1. What is an atom? what are atoms made of?

ans: Atoms are the basic buiding blocks of matter that make up everyday object. A desk, the air, even you are made ~~of~~ up of atoms.

Atoms are made of particles called protons, electrons and neutrons. protons carry a positive electrical charge and electrons carry carry a negative electrical charge and neutrons carry no electrical charge at all.
The protons and neutrons cluster together in the central part of the atom, called the nucleus, and the electrons 'orbit' around the nucleus.

A particular atom will have the same number of protons and electrons and most atoms have at least as many neutrons as protons.

2. Define Isotopes and Isobars with examp

Ans:

Isotopes: The atoms which have the same number of protons and different number of neutrons are called Isotopes.

Example: $^{12}_{6}C$ or carbon-12

$^{14}_{6}C$ or carbon-14

Isobars: The atoms which have the same mass number but different atomic numbers are called isobars.

Example: $^{40}_{18}Ar$ or Argon-18

$^{40}_{19}K$ or potassium-19

$^{40}_{20}Ca$ or calcium-20

Isotones: The atoms which have different atomic number and different atomic masses but the same number of neutrons are called Isotones.

Example: $^{14}_{6}C$, $^{15}_{7}N$, $^{16}_{8}O$

3. Define electron, proton and neutron?

Ans:

Electrons: Electrons are negatively charged particles that surround the atom's nucleus. Electrons were discovered by J.J Thomson.

particle Data

symbol	Mass	charge	spin
e^-	9.11×10^{-31} kg	-1.6×10^{-19}	1/2

protons: protons are positively charged particles found within atomic nuclei. protons were discovered by Ernest Rutherford.

particle data

symbol	Mass	charge	spin
p	1.67×10^{-27} kg	1.6×10^{-19}	1/2

Neutron: Neutrons are uncharged particles found within atomic nuclei. Neutrons were discovered by James chadwick.

particle data

symbol	Mass	charge	spin
n	1.67×10^{-27} kg	0	1/2

4. What are Quantum Numbers? Describe different types of Quantum Numbers with example.

Ans: The set of numbers used to describe the position and energy of the electrons in an atom are called quantum numbers.

There are four quantam numbers:
i) principal quantam number. (n).
ii. Azimuthal quantam number (l)
iii. Magnetic quantam number (m_l)
iv. Spin quantam number (m_s).

i. principal Quantum Number (n):

$n = 1, 2, 3, \ldots\ldots \infty$

specifies the energy of an electron and the size of the orbital. All orbitals that have the same value of n are said to be in the same shell. For a hydrogen atom with $n=1$, the electron is in its ground state; if the electron is in the $n=2$ orbital, it is in an excited state. The total number of orbitals for a given n value is n^2.

ii. Azimuthal quantam number (l):

$l = 0, 1, 2, 3, \ldots\ldots (n-1)$

specifies the shape of an orbital. The secondary quantam number divides the shells into smaller groups of orbitals called subshells. usually, a letter code is used to identify l to avoid confusion with n.

$l \rightarrow$	0	1	2	3	4	5 ...
Letter $\rightarrow$	s	p	d	f	g	h ...

if $n = 2$ and $l = 1$ is the 2p subshell.
if $n = 4$ and $l = 2$ is the 4d subshell.
The value of l also has a slight effect on the energy of the subshell; the energy of the subshell increases with l ($s < p < d < f$).

iii. Magnetic quantum number (m_l): ~~↑↓ ↑↓ ↑↓ ↑↓ ↑↓~~.

$m_l = -l, \ldots\ldots 0 \ldots\ldots +l.$

specifies the orientation in space of an orbital of a given energy (n) and shape (l). This number divides the subshell into individual orbitals which hold the electrons; there are $2l+1$ orbitals in each subshell. Thus the 's' subshell has only one orbital, the p subshell has three orbitals, and so on.

iv. spin quantum number (m_s): $+\frac{1}{2}$ or $-\frac{1}{2}$ specifies the orientation of the spin axis of an electron.

Unlike n, l, m_l, the electron spin quantum number m_s does not depend on another quantum number. It may have a spin of $+\frac{1}{2}$, represented by ↑, or $-\frac{1}{2}$, represented by ↓. This means that when m_s is (+ve) the electron has an upward, otherwise downward spin. The significance of the electron spin quantum number is its determination of an atom's ability to generate a magnetic field or not.

4. spin quantum number: Denoted by s. It specifies the direction of the electron. The value of spin quantum number is $+\frac{1}{2}$ and $-\frac{1}{2}$. The positive value of s says the spin of electron up that denoted by (↑). And the spin of electron is downward when the value of s is (-ve)

		Quantum Numbers			
n	l	m_l	Orbital	Element	Shell
n=01	0	0	1S	2 → 2	K
n=02	0	0	2S	2 } 8	L
	1	-1,0,1	2P	6 }	
n=03	0	0	3S	2	M
	1	-1,0,1	3P	6 } 18	
	2	-2,-1,0,1,2	3d	10	
n=04	0	0	4S	2	N
	1	-1,0,1	4P	6	
	2	-2,-1,0,1,2	4d	10 } 32	
	3	-3,-2,-1,0,1,2,3	4f	14	

5. Briefly describe Rutherford's atom Model with its postulates and limitation

Ans: Rutherford has given a model on the structure of atom in 1911. The model stands:

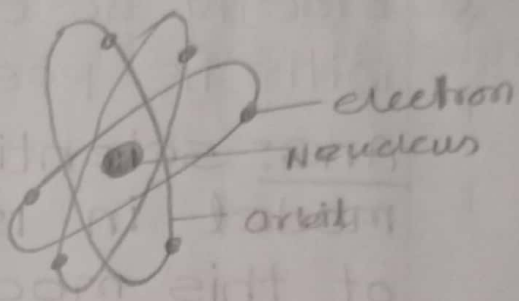
1. Atom has a centre. That is known as nucleus. proton and electron are situated inside and outside this nucleus respectively, since, Here the volume of electrons is zero. so, inside of the nucleus, proton and neutron mass is called atoms mass

2. Nucleus is very tiny and most of space inside of the atom is void.

3. Electrons in an atom always move round the nucleus as like planets move round the sun. In atom electrons = protons. so, overall charge of an atom is zero.

4. The electrons with negative charge are attracted to the positively charged nucleus. This force is centripetal. Electrons move round the nucleus like our earth does does round the sun.

fig



Limitation:

1. Rutherford's model did not give any idea about the size and shape of the orbits.
2. plannets in the solar system are electrically neutral but electrons and nucleus are charged.
3. There is no idea how the electrons move around the nucleus in case of atoms having more than one electrons.
4. According to maxwell's theory, Rutherford's atomic model is not correct.
5. Although the early atomic models were inaccurate and failed to explain certain experimental results, they were the base for future developments in the world of quantum mechanics.

6. Briefly describe Bohr's atom model with its postulates and limitations.

Ans: scientist Neils Bohr gave this model in 1913. The main postulates of this model are:

1. Around the nucleus there are some circular stable axes on which electron moves around. They are called energy level or orbit. They are also known as shell.
we can say the permanent orbit as n, then $n = 1, 2, 3, \ldots$ if $n = 1$ the principal energy level is K, similarly $n = 2$, $n = 3$, $n = 4$, the principal energy level is L, M, N respectively

2. The orbits are termed as "stationary orbit. কক্ষপথগুলিকে স্থির কক্ষপথ বলা হয়।

3. According to Bohr's model, the angular momentum of electron eq. $mvr = nh/2\pi$.

Here, $m = 9.11 \times 10^{-31}$ Kg
r = radius of the orbit
v = velocity of electron
$n = 1, 2, 3, 4$
h = plank constant 6.63×10^{-34} Kg/s

Here, n is lower when energy level is lower.
n is higher when energy level is higher.

④ when electrons moves from higher to lower energy level, it emitted energy. when electrons moves from lower to higher energy level it absorbed energy.

This absorbed or emitted energy is

$c = 3 \times 10^8 \, ms^{-1}$

ν = frequency (Hz)

λ = wave

$\therefore h\nu = \frac{hc}{\lambda}$

Success of Bohr's model:

1. Bohr's atomic model specifies the circular size of the energy levels But Rutherford didn't mention it.
2. Rutherford's model doesn't mention about the changed in structure of atom when they absorbed or emitted energy. But Bohr's mention it
3. Rutherford model doesn't explain the atomic spectra but Bohr's model can explain this.

Therefore,
1st orbit is represented as K shell and it can hold up to 2 electrons.

2nd orbit is represented as L shell and it can hold up to 8 electrons

3rd orbit is represented as M shell and it can contain up to 18 electron

4th orbit is represented as N shell and it can contain max. 32 electrons

Distribution of electrons in orbit or shell is below formula:

$2n^2$ → Here n is the number of orbits.

for K shell: maximum number of electron $2n^2 \mid n=1$

$= 2 \times 1$

$= 2$

for L shell: $2n^2 \mid n=2$

$= 2 \times 2^2$

$= 8$

we can determine the max. elec. in a similar way

Limitation:

1. It explain only when the spectrum of Hydrogen containing one electron.
2. Bohrs told that orbits of electron in an atom is circular. later on, it was proved that the orbits can be of oval shape too.
3. Failure to explain zeeman effect (how atomic spectra are affected by magnetic field.
4. It contradicts Heisenberg Uncertainty principle.

7. Write some characteristics of periodic table.

Ans:

1. The arrangement of elements in modern periodic table is based on their electronic configurations.
2. There are 7 periods in modern periodic table.
3. There are 18 groups in modern periodic table.
4. The horizontal rows of elements in periodic table are called periods
5. The vertical columns in a periodic table are called groups.
6. The element in a period have consecutive atomic number.
   Example: period 2 we have element Li, Be, B, C, N, O, F, Ne having atomic no. 3, 4, 5, 6, 7, 8, 9, 10
7. The element in group don't have consecutive atomic number.
   Example: Group 2 we have element Be, mg, ca, Sr, Ba, Ra with atomic no. 4, 12, 20, 38, 56, 88.

2 8 8 18 32

8. Elements in period shows different properties

9. Elements in group show same ~~different~~ properties.

10. Elements are classified into four blocks in the periodic table these are s, p, d, f.

11. Elements of 1st two groups are called s block element. Elements of 3rd to 12th groups are called d block. Elements of 13th to 18 th groups are called p block elements. Elements of 6th and 7th periods are called f block elements.

12. s-block elements contain alkali and alkaline earth metal.

13. p-block elements contains chalcogens, halogens, nitrogen and oxygen family, and ~~not~~ noble gas.

14. d-block elements are called transition elements.

15. f-block elements are called lanthanides and actinides.

8. Why is Ca called an alkaline earth metal?

Ans: Different compounds of the metal Ca are available in soil which makes it an earth metal. Again, Hydroxide compound of Ca is $Ca(OH)_2$, is an alkali. Therefore, it is an alkaline. The two information contribute in Ca being called alkaline earth metal.

9. Why are noble gases so unreactive?

Ans: The atoms of noble gases already have complete outer shell. so they have no tendency to lose, gain, share electrons. This is why the noble gases are inert and do not take part in chemical reactions.

10. Why is He an inert gas? explain.

Ans: He doesn't bond with the other elements of its group. He isn't interest to bond with other elements, so, He is an inert element. since, in normal temperature, it remains in gas form, so we call it an inert gas.

11. Write some advantage of the periodic table

Ans:

Advantages of the periodic table:

1. It is easier to remember the properties of an element if its position in the periodic table is known.

2. The periodic table has made the study of chemistry systematic and easy. It acts as an aid to memory.

3. Knowing the of position of the element in the periodic table. The idea of compounds can be given.

12. ~~Ans~~ solve the following electronic configurations: (i) Cr (ii) K (iii) Cu

Ans:

(i) Cr (24) → $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^5, 4s^1$.

(ii) K (19) → $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1$.

(iii) Cu (29) → $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}, 4s^1$

13. Define periodic table, symbol and atomic number.

Ans:

periodic table: The periodic table is tabular arrangement of all the chemical elements on the basis of their respective atomic number.

symbol: In chemistry, an element symbol usually refers to the one or two letter abbreviation for a chemical element. When a symbol consists of two letters, the first letter is always capitalized and lowercase in other.

atomic number: The number of protons in an atomic nucleus is called atomic number. It indicates the position of element in the periodic table

14. Define and explain Inert gas and Halogen Group.

Ans: Elements belonging to group-18 are called inert gas. They are He, Ne, Ar, Kr, Xe, Rn and Og. As their outermost energy level is filled with electrons, they do not show any tendency to form compound by accepting donating or sharing electrons. They remain in gaseous form in normal temperature.

Elements belonging to group-17 are called Halogen. They are F, Cl, Br, I, At, Ts. The meaning of Halogen is salt maker. Metals bonding with these elements produce salts, like Na and F bond together to produce sodium Fluoride. The main source of Halogens is the sea salt. They themselves form diatomic molecules by sharing electrons like Cl_2, I_2 (etc).

15. Distinguish between compound and element.

Elements	compounds
1. Element are made up of one kind of atoms.	1. compounds are made up of two or more kinds of atoms.
2. There are nearly 118 elements	2. compounds are almost endless.
3. Elements are classified as either metals, non-metals or metalloids.	3. compounds are classified according to their bonds which can be ionic, metallic.
4. Elements are represented by symbols and number For ex. sodium → Na.	4. compounds are represented by their chemical formula. Like as salt is → Nacl
5. Elements are distinguished by their atomic number	5. compounds are distinguished by their ratio.
6. Example: H, Ag, Au	6. Example: H_2O, Nacl
7. Elements can not be broken down by chemical reaction	7. compounds can be easily separated into simpler substances by chemical reaction

16. Find out the mass number, number of protons, number of electrons, and neutrons from (i) $^{7}_{3}Li$ (ii) $^{9}_{4}Be$

Ans:

(i) $^{7}_{3}Li$

mass number → 7

number of protons → 3

number of electrons → 3

number of neutrons → 4

(ii) $^{9}_{4}Be$

mass number → 9

number of protons → 4

number of electrons → 4

number of neutrons → 5

17 Write short notes on:

i) Diagonal relationship between element.

ii) The position of Hydrogen in the periodic table.

iii) The position of rare earth elements in the periodic table.

Ans: (i) The diagonal relationship exists between the certain pair of diagonally adjacent element in the second and third periods of the periodic table.
These pairs Li → mg, Be → Al, B → si (etc) exhibits the same properties. For example, Boron and silicon, both of them are semiconductors and they have acidic oxides and form halides which are hydrolyzed in the water. This relaestionship occurs because the periodic table has opposing effects due to descending and crossing.

Reason: The diagonal relationship is due to the polarizing power, that is, ionic charge / ionic radius being similar for the diagonally placed elements.

ii. Hydrogen is the first element of the periodic table its atomic number is one, which means it has only one electron and its outermost electrons is one. The placement of element in the periodic table is based on their electronic configuration

This structure is similar to that of alkali metals (ns^1) which have one electron in their outemost shell. It can attain the noble gas configuration of helium by accepting one electron. This character is very much similar to that of halogen family (ns^2np^5) which are also short of one electron to complete the octet of electrons in their shell. When Hydrogen loses an electron and form a cation, it resembles alkali metals but when it gains an electrons and becomes a uni-negative ion it shows similarity to halogens.

Though H shows a lot of resemblance to halogens and alkali metals, it is very different from both. so a great thought has to be given for the position of H. When H loses electrons, the size of nucleus decreases and which is very small as compared to the atomic sizes of normal metal and hence H ion doesn't exist freely in nature.

In periodic table, Rare earth elements stay at grp-(III). ⇒

iii. Rare earth elements are a group of 17 chemical elements that occurs periodic table and this 17 chemi. stay at Group 3, ⇒ They consists of Yattrium and the 15 lanthanide elements. Sc is most rare earth elements and some time classified as a rare earth element. The IUPAC includes Sc in their rare earth element definition.

The rare earth metal elements are all metals, and the group is often reffered to as the "rare earth metal". These metals have many similar properties.

uses of REE:

i) computer memory
ii) DVDs.
iii) Rechargeable battery
iv) cell phones.
v) catalists.

P.T.O

vi) Magnents
vii) fluorescent light.
viii) camera.
ix) Glass & ceramics.

Rare elements are not as "rare" as their name. The most abundant rare earth meta are cerium, Y, lanthanum, ∞

(2) H is a non-metal. But in the periodic table, H is placed in Grp-1 with alkali metals (Na, K, Rb, Cs, Fr) The structure of outermost s shell in H and alkali meta are similar. Again, many properties of H and Alkali metals are coincide.

On the other hand, H atom receives an electron same as Halogen element (F, Cl, Br, I). So many properties of Halogen and H is similar.

However, since most of the properties of H coincide with of alkali metals, they have been placed in Grp-1 with alkali metals.

Solutions

18. Define solution with example.

A solution is a homogeneous mixture of two or more components in which the particle size is smaller than 1 nm

common example of solutions are the sugar in water and salt in water solutions, blood, gasoline.

19. What do you know by the term 'solute' and 'solvent'

Solvent: The substance in which a solute dissolves to produce a homogeneous mixture
→ is a substance that dissolves a solute.

solute: The substance in which a solvent dissolves to produce a homogeneous mixture.
→ a substance that is dissolved to make a solution.

water + sugar
↙ ↘
solvent → [illegible] solute → [illegible]

20. Write some properties of solvents change in solutions

(i) High volatillity
(ii) colourless liquid
(iii) low boiling point
(iv) Molecular weight
(v) A solutions physical properties are different from the pure solvent.
(vi) The amount of solute in the solution determines how much the physical properties of the solvent are changed

21. What is solute concentration? writes its degree.

Concentration: The amount of solute dissolved in a solvent at a given Temp.
Ex, Hot chocolate, more powered mix you add the higher the conce.. of chocolate.

Degree:

(i) Dilute: A solution has low concentration of solute.

(ii) Saturated: A solution that contains the max. amount of solute that can be dissolved into the solvent at a given temperature.

(iii) Supersaturated: A solution can contain more solute than normal by rising the temp of the solvent.

The solvent is the largest part of the solution and the solute is the smallest part of the solution.

Saltwater → salt = solute, water = solvent.

Blood → calcium ions, sugars = solutes
water = solvent

Science
~~seei~~
seei

22. What is an azeotrope mixture?

An azeotropic mixature is a mixture of substance that has the same concentration of vapour and fluid phases.
It is basically a mixture that contains two/more liquids. Example: ethanol (96%)/water, boils at 78.1°C.

23. Why water and benzene mixture can not be seperated by distillation?

immiscible

Normal boiling point of C_6H_6 = 80°C
Normal boiling point of H_2O = 100°C
Benzene and water are two ~~mis~~ imminscible liquids.

The boiling point for the benzene and water mixture is slightly below 80°C. ✓

Distillation is a process of boiling then condensation. since, both C_6H_6 and H_2O boil simultaneously at a temperature slightly below 80°C, C_6H_6 and H_2O can't be seperated by distillation

condensation

24. Mass % of benzene (C_6H_6) = $\frac{\text{Mass of } C_6H_6}{\text{Total Mass of solution}} \times 100$

$= \frac{\text{Mass of } C_6H_6}{\text{Mass of } C_6H_6 + \text{Mass of } ccl_4} \times 100$

$= \frac{22}{22+122} \times 100$

$= 15.28\%$

Mass % of carbone tetrachloride (ccl4)

$\frac{\text{Mass of } ccl4}{\text{Total Mass of solution}} \times 100$

$= \frac{\text{Mass of } ccl4}{\text{Mass of } C_6H_6 + \text{Mass of } ccl4} \times 100$

$= \frac{122}{22+122} \times 100$

$= 84.72\%$

25. Molarity:

Molarity (M) is defined as the number of moles of solute per litre of solution.

Molarity = moles of solute / litre of solution

Example: Mass of H_2SO_4 is 98. Now 98g H_2SO_4 presented in 1L of solution then it is 1M solution of H_2SO_4. And Molarity will be 1.

Molality: Molality is defined as the number of moles of solute per Kilogram of solvent.

Molality = moles of solute / Kilograms of solvent

Example. if 98g of H_2SO_4 is presented in 1 Kg of H_2O then it is 1 molal solution of H_2SO_4 in H_2O. And molality is will be 1.

Normality:

Normality is defined as the number of equivalents per litre of solution

Normality = number of equivalents / 1L of solution

A 1N HCl solution = A 1M HCl solution bcz only 1 mole of H^+ is formed per mole of HCl.

26. state Henry's law with limitations.

State:

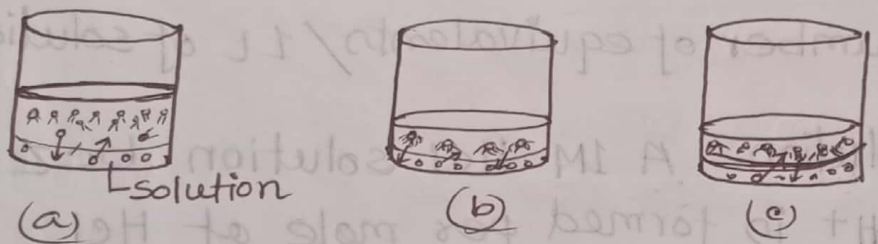
The solubility of a gas in a liquid is proportional to the pressure of the gas over the solution at constant temperature.

$C = KP$

C is the concentration of dissolved gas

P is the pressure of the gas over the solution.

K is the constant that depends only temperature.



Limitations:

(i) At moderate temperature and pressure.

(ii) solubility in solvent is low.

(iii) Gas react with solvent

(iv) Associate or dissociate the molecules.

dissociate the molecules

27. Given,
partial pressure of CO_2 is 4.0 atm
Henry's law constant of CO_2 3.1×10^{-2} mol/L-atm
concentration of CO_2 = ?

Now,

$$S_{CO_2} = KP_{CO_2}$$

$$= (3.1 \times 10^{-2} \text{ mol/L-atm})(4.0 \text{ atm})$$

$$= 0.12 \text{ mol/L}$$

$$= 0.12 M$$

mol/L = M

8. What are colligative properties ?
সমধর্মিতা বৈশিষ্ট্য

Colligative properties is a properties of solutions which depend on the number of solute particles but not on their nature.

Among colligative properties are:
(i) Vapor pressure lowering (বাষ্পের চাপ কমানো)
(ii) Boiling point elevation (স্ফুটনাঙ্কের উচ্চতা)
(iii) Melting point depression (~~হিমাঙ্কের~~ গলনাঙ্কের বিষণ্নতা)
(iv) Osmotic pressure. (অসমোটিক চাপ)

29. How is the molecular weight of a solute determ from vapour pressure lowering.?

from Raoult's law

$$(P-P_S)/P = n/(n+N)$$

Considering,

ω gms of solute; Moles of solute $(n) = \omega/m$

W gms of solvent; Moles of solvent $(N) = W/M$

where, m = molecular weight of solute

M = molecular weight of solvent

Now,

$$\frac{P-P_S}{P} = \frac{n}{n+N}$$

$$\Rightarrow \frac{P-P_S}{P} = \frac{\omega/m}{\omega/m + W/M}$$

$$= \frac{\omega/m}{\frac{M\omega + mW}{mM}}$$

$$= \frac{\omega}{m} \times \frac{mM}{M\omega + mW}$$

$$= \frac{\omega M}{M\omega + mW}$$

$$= \boxed{\frac{\omega M}{M\omega}}$$

30. What is Raoult's law and write its Limitations.

The vapor pressure (P_s) of a solvent is directly proportional to the mole fraction of the solvent in the solution.

Vapor pressure (P_s) $\propto$ mole fraction of solvent

Law: $$P_s = \frac{N}{N+n} \times P$$

When solute is added the vapor pressure drop.

Here,
P = vapor pressure of the pure solvent
N = moles of solvent
n = moles of solute
For pure solvent $P_s = P$

p = the vapor pressure of the pure solvent
P_s = the vapor pressure of the solution with solute

$$P_s = \frac{N}{n+N} \times P$$

$$\Rightarrow \frac{P_s}{P} = \frac{N}{n+N}$$

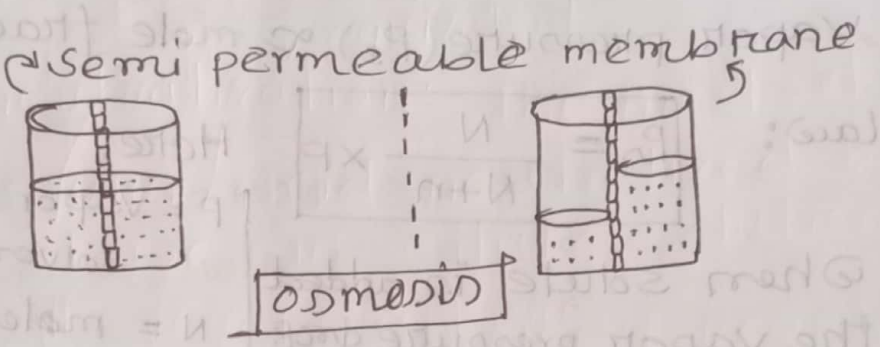
$$\Rightarrow 1 - \frac{P_s}{P} = 1 - \frac{N}{n+N}$$

$$\Rightarrow \frac{P - P_s}{P} = \frac{n}{n+N}$$

Limitations:

(i) At higher concentration, solute gain intermolecular force.
(ii) It does not applies to valatile solutes.
(iii) Associate or Dissociate the molecule.

31. **Osmosis:** osmosis is a process by which the molecules of a solvent pass from low concentration to high concentration through a semi-permeable membrane.



osmotic pressure: It is a minimum pressure that must be applied to a solution to prevent the flow of solvent molecules through a semi-permeable membrane. It is colligative property and is dependent on the concentration of solute particle in the solution.

Formula: $\pi = iCRT$

where, π = osmotic pressure
i = Van't Hoff factor
C = molar concentration of the solute in the solution.
R = Universal gas constant
T = Temperature

Themochemistry

32. What do you understand by exothermic and endothermic process.

Exothermic: It is a chemical reaction in which heat is released.

Example: of Endothermic

photosynthesis: plants absorb heat energy from sunlight to convert carbon dioxide and water into glucose and oxygen.

$$6CO_2 + 6H_2O \xrightarrow{\Delta} C_6H_{12}O_6 + 6O_2$$

Endothermic: It is a chemical reaction in which heat is absorbed.

Example: of Exothermic

Rain: process of rain is the proper example of exothermic or heat released process.

33. (i) Heat of solution: Heat of solution refers to the change in enthalpy when a solute is dissolved into a solvent.

(ii) Heat of neutralization: The heat set free when one gram equivalent acid neutralized by one gram equivalent base in dilute solution at constant temperature.

(iii) Heat of vaporization: The amount of heat required to convert a unit mass of a liquid at its boiling point into vapor without increase temper..

(iv) Heat of formation: The change of enthalpy during the formation of a mole of a substance from pure elements under standard condition.

$\Delta Hf = \Sigma \Delta Hf (\text{reactants}) - \Sigma \Delta Hf (\text{products})$

(v) Heat of combustion: When a certain amount of matter is completely burned with oxygen, the energy emitted by the combustion of the substance.

34. Hess's law of constant T.

Soln State: Heat of reaction is same whether it is carried out in one step or in several step.

Consider the formation of $CO_{2(g)}$

step 1: A → B	ΔH_1
step 2: B → C	ΔH_2
A → C	$\Delta H = \Delta H_1 + \Delta H_2$

In one step: $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$ $\Delta H = -394$ KJ

In two step: $C_{(s)} + \frac{1}{2}O_{2(g)} \rightarrow CO_{(g)}$ $\Delta H_1 = -83$ KJ

$CO_{(g)} + \frac{1}{2}O_{2(g)} \rightarrow CO_{2(g)}$ $\Delta H_2 = -311$ KJ

$\therefore \Delta H = \Delta H_1 + \Delta H_2 = -83 + (-311) = -394$ KJ

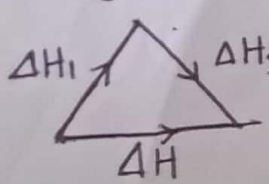
Applications: Hess's law is used for:

(i) To calculate heat of formation, combustion, neutralisation, ionization etc

(ii) To calculate the heat of reactions which may not take place directly.

(iii) To calculate heat of extremely slow or fast reactions.

(iv) To calculate enthalpies of reactants and products.



Hess's law

Heat of reaction depends on temperature. How it will vary with temp. is expressed by eq., called Kirchoff's equation.

35. Derive thermodynamically Kirchoff's eq:
or,
How does the "Heat of reaction" vary with Temp? Mention Kirchoff's eq. in this connection.

→ Kirchhoff's equation: Influence of Temperature on Heat of reaction.

$$A \longrightarrow B$$

Let at constant P, enthalpy of reactant and product are H_1 and H_2 respectively

Thus enthalpy of reaction

$$\Delta H = H_2 - H_1 \qquad \text{(i)}$$

Differentiating eq. (i) we get, at constant P w.r.t. T

$$\left[\frac{d\Delta H}{dT}\right] = \left[\frac{dH_2}{dT}\right] - \left[\frac{dH_1}{dT}\right] \qquad \text{(ii)}$$

We know that,

$$\frac{dH}{dT} = C_p \qquad \text{(iii)}$$

C_p = Heat capacity of constant te

Now, eq (ii) can be written,

$$\left[\frac{d(\Delta H)}{dT}\right] = (C_p)_2 - (C_p)_1$$

$$\Rightarrow \frac{d(\Delta H)}{dT} = \Delta C_p$$

$$\Rightarrow d\Delta H = \Delta C_p \, dT \quad \text{——————(iv)}$$

Above eq. is called Kirchhoff's eq.

Intrigating eq. (iv) we get,

$$\int_{H_1}^{H_2} d\Delta H = \Delta C_p \int_{T_1}^{T_2} dT$$

$$\Rightarrow \Delta H_2 - \Delta H_1 = \Delta C_p (T_2 - T_1) \quad \text{——————(v)}$$

eq. (v) is also called Kirchhoff's eq.

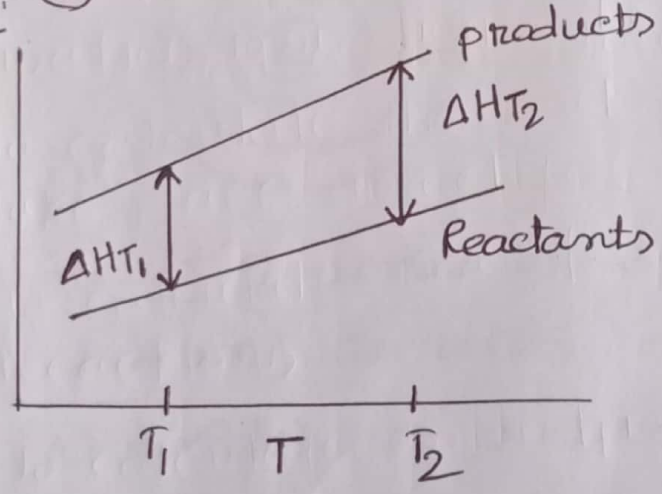


Fig: Kirchoff's law

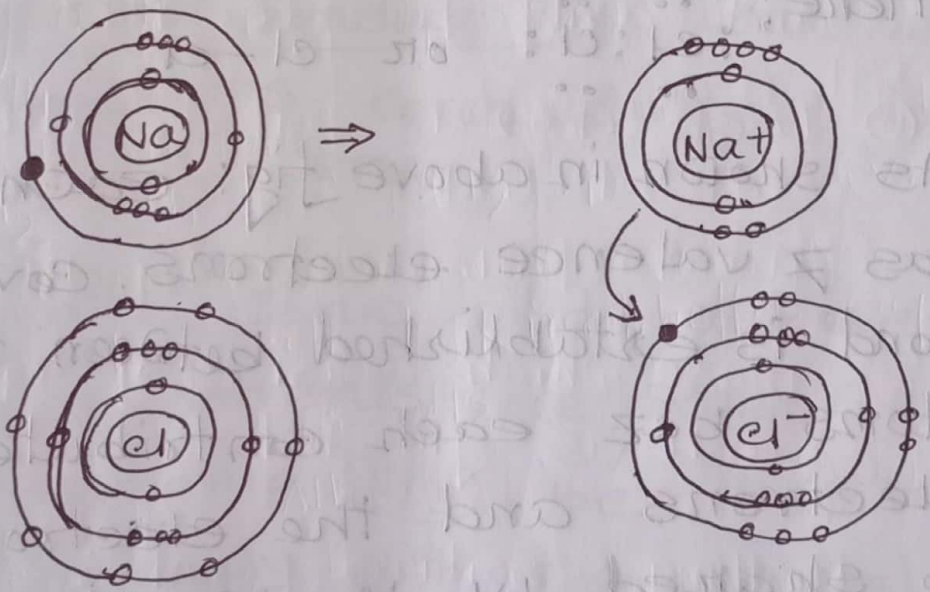
chemical Bonds

1. Explain with example Ionic & covalent Bonds.

→ Ionic bond : It is also called electrovalent bond, oppositly charged ion can be created ionic compound.

This bond create when the valence (outermost) electrons of one atom are transferred permanently to another atom. [strong bond]

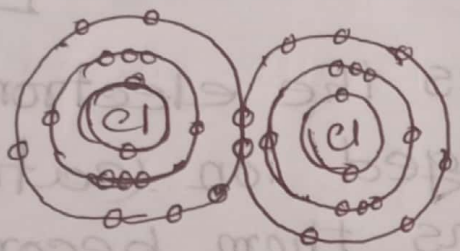
The atom that loses the electrons becomes a positively charged ion (cation). While the one that gains them becomes a negatively charged ion (anion).



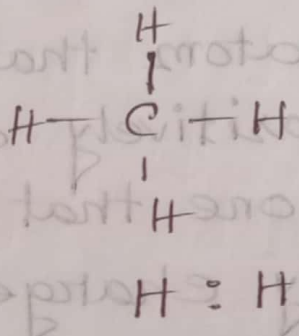
Above fig Ionic bond in sodium chloride Na (sodium) donates one of its electrons to Cl (chloride) in a chemical reaction.
For this reason (+ve)ly ion (Na+) and (-ve)ly ion (Cl-) for a stable ionic compound.

Covalent bond: It is also called molecular bond. When pair of electrons are shared between two atoms., covalent bond is created.

By sharing the electrons, the two atoms in many cases, acquire a noble gas configuration **Non polar bond**



Cl 2,8,7



Here; :Cl:Cl: or Cl–Cl

As shown in above fig: each Cl atom has 7 valence electrons. Covalent bond is established between the two atoms bez each contributes one electrons and the electron pair is shared by the two atoms so that each has 8 electrons in its valence shell thereby stability.

As seen each chlorine achieves argon structure.

2. Write some properties of Ionic & covalent bond or, Difference between them.

→ Ionic :

(i) Crystaline structure: As published by x-ray diffraction patterns such solids usually have crystaline structure. Example, In a Nacl crystal.

(ii) Melting & boiling points: In Ionic compound they have electrostatic forces. They have high melting & boiling points.

(iii) Electrical conductivity: Ionic solids are good insulators. conductivity of ionic solids increases with temp.

(iv) Solubility: Ionic solids are easily soluble in solvents like water (H_2O) and Liquid ammonia (NH_3). bez their molecules intract strongly with the crystal ions.

(v) Ionic reactions: Ionic reations are practically instaneous. For example:

$$Na^+ + Cl^- \rightarrow Nacl.$$

Covalent:

(i) **physical state:** Covalent compounds may be solids, Liquid or gases. At normal temp. & pressure, they exist as gases or solids. For example

Chlorine (Cl_2) → gas
Bromine (Br_2) → Liquid.
Iodine (I_2) → solid.

(ii) **crystal structure:** crystal of covalent compounds are of three types:

(a) Molecules are small & held together by weak force. such crystal are soft and easily fusible. Ex. S and I_2

(b) Each atom is united with other by covalent links as a result they form giant molecules. Ex. Diamond.

(c) Those which consists of separate layers such as graphite.

(iii) **Melting & boiling points:** since covalent bonds are not as powerful as ionic bonds, the covalent compounds have comparatively low melting & boiling points.

(iv) Electrical conductivity: All covalent crystals are basically insulators because there is no electrons in conduction band. Diamond is the proper example of insulators. Ge is a semi-conductor. The conductivity of semiconductors are increased with suitable doping and temperature.

(v) solubility: covalent compounds are soluble in non-polar solvents such as benzene and carbon tetrachloride. (C_6H_6 & CCl_4)

properties of ionic bonds:

(i) Metals & non-metals form ionic compounds
(ii) High melting & boiling point.
(iii) They are soluble in water.
(iv) The speed of chemical reaction is fast

properties of covalent bonds:

(i) Non-metal & non-metal form covalent compounds
(ii)

Difference

Ionic bonds	covalent bonds
Metal & non-metals form ionic compounds	Non-metal & Non-metal form covalent compound.
polarity is high	polarity is low
No definite shape	Definite shape
Melting point is High	Melting point is low
Boiling point is High	Boiling point is low
solid at a room temp.	Liquid/Gas at room temp
Example: NaCl	Example: CH_4
Soluble in polar solvents	Soluble in non-polar solvent
speed high	speed low
strong	weak

3. Define chemical bond and named some types of bond.

→ A chemical bond is a lasting attraction between atoms, molecules or ion that enables the formation of chemical compound

Types of chemical bond:

(i) Ionic Bonds.
(ii) covalent Bonds.
(iii) Hydrogen Bonds
(iv) polar Bonds.

4. How covalent bond is formed?

→ Covalent bond forms when the difference between the electronegaties of two atoms is too small. (+ Question no 01)

5. Explain the formation of Ionic bonds.

→ Answer→ Q: No: 01

6 How do name an ionic compound?

→ The stock Method of naming: An ionic compound is named first by its cation and then by its anion.

The cation has the same name as its element. For example, Na^+ is called Sodium ion. The anion is named by taking the element name, removing the ending and adding "ide". For ex. Cl^- is called chloride. The element name was chloride. The "ine" was removed and replaced with "ide". The cation & anion created the compound. Example NaCl is called sodium chloride.

7 What are metallic compounds and why they conductive?

→ A metallic bond is that sharing of many detached electrons between many positive ions, where the electrons acts as a glue.

Atoms quickly shed electrons in a metal to generate positive ions (cations). The conductivity of these ion is due to delocalized electrons around them.

8. What are the main properties of covalent compounds?

→ Solve → Q

9. What are the main properties of ionic compounds?

→ solve → Q

10. What is hydrogen bonding?

→ H bond is a special class of attractive intermolecular forces that is arise due to the dipole-dipole interaction between a H atom that is bonded to a highly electronegative atom & another highly electronegative atom which lies in the vicinity of the H atom. Ex: H_2O

কাছাকাছি

Chemical Kinetic

1. What do you understand by chemical Kinet

→ Chemical kinetics is the description of the rate of a chemical reaction. This is the rate at which the reactants are transformed into products. This may take place by abiotic system.

2. Define order of reaction.

→ The order of reaction refers to the relationship between the rate of chemical reaction and the concentration of the species taking part in.

3. What is zero order reaction? Give an example

→ <u>Zero order reaction:</u> The rate of reaction is directly proportional to the sum of the concentration of the reacting species.

Ex. $H_2 + Cl_2 \xrightarrow{U.V\ Light} 2HCl$

$$\frac{dx}{dt} \propto [H_2]^0[Cl_2]^0$$

4. What do you understand by the rate of reaction?

→ The rate of reaction refers to the speed at which the products are formed from the reactants in a chemical reaction.

Example: the reaction rate of the combustion of cellulose in fire is very high and the reaction is completed in less than a second.

5. Derive a 2nd order rate equation for the reaction $2A \rightarrow$ products.

→ $2A \rightarrow$ product

Initial concentration : $a\ mol l^{-1} \rightarrow 0$

Final " $(t=t)$: $(a-x)\ mol l^{-1} \rightarrow x\ mol l^{-1}$

∴ The rate of reaction, $\frac{dx}{dt} = k(a-x)^2$

$$\Rightarrow \frac{dx}{(a-x)^2} = k\,dt$$

Integrating, $\frac{1}{a-x} = kt + c$ ——— (i)

Here, c is integ. constant.

At $t=0, x=0$, then eq. (i), we have $c = \frac{1}{a}$

Hence: $\frac{1}{a-x} = kt + \frac{1}{a}$

$$\Rightarrow kt = \frac{1}{a-x} - \frac{1}{a}$$

$$\Rightarrow k = \frac{1}{t} \cdot \frac{x}{a(a-x)}$$ [This is the required exp.]

6. Show that the half life period of a first order reaction is independent of initial reactant concentration.

→ The rate constant for a first order reaction is given by,

$$K = \frac{2.303}{t} \log \frac{[A_0]}{[A]}$$

$t = t_{1/2}$, $[A] = \frac{[A_0]}{2}$

$$\Rightarrow K = \frac{2.303}{t_{1/2}} \log \frac{[A_0]}{\frac{[A_0]}{2}}$$

$$\Rightarrow K = \frac{2.303}{t_{1/2}} \log(2)$$

$$\Rightarrow K = \frac{2.303 \times 0.3010}{t_{1/2}}$$

$$\Rightarrow K = \frac{0.6932}{t_{1/2}}$$

$$\therefore t_{1/2} = \frac{0.6932}{K}$$

Thus, a first order reaction, the half life is a constant i.e, it does not depend the initial reactant concentration.

7. Discuss the collision theory of reaction rate?

→ collision theory states that the rate of a chemical reaction is proportional to the number of collisions between reactant molecules.

The more often reactant molecules collide the more often they react with one another, and the faster the reaction rate.

In reality, only a small fraction of the collisions are effective collisions. Effective collisions are those that result in a chemical reaction.

For a bimolecular elementary reaction,

$A + B \longrightarrow$ product

The rate of reaction is-

$$R = Z_{AB} e^{-\frac{Ea}{RT}}$$

Where Z_{AB} represent the collision frequency of reactants A and B, and $e^{-\frac{Ea}{RT}}$ represents the fraction of molecules with energies equal / greater than the activation energy of the reaction.

Chemical Equilibrium

1. What do you mean by reversible reaction?

→ A reversible reaction is defined as a chemical reaction where the reactants and the products react together to give the reatants back.

The main characteristic of such type of reaction is that the reactants and products are never fully exhausted.

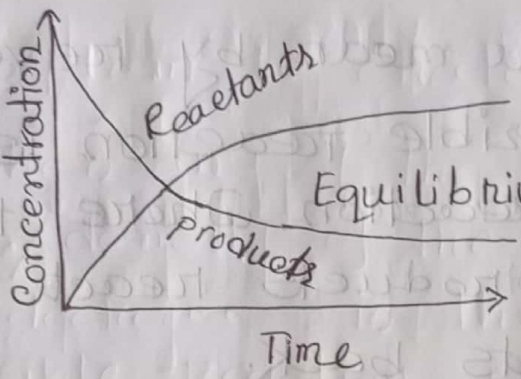
A reversible reaction is indicated as follow:

$$X + Y \rightleftharpoons A + B$$

X and Y can react to form A and B and in reverse reaction, A and B can react to form X and Y. The double arrow says that the reaction is reversible.

2. What is chemical equilibrium?

→ chemical equilibrium is a equilibrium in which the concentration of the reactant and the concentration of the products do not change with time and the system does not display any further change in properties.



When the rate of the forward reaction is equal to the rate of the reverse reaction the state of chemical equilibrium is achieved by the system.

3. Chemical equilibrium is dynamic equilibrium Explain Why?

→ It is also called dynamic equilibrium bcz the equilibrium can shift towards both sides that is reactant and product known as equilibrium shifting.

In chemical equilibrium, the reaction is going on but the rate of formation of reactant is equals to the rate of formation of product. so, it seems to be in equilibrium but actual reaction is going on.

Hence it is dynamic.

4 Define and explain law of Mass Action by molecular collision theory.

4

→ The law of mass action states that the rate of a reaction is proportional to the product of the concentrations of each reactant.

This law can be used to describe the behaviour exhibited by solutions in dynamic equilibria. The law of mass action also suggests that the ratio of the reactant concentration and the product concentration is constant at a state of chemical equibrium

Consider the following reverriable reaction where A & B are reactants, C & D are the products.

$$A + B \rightleftharpoons C + D$$

This relation can be equated as follows by the equilibrium constant K_c :-

$$K_c = \frac{[C][D]}{[A][B]}$$

The law of mass action dictates that the equilibrium constant, at a given temp. it is also called equilibrium law.

5. State & explain le chatelier's principle.

→ State: When any of the regulators (temp./ pressure./ density of the reactant) changes (increases/decreases) in the equilibrium of the reversible reaction, the reaction equilibrium changes in such a way that the result of the regulator change is mitigated.

(i) The effect of temperature on equilibrium:

Exothermic reaction:

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)} \quad \Delta = -92KJ$$

If Temperature (↑) is increased then:—
The rate of forward reaction (↓) সামনের দিকে বাধাদিবে
The rate of backward reaction (↑) " পেছনের দিকে

If Temperature (↓) is decreased then:—
The rate of forward reaction (↑)
The rate of backward reaction (↓)

Endothermic reaction:

$$N_{2(g)} + O_2 \rightleftharpoons 2NO \quad \Delta H = 180KJ$$

If the Temp. (↑) is increased then:—
The rate of forward reaction (↑)
The rate of backward reaction (↓)

If the Temp (↓) is decreased then:—
The rate of forward reaction (↓)
The rate of backward reaction (↑)

(ii) The effect of pressure on equilibrium:

- Mole of reactant > mole product

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$$

If pressure (↑)
The rate of forward reaction (↑)
The rate of backward reaction (↓)

If pressure (↓)
The rate of F.R (↓)
The rate of B.R (↑)

- Mole of reactant < mole of product

$$N_2O_{4(g)} \rightleftharpoons 2NO_{2(g)}$$

If pressure (↑)
The rate of F.R (↓)
The rate of B.R (↑)

If pressure (↓)
The rate of F.R (↑)
The rate of B.R (↓)

- mole of reactant = mole of product

$$N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$$

In this reaction, no change the pressure

(iii) The effect of density on equilibrium:

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3$$

If the density of reactant (↑)
The rate of F.R (↑)
The rate of B.R (↓)

If the density of reactant (↓)
The rate of F.R (↓)
The rate of B.R (↑)

If the density of product (↑)
The rate of F.R (↓)
The rate of B.R (↑)

If the density of product (↓)
The rate of F.R (↑)
The rate of B.R (↓)

Question - 5

CF→1600
CF→577B

2015 2016 2017 2018 2019 2020 কে 3 দ্বারা ভাগ করলে কত অবশিষ্ট থাকবে?

Dividing 2015 2016 2017 2018 2019 2020 by 3, how much will be left?

Sol: ডিজিটগুলোর যোগফল:-

2+0+1+5+2+0+1+6+2+0+1+7+2+0+1+8+2+0+1+9+2+0+2+0 = 54

54 কে 3 দ্বারা ভাগ করলে: 3) 54 (18
3
24
24
0

উ: অবশিষ্ট 0.

1 2 3 4 5 6 7

1 → 1

2 →

1	4
2	3

4	1
3	2

1 2 4
3 5

7

5 3

1 2 4
1 2 1
1 3 4

n = 1, 2, 3, 4, 5 K = 7

(1,1) (2,1) (3,1) (4,1) (5,1)
(1,2) (2,2) (3,2) (4,2) (5,2)
(1,3) (2,3) (3,3) (4,3) (5,3)
(1,4) (2,4) (3,4) (4,4) (5,4)
(1,5) (2,5) (3,5) (4,5) (5,5)

1-5

5

1 3 6 9
1 1 4

7

1 1 1 2
0 1 1 0

7/5 = (2,2)

sort(all(ar));

Ans: ar[K/n], ar[K/n]

2nd Year 2nd Semester Examination-2020
Department of Computer Science and Engineering
Islamic University, Kushtia

Course Code: CHEM 2211 **Course Title: Chemistry**

Time: 04 Hours Full Marks: 70

Answer any five of the following

1. a) What do you mean by atomic number? Draw a structural diagram of Mg (12) atom. 1+2
   b) Describe the limitations of Rutherford's atomic model. 5
   c) Explain why atoms of different elements can have the same mass number and neutron number, but they can't have same number of protons. 4
   d) How are ions formed? 2

2. a) Why are noble gases so unreactive? 2
   b) Write short notes on: 9
      i) Diagonal relationship between elements.
      ii) The position of Hydrogen in the periodic table
      iii) The position of rare earth elements in the periodic table
   c) Distinguish between Compound and Element. 3

3. a) Distinguish between Ionic and covalent bonds 4
   b) Explain the formation of Ionic bond with example and figure. 5
   c) What are metallic compounds and why they conductive? 3
   d) What is hydrogen bonding 2

4. a) Define Solution with example. 2
   b) What do you know by the term 'Solute' and 'Solvent'? 3
   c) Write some properties of solvents change in solutions. 3
   d) Define the following terms: 6
      i. Molarity
      ii. Molality
      iii. Normality

5. a) What is an azeotrope or azeotropic mixture? 2
   b) Explain why a mixture of water and benzene cannot be separated by distillation 3
   c) If 22 g of benzene is dissolved in 122 g of carbon tetrachloride, determine the mass percentage of carbon tetrachloride (CCl4) and benzene (C6H6) 3
   d) What is *Rault 'slaw* and also write its's limitations. 4
   e) What is meant by the term "Osmosis"and Osmotic Pressure"? 2

6. a) What do you understand by Exothermic and Endothermic reactions/process? 3
   b) Define the following terms: 6
      (i) Heat of solution;
      (ii) Heat of neutralization;
      (iii) Heat of vaporization;
      (iv) Heat of formation.
   c) State and explain Hess's law of constant heat summation. 5

7. a) What do you understand by pH value? Explain the importance of pH in health issue and beautification. 1+3
   b) Why all metals are electrical conductor? 2
   c) What is acid rain? Explain the negative effects of acid rain. 4
   d) What do you understand by hardness of water? How does it cause problems in our daily life? 4

8. a) What is an exothermic reaction? Give an example of exothermic reaction. 2
   b) Why heat is necessary in the photosynthesis process? 3
   c) Analyze the energy diagram of exothermic and endothermic reaction. 5
   d) Calculate the bond energy of N-H of the reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3$ 4