000 are called macromolecules. The molecules of PVC, starch, and cellulose are macromolecules.

23. Mass spectrometry:

It is a technique in which gas molecules are converted to gaseous ions, which are separated on the basis of their mass to charge ratio. It may be for isotopes of an element or to see the fragmentation pattern of a molecule. The isotopes of Ne can be separated by it.

24. Mass spectrum: (Sarg. 2014)

It is a graphical representation of the masses and the relative abundances of molecular ions. The positively charged fragments are formed from it by the electron bombardment. It shows peaks. The % of fragments is calculated from the base peak.

25. Molar volume: Rwp (2012), (D. G. Khan 2014)

It is the volume of one mole of an ideal gas at standard temperature and pressure. Its value is 22.414 dm^3 . H_2 , He, CH_4 has 22.4 dm^3 of their volumes, when we take 2 g, 4 g and 16 g of them respectively at S.T.P.

26. Mole: D.G. Khan (2013), (Lahore 2014)

The atomic mass of an element, molar mass of a compound, formula mass of an ionic substance and ionic mass of ionic substance expressed in grams is called one mole of the substance. 2 g of H_2 , 12 g of C, 17 g of OH^- , 58.5 g of NaCl are one mole of each.

100 g of diamond will be $\frac{100}{2} = 8.33$ moles.

27. Molecular formula:

Rwp (2012)

That formula of a substance which gives us the kinds and total number of atoms present in the molecule of a substance. KMnO_4 is molecular formula of potassium permanganate.

28. Molecular ion:

(Sahiwal 2014)

Any molecular species having positive or negative charge is called molecular ion.

MnO_4^{2-} , $\text{Cr}_2\text{O}_7^{2-}$ are molecules ions. CH_4 is a molecular ion.

29. Molecule:

Bahawalpur (2008), Rwp (2011), (D.G. Khan 2014)

The smallest particle of a substance which can exist independently is called a molecule. CO_2 , NH_3 , H_2O show one molecule of each of them.

30. Polyatomic molecule:

A molecule having more than two atoms is called polyatomic molecule. $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ is polyatomic molecule of sugar.

31. Relative abundance of an isotope:

The percentage of an isotope of an element relative to other isotope of the same element is called relative abundance of isotope. ^{35}Cl is 75.53% and ^{36}Cl is 24.47% in nature.

32. Relative atomic mass:

D.G. Khan (2013)

It is the mass of one atom of an element compared with the mass of one atom of carbon taken as 12. The relative atomic mass of H, O, and U are 1.0794, 15.9994 and 238.024 amu respectively.

33. Stoichiometric amounts:

The amounts of reactants and products in a balanced chemical equation are called stoichiometric amounts. 12 g of C, 32 g of O_2 and 44 g of CO_2 are stoichiometric amounts in the reaction $\text{C} + \text{O}_2 \longrightarrow \text{CO}_2$.

34. Stoichiometric calculations:

Faisalabad (2008)

Those calculations which are based on stoichiometry are called stoichiometric calculations. These calculation can be done on the basis of mole-mole, mole-wt. mole-volume etc.

35. Stoichiometry:

D.G. Khan (2013)

That branch of chemistry which deals with the quantitative relationship between reactants and products in a balanced chemical equation is called stoichiometry.

36. Structural formula:

That formula of a substance which gives us the relative position of atoms and groups in the molecule of a substance along with its bond lengths and bond angles is called structural formula. The structural formula of CH_4 is tetrahedral having certain bond lengths and six bond angles as 109.5° .

37. Theoretical yield:

The amount of the product calculated from balanced chemical equation is called theoretical yield. It is calculated from the balanced chemical equations by the basic principles of stoichiometry. In $2\text{H}_2 + \text{O}_2 \longrightarrow 2\text{H}_2\text{O}$, 1g of H_2 combines with 16 g of O_2 to give 18 g of H_2O . This 18 g of H_2O is theoretical yield of H_2O .

38. Yield:

The amount of product obtained in a chemical reaction is known as yield of reaction or yield of the product. The yield is of two types i.e., theoretical and actual. Theoretical yield is calculated from balanced chemical equation, but actual is an experimental quantity.

ANSWERS TO THE SHORT QUESTIONS

Atoms, Ions and Molecules

Q.1 What is atomic mass unit?

-1 ایٹم کا ماس یونٹ کیا ہوتا ہے؟

(Multan Board 2005, Sargodha 2008, Fd.abad 2009, Sarg. 2009, Gujranwala 2011)

Ans: It is a unit of mass used for atoms and molecules (ایٹمز اور مالیکیولز کے لئے کیت کی اکائی ہے) and is equal to the $1/12$ of the mass of an atom of carbon-12. It is obtained by dividing the unity (ایک) by Avogadro's number (6.02×10^{23}).

$$\text{One a.m.u.} = 1.6603 \times 10^{-27} \text{ kg} = 1.6603 \times 10^{-24} \text{ g.}$$

Q.2 Whenever an electron is removed from the atom a cation is produced, and the formation of the cation is an endothermic process. Comment.

-2 ایک ایٹم سے جب الیکٹران نکالتے ہیں تو کیٹائن بنتا ہے۔ کیٹائن کا بننا انرجی کو جذب کرنے کا ایک عمل ہے۔ اس پر لہنی رائے دیں۔

Ans: The number of electrons and protons in an atom are equal. When the electron is removed from the atom, energy has to be supplied (دینی پڑتی ہے). So, it is an endothermic process (حرارت جذب کرنے والا عمل). The ion develops the positive charge and is called cation (مثبت بار والا آئن).

Q.3 What do you mean by molecular ions?

-3 مالیکیولر آئن سے کیا مراد ہے؟

(Azad Jammu & Kashmir Board 2005, Sarg. 2009, Sarg. 2010, DG. Khan 2012, Multan 2012, B.pure 2012, B. Pure 2013, Lahore 2014, Rwp. 2014, D.G. Khan 2014)

Ans: Any molecular species (مالیکیول کی طرح کی شے) having positive or negative charge is called molecular ion (مالیکیول کی طرح کا آئن). They are mostly produced when a beam of electrons (الیکٹرانز پر مشتمل شعاع) having energy between 10 to 15 eV is bombarded

on molecules of a compound in the vapour phase (بخاراتی حالت میں). The examples may be CO^+ , N_2^+ , C_2H_4^+ , O_2^+ , CH_4^+ .

Q.4 The atomic masses may be in fractions. Why? (Lahore 2004, AJK 2005, Multan 2008, Lahore 2008, Multan 2008, Lahore 2008, Sarg. 2009, B.Pur 2009)

-4 کسی ایٹم کے ایٹمی وزن کی ایک کسری مقدار ہونے کی کیا وجہ ہوتی ہے؟

Ans: Most of the elements have isotopes (آکسوٹوپس). Each isotopes contributes its atomic masses. Hence, the average of atomic masses of isotopes will be definitely in fractions (کھل کا کوئی جزو). Anyhow, the monoisotopic elements have also fractional atomic masses.

Isotopes and their Identification

Q.5 Why positively charged ions of isotopes are passed through magnetic field in the mass spectrometer?

-5 آکسوٹوپس کے مثبت چارج والے آئنز کو ماس سپیکٹرومیٹر کے مقناطیسی میدان سے کیوں گزرا جاتا ہے؟

Ans: The positively charged ions bend perpendicular (عموداً ٹھکانا) to the joining lines of the two poles, when passed through the magnetic field (مقناطیسی میدان). In this way, magnetic field gives semicircular path (ادھا گول راستہ) to ions, scatters (بکھیر دینا) them on the basis of m/e values and compels (مجبور کرنا) them to fall on the electrometer. Electrometer records them.

Q.6 What is the function of electrometer in separation of isotopes in mass spectrometer? (Gujranwala 2008, Fd.Abad 2009, M.pure 2012, Multan 2013)

-6 ماس سپیکٹرومیٹر آکسوٹوپس کو علیحدہ کرتا ہے۔ اس میں electrometer کا کیا کام ہے؟

Ans: When positively charged ions of different isotopes fall upon the electrometer (الیکٹرومٹر) (کے چارج کو ریکارڈ کرنے والا) (اضافی کثرت) to the number of ions falling upon that. In this way, the relative abundance (اضافی کثرت) of these isotopes can be recorded, in the form of peaks on the graph.

Q.7 What is mass spectrum (کمیت کے حوالے سے حاصل شدہ سپیکٹرم) or mass spectrograph? (Guj. 2013)

-7 ماس سپیکٹروگرام یا ماس سپیکٹروگراف کیا ہوتا ہے؟

Ans: It is a graph which is plotted between m/e of the positive ions on x-axis and the relative abundance (اضافی کثرت) of the isotopes (% age) on y-axis. This graph is plotted with the electrometer and system is computerized.

Q.8 How does the change of either electric field or magnetic field help us to record the isotopic separation by mass spectrometer? (Multan 2013)

-8 ماس سپیکٹرومیٹر میں برقی اور مقناطیسی میدانوں کو تبدیل کر کے، ہم کس طرح آکسوٹوپس کو الگ الگ کر سکتے ہیں؟

Ans: Since $\frac{m}{e} = \frac{H^2 r^2}{2E}$, when the magnetic field H increases, radius of curvature

electrometer. Similarly, the increase of electrical field E increases r. The change of r means that we can do the separation of ions (گولائی کے نصف قطر میں تبدیلی آئنز کو علیحدہ کر سکتی ہے).

Q.9 Why the isotopes have the same chemical properties?

-9 آکسوٹوپس کی کیمیائی صفات ایک جیسی کیوں ہیں؟

(Rwp-2007, Rwp. 2009, Lahore 2012)

Ans: The isotopes of an element have same the number of electrons in different orbitals (مختلف آریٹلز). They have the same number of unpaired electrons (بغیر جوڑا بنے الیکٹرانز) in the outermost (سب سے باہر والے) orbitals. The number of unpaired electrons in the outermost orbitals determine (فیصلہ کرنا) the chemical properties of elements.

Q.10 One hundred ions of NO_3^- and fifty ions of SO_4^{2-} have equal number of charges, but they have unequal masses and unequal number of atoms in them individually. Justify it.

-10 ایک سو NO_3^- آئنز اور پچاس عدد SO_4^{2-} آئنز میں چارجز کی تعداد برابر ہے۔ لیکن ان کے ماسز اور ایٹمز کی تعداد برابر نہیں ہے۔ اس کو صحیح ثابت کریں۔

Ans: 100 NO_3^- ions have 100 negative charges. 50 SO_4^{2-} have 100 negative charges. Their ionic masses are respectively (بالترتیب) 62 and 96 g/mole. So even if the number of ions are same, then they have unequal masses (میتیں برابر نہ ہونا). Each ion has different number of atoms in them, so there will be 400 atoms in 100 NO_3^- and 250 atoms in 50 SO_4^{2-} .

Q.11 In the mass spectrum of isotopes of oxygen, the highest peak is due to ^{16}O , the second highest is of ^{18}O while ^{17}O has the smallest peak. Why?

-11 آکسیجن کے ماس سپیکٹرم میں ^{16}O کی peak کی بلندی سب سے زیادہ، ^{18}O کی دوسرے نمبر پر اور ^{17}O کی سب سے چھوٹی ہے۔ کیوں؟

Ans: The relative abundance of various (مختلف) isotope is determined by the height of the peak (چوٹی کی بلندی) in mass spectrometer. ^{16}O has 99.759 % of relative abundance. ^{18}O has 0.204 % while ^{17}O has 0.037 % of relative abundance. So, the height of the peak due to ^{17}O will be smallest (اس آئن کی چوٹی کی بلندی سب سے کم ہوگی جس کی % سب سے کم ہوگی).

Q.12 The ratio of heights of the peaks for the isotopes of chlorine is 3:1, but in case of bromine two peaks of equal heights are obtained. Why?

-12 Cl کے آکسوٹوپس کی peaks کی بلندیاں 3 : 1 کی نسبت سے ہیں جبکہ Br_2 کے لیے برابر ہیں۔ کیوں؟

Ans: The height of the peak depends upon the relative abundance of isotopes (آکسوٹوپس کی اضافی کثرت) of that element. Chlorine has two isotopes $^{35}\text{Cl} = 75.53\%$ and $^{37}\text{Cl} = 24.47\%$. The intensities of these two peaks (دو چوٹیوں کی بلندی کی شدت) are in the ratio of 3:1.

In the case of bromine the relative abundance are 50.54 % for ^{79}Br and 49.46 % for ^{81}Br .

Q.13 What is the reason for two equally strong peaks in the mass spectrum for bromine ; while for iodine only one peak at 127 a.m.u is indicated? (Bahawalpur Board 2007, B.P. 2008)

Br₂ کے ماس سپیکٹرم میں دو عدد peaks کی بلندیوں برابر ہیں۔ جبکہ 2 کی صرف ایک ہی peak ہے۔ کیا وجہ ہے؟ -13

Ans. Bromine has two isotopes, which are almost equally abundant (کثرت کا برابر ہونا). Therefore, mass spectrometer gives two equally strong peaks. Iodine is mono-isotopic (ایک ہی آئسوٹوپ ہے), so only one peak is obtained in the mass spectrum.

Q.14 No individual neon atom in the sample of the element has a mass of 20.18 a.m.u. Why? (Mirpur-2006, Model Paper-2006-07, F.Abad 2007, B.P. 2008, Multan 2012, Bahawalpur 2012, F. Abad 2012, B. Pure 2013, Guj. 2013, Lhr 2014, Guj. 2014)

Ne کے کسی ایٹم کا ایٹمی وزن 20.18 amu نہیں ہوتا۔ کیوں؟ -14

Ans. Neon has three isotopes of atomic masses 20, 21 and 22 with relative abundances (اضافی کثرت) as 90.92%, 0.26% and 8.82%.

The relative atomic mass of neon, comes out to be 20.18 a.m.u. So 20.18 a.m.u. is the average atomic mass (اوسط ایٹمی کثرت) of all the three isotopes and there is no atom of Ne with this atomic mass.

Empirical And Molecular Formula

Q.15 Define empirical formula and how it is related to molecular formula?

(Faisalabad Board 2004, Lahore 2007, Multan 2008, Multan 2008, B.Pur 2009, Multan 2011, F. Abad 2012, Guj. 2013, D.G. Khan 2013, Multan 2013, D.G. Khan 2014, Rwp. 2014, Multan 2014, Guj. 2014, F. Abad 2014, B. Pur 2014)

امپیریکل فارمولہ کی تعریف کریں۔ یہ مالیکیولر فارمولہ سے کس طرح تعلق رکھتا ہے؟ -15

Ans: The simplest (سادہ ترین) formula of a substance which tells us the ratio of atoms (ایٹمز کی نسبت) in the molecule of a substance is called empirical formula.

M.F. = n(E.F.).

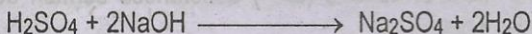
E.F. of benzene is CH, but M.F. is C₆H₆. Therefore M.F. = 6(E.F.)

H₂O, CO₂, H₂SO₄, KMnO₄ have same molecular are empirical formulas.

Q.16 One mole of H₂SO₄ should completely react with two moles of NaOH. How does Avogadro's number help to explain it?(Fed-2006, F.D-2006)

H₂SO₄ کا ایک مول NaOH کے دو مولز سے ری ایکشن کرتا ہے۔ ایوو گڈروڈز کا نمبر کس طرح اس کو سمجھنے میں ہماری مدد کرتا ہے۔ -16

Ans: The balanced chemical equation between H₂SO₄ and NaOH.



One mole of H₂SO₄ releases (آزاد کرتا) two moles of H⁺ in the solution. It needs two moles of OH⁻ ions for complete neutralization (مکمل تعدیل کے لئے).

Q.17 NaCl has 58.5 amu as formula mass and not the molecular mass. Justify it. (Rwp. 2005, Rwp. 2007, Multan 2009, Sarg. 2009)

NaCl کا فارمولہ ماس 58.5 amu ہے۔ یہ اس کا مالیکیولر ماس نہیں کہلاتا صحیح ثابت کریں۔ -17

Ans: NaCl is a ionic compound. it has no molecules in the crystal structure (قائم ساخت میں مالیکیولز نہیں ہوتے). So 58.5 amu cannot be called as its molecular mass.

Its formula is NaCl because for one Na^{\oplus} , there is one Cl^{\ominus} in the crystal. Here, 58.5 amu is its formula mass.

Q.18 Molecular formula is multiple of empirical formula. Give an example.
 (Lahore Board 2005, Lahore 2012, Multan 2013)

-18 مائیکو لرفار مولو اڀرئیکل فار مولو کا سادہ حاصل ضرب ہے۔ ایک مثال سے واضح کریں۔

Ans: The empirical formula is the simplest whole number ratio of atoms of different elements present in a compound. Molecular formula tells us the actual number of atoms of each element in a molecule. Hence the empirical formula has to be multiplied (ضرب دینا) with a suitable digit (مناسب ہندسے سے) to get the molecular formula.

Benzene, $\text{C}_6\text{H}_6 = 6(\text{CH})$, Ethane, $\text{C}_2\text{H}_6 = 2(\text{CH}_3)$

Concept of Mole and Avogadro's Number

Q.19 Calculate the mass in grams of 10^{-3} moles of water.
 (Rawalpindi Board 2005), (D.G. Khan 2011), (Rwp. 2011)

-19 10^{-3} مولز پانی کا وزن معلوم کریں۔

Ans: Mass of water = No. of moles \times molar mass
 $= 10^{-3} \times 18 \text{ g} = 1.8 \times 10^{-2} \text{ g}$
 $= 0.018 \text{ g}$

Q.20 Mg atom is twice heavier than that of carbon atom. How?
 (Rawalpindi 2005, Lahore 2007, Rawalpindi 2008, Rwp. 2008, Rwp. 2010), (Lahore 2011, Gujranwala 2011, Rwp. 2013, Sarg. 2014, Lhr, 2014, Guj. 2014)

-20 Na کا ایک ایٹم کے ایک ایٹم سے دو گنا بھاری ہے۔ کیسے؟

Ans: The atomic mass of Mg is 24 g mol^{-1} which is twice (دو گنا) in mass as compared to the atomic mass of C i.e. 12 g mol^{-1} . So Mg atom is twice heavier (بھاری ہوتا) than that of carbon.

Q.21 180 grams of glucose and 342 grams of sucrose have same number of molecules, but different number of atoms present in them. Justify it.
 (Lahore-2003, Faisalabad 2008, Bahawalpur 2008, Guj 2012, F. Abad 2014, Lhr 2014)

-21 180 گرام گلو کو ز اور 342 گرام سینی میں مائیکو لری تعداد برابر ہے لیکن ان میں ایٹمز کی تعداد مختلف ہے۔ اس کو صحیح ثابت کریں۔

Ans: 180 grams of glucose ($\text{C}_6\text{H}_{12}\text{O}_6$), and 342 grams of sucrose ($\text{C}_{12}\text{H}_{22}\text{O}_{11}$) are one mole of each. One mole of various (مختلف) substances contain equal number of molecules i.e. 6.02×10^{23} .

One molecule of $\text{C}_6\text{H}_{12}\text{O}_6$ has 24 atoms. The total number of atoms of glucose in one mole is $24 \times 6.02 \times 10^{23}$. One molecule of $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ has 45 atoms. The total number of atoms of sucrose in one mole of sucrose is $45 \times 6.02 \times 10^{23}$. It means that one mole of both glucose and sucrose will have different number of atoms.

Q.22 What is the number of H^{\oplus} ions in 9.8 g of H_3PO_4 ? (Fd. Abad 2009)

-22 H_3PO_4 9.8 g میں H^{\oplus} کی تعداد کیا ہے؟

Ans: When one molecule of H_2SO_4 ionizes (آکسز بناتا ہے), it produces two H^{\oplus} and one $SO_4^{\ominus 2}$ ion. Hydrogen ion contains +1 charge while sulphate ion has -2 charge. The ions produced by complete ionization (مکمل آکسز میں تبدیلی) of 4.9 grams of H_2SO_4 in water will have equal +ve and -ve charges but the number of H^{\oplus} ions is twice than number of negatively charged sulphate ions.

Similarly 1 mg of K_2CrO_4 will have thrice the number of ions ($2K^+ + CrO_4^{\ominus 2}$). If the number of formula units is X then ions will be 3X.

Q.28 96 gm of $SO_4^{\ominus 2}$ has Avogadro's number of $SO_4^{\ominus 2}$ ions, twice the Avogadro's numbers of negative charges, $4N_A$ as oxygen atoms and $5N_A$ as total number of atoms. How?

-28 96 گرام $SO_4^{\ominus 2}$ میں N_A $SO_4^{\ominus 2}$ یون ہیں۔ $2N_A$ منفی چارجز ہیں۔ $4N_A$ آکسیجن کے ایٹمز ہیں اور $5N_A$ کل ایٹمز کی تعداد ہے۔ کیسے یاد رکھیں N_A کا مطلب ایوگڈروڈز نمبر ہے۔

Ans: The ionic mass of $SO_4^{\ominus 2}$ is 96 a.m.u. So, in 96 gms of $SO_4^{\ominus 2}$, there is one mole of $SO_4^{\ominus 2}$ and one mole of the species have Avogadro's number of particles. i.e., 6.02×10^{23} .

Each $SO_4^{\ominus 2}$ ion has two negative charges, so total negative charges are $2N_A$.

Each $SO_4^{\ominus 2}$ ions has four oxygen atoms, so, there are total $4N_A$ oxygen atoms in

96 gms of $SO_4^{\ominus 2}$. Each $SO_4^{\ominus 2}$ has five atoms. So, one mole of $SO_4^{\ominus 2}$ has total $5N_A$ atoms.

Q.29 One mole of H_2O has two moles of bonds, three moles of atoms, ten moles of electrons and twenty-eight moles of the total fundamental particles present in it. Justify.

-29 ایک مول پانی میں دو مول بانڈز ہیں۔ تین مول ایٹمز ہیں۔ دس مول ایلیکٹرانز ہیں اور 28 مول بنیادی ذرات ہیں۔ ثابت کریں۔

Ans: The molecule of $H - O - H$ has two bonds in it. Therefore, one mole of H_2O contains two moles of bonds and three moles of atoms. Similarly, there are eight electrons in oxygen and one electron in each of the two H atoms. One molecule of H_2O has 10 electrons. So one mole of water contains 10 moles of electrons. There are 28 moles of all fundamental particles (بنیادی ذرات) in one mole of water 10 moles of electrons, 10 moles of protons, 8 moles of neutrons.

Q.30 Prove that one mole of each N_2 , CO_2 and H_2 contain equal number of molecules. (Multan 2004, Sargodha 2008, Lahore 2008, Lahore 2009, Multan 2009)

-30 ثابت کریں کہ H_2 اور CO_2 , N_2 کے ایک ایک مول میں بالیکو لری تعداد برابر ہے۔

Ans: This is according to Avogadro's law that one mole of a substance has 6.02×10^{23} molecules in it. So, 28 g of H_2 , 44 g of CO_2 and 2 g of H_2 have 6.02×10^{23} molecules in each.

Q.31 N_2 and CO have same number of electrons, protons and neutrons. Justify. (B.Pur-2006, Rwp-2007, B.Pur-2007, Guj. 2008, Faisalabad 2010, Sarg. 2011, M. Pure 2012, Guj. 2012, D. G Khan 2012, Guj. 2013, Faisalabad 2013, D.G. Khan 2013, B. Pur 2014, Guj. 2014, B. Pur 2014)

Ans: The molar mass of H_3PO_4 is 98 amu. 9.8 g of H_3PO_4 is 0.1 moles. 1 molecule of H_3PO_4 has $3H^+$. Hence the number of H^+ ions in 0.1 moles of H_3PO_4 is 1/10th of Avogadro's number multiplied with 3 i.e., $3 \times 6.02 \times 10^{23} = 1.806 \times 10^{24}$.

Q.23 What is the mass and number of molecules of CO_2 in 0.224 dm^3 of CO_2 at S.T.P?

-23 کاربن ڈائی آکسائیڈ کے 0.224 dm^3 کا S.T.P پر کتنا وزن اور کتنے مالیکیوں کی تعداد ہوتی ہے؟

Ans: 0.224 is 1/100th of one molar volume at S.T.P. Hence the number of molecules will be 1/100th (سواں حصہ) of Avogadro's number i.e., 6.02×10^{23} , and mass will be $44/100 = 0.44 \text{ g}$.

Q.24 Define Avogadro's number? How does it relate to the masses of chemical substances? (Gujranwala 2005, Rwp. 2009, B.P 2012, D.G. Khan 2013, B. Pur 2014, Multan 2014)

-24 ایوگیڈروں نمبر کی تعریف کریں۔ یہ کیمیکلز کے کیت کے ساتھ کس طرح منسلک ہے؟

Ans: It is the number of atoms, molecules or ions in one gram mole of an element, compound and ion. One gram mole (مولر ماس کو گرام میں لینے سے) of the substance is the atomic mass, molar mass or ionic mass taken in grams. It means that the number of the species (چیزوں) is related with the masses (کمیتیں) of the species. 23 g of Na and 238 g of U have equal number of atoms in them.

Q.25 What is the number of covalent bonds in 8 g of CH_4 ? (B.P. 2008)

-25 8 گرام CH_4 میں کوویلنٹ بانڈز کی تعداد کیا ہے؟

Ans: 8 g of CH_4 is 0.5 moles of CH_4 . It has 3.01×10^{23} molecules of CH_4 . Each molecule has four bonds, so the total number of bonds is $4 \times 3.01 \times 10^{23} = 12.04 \times 10^{23} = 1.204 \times 10^{24}$.

Q.26 Two grams of H_2 , 16g of CH_4 and 44g of CO_2 occupy separately the volumes of 22.414 dm^3 at STP although the sizes and masses of molecules of three gases are very different from each other. Give reason.

(Model Paper-2006-07, Lahore 2012)

-26 کیا وجہ ہے کہ 2 گرام H_2 ، 16 گرام CH_4 ، 44 گرام CO_2 کی S.T.P پر 22.414 لیٹرز کی برابر جسامت رکھتی ہیں۔
 حالانکہ ان گیسوں کے مالیکیوں کی سائز اور کمیتیں مختلف ہیں۔

Ans: One mole of an ideal gas at S.T.P occupies (جگہ گھیرنا) a volume of 22.414 dm^3 . Sizes and masses of molecules of different gases do not affect the volume. Normally (عام طور پر) it is known that in the gaseous state, the distance between the molecules is 300 times greater than their diameter (قطر). Therefore two grams of H_2 , 16g of CH_4 and 44g of CO_2 (1 mole of each gas) separately (انگ-انگ) occupy a volume of 22.4 dm^3 . This is called molar volume (V_m).

Q.27 4.9 g of H_2SO_4 , when completely ionized in water have equal number of positive and negative charges, but number of positively charged ions are twice the number of negatively charged ions. Give reason.

(Lahore 2012, Sarg. 2014)

-27 4.9 گرام H_2SO_4 جب پانی میں مکمل طور پر آئنز میں تبدیل ہوتا ہے تو مثبت اور منفی چارجز کی تعداد برابر ہوتی ہے لیکن مثبت آئنز کی تعداد منفی آئنز کی تعداد سے دوگنی ہے۔ سبب بتائیں۔

Ans: When one molecule of H_2SO_4 ionizes (آکسز بناتا ہے), it produces two H^+ and one SO_4^{2-} ion. Hydrogen ion contains +1 charge while sulphate ion has -2 charge. The ions produced by complete ionization (مکمل آکسز میں تبدیلی) of 4.9 grams of H_2SO_4 in water will have equal +ve and -ve charges but the number of H^+ ions is twice than number of negatively charged sulphate ions.

Similarly 1 mg of K_2CrO_4 will have thrice the number of ions ($2K^+ + CrO_4^{2-}$). If the number of formula units is X then ions will be $3X$.

Q.28 96 gm of SO_4^{2-} has Avogadro's number of SO_4^{2-} ions, twice the Avogadro's numbers of negative charges, $4N_A$ as oxygen atoms and $5N_A$ as total number of atoms. How?

28- 96 گرام SO_4^{2-} میں N_A SO_4^{2-} منفی چار جز ہیں $4N_A$ آکسیجن کے ایٹمز ہیں اور $5N_A$ کل ایٹمز کی تعداد ہے۔ کیا یاد رکھیں N_A کا مطلب ایوڈ گیڈروڈ نمبر ہے۔

Ans: The ionic mass of SO_4^{2-} is 96 a.m.u. So, in 96 gms of SO_4^{2-} , there is one mole of SO_4^{2-} and one mole of the species have Avogadro's number of particles. i.e., 6.02×10^{23} .

Each SO_4^{2-} ion has two negative charges, so total negative charges are $2N_A$.

Each SO_4^{2-} ions has four oxygen atoms, so, there are total $4N_A$ oxygen atoms in

96 gms of SO_4^{2-} . Each SO_4^{2-} has five atoms. So, one mole of SO_4^{2-} has total $5N_A$ atoms.

Q.29 One mole of H_2O has two moles of bonds, three moles of atoms, ten moles of electrons and twenty-eight moles of the total fundamental particles present in it. Justify.

29- ایک مول پانی میں دو مولز بانڈز ہیں۔ تین مولز ایٹمز ہیں۔ دس مولز الیکٹرانز ہیں اور 28 مولز بنیادی ذرات ہیں۔ ثابت کریں۔

Ans: The molecule of $H - O - H$ has two bonds in it. Therefore, one mole of H_2O contains two moles of bonds and three moles of atoms. Similarly, there are eight electrons in oxygen and one electron in each of the two H atoms. One molecule of H_2O has 10 electrons. So one mole of water contains 10 moles of electrons. There are 28 moles of all fundamental particles (بنیادی ذرات) in one mole of water 10 moles of electrons, 10 moles of protons, 8 moles of neutrons.

Q.30 Prove that one mole of each N_2 , CO_2 and H_2 contain equal number of molecules. (Multan 2004, Sargodha 2008, Lahore 2008, Lahore 2009, Multan 2009)

30- ثابت کریں کہ N_2 , CO_2 اور H_2 کے ایک ایک مول میں مایکیو لری کی تعداد برابر ہے۔

Ans: This is according to Avogadro's law that one mole of a substance has 6.02×10^{23} molecules in it. So, 28 g of H_2 , 44 g of CO_2 and 2 g of H_2 have 6.02×10^{23} molecules in each.

Q.31 N_2 and CO have same number of electrons, protons and neutrons. Justify. (B.Pur-2006, Rwp-2007, B.Pur-2007, Guj. 2008, Faisalabad 2010, Sarg. 2011, M. Pure 2012, Guj. 2012, D. G Khan 2012, Guj. 2013, Faisalabad 2013, D.G. Khan 2013, B. Pur 2014, Guj. 2014, B. Pur 2014)

-31 CO, N₂ میں e⁺, e⁻ اور نیوٹرونز کی تعداد برابر ہے۔ صحیح ثابت کریں۔

Ans: No. of electrons in N₂ = 7 + 7 = 14, number of protons in N₂ = 7 + 7 = 14 and number of neutrons (14 - 7) = 7 + 7 = 14.

In CO, number of electrons in C = 6, number of electrons in O = 8, total number of electrons = 6 + 8 = 14.

Number of protons in C = 6, number of protons in O = 8, total number of protons = 6 + 8 = 14.

Number of neutrons in C = 6, number of neutrons in O = 8, total number of neutrons = 6 + 8 = 14.

Q.32 Calculate the mass in kg of 2.6×10^{23} molecules of SO₂. (Faisalabad 2010)

-32 SO₂ کے 2.6×10^{23} مالیکیولز کا وزن دریافت کریں۔

Ans: 6.02×10^{23} molecules of SO₂ have mass = 64 gm

1 molecule of SO₂ has mass = 64 gm

$$6.02 \times 10^{23} \text{ molecules of SO}_2 \text{ have mass} = \frac{64}{6.02 \times 10^{23}}$$

$$2.6 \times 10^{23} \text{ molecules of SO}_2 \text{ have mass} = \frac{64 \times 2.6 \times 10^{23}}{6.02 \times 10^{23}}$$

$$= \frac{64 \times 2.6}{6.02} = 27.641 \text{g}$$

Q.33 One mole of H₂SO₄ should completely react with 2 moles of NaOH. Justify it. (Rwp. 2009)

-33 1 مول H₂SO₄ اور 2 مول NaOH آپس میں مکمل طور پر ری ایکشن کر لیتے ہیں۔ صحیح ثابت کریں۔

Ans: According to balanced equation. 1 mole of H₂SO₄ give 2N_A H⁺ ions. So 2 moles of NaOH are needed to give 2N_A OH⁻.

Stoichiometry, Limiting Reagent and Yield

Q.34 How can the efficiency of a chemical reaction be expressed?

(Gujranwala Board 2005, Lahore 2007, Lahore 2014)

-34 ایک ری ایکشن کی کارکردگی کیسے ظاہر کی جاسکتی ہے؟

Ans: The efficiency (کارکردگی) of a chemical reaction can be expressed (ظاہر کرنا) by the percentage yield (% پیداوار) of the chemical reaction. Percentage yield depends upon the ratio of actual yield (اصلی پیداوار) and theoretical yield (علمی پیداوار)

$$\% \text{ yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 10$$

Q.35 11 g of carbon is reacted with 32 g of oxygen to give CO₂. Which is the limiting reactant. (Multan Board 2005, Multan 2008, B. Pur 2009, F. Abad 2013)



-35 11 گرام کاربن کو 32 گرام آکسیجن سے ری ایکشن کرنے کو کہا جاتا ہے۔ اس میں کونسا Limiting ری ایکٹنٹ ہے؟

Ans: According to the balanced chemical equation, 12 g of carbon should completely react (مکمل طور پر تعامل کرنا چاہیے) with 32 g of oxygen to gives 44 grams of CO₂. So 32

grams of oxygen will be in excess (فالتو ہوتا) in comparison (مقابلتاً) to 11 grams of carbon. So carbon is the limiting (کم رہنے والا) reactant.

Q.36 Concept of limiting reactant is not applicable to the reversible reactions. Explain it. (Lahore Board 2005, Faisalabad 2007, Fd.Abad 2009)

Limiting -36 ری ایکشن کا ادراک ان ری ایکشنز پر لاگو نہیں ہوتا جو پلٹا کھا سکتے ہیں۔ کیوں؟

Ans: In the case of reversible reactions (پلٹا کھانے والے تعاملات), certain amounts of the reactants are left behind at the equilibrium stage. In the case of reactions having one of the substance as limiting one of the substance has to be consumed completely. So, the reversible reactions donot help us to understand (سمجھنا) the concept (ادراک) of limiting reactant (ری ایکشن میں عمل کرنے والا جو کم رہ جائے).

Q.37 Distinguish between actual and theoretical yield. Calculate efficiency of a reaction. (B.Pur Board 2005, Multan-2006, Mirpur-2006, Multan 2007, Rwp. 2009, Lahore 2010, B. Pure 2013, Multan 2014, F. Pur 2014)

-37 کسی تعامل میں حقیقی اور علمی پیداوار میں پہچان کریں۔ ایک ری ایکشن کی ایفی شنسی کیا ہوتی ہے؟

Ans: The amount (مقدار) of the product that is actually (حقیقتاً) obtained in a chemical reaction is called actual yield. The amount of product calculated from balanced chemical equation is called theoretical yield.

(جو نکھی ہوئی کیمیائی مساوات سے پیداوار نکالی جاتی ہے وہ علمی پیداوار کہلاتے گی۔)

The efficiency (کار کردگی) of the chemical reaction is calculated from the percentage yield

$$\% \text{ yield} = \frac{\text{Actual yield}}{\text{Theoretical yield}} \times 100$$

Q.38 What is limiting reagent? How it helps to control the reaction?

(Lah 2005, Guj. 2006, B. Pur-2006, Rwp-2007, F. Abad-2007, Guj. 2009, Multan 2009, Sarg. 2010, Guj. 2010, Rwp. 2010, Faisalabad 2011, Rwp. 2013, Sarg. 2014, F. Abad, 2014, Guj. 2014)

Limiting -38 ری ایکشنٹ کیا ہوتا ہے؟ یہ کسی ری ایکشن کو کس طرح کنٹرول کرتا ہے؟

Ans: A limiting reactant is that one which is in lesser quantity and it is consumed earlier (پہلے ختم ہو جاتا ہے). Whenever, it is consumed then the further formation of the product stops, although the excess reagent is lying in the vessel. If the limiting reagent is not available (میسر نہیں ہے) to the excess reagent then product cannot be formed further.

Q.39 Why the experimental yield is mostly less than the theoretical yield?

(Mirpur 2004, Sargodha 2005, Model Paper-2006-07, B.P-2007, Guj. 2008, B.P. 2008, Rwp. 2010, Multan 2011, Bahawalpur 2011, Multan 2011, F. abad 2012, Guj. 2012, Rwp. 2012, Guj. 2013, Multan 2013, D.G. Khan 2014, B. Pur 2014)

-39 تجرباتی پیداوار اکثر علمی پیداوار سے کیوں کم ہوتی ہے؟

Ans: Experimental yield is mostly less than theoretical yield due to the following reasons:

(1) Mechanical loss of products due to:

(a) filtration (b) separation by distillation

(c) separating by separating funnel (ملیحدہ کرنے والی تیف)

- (d) washing (e) drying (f) crystallization
 (2) Side reaction. (3) Reversibility of reaction.

Q.40 Law of conservation of mass (قانون بقائے مادہ) has to be obeyed in stoichiometric calculations. (Lahore 2013)

40- سٹائیچیومیٹری کے اصولوں کے مطابق حساب کرنے کے دوران قانون بقائے مادہ کا کیوں خیال رکھنا پڑتا ہے؟

Ans: Total mass of reactants must be equal to total mass of products in a chemical reaction. So, the calculation (حساب لگانا) can be done for relative amounts of reactants and products in a chemical reaction.

Q.41 Define stoichiometry. What are its basic assumptions?

(Faisalabad 2010, Guj. 2014, Lahore 2014, Lahore 2014)

41- سٹائیچیومیٹری کی تعریف کریں۔ اس کے بنیادی مفروضے کیا ہیں؟

Ans: The branch of chemistry which deals with quantitative relationships (مقداری تعلقات) between reactants and products in a balanced chemical equation (کیمیائی تعامل کی متوازن مساوات) is called stoichiometry.

To perform stoichiometric calculations following assumptions are necessary:

- All the reactants are completely converted into products.
- No side reaction is taking place.
- Law of conservation of mass and law of definite proportions are obeyed.

Q.42 The reaction of combustion in atmosphere consumes O_2 , which is in excess. The O_2 or material being burnt?

(D. G. Khan 2012, Sarg. 2014, B. Pur 2014, B. Pur 2014, D.G. Khan 2014, Rwp. 2014)

42- فضا میں چیزوں کے جلنے کا عمل O_2 کی موجودگی میں ہوتا ہے۔ جو زیادہ مقدار میں ہو اس میں موجود ہے۔ بتائیے O_2 یا ملنے والا

میٹرل Limiting reactant ہے؟

Ans: Since O_2 is always excess and is left over in the atmosphere. A small part of total O_2 can burn the whole material. So burning material is limiting reactant. This is one of the best example of a reaction which is frequent in our surrounding in which one substance is limiting. One of the reactants should be taken in large excess to consume other material completely.