

CHAPTER 1

Differentiate b/w Mendeleev's periodic law and modern periodic law.

Ans. Mendeleev's Periodic Law

Its elements are arranged in ascending order of atomic masses, the "properties" of elements are periodic function of their atomic masses.

Modern Periodic Law

Its elements are arranged in ascending order of their atomic number, their chemical properties repeat in a periodic manner.

How does the Mendeleev's periodic table help us to correct the atomic masses of some of the elements?

On the basis of similarity in chemical properties, Mendeleev arranged certain elements in certain groups. He placed Be above Mg, Ca, Sr and Ba. Its atomic mass was thought to be 13.5 a.m.u. which was wrong. He gave correct position to it. Its atomic mass was proposed to be 9.00 a.m.u.

How does Moseley's periodic law help to correct the rearrangements of some elements?

According to Moseley's law, the physical and chemical properties of elements are the periodic function of their atomic numbers.. So, Moseley said that Ar should be placed before K, Co before Ni and Te before I. Moreover, he adjusted the positions of the rare earths, noble gases and coinage metals.

How Lanthanide contraction controls the atomic sizes of elements of 6th and 7th periods?

Lanthanides are present in 6th period. Similarly, actinides are present in 7th period. They are 14 elements each. The number of protons increase but the number of electrons remain the same in shells, i.e., in 5f and 6f. There

happens a contraction in their sizes. In case of lanthanides, the number of protons increase from Ce to Lu₇₁, but electrons are being accommodated in same sub-shell, i.e. 4f. This aspect even strongly affects the next d-block elements.

How the shielding effect is one of the important parameters to determine the size of an atom?

Shielding effect is due to the electrons in between the nucleus and the outermost electron. Greater the number of electrons in these shells, lesser the forces of attraction between the nucleus and the outermost electrons and greater the sizes of atoms.

Why is cationic radius smaller than that of its parent atom?

Ans. This is due to the reason that with the successive loss of electrons, the nuclear charge attracts the remaining electrons with a greater force. Hence electronic cloud shrinks.

Why is anionic radius larger than that of its parent atom?

Ans. This is due to the reason that with the successive addition of electrons in outer most shell electron electrons repulsion increase and electronic cloud expands.

Why is difficult to measure exact atomic radii of the atoms?

Ans. There are not sharp, boundaries for the atomic orbitals, because their probability for finding electron never becomes zero, even if the electron is at a large

distance
nucleus.

from

the

Why atomic radii decrease from left to right in a period?

Ans. The increase of nuclear charge and the no change of shielding effect decreases the atomic radii from left to right.

Why atomic radii increase from top to bottom in a group?

Ans. The increasing number of shells and increasing shielding effect increase the atomic radii from top to bottom.

How does the nature of orbital influence the value of ionization energies of elements?

Ans. The outermost electrons to be removed may be in s, p, d, or f orbitals. s-orbitals are most penetrating and f-orbitals are least. So the electron removal from s-orbital is most difficult and easiest from f-orbital.

Why does ionization energy decrease from top to bottom in a group?

Ans. Ionization energy decreases from top to bottom in a group because atomic size increases due to gradual increase in number of shells and shielding effect also increases. As a result ionization energy decreases. "

Why does ionization energy increase from left to right in a period?

Ans. Ionization energy increases from left to right in a period because nuclear charge increases gradually from left to right in a period. The attractive forces between nucleus and electrons increase. Decrease in size also occurs because number of shells is not increasing. As a result it becomes harder to remove electrons from the outermost shell.

The ionization energy is measured by taking the atom in the isolated state. Give reasons.

When the atom is in the isolated state, then its electronic cloud is not being disturbed by the neighbouring atoms or molecules. In this way, we can measure the force of attraction between the nucleus and the outermost electron in the form of ionization energy.

Why is there a big gap between first and second ionization energies of sodium?

Sodium has only one electron in the outermost orbital $n = 3$, and requires 496 kJ mol^{-1} of energy, but the second electron is in $n = 2$. So 4560 kJ mol^{-1} is the amount of energy required to remove the second electron.

Why the elements of group III-A have less ionization energy values than II-A?

When we shift from groups II-A to III-A, the nature of orbital changes from s to p orbital, p orbital is less penetrating, so electron removal from p-orbital of group III-A is easier.

Why the elements of group VI-A have less ionization energy values than V-A?

When we move from V-A to VI-A, then we move from half-filled p-sub-shell of V-A to unstable p-sub-shell of VI-A. Half-filled sub-shell is extra stable. So, the electron removal from VI-A is easier.

Why most of the elements release energies when electrons are added in their outermost orbitals?

In most of the elements, the outermost orbital is in the process of completion. In this way, they have a demand for electrons and feel happier in having the electron. So, they accept the electron and get stability like noble gases.

The first electron affinity of oxygen is negative, but the second is positive. why?

When oxygen is given the first electron, it releases energy of 141 kJ per mol and becomes O^{-1} . When the second electron is given to O^{-1} , 880 kJ per mol is to be given. The reason is that the second incoming electron is repelled by O^{-1} .

Why does electron affinity decrease from top to bottom in a group?

Ans. Electron affinity decreases from top to bottom because atomic size increases due to gradual increase in number of shells and shielding effect also increases. As a result electron affinity decreases.

Why does electron affinity increase from left to right in a period?

As we go from left to right in a period nuclear charge and electrons increase. Decrease in size also occurs because number of shells is not increasing. As a result become more tightly bound and so difficult to add electron. Therefore, electron affinity increases in a period.

Why there is not a systematic increase in the electron affinity values from left to right in a period?

The elements of group II-A, V-A and VII-A show abnormally low values of electron affinities as compared to the neighboring groups. This is due to the fulfilled and half filled outermost orbitals of II-A, V-A and VIII-A and extra stable outermost orbital.

Why the electron affinities of group VA are less than those of group VIA?

The outermost p-sub shell of elements of group V-A are half filled, are extra stable and hesitate to have the electron. For this reason they have low electron affinities.

The melting and boiling points of the elements increase from left to the right upto the middle of s- and p-block elements and decrease onwards. why?

When we go from left to the right in a period, the number of electrons go on increasing in the outermost shell. The tendency to impair the electrons increase upto group IV-A. In this way, the binding forces increase, hence melting and boiling points increase upto group IV-A. After that, pairing of electrons starts and binding force become less. There are no binding forces in group VIII elements, and that is why, they are gases at room temperature.

Why the melting and boiling points of halogens increase from top to the bottom?

The atomic sizes of the halogens increase with increasing shielding effects. The diatomic molecules of halogens can create intermolecular forces due to loosely held electrons down the group. This thing increases the melting and boiling points down the group.

Why does metallic character increase from top to bottom in a group?

Metallic character increases from top to bottom in-group due to, increase in electro positivity and decrease in ionization energy which is due to increase in atomic size and decrease in nuclear hold.

Why does metallic character decrease from left to right in a period?

Metallic character decreases from left to right in a period due to decrease in electropositivity and increase in ionization energy which is due to decrease in atomic size and increase in nuclear hold.

Why the elements of groups I-A and II-A are good metals of the periodic table?

The elements of group I-A and II-A have low ionization energies as compared to the rest of the periodic table. Their outermost electrons are loosely held and they get free in the crystal lattice. This property makes them good metals.

The oxidation states vary in a period but remain almost constant in a group. why?

The number of electrons in outermost shells go on changing in periods from left to the right, so oxidation states go on changing. The number of electrons in the outermost shells remain the same in a group, so the oxidation states remain the same. Anyhow, the process of unpairing of electrons may happen in a group and oxidation states may change.

why is- oxidation state of noble gases usually zero?

Oxidation state of noble gases is zero because there is- no vacancy in their outermost shell they have no tendency to lose or gain electrons.

Elements of group VI-A show the variable oxidation states except oxygen. why?

d-orbital is not available to oxygen for the promotion of electrons, but for sulphur, Se and Te, d-orbitals in the same principal quantum number are available. In this way, the greater number of unpaired electrons make the oxidation number to increase.

why the elements of VII-A can show the maximum oxidation state of +7?

Except fluorine, d-orbitals are available for the promotion of electrons and the oxidation states can increase. These oxidation states may become +3, +5 and +7. The reason is that, the maximum number of electrons which can be unpaired are 7.

why the elements of I-A, II-A and III-A have high electrical conductivities?

These elements have low ionization values and their outermost electrons are loosely held. For this reason, they are good conductors

why graphite is a good conductor of electricity, but diamond is not?

Graphite has hexagonal layered structure. Free electrons are available in between the layers. These electrons are responsible for making graphite as a good conductor. No free electrons are available in diamond.

The hydration energies of the ions are in the following order. Give reason: $Al^{+3} > Mg^{+2} > Na^{+1}$.OR

why the hydration energies increase from left to right for isoelectronic ions?

Hydration energy of an ion depends upon the charge density. Greater the charge density, greater the hydration energy. Al^{+3} , Mg^{+2} , Na^{+1} have same number of electrons, but different number of protons. Al^{+3} has maximum charge density due to 13 protons 10 electrons, and +3 charge.

Na has least charge density because it has 11 protons, 10 electrons and +1 charge.

why the hydration energy depends upon the size of the ion?

Smaller the size of the positive or negative ion greater the charge density of the ion. This creates greater force of attraction between the ion and the water molecules. it evolves greater hydration energy.

why the hydration energies of halide ions decrease from F^- to I^- ?

This is due to the decreasing charge densities of halide ions. I^- has maximum size, smallest charge density and smallest hydration energy among the halogens.

Ionic character of halides decreases from left to the right in a period.

Elements on the left side of the periodic table are electropositive. They have low I.E. values and make ionic bonds with halogens, which have high electron affinities. Elements on the right side of the periodic table are electronegative. They have least tendencies to lose electrons, and to give to halogens. So, they give covalent halides, $NaCl$ is ionic to good extent, but Cl_2 is 100 % covalent in the same period.

Why does covalent character of hydrides increase from left to right in a period?

Ans. Hydrides are binary compounds of hydrogen with other elements of periodic table. From left to right in period electronegativity increases and electropositivity decreases and ionization energy also increases. So probability of covalent bond b/w H and other elements increases from left to right.

Why the melting points of halides decrease from left to right in period?

The covalent halides have low melting and boiling points as compared to the ionic halides. The %age of ionic character of halides decrease from left to right in a period.

Why is AlF_3 an excellent conductor while AlI_3 a non-conductor?

AlF_3 is ionic compound therefore, it is conductor while AlI_3 is covalent compound therefore it is non-conductor,

Why is it true that the higher oxidation state of an element gives greater % of covalent character?

Greater the positive oxidation state of elements, greater the charge density, greater the polarizing power and greater the % age of covalent character in a bond.

Why the ionic hydrides have high melting and boiling points and conduct electricity in the molten state?

Ionic hydrides just like other ionic compounds are hard crystalline substances and they should have high melting and boiling points. In the molten state, free ions are present which conduct the electrical current.

Why the melting and boiling points of covalent hydrides of group IV-A increase from upper to the downward direction?

The electronegativities of group IV-A decrease down the group along with their increasing sizes. These two parameters are responsible for creating van der Waal's forces of attraction among the hydrides. In this way, their melting and boiling points increase.

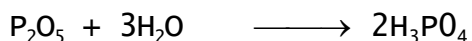
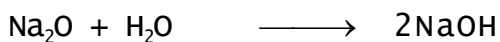
Water is liquid at room temperature while H_2S is a gas. Give reason.

Oxygen and sulphur belong to the same group of periodic table i.e. VI-A. The size of sulphur is higher and its electronegativity is less than that of oxygen. Hydrogen bonding is present in water which makes it high boiling liquid as compared to H_2S , which remains in gaseous state.

Although both sodium and phosphorus are present in the same period of the periodic table yet their oxides are different in nature, Na_2O is basic while P_2O_5 is acidic in character. Why?

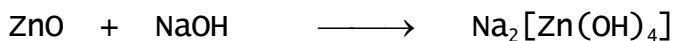
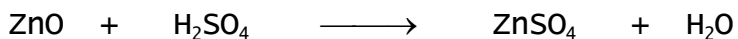
Sodium is electropositive while phosphorus is electronegative. Hence,

sodium gives basic oxide, while the oxide of phosphorus is acidic. Na_2O reacts with water to give NaOH . P_2O_5 reacts with water to give H_3PO_4 ,



How do you justify that ZnO is amphoteric in nature?

Zn is a non-typical transition element and ZnO can react with H_2SO_4 to give ZnSO_4 and reacts with NaOH to give $\text{Na}_2[\text{Zn}(\text{OH})_4]$.



How does the nature of oxide change from basic to acidic character when one moves from left to the right in a period?

When one travels from left to right in a period, the oxide becomes more and more acidic in character. The electropositive character decreases from left to the right. Na_2O is strongly basic, while Cl_2O_7 is strongly acidic in the third period.

How does the acidic nature of oxide change with the increase of oxidation number of the central atom?

When the oxidation number of the central atom increases, the oxides become more and more acidic in nature. This is due to the reason that the greater oxidation state of the central atom increases the polarizing power of this atom and greater tendency to attract the OH^- ions from water and to release H^+ ions in the solution.

Why does basic character of oxides increase from top to bottom in a group?

Oxides are binary compounds of oxygen with elements as from top to bottom in a group electropositivity increases and electronegativity decreases. So the basic character of oxides increases from top to bottom.

CHAPTER 2

Why the elements of group I-A are called alkali metals?

The name alkali is derived from the Arabic word means "ashes". Actually, the metals like Na and K etc. are present in the ashes of plants. They, produce strong alkaline solution in water.

Why the elements of group II-A are called alkaline earth metals?

The word alkaline means that they produce alkalies in water. Moreover, they are widely distributed in earth's crust, so are called alkaline earths.

What are the flame test of alkali metals?

Lithium shows crimson red, sodium golden yellow, potassium violet, while rubidium and cesium also show violet flame tests.

The compound of Alkali and alkaline earth metals are colourless, but some of them are coloured. Give reason.

Alkali and alkaline earth metals are s-block elements, which mostly do not show the colors in their compound while d-block elements show the colors. The compounds like KMnO_4 , and $\text{K}_2\text{Cr}_2\text{O}_7$ show the colour due to Mn and Cr , but not due K and oxygen.

What are the important ores and minerals of sodium.

Sodium is found in the form of

Rock salt (Halite)	NaCl
Chile Saltpeter	NaNO ₃
Natron	Na ₂ CO ₃ .H ₂ O
Trona	Na ₂ CO ₃ .2NaHCO ₃ . 2H ₂ O
Borax	Na ₂ B ₄ O ₇ .10H ₂ O

why the alkali metals are not found free in nature?

Alkali metals are very reactive. They have strong tendencies to make compounds by reacting with other elements. So, they are not found free in nature but in the form of ores and minerals.

what are the important ores and minerals of potassium?

The important ores and minerals of potassium are Carnallite KCl. MgCl₂. 6H₂O

Sylvite KCl

Alumite (alum stone) K₂SO₄. Al₂(SO₄)₃. 4Al(OH)₃.

why the melting and boiling points of group I-A and II-A decrease down the group?

The sizes increase down the group and due to decreasing polarizabilities, their forces of attraction decrease. It decreases the melting and boiling points.

why the alkali metals are strong reducing agents?

The alkali metals have low ionization energy values, so they can give the electrons to other species very easily. In other words, they can decrease the oxidation number of other species and can act as reducing agents.

why the alkaline earth metals are reducing agents, but less reducing than those of group I-A?

Elements of group II-A have low ionization potentials, but greater than I-A. They can give the electrons to other species, but not as efficiently as I-A. This is due to smaller sizes and greater nuclear charges.

Lithium only gives a simple oxide with oxygen, but sodium and potassium give peroxide and superoxide. why?

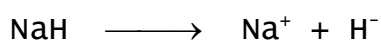
The formation of peroxide and superoxide is due to greater reactivity of alkali metals. Since Na and K are more reactive than Li so they should give normal oxides, peroxides and superoxides.

when sodium reacts with water, the hydrogen which evolves catches fire: why?

The reaction of sodium with water is very fast and highly exothermic. The heat evolved compels hydrogen gas from the reaction to react with the oxygen of the atmosphere. This burning of hydrogen with oxygen is the fire.

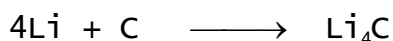
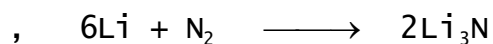
why the ionic hydrides are very good reducing agents?

Ionic hydrides release H⁻ in the solution which combines with other species to give its electrons and so it reduces the others.



which element of group I-A reacts with nitrogen and carbon?

Lithium is the only I-A group element which combines with nitrogen and carbon to give a nitride and a carbide



Why does lithium differ from its own family members?

- (i) Li and Li^+ have very small sizes.
- (ii) Li has high charge density and high polarizing power.
- (iii) The ionization energy and electronegativity of Li are very high, as compared to others.

Which salts of lithium are insoluble in water, but corresponding salts of other alkali metals are water soluble?

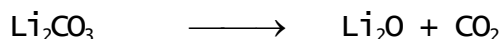
LiOH , LiF , Li_2CO_3 and Li_3PO_4 are insoluble in water. Anyhow, the hydroxide, fluorides, carbonates and phosphates of other alkali metals are water soluble.

How do you compare the basic strength of LiOH with NaOH and KOH ?

The basic strengths for hydroxides increase down the group. LiOH is less soluble in water and is a weak base. NaOH and KOH are highly water soluble and they are strong bases.

How do you compare the carbonate of lithium with the carbonates of other family members?

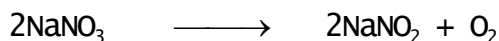
Li_2CO_3 is sensitive to high temperature and decomposes on heating.



But the carbonates of other alkali metals are stable towards heat.

How do you compare LiNO_3 with nitrates of other alkali metals?

LiNO_3 on heating decomposes to give Li_2O and NO_2 gas. The nitrates of sodium give NaNO_2 and oxygen



Give the names and formulas for common minerals of beryllium:

Beryllium has two important minerals:

Beryl $\text{Be}_3\text{Al}_2(\text{SiO}_3)_6$

Chrysoberyl Al_2BeO_4

Give the names and formulas for the common minerals of magnesium:

Some important minerals of magnesium are as follows:

Magnesite MgCO_3 ,

Dolomite $\text{MgCO}_3 \cdot \text{CaCO}_3$ KCl

Carnallite $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$

Epsom salt $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$

Soap stone (talc) $\text{H}_2\text{Mg}_3 \cdot (\text{SiO}_3)_4 \cdot 7\text{H}_2\text{O}$

Asbestos $\text{CaMg}_3(\text{SiO}_3)_4$

Give the names and formulas for common minerals of calcium:
Some important minerals of calcium are:
Calcite (lime stone) CaCO_3

Gypsum $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$

Fluorite CaF_2

Phosphorite $\text{Ca}_3(\text{PO}_4)_2$

Heat of hydration of alkaline earth metals go on decreasing from upper to the downward direction: why?

The atomic and ionic sizes go on increasing from upper to the downward direction. The charge densities decrease down the group. So the heat of hydration decreases down the group.

Mention the flame test of II-A group elements:

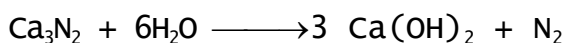
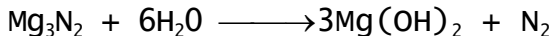
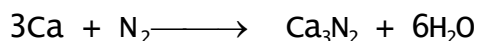
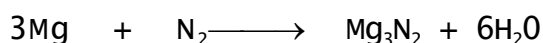
Beryllium and magnesium do not show any colour to the flame. Calcium shows brick red, strontium shows crimson, barium shows apple green and radium shows red colour.

How do you compare the polarizing powers of ions of II-A and that of I-A group elements?

The first members of I-A and II-A i.e. Li^+ and Be^{2+} have high polarizing powers due to greater charge densities and smaller sizes. The polarizing powers decrease down the group in both cases i.e. I-A and II-A. Anyhow, ions of II-A are better polarizers.

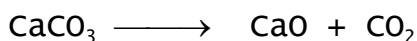
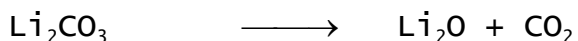
How magnesium and calcium react with nitrogen to give nitrides which on hydrolysis give ammonia?

The reactions are as follows:



How do you discuss the effects of heat on the carbonates of group I-A and II-A?

The carbonates of I-A group are stable towards heat except Li_2CO_3 which decomposes to give CO_2 just like the carbonates of alkaline earth metals.

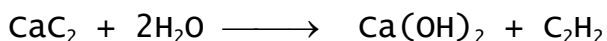
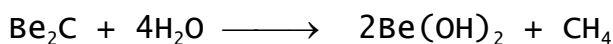


Why does beryllium differ from its own family members?

- (i) It has very small size as compared to other family members.
- (ii) It has very high electronegativity.

How do you compare the carbide of beryllium with carbide of calcium?

Be_2C reacts with water to give CH_4 while CaC_2 reacts with water to give, C_2H_2

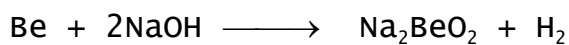


What is the trend of changing basicity of oxides down the group?

In all the groups, the basic characters of oxides increase down the group. Li_2O is less basic than Na_2O . Similarly BeO is amphoteric while the oxides of Mg, Ca, Sr and Ba are basic.

How does beryllium react with NaOH to give a salt and evolve hydrogen?

Beryllium is the only member of II-A group elements which reacts with alkalis to give hydrogen

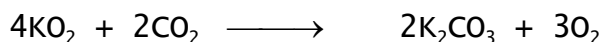


Sodium

beryllate

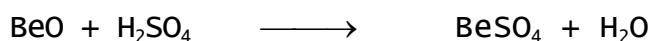
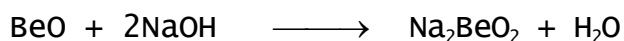
How KO_2 can be used by mountaineers?

Actually KO_2 reacts with CO_2 to give K_2CO_3 and oxygen. So KO_2 can be used in breathing equipment for mountaineers because KO_2 absorbs CO_2 released by the mountaineers and releases oxygen at the same time.



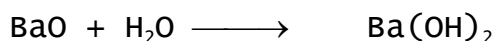
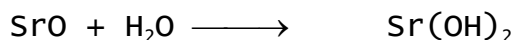
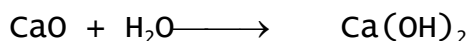
Justify-that BeO is an atmospheric oxide:

BeO is not basic oxide. It is amphoteric in nature and reacts with H_2SO_4 and NaOH to give salts and water.



What is the trend of the solubilities of oxides of alkaline earth metals?

The solubilities of oxides of alkaline earth metals increase down the group and they are converted into hydroxide. BeO and MgO are insoluble in water:



How do you compare the solubilities of hydroxide of alkaline earth metals?

Be(OH)_2 and Mg(OH)_2 are insoluble in water. The hydroxides of other metals are slightly soluble. The solubilities increase down the group.

What is the trend of solubility of Alkaline Earth metal hydrides in the group?

The melting points of halides decrease from left to right in period because trend of bonding changes from ionic to covalent along the period.

What is lime and lime water?

The formula of lime is CaO. When it is dissolved in water it gives Ca(OH)_2 which is called lime water. Lime is found in solid state whereas the latter in the liquid state.

What is milk of magnesia and what is its use?

Milk of magnesia is the suspension of Mg(OH)_2 in water. It is used for the treatment of acidity in stomach.

What is the effect of temperature on Na_2CO_3 ?

Na_2CO_3 is stable towards heat just like the carbonates of other alkali metals except Li_2CO_3 which decomposes to give Li_2O and CO_2 .

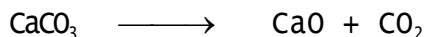
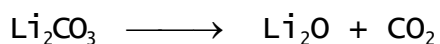
What is difference between soda ash and washing soda?

Anhydrous Na_2CO_3 is called soda ash while decahydrated ($\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$) is called

washing soda.

How do you discuss the effects of heat on the carbonates of group 1-A and 2-A?

The carbonates of I-A group are stable toward heat except Li_2CO_3 which decomposes to give CO_2 just like the carbonates of alkaline earth metals.



What is milk of lime? Give its use?

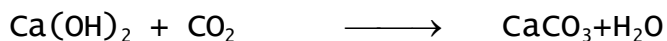
A suspension of calcium oxide is called lime of water. It is used for white wash.

Why the limewater turns white after white wash on the walls?

Lime water is $\text{Ca}(\text{OH})_2$. It reacts with CO_2 of the air and converts it into CaCO_3 which is a white solid.

What happens when excess CO_2 is passed $\text{Ca}(\text{OH})_2$ solution first milky than clear solution.?

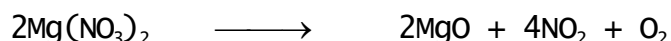
Lime water turns milky and CaCO_3 is produced in lime when CO_2 is passed through it CaCO_3 is water insoluble so white suspension is produced and we say that solution of lime turns milky.



Excess CO_2 converts CaCO_3 to $\text{Ca}(\text{HCO}_3)_2$. It is water soluble. So milkiness of lime water disappears.

In what respects nitrates of Li, Mg and Ba are related with each other?

They all decompose on heating to give metal oxides, NO_2 gas

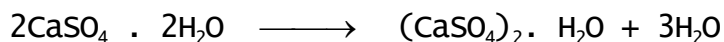


How do you compare the solubilities of sulphates of alkaline earth metals?

BeSO_4 and MgSO_4 are fairly water soluble. CaSO_4 is slightly soluble in water. SrSO_4 and BaSO_4 are totally water insoluble.

What is gypsum and how it is related with plaster of Paris?

Gypsum is $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$. When it is heated a little bit above 100°C , then half hydrate is produced which is called plaster of Paris



Why is CaCl_2 added to NaCl in Down's cell for manufacture of sodium metal?

CaCl_2 lowers the melting point of NaCl up to 600°C . in this way, fuel is saved and the plant gets the longer life due to working at low temperature.

What is the purpose of iron screen in Down's cell?

The iron screen permits the electric current to pass freely but prevents Na and chlorine (Cl) from mixing after they have been set free at the electrodes.

What are the advantages of Down's cell for the preparation of sodium on commercial scale?

Metallic fog is not produced. Liquid sodium can be easily collected at 600°C. The material of the cell is not attacked by the products during electrolysis.

Which substances are deposited at cathode and anode in the Nelson's cell?

Hydrogen is collected at the cathode. Sodium is also collected at the cathode but reacts with water to give caustic soda. Chlorine is liberated at the anode.

Why the plaster of Paris is called hemihydrate.

The formula of plaster of Paris is $(\text{CaSO}_4)_2 \cdot \text{H}_2\text{O}$. It means that for one molecule of CaSO_4 half water molecule is present in crystal structure.

What is the hard finish plaster?

Those plasters which are made by the calcination of anhydrous calcium sulphate with alum or borax are called hard finish plasters. They set very slowly but give a hard finish.

What do you mean by dead burnt gypsum?

When gypsum is heated at high temperatures, it becomes completely anhydrous. When water is mixed with anhydrous CaSO_4 , then it does not set to a hard mass. So it is called dead burnt gypsum.

What is the importance of sulphur for the plants?

Sulphur affects the growth of the plants and becomes the part of some of the proteins. It influences the chlorophyll development and improves the roots of the plants.

What do you mean by setting of plaster of Paris?

Plaster of Paris sets to a hard mass when it is mixed with half of its weight of water. It sets to a hard porous mass. It becomes hydrated within 10-15 minutes and one percent increase of volume takes place.

What are the main uses of plaster of Paris?

Plaster of Paris is used,

- (i) for making plaster walls.
- (ii) cast of statuary.
- (iii) making coins
- (iv) surgery.

What is the use of material which is produced when the plaster of Paris is mixed with wood pulp?

A material is obtained which is used for the construction of buildings. This is also used as wall boards and for the purpose of partition.

What is the role of gypsum in cement industry?

The clinker obtained from the rotary kiln is ground to a fine powder and mixed with 2 % gypsum. The cement so produced does not harden so rapidly. It decreases the setting time of cement.

What is the function of calcium in the plant growth?

Calcium improves the entire root system and leaves development. It increases the activity of the micro-organisms. Calcium manages the supply of available phosphorus from the soil to the plants.

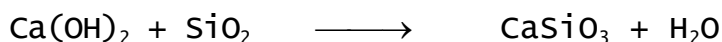
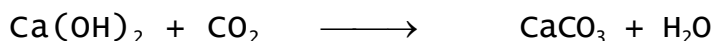
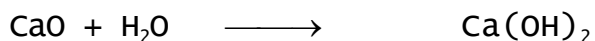
Indicate the processes in which lime acts as dehydrating reagent:

Lime is used for drying the ammonia gas. It is also used to remove 5% water from azeotropic mixture of commercial alcohol.

Soda lime which is a mixture of NaOH and Ca(OH)_2 can remove water and CO_2 from certain gases.

What is lime mortar?

It is prepared by mixing lime with the sand and water. A thick paste is obtained and when placed between the stones and bricks, binds them together. The reactions are as follows:



What is soda lime?

A solid mixture of NaOH and CaO is called soda lime.

CHAPTER 3

B^{+3} does not exist but Al^{+3} . Why?

The size of B^{+3} is very small. It has high charged density and immediately forms the covalent bonding due to greater polarizing power. Al^{+3} gives the ionic bonding and its compounds are dissociated in water to give Al^{+3} ions.

What is trend of metallic characters in group IIIA? Metallic character in group HIA abruptly changes from Boron to Aluminium due to the increased size of Aluminum atom. The increase in atomic size is not regular in this group Boron is non metal while all other members are metals. This due to the presence of d-electrons in heavier members which have poor shielding effect than s and p electrons.

Why first ionization energy of germanium is greater than first ionization of silicon,

Ionization Energy decreases down the group and germanium comes lower than silicon in group IVA. So germanium has lower ionization energy than silicon. This is due to fact that as we go from top to bottom in a group no. of shells increases as a result shielding effect increases, so it becomes easy to remove electron from outermost shell.

What is inert pair effect?

The pair of valence electrons which does not take part readily in chemical reaction is called inert pair. One to the presence of an inert pair metallic character increases. This increase in metallic character due to inert pair is called inert pair effect.

How the elements of group III-A show the valency of three?

The elements of group III-A have three electrons in the outermost principal quantum number. One of the electrons is promoted from s-orbital to one of the p-orbitals and three unpaired electrons make the valency three.

Why the heat of sublimation in III-A group elements decrease down the group?

It is due to the reason that the atoms of elements with greater atomic number are less tightly packed due to their bigger sizes.

How the nature of the oxides of the group III-A change from upper to the downward direction?

B_2O_3 is acidic in nature. Al_2O_3 and Ga_2O_3 are amphoteric. In_2O_3 and Tl_2O_3 are basic in character.

The hydrides of boron have different structures from the hydrides of other family members. How?

Boron gives polymeric hydrides having bridge structures. B_2H_6 and B_3H_9 have bridge structures and they are electron deficient molecules. The hydrides of other family members are not bridged molecules.

Give the names and the formulas of different acids of boron.

Boron gives four important acids. These acids are as follows:

(i) Orthoboric Acid, H_3BO_3 or $B_2O_3 \cdot 3H_2O$

(ii) Metaboric Acid, HB_2O_4 or $B_2O_3 \cdot H_2O$

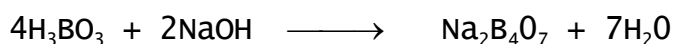
(iii) Tetraboric Acid, $H_2B_4O_7$ or $2B_2O_3 \cdot H_2O$

(iv) Pyroboric Acid, $H_6B_4O_9$ or $2B_2O_3 \cdot 3H_2O$

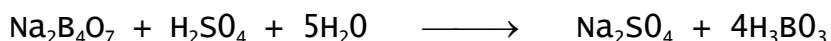
Orthoboric acid is the most important and stable compound while the other acids are stable in solid state and change to orthoboric acid in solution.

How will you convert boric acid into borax and vice versa?

When orthoboric acid H_3BO_3 is neutralized by caustic soda, we get borax



When borax is treated with concentrated H_2SO_4 then boric acid is produced. On cooling, the crystals of boric acid are separated out



How the solubility of borax changes with the change of temperature?

Borax is sparingly soluble in cold water. 3 grams is dissolved in 100 grams of water at $10^\circ C$. At $100^\circ C$, 99.3 grams of H_3BO_3 becomes soluble in 100 grams of water.

How does the temperature influence the water of crystallization of borax?

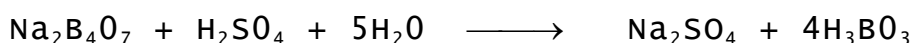
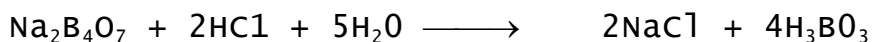
Below $62^\circ C$ decahydrated crystals are formed. Above $62^\circ C$ octahedral crystals of pentahydrated borax are obtained.

Justify that the aqueous solution of borax turns red litmus blue:

$Na_2B_4O_7$ is hydrolyzed by water to give H_3BO_3 and $NaOH$. Since the base is strong, so the solution turns red litmus blue.

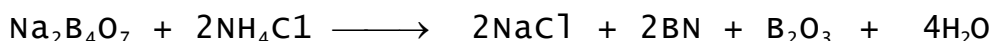
How borax can be converted to orthoboric acid?

When borax is treated with HCl or H_2SO_4 in the presence of water, then orthoboric acid is produced



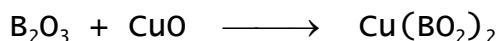
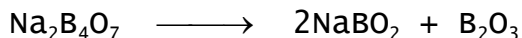
How can we prepare boron nitride (BN) from borax?

When borax is heated with NH_4Cl , then BN is produced



What is the chemical nature of bead in borax bead test?

Bead is combination of sodium metaborate and coloured ions metaborates. Borax on heating changes to sodium metaborate and boron oxide. B_2O_3 reacts with metal oxide to form metal meta borate,



What is effect of heat on borax?

When heated, borax loses water and swells up into a white porous mass due to expulsion of water on further heating it melts into a clear transparent glass, which dissolves many metallic oxides forming coloured beads. This reaction forms the basis of borax bead test.

How the glassy mass is produced from borax?

When borax is heated, it swells up. When it is heated further, it melts into a clear transparent glass



glassy mass

Which basic radicals give the response to borax bead test?

There are seven basic radicals in salt analysis scheme which give coloured beads when borax bead test is performed. These radicals are Cu^{+2} , Fe^{+2} , Fe^{+3} , Mn^{+2} , Co^{+3} , Ni^{+2} , Cr^{+3} . They have different colours in the cold and hot states in the oxidizing and reducing flames.

What is the nature of compounds which give coloured beads in borax bead test?

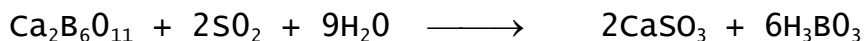
Those metals which give the borax bead test are converted into their metaborates. These metaborates appear in the form of beads. They show different colours in the cold and hot state and in oxidizing and reducing flame.

Justify that aqueous solution of borax turns red litmus blue.

Aqueous solution of borax is alkaline in nature due to the formation of NaOH. Since NaOH is a strong base so aqueous solution of borax turns red litmus paper blue.

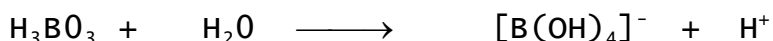
How H_3BO_3 can be prepared from colemanite?

Colemanite is suspended in boiling water and SO_2 gas is passed through it. H_3BO_3 crystallizes out from the solution



Boric acid is monobasic acid. Justify it.

H_3BO_3 reacts with water and releases H^+ ion from water. It itself accepts OH^- ion and acts as a monobasic acid



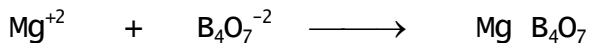
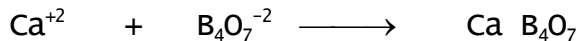
What is the effect of heat on H_3BO_3 ?

When H_3BO_3 is heated, it releases water molecules in three stages and B_2O_3 is produced in the long run.

Why does borax serve as a water softening agent?

The hardness of water is due to dissolved bicarbonates, chlorides and sulphates of Ca and Mg. When borax is treated with hard water,

hardness in water is removed as follows.



Name three important ores of Aluminium along with chemical formulas.

Three important ores of Aluminium are as follows:

- (i) Bauxite $\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$
- {ii} Corundum Al_2O_3
- (iii) Cryolite Na_3AlF_6

what is anodizing?

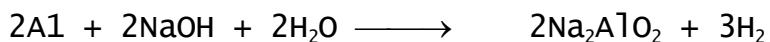
The layer of Al_2O_3 on the surface of aluminium is very useful. Its thickness is increased purposely in the industry, by electrolytic process which is called anodizing.

what is the utility of reaction of Al with O_2 ?

Aluminium reacts with oxygen and this reaction is highly exothermic. This heat can be used for the melting of those metals whose oxides are reduced by aluminium powder. These molten metals can be used for welding.

How does Al become water soluble by using NaOH.

Ans: Aluminium dissolves in alkalis with the evolution of hydrogen gas, and soluble aluminates are produced. The reaction is as follows:



why the Aluminium vessels are not wash with alkalis?

Al vessels are not washed with alkalis due to the reason that Aluminium dissolves in alkalis with the evolution of hydrogen gas and soluble aluminates are produced.

why is Aluminium used in flash lights?

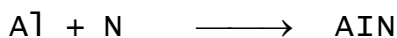
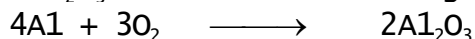
If the Al powder is heated upto 800°C and above, the metal will react with air to form Al_2O_3 and AlN. The reaction is accompanied by evolution of heat and intense white light. This property of Al is made use in flash light photography.

why is HNO_3 ported in Aluminium containers?

Aluminium does not react with HNO_3 at every concentration. Actually it is rendered passive by HNO_3 . One to this reason HNO_3 is transported in Al containers.

why is Aluminium used to remove bubbles from molten metals?

Al reacts with oxygen to form Al_2O_3 and with nitrogen to form AlN.



So it is used to remove air bubbles from molten metals.

No doubt aluminum is an excellent conductor of heat and electricity, yet it is used to insulate buildings. why?

Aluminium is an excellent reflector of radiant energy. For this reason, it is commonly used to insulate buildings.

What is passivity of metals?

Some metals react with acids and form a protective layer. This protective layer, prevents the further attack of acid on metals. This phenomenon is called passivity of metals. Aluminium, iron and chromium show such behaviour when reacts with concentrated nitric acid.

How inert pair effect controls the oxidation state of Sn and Pb?

Sn and Pb can hardly promote their electrons from s-orbitals to vacant p-orbitals. So they show the valency of two rather than four. Well C, Si, Ge do not show the inert pair effect.

How melting points of elements of group IV-A of the periodic table show variation?

The melting points of elements of group IV-A do not show the regular decreases and show abnormally low values. Pb has higher melting point than Sn due to presence of d orbital.

Mention various allotropic modifications of elements of group IV-A:

The property of allotropy is associated with all the elements of group IV-A except Pb. Carbon shows three, Si two, Ge two and Sn has three allotropic forms.

Give names and formulas of different minerals of carbon?

Limestone (Calcite) CaCO_3

Dolomite $\text{MgCO}_3 \cdot \text{CaCO}_3$

Magnesite MgCO_3

Why is CO_2 acidic in nature?

It is a non-metal oxide and its aqueous solution is acidic i.e. it gives H_2CO_3

What are the important ores of SiO_2 ?

Important ores of silicon are as follows

$\text{NaAl}(\text{SiO}_3)_2 \cdot \text{H}_2\text{O}$ = Asbestos

$\text{CaMg}_3(\text{SiO}_3)_4 = \text{H}_2\text{Al}_2(\text{SiO}_4)_2 \cdot \text{H}_2\text{O}$ = zeolite ZrSiO_4

$\text{H}_2\text{Mg}_3(\text{SiO}_3)_4$ Kaolin (china clay)

Why is CO_2 non-polar in nature?

Being a linear molecule its dipole moment is zero. Hence it is non polar in nature

What are the different forms in which SiO_2 exists in the earth's crust?

- (i) Rock crystal (ii) Amethyst quartz (iii) Smoky quartz
(iv) Rose quartz (v) Milky quartz

What is the structure of carbon monoxide?

Carbon monoxide is a linear molecule. It has a triple bond in it. One of the bonds is co-ordinate covalent and the polarity is from oxygen to carbon

What is quartz and what are its properties?

Quartz is one of the common crystalline form of SiO_2 . It is hard, brittle, refractor and a colourless solid.

Why is CO_2 a gas at room temperature while SiO_2 is a solid?

CO_2 is a gas at room temperature while SiO_2 is a solid. The reason is

that CO_2 exists in the form of discrete molecules which exist independently. In case of SiO_2 , there is a network structure. It is three dimensional structure giving a giant molecule.

What is silica glass?

It is also called fused quartz. It is obtained by heating SiO_2 . It has random structure. When it is cooled, it is not crystallized readily.

How sodium silicate is prepared?

When Na_2CO_3 is reacted with pure sand and heated in furnace, Na_2SiO_3 is obtained. It is called water glass or soluble glass.

What is chemical garden?

When crystals of various soluble colored salts like NiCl_2 , FeSO_4 and CuSO_4 etc. are placed in solution of water glass, there happens a beautiful growth of crystal. This is called silica garden or chemical garden.

What are silicates?

The compounds derived from silicic acids are termed as silicates e.g. Na_2SiO_3 which is sodium salt of metasilicic acid i.e. H_2SiO_3 .

What is soapstone? Where is it used?

The magnesium silicate, $\text{Mg}_3\text{H}_2(\text{SiO}_3)_4$. we commonly known as talc or soapstone. It is physically greasy to touch. Therefore it is used in cosmetics. It is used to make household articles also.

What is asbestos? Give its uses.

Asbestos is hydrated calcium magnesium silicate $\text{CaMg}_3(\text{SiO}_3)_4$. It is commonly used in making incombustible fabrics and hardboard etc.

What are the properties of water glass?

It is water soluble and its aqueous solution is strongly alkaline. It is used in the preparation of chemical gardens and is used in soap manufacture.

What are the uses of sodium silicate?

It is used as a filler in the manufacture of soap, as a fire proof in textile, in furniture polish, in calicoprinting and in preservation of eggs.

What are the uses of aluminium silicates or clay?

It is used to make porcelain and china clay. Impure clay is used to make bricks, tiles and stone wares.

How the clay is hardened?

Clay is soaked in water and it is hydrated with the passage of time. It becomes more and more plastic in nature. On heating, water of hydration is lost and hard rock like mass is obtained.

What are silicones?

Silicones are organic compounds of silicon which are produced when dichlorodimethyl silicon is treated with water. Lower silicon are oily liquids while higher members are waxy solids. They are stable towards heat and chemical reagents.

Why are liquid silicones preferred over ordinary organic lubricants?

There happens a very small change in viscosity with the change in temperature for silicones. When the temperature drops from 100°C to 0°C , then the viscosities of petroleum oils which are used as

Lubricants increase their viscosity 100 times. Anyhow, viscosities of silicon oils increase less than four times for this change of temperature. Hence, silicones are preferred over ordinary organic lubricants.

Which elements and compounds act as semiconductor?

Silicon, germanium and selenium are good semiconductors. The important semiconductors among the compounds are PbS , SiC , CdS , etc.

What is the effect of temperature on semiconductor.

When a semiconductor is heated, its resistance decreases and conductivity increases. Similarly when a semiconductor absorbs light, the electrons become more mobilized and conductivity increases.

How semiconductors are used in transistors?

A semiconductor is joined with another metal of a different semiconductor. The junction between different materials forms a boundary. So, this combination of two materials allows electricity to pass through that more properly.

What are lead pigments? Give their common names as well:

The important lead pigments are

- (a) Pb_2O (b) PbO (c) Pb_3O_4 (d) PbO_2 (e) white lead

How litharge changes its colour?

Litharge varies in colours from pale yellow to reddish yellow. Actually, it

has two forms:

- (a) Rhombic (yellow)
(b) Tetragonal (red)

What is the formula of white lead? Give its properties and uses:

Formula of white lead is $2 PbCO_3 \cdot Pb(OH)_2$. It is white amorphous powder, insoluble in water and highly poisonous. It is mixed with linseed oil and has a good covering power.

What is the importance of oxides of lead in paints?

Various oxides of lead e.g. basic lead carbonate and lead chromate are commonly used as pigments in paint industry.

CHAPTER 4

What is the general occurrence of elements of group V-A?

Nitrogen occurs as N_2 in the atmosphere 80 % by volume.

Phosphorus occurs in the form of its compounds as phosphates.

Arsenic, antimony and bismuth are less abundant.

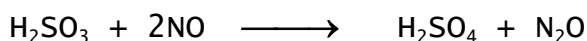
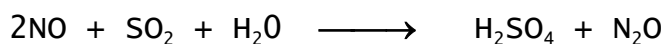
How allotropy is associated with nitrogen and phosphorus?

Nitrogen has two allotropic forms in the solid states i.e. α -nitrogen and β -nitrogen:

Phosphorus has six allotropic forms:

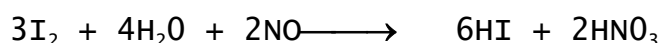
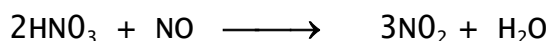
- (i) white (ii) red (iii) scarlet (iv) α -black
(v) β -black (vi) violet

NO oxidizes SO_2 to H_2SO_4 . It oxidizes H_2SO_3 to H_2SO_4 and H_2S to S



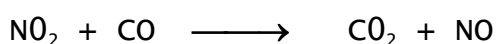
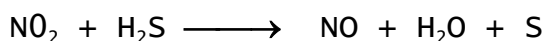
Justify that NO acts as a reducing agent:

NO reduces HNO_3 to NO_2 . It reduces I_2 to HI and also reduces acidified KMnO_4 .



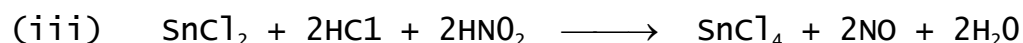
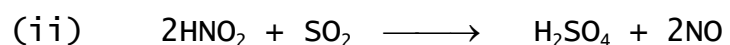
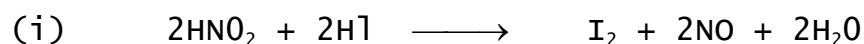
How does NO_2 act as an oxidizing agent?

NO_2 can oxidize H_2S to S, CO to CO_2 , FeSO_4 to $\text{Fe}_2(\text{SO}_4)_3$



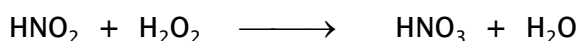
How does HNO_2 acts as an oxidizing agent?

HNO_2 releases atomic oxygen which converts HI to I_2 , SO_2 to H_2SO_4 , SnCl_2 to SnCl_4 etc.



How does HNO_2 act as a reducing agent?

Certain strong oxidizing agents like acidified KMnO_4 , acidified $\text{K}_2\text{Cr}_2\text{O}_7$ and H_2O_2 are reduced by HNO_2 .

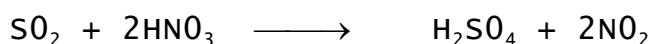
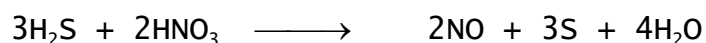
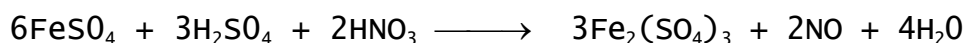


How dilute HNO_3 can be concentrated on commercial scale?

with concentrated H_2SO_4 , 68 % HNO_3 is converted into 98 % HNO_3 . Water is absorbed by H_2SO_4 . To get 100 % HNO_3 , it is strongly cooled. Pure acid is deposited as colourless crystals at 42°C . These crystals are melted to get 100% HNO_3 .

Gives the reactions of HNO_3 in which it acts as an oxidizing agent:

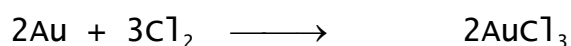
HNO_3 can oxidize FeSO_4 , H_2S , HI, SO_2 and sugar



what is aqua regia and how does it dissolve the noble metals?

when cone. HCl and cone. HNO_3 are mixed in the ratio of 3:1, the mixture is called aqua regia





What is meant by fuming nitric acid?

Concentrated nitric acid is a colourless volatile liquid and it fumes strongly in the air. Actually it evolves the NO_2 gas.

Describe "Ring test" for the confirmation of the presence of nitrate ions in solution.

Ring test is for NO_2 ion in aqueous solution. To the salt solution add freshly prepared solution of FeSO_4 . Then add a few drops of cono. H_2SO_4 along the side of the test tube. A brown ring is produced. This is due to FeSO_4NO .

How does phosphorus occur in the form of minerals, in plants and animal tissues?

The important ores of phosphorus are

$\text{Ca}_3(\text{PO}_4)_2$ = Phosphate rock

$\text{Ca}_3(\text{PO}_4)_2 \text{ CaCl}_2$ = Chlorapatite

$3\text{Ca}_3(\text{PO}_4)_2 : \text{CaF}_2$ = Fluorapatite

It also occurs in plants and animal tissues, Phosphorus is found in seeds, yolks of eggs, nerves, brain and bone marrow.

How do you compare the properties of white and red phosphorus?

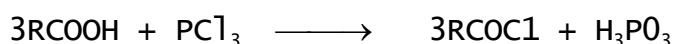
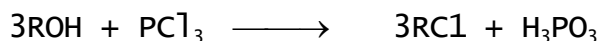
White phosphorus is yellowish white substance and is a waxy solid. It is volatile in nature, soluble in benzene and CS_2 . Its molecules are P_4 and tetrahedral in shape. Red phosphorus is poisonous, but less than that of white phosphorus. It is less reactive than white phosphorus. It exists in the form of tetrahedral P_4 units to give macromolecules.

How do you compare the structures of PCl_3 and NH_3 ?

Ans: In both molecules, the central atom is sp^3 -hybridized and, they have lone pair at the fourth corner. They have pyramidal structures. Anyhow, bond angles and bond lengths are different.

How PCl_3 and PCl_5 react with alcohols and carboxylic acids?

The phosphorus halides react with alcohols and carboxylic acids to give alkyl halides and acid halides



Give the names and formulas of various oxides of phosphorus?

Phosphorus gives four different types of oxides.

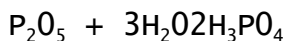
Phosphorus trioxide = P_2O_3 or P_4O_6

Phosphorus tetraoxide = P_2O_4

Phosphorus pentoxide = P_2O_5

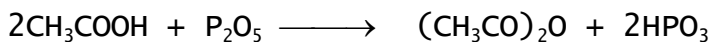
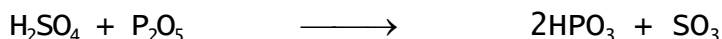
Phosphorus peroxide = PO_3 or P_2O_6

normalhot



Justify that P_2O_5 is the dehydrating reagent?

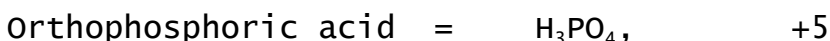
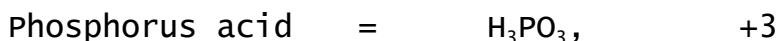
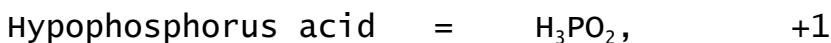
P_2O_5 takes up water molecule from various compounds to give HPO_3 .



Give the names and formulas of oxyacids of phosphorus and indicate the oxidation number of phosphorus in them:

typical oxyacids of phosphorus are as follows:

oxidation states of P

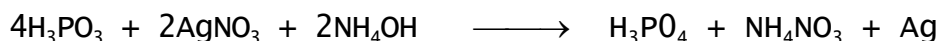
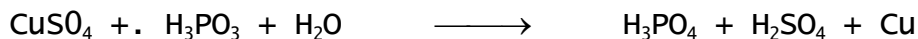


H_3PO_3 is dibasic acid although it has three hydrogen atoms in that. Give reasons:

The structure of H_3PO_3 shows that one of the hydrogens is directly connected with phosphorus which is not ionizable. So it does not release third hydrogen. Only two hydrogens are ionizable.

Give reactions to justify that H_3PO_3 is a reducing agent:

H_3PO_3 reduces $CuSO_4$ to copper metal, $AgNO_3 + NH_4OH$ to silver metal



How do you compare the elements of the group VI-A in their physical states?

Oxygen is a gas while other family members are solids. Anyhow, their melting and boiling points increase down the group. Po is a soft substance as compared to Te.

How sulphur can increase its oxidation number but oxygen can not?

Electronic distribution of sulphur shows that d-orbital is available for the promotion of electrons. So four and six unpaired electrons can develop. In this way, it increases its oxidation number as +4 and +6.

Mention various allotropic forms for the elements of group VI-A: Oxygen has two non-metallic forms as O_2 and O_3 . Sulphur exists as rhombic, monoclinic and plastic sulphur. Se has red and grey, both are non-metallic. Te has two forms, metallic and non-metallic. Po has two metallic forms i.e. α and β .

Due to which reasons oxygen differs from its own family members?

Oxygen has very small size and high electronegativity. d-orbitals are not available for the promotion of electrons. So oxidation number does not increase.

How does oxygen occur in nature?

It is a 44.6 % of earth's crust. 25 % of atmosphere by weight is free oxygen. Water contains 89 % oxygen by weight. Chalk contains 48 % oxygen, while SiO_2 has 53 % of oxygen by weight.

How does sulphur occur in nature?

Sulphur occurs in the form of compounds like galena (PbS), zinc blend (ZnS) cinabar (HgS), copper pyrite (Cu₂S) and iron pyrites (FeS₂): The organic compounds and vegetables products like onion, garlic, mustard, hair, eggs and proteins contain sulphur in them.

Mention the catalytic condition for the manufacture of H₂SO₄ in contact process:

V₂O₅ or Fe₂O₃ with the little amount of CuO can be used as catalyst. Anyhow, Pt. metal supported on MgSO₄ can also be used as a catalyst.

What are the optimum conditions for the manufacture of H₂SO₄ in the contact tower?

The temperature of 400 - 500°C is maintained at a pressure of 1 atm. A suitable catalyst like V₂O₅ is used to increase the rate of reaction.

Give the advantages of contact process for the manufacture of sulphuric acid.

Contact process is superior to lead chamber process for the manufacture of H₂SO₄ due to following reasons:

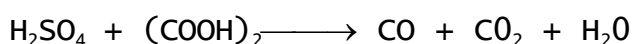
1. A purified form of H₂SO₄ is prepared.
2. Solid catalyst is used like V₂O₅ and Pt, while in the lead chamber-process, NO₂ gas is used as a catalyst.

Why SO₃ gas is dissolved in H₂SO₄, but not in water in contact process?

SO₃ is dissolved in H₂SO₄ to form oleum or fuming H₂SO₄. If SO₃ is dissolved directly in water, then a large amount of heat is evolved. This heat gives a dense form of minute particles of H₂SO₄. These particles do not easily condense down.

How does H₂SO₄ act as a dehydrating reagent?

H₂SO₄ has a strong affinity for water. It dehydrates oxalic acid, formic acid ethyl alcohol, glucose, sucrose and starch.



Write down the equation for the reaction between cone. H₂SO₄ and copper and explain what type of reaction is it.

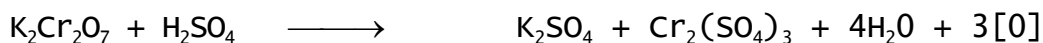
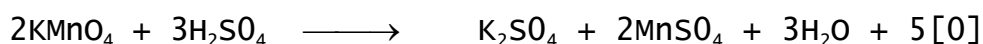
When concentrated H₂SO₄ in the cold state then no reaction takes place with copper. Anyhow when hot concentrated H₂SO₄ is reacted with Cu metal then SO₂ gas evolves along with the formation of CuSO₄ and H₂O.



This is an oxidation reduction reaction. Cu is oxidized and its oxidation number increases from zero to +2. Sulphur is reduced from H₂SO₄ and changes its oxidation number from +6 to +4.

How KMnO₄ and K₂Cr₂O₇ react with H₂SO₄?

The reactions are as follows in which atomic oxygen is evolved:



Justify that H₂SO₄ is a king of chemicals:

H₂SO₄ is used in almost all the industries. Industrial development of a country can be best estimated from annual consumption of H₂SO₄. It is a barometer of industries.

CHAPTER 5

Why the elements of group VII-A are called halogens?

The term halogen is derived from the Greek, "halos" which means "salts" and "genes" mean born. The most of the salts are the derivatives of halogens.

How does astatine differ its own family members?

Astatine was discovered in 1940 much after other halogens. It is an unstable element and it is radioactive in nature. Its half life period is 8.3 hours.

What are the important ores and minerals of fluorine and iodine?

The important minerals of fluorine and iodine are as follows.

Fluorine

Fluorspar CaF_2

Cryolite Na_3AlF_6

Apatite $[\text{CaF}_2 \cdot 3\text{Ca}_3(\text{PO}_4)_2]$

Iodine NaIO_3 and NaIO_4 are the deposits in Chile brine wells

What is iodized salt?

When sodium iodide or potassium iodide is added in a definite ratio with NaCl , then it is called iodized salt. Iodine is good for health and this iodized salt is suitable in those areas where there is a deficiency of iodine in water.

Compare the physical states and colours of halogens at room temperature:

F_2 and Cl_2 are gases, Br_2 is a liquid while I_2 is a solid. Fluorine is the yellow gas, chlorine is greenish yellow gas, bromine is a reddish brown liquid, while iodine is a deep violet solid.

Why the dissociation energies of halogens go on decreasing down the group?

The sizes of the halogen atoms go on increasing down the group. Their bond lengths go on increasing. Longer bonds are weaker, so their dissociation energies go on decreasing down the group.

Halogens are strong oxidizing agents. Justify it:

Halogens have tendencies to accept one electron, and so they oxidize other species. Anyhow, their oxidizing capabilities decrease down the group. Fluorine is the strongest oxidizing agent, while iodine is the weakest.

Due to which reasons fluorine shows peculiar behaviour from other family members?

The size of F and F^- are very small. Fluorine has high ionization potential and electronegativity. Moreover, its bond dissociation energy is very small. It has no available d-orbital to expand its oxidation state.

How does the hydrogen bonding in HF change the properties of this compound from other halogen acids?

HF undergoes extensive hydrogen bonding and forms the zigzag structure. Due to this reason, it is the weakest acid among the halogen acids.

Arrange the following ions in the order of increasing sizes.

The sizes of the halogens atoms and halogen ions increase down the group.

from F^{-1} to I^{-1} . The reason is the increasing number of shells and increasing shielding effect.

What are those factors which affect the oxidizing power of halogens?

These are the electrons affinity values which affect the oxidizing power of halogens. The electrons affinities decrease down the group, so their oxidizing powers decrease. But fluorine shows an exceptional behavior.

Why iodine has metallic lustre?

The melting and boiling points of halogens increase down the group. Iodine is solid at room temperature.

This is due to the presence of dispersion forces among the molecules of I_2 .

Why fluorine and chlorine act as decolourizing agents?

They can oxidize dyes to colourless substances. Litmus and universal indicators can be decolorized. Chlorine is used in the bleaching powder which bleaches the substances due to oxidizing capabilities of chlorine.

Which halogen is used as an antiseptic?

Iodine is used in the form of tincture of iodine. This medicine is prepared by dissolving iodine in ethyl alcohol. It is antiseptic and kills the germs.

Which halogen is used in water treatment to kill bacteria?

Chlorine is used in water treatment. Chlorine is an oxidizing agent and releases atomic oxygen by reacting with water. That atomic oxygen is very reactive and kills the bacteria present in water.

How do you compare preparations of halogen acids?

The reaction of H_2 and F_2 is very fast. HCl and HBr can be prepared from H_2 and halogens at high temperature. The reaction of H_2 and I_2 is very slow and is reversible.

How are the halogen acids ionized in water?

Halogen acids break the $H-X$ bonds in water. All the HX molecules are polar. Water is also polar. H ions after dissociation are converted into hydronium ions. X ions are solvated by water molecules. In this way the products are stabilized as compared to the reactants.

Anyhow, the tendency to be ionized increases from upper to the downward direction.

How do you justify the decreasing bond dissociation energy of halogen acids?

Bond dissociation energy of halogen acids goes on decreasing from upper to the downward direction. This is due to increasing bond lengths and decreasing differences of electronegativities between hydrogen and halogen.

How the thermodynamic properties of halogen acids change in a group from upper to the downward direction?

The heat of fusion and heat of vaporization do not show the regular trend from HF to HI , but the heat of formation and bond dissociation energy change in a systematic way.

Why HF is a weaker acid than HCl :

HF has sufficient hydrogen bonding. H ions are entrapped between two ions to strongly electronegative atoms of fluorine. So it is difficult for H to be dispersed in water and to make HF to act as a good

acid.

Give the formulas and names of important oxides of chlorine and bromine.

Important oxides of chlorine and bromine are as follows

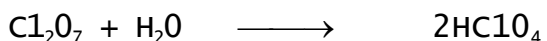
Chlorine: Dichlorine monoxide Cl_2O

Chlorine dioxide ClO_2 , Chlorine hexaoxide Cl_2O_6 , Chlorine heptaoxide Cl_2O_7

Bromine: Bromine monoxide Br_2O , Bromine dioxide BrO_2 , Bromine trioxide Br_2O_3

How do you justify that Cl_2O_7 is the anhydride of perchloric acid?

When Cl_2O_7 is reacted with water. It gives HClO_4 , which shows that Cl_2O_7 is the anhydride of HClO_4 .



Justify that reaction of chlorine with NaOH in the cold state is disproportionation reaction?

Cl_2 reacts with NaOH in cold state to give NaCl and NaClO. The oxidation number of chlorine changes from zero to -1 and zero to +1. This is self oxidation-reduction reaction:

Justify that the reaction of chlorine with NaOH in the hot state is disproportionation reaction:

When chlorine reacts with NaOH in the hot state, NaCl and NaClO_3 are produced. It shows that chlorine atoms change their oxidation numbers from zero to -1 and +5. This is a self oxidation-reduction reaction.

Give the names and formulas of oxyacids of chlorine and iodine:
The general formulas for oxyacids of halogens are: .

HXO , HXO_2 , HXO_3 and HXO_4 .

Fluorine does not have such compounds. Moreover, bromine and iodine also do not give HBrO_2 and HIO_2 .

How do you compare the stabilities of oxyacids of halogens.

Oxyacids of fluorine do not exist. The oxyacids of other halogens are mostly unstable compounds and can not be isolated in pure form. They are stable in aqueous solution or in the form of their salts,

How do you justify the increasing acid strengths of oxyacids of chlorine?

Greater the number of oxygen atoms in the oxyacids, greater the polarity of the OH bonds and greater the dissociating powers in the solution of that acid.

Why HClO_4 is a stronger acid than HBrO_4 than HIO_4 ?

Since the electronegativity of chlorine is greater than bromine which is greater than iodine, so acid strengths decrease from HClO_4 to HIO_4 .

HClO_4 may cause explosion. Give reason:

HClO_4 is a powerful oxidizing agent when it is hot. When it is heated it decomposes with explosion.

What do you mean by available chlorine and how is it calculated?

Amount of chlorine which is set free during the reaction of bleaching powder with acid is called available chlorine, It is calculated by reacting bleaching powder with H_2SO_4 . The theoretical percentage of

available chlorine is 49 but mostly it varies from 35 to 40%.

How does bleaching powder act as an oxidizing agent towards halogen acids?

When bleaching powder is reacted with HCl, HBr, and HI then Cl_2 , Br_2 and I_2 are produced. In other words halogen acids are oxidized. The oxidation number of halogens increase from -1 to zero.

How does bleaching powder act as a bleaching agent for fabrics?

Bleaching powder can bleach cotton, linen, paper, pulp and wood pulp. The coloured matter is oxidized and becomes colourless.

What are freons? Give their uses:

Chlorofluorocarbons obtained from CFC are called freons. It is a mixture of CCl_2F_2 and CClF_3 . They are used as solvents, lubricants, insulators and in refrigeration.

What is teflon? Give its uses:

When C_2F_4 is polymerized. It gives $(\text{C}_2\text{F}_4)_n$, called teflon. It is used in the construction of chemical plants. It is used as insulating material in cables.

Give important uses of chlorine:

Chlorine acts as a bleaching agent, in the manufacture of antiseptics, insecticides, weed killers and herbicides. It is also used for the preparation of HCl, PVC, CHCl_3 and CCl_4 .

Give the important uses of bromine:

Bromine is used for the preparation of $\text{C}_2\text{H}_4\text{Br}_2$ as germicide, fungicide and as an oxidizing agent. AgBr is used in photography.

Give important uses of iodine:

Iodine is used in pharmaceutical industries and in the preparation of tincture of iodine. It is used as an analgesic. It is used in the preparation of iodoform and dyes.

Why the elements of group VIII-A are called noble gases?

The elements of group VIII-A have complete outermost orbitals. So, they do not show tendency to react with others. That is why, they are chemically inert and are thought to be noble in reactivity.

Where does He occur in nature and what is its relative abundance?

Helium was detected in the chromosphere of the sun. On the surface of earth, helium is present due to the emission of radioactive substance.

How does radon differ from its own family members?

Radon is present in very small amounts in air. It is radioactive and it is the decay product of Ra^{226} .

How the solubilities of noble gases are affected in water?

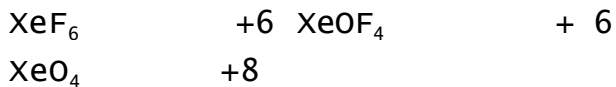
They are least soluble in water. Xe is slightly soluble in water that is 110 cm^3 in 1 dm^3 at 20°C . Anyhow, solubility increases down the group.

Give the names and formulas of important compounds of xenon. Give the oxidation number of xenon in these compounds.

Some fluorides, oxyfluorides and oxides of xenon are as follows:

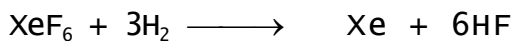
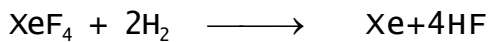
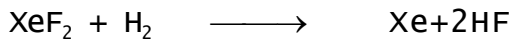
Oxidation state of Xe

XeF_2 +2 XeF_4 +4



How does hydrogen react with the fluorides of xenon?

Reactions are as follows in which xenon gas is set free:



Give the important applications of helium:

Helium is used in the treatment of asthma, filling of weather balloons, producing low temperature, preservation of food, creating inert atmosphere and in welding. It is used in signal lights and atomic reactors.

Give the important uses of argon:

Argon is used in filling electrical bulbs in Geiger counter, producing inert atmosphere, filling fluorescent tubes and mixing with neon in neon signs.

Give the important uses of radon:

Radon is used in the radiotherapy of cancer, earthquake predictions, preparation of ointments for the treatment of cancer and photographing the interior of opaque materials.

What is the effect of high voltage on noble gases?

When noble gases are maintained at low pressure in the discharge tube and electric current is passed through them, spectra of different colours are produced. These spectra are utilized in advertising lamps.

CHAPTER 6

What are the d-block elements? Why are they called so?

Those elements of periodic table whose outermost sub-shell is d- and it is in the process of completion are called d-block elements. There are four series of d-block elements i.e., 3d, 4d, 5d and 6d in period number 4, 5, 6 and 7 respectively.

What are f-block elements? Why are they called so?

Those elements of the periodic table whose outermost sub-shell is f- and that is in the process of completion are called f-block elements. There are two series of f-block elements i.e. 4f and 5f. They lie in sixth and seventh periods of the periodic table.

Why d and f-block elements are called transition elements?

In the periodic table, d- and f-block elements lie in between s and p-block elements. So, their properties lie in between s and p. That is why, they are called transition elements.

Why the electronic distribution of chromium and copper are different from the rest of the elements of 3d series?

In case of ${}_{24}\text{Cr}$, 3d-sub-shell has four electrons normally. It promotes one electron from 4s-orbital and makes five electrons in 3d to make it half filled and get extra stability. Similarly, copper promotes one electron from 4s-orbital to 3d to make it fulfilled and make it stable.

What are non-typical transition elements and why are they called *o?

The elements of group II-B (Zn, Cd, Hg) and III-B (Sc, Y, La) are non-typical transition elements. They are at the boundaries of the series, and their properties are not exactly identical to other d-block elements.

How do you distinguish between outer transition and inner transition elements?

The transition elements of d-series are outer transition elements. There are four series of this category. The elements of f-block i.e. lanthanides and actinides are inner transition elements.

How the atomic radii of d-block elements vary from left to the right in a period?

The atomic radii decrease from left to the right in all d-series. This is due to the increasing nuclear charges and same shielding effects. Anyhow, Zn, Cd and Hg show the abnormal behaviour due to their completely filled sub-shells.

How the ionization energy values change from left to the right in d-block elements?

Due to decreasing sizes from left to the right, the ionization energy values should increase from left to the right but some of the elements like Cr and Ni in 3d-series show the abnormal behaviour.

Justify the variation of binding energies in d-block elements from left to right:

The binding energies depend upon the number of unpaired electrons in the outermost sub-shell. They are maximum in the middle of the series. So binding energies increase from left to right upto the middle and then they decrease.

Why the melting and boiling points are maximum somewhere in the middle of the series of d-block elements?

The melting and boiling points depend upon the binding energies which are the results of number of unpaired electrons. Since the number of unpaired electrons in the middle of the d-block series are greater. So melting and boiling points in the middle are greater.

What is paramagnetism? What are its units?

Those substances which when placed between magnetic poles allow the magnetic lines of forces pass through them are called paramagnetic. It is measured in Bohr magneton (B.M). It is measured by Gouy's balance.

How the property of paramagnetism is developed in the substances?

The unpaired electrons in the outermost orbitals of substances create the magnetic moment. This is due to the orbital motion and spin motion. This magnetic moment is influenced by the external magnetic field.

Why the maximum paramagnetic strength is associated with the middle elements of d-block series?

The elements in the middle of the series have greater number of unpaired electrons in their outermost orbitals. This will create greater values of magnetic moments. Hence they show greater paramagnetic strength.

What is the reason for the variations of oxidation states of transition elements?

This is due to the greater number of unpaired electrons in the outermost orbitals. These electrons can change the orbital due to small energy differences and so the oxidation states can vary.

What is the reason for the development of the colours in the compounds of transition elements?

Colours are developed due to the jumping of electrons from low energy levels to the higher ones and vice versa, d-orbitals are split up into orbitals. Electrons are excited and photons of light are absorbed. The colour of the rest of the compounds depends upon the complementary colours which is absorbed.

What are complementary colours? Give examples:

When a particular wavelength is absorbed by a certain substance from the white light, the rest of the light has a different colour from that one which is absorbed. So, that colour is called the complementary colour of the absorbed one.

Why the catalytic properties are associated with the transition elements?

The substances having unpaired electrons mostly act as catalysts. Actually, they give the electrons to other species and make them activated and increase the rates of reactions.

What are interstitial compounds? Give their examples:

Those compounds in which the interstices of the transition metals in their crystal structures are filled by small sized atoms like H, C, B, etc. are called interstitial compounds.

Give examples of alloys and give their properties:

Alloys are mixtures of two or more than two metals. For example, brass, bronze and coinage alloys are the best alloys. They are usually harder than pure metals. They have high melting points and more resistant to corrosion.

How many types of various groups are present in the transition metal complex? -

Transition metal complexes consist of cations and anions with a few exceptions. One of the ion is complex which has central transition metal atom or ion and a few ligands are attached with that.

Indicate the central metal atom or ion along with its oxidation number in the complexes:

(i) $K_4[Fe(CN)_6]$ (ii) $K_3[Fe(CN)_6]$ (iii) $[Ag(NH_3)_2] Cl$

(i) iron is in +2 oxidation state

(ii) iron is in +3 oxidation state

(iii) silver is in +1 oxidation state

What is co-ordination number and co-ordination sphere of a complex compounds?

The number of ligands which surround the central metal atom or ion is called co-ordination number. The collection of central metal atom with all the ligands is called co-ordination sphere.

What are chelates?

When a polydentate ligand surrounds the central metal atom or ion, cyclic co-ordination complex ions are produced. These are called chelates.

While naming the complex compounds, how do you end with negatively charged ligands, positively charged ligands and neutral ligands?

Negatively charged ligands end in 'o', positively charged ligands end in 'ium', and neutral ligands are called as such.

Name the following complexes.



Potassium hexachloroplatinate (IV); sodium pentacarbonylmanganese (-1)

Indicate the shapes of the transition metal ions in which the central metal atom or ion has sp^3 , dsp^2 and dsp^3 hybridization:

For sp^3 hybridization, the structure is tetrahedral. For dsp^2 hybridization the structure is square planar. For dsp^3 hybridization triangular bipyramidal structure is produced.

Give the names and formulas for important ores of iron:

The important ores of iron are as follows:

Magnetite Fe_3O_4

Haematite Fe_2O_3

Limonite $Fe_2O_3 \cdot 3H_2O$

Copper iron pyrite $CuFeS_2$

How do you compare the cast iron, wrought iron and steel with respect to the percentage of carbon?.

Cast iron , carbon = 2.5 - 4.5 %

wrought iron , carbon = 0.1 - 0.25 %

Steel . carbon = 0.25-2.5%

What are the uses of wrought iron?

It is extremely tough and used for the manufacture of those articles which have to stand severe and sudden stresses.

**How do you compare mild steel, medium carbon steel and high carbon steel with respect to their carbon contents and their properties?
% age of carbon**

Mild steel 0.1-0.2

Medium carbon steel 0.2-0.7

High carbon steel 0.7-1.5

What is the role of acidic and basic lining in the open hearth process for the manufacture of steel?

Basic lining of dolomite is a mixture of CaO and MgO . It removes the acidic impurity like sulphur and phosphorus. Acidic lining is of SiO_2 and it removes manganese and silicon.

Discuss the general shape of Bessemer's converter:

It is a pear-shaped vessel made up of steel plates. There are holes at the bottom. It is held on a central axis and can be tilted.

How do you remove the entrapped gases from the steel?

A little aluminium or ferrosilicon is added. Aluminium combines with nitrogen to give aluminium nitride. Entrapped bubbles of gases are called blow holes.

Why the corrosion of metals is more rapid in the presence of water?

In the presence of water, the layer of oxides, sulphides or carbonates is dissolved in water, so the corrosion penetrates into the metal.

How does electrochemical theory explain the corrosion of aluminium in the presence of copper?

In the mixture of copper and aluminium, aluminium corrodes because it loses the electrons, makes the Al^{+3} and give $Al(OH)_3$.

How does the metallic coating prevent the corrosion?

When the surface of iron is covered with a layer of metal which is more active than iron, iron will be protected. For examples, Zn, Sn, Al and Cr coatings can help to stop corrosion of iron.

What do you mean by cathode coating?

If the sheets of iron are dipped in molten tin and then passed to the hot pairs of rollers, the process is called galvanizing. This is also called cathode coating.

What are chromates and dichromates?

Chromates are the salt of H_2CrO_4 and dichromates are the salts of $H_2Cr_2O_7$ and these are two acids of chromium.

Give the uses of potassium chromate and its structure?

K_2CrO_4 is used for the manufacture of pigments, as a corrosion inhibitor, in dyeing and tanning of leather and as an indicator in $AgNO_3$ titrations. The structure of K_2CrO_4 is that of CrO_4^{-2} ion which is tetrahedral in shape

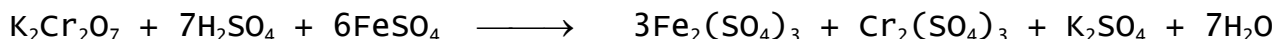
How does $K_2Cr_2O_7$ act as an oxidizing agent in the presence of H_2SO_4 ?

$K_2Cr_2O_7$ reacts with H_2SO_4 to give atomic oxygen which can oxidize other substances:



How the mixture of $K_2Cr_2O_7$ and H_2SO_4 oxidizes H_2S gas and $FeSO_4$ separately?

The atomic oxygen released by acidified $K_2Cr_2O_7$ oxidizes H_2S to S and $FeSO_4$ to $Fe_2(SO_4)_3$:



What is chromyl chloride test?

When mixture of $K_2Cr_2O_7$ and a soluble chloride say NaCl is heated with conc. H_2SO_4 then a deep red coloured liquid appears in the form of fumes having the formula CrO_2Cl_2 . This is called chromyl chloride.



How do you compare $KMnO_4$ and K_2MnO_4 ?

These two compounds differ from each other in the oxidation number of manganese which is +6 and +7 in K_2MnO_4 and $KMnO_4$ respectively.

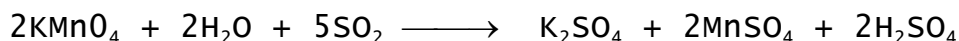
How $KMnO_4$ and H_2SO_4 act as oxidizing agents?

They react with each other to release atomic oxygen which can oxidize other substances;



How $KMnO_4$ oxidizes SO_2 to H_2SO_4 ?

The reaction is as follows:



CHAPTER 7

Why carbon forms a large number of compounds?

Carbon has unique property of linking with other carbon atoms to form a long chain in indefinite number. This property is called catenation and due to it carbon forms millions of compound.

What is modern definition of organic chemistry?

Organic chemistry is that branch of chemistry which deals with the study of compounds of carbon and hydrogen (Hydrocarbons) and their derivatives.

What are fossil fuels and how they are formed?

Petroleum, coal and natural gas are vast reservoirs from which many organic compounds are obtained. These are called fossil fuels and are formed from decay of plants and animals over long period of time.

What is coal? How it was formed?

Coal is an important solid fuel. It is believed that coal in nature was formed from the remains of the trees buried inside the earth crust some 500 millions years ago. Due to the bacterial and chemical reactions on wood it got converted into peat. When as a result of high temperature and pressure inside the earth crust, peat got transformed into coal.

What is carbonization or destructive distillation?

The heating of coal in the absence of air at a very high temperature 500-1000 C is called carbonization or destructive distillation. Coal is converted into coke, coal gas and coal tar. Coal tar contains a large number of organic compounds, which separate out on fractional distillation.

What are petrochemicals? Give their important uses.

Cracking process is used to increase the yield of gasoline. It also produced large amounts of useful by-products such as ethane, propene, butane and benzene these by products are called petrochemicals. These are used for manufacturing drugs, plastics, detergents, synthetic fibers, fertilizers, weed killers and important chemicals like ethanol, phenol and acetone.

What is knocking?

The gasoline fraction present in petroleum is generally not of good quality. When it burns in an automobile engine, combustion can be initiated before the spark plug fires. This produce a sharp metallic sound called knocking.

What is octane number?

The octane number of the fuel is the percentage ratio of isooctane with n. heptane in a fuel that shows specific knocking characteristic when examined in a standard one cylinder engine operated under specific conditions. The octane number of pure isooctane is taken as standard which is 100. The octane number of pure n. Octane is zero. Higher the octane number of fuel, lesser is the knocking. Octane number decreases with increase in carbon atoms of the chain. It increases with branching in alkenes and presence of alkenes and aromatic hydrocarbons.

How octane number of a fuel can be improved?

The octane number of fuel can be improved by the process of cracking, reforming. It can also improved by mixing small amount of additive like tetraethyl lead (TEL) $(C_2H_5)_4 Pb$ to the fuel.

What is petroleum?

It is refined from of mineral oil. It is thought to have been formed by slow chemical and biochemical decomposition of the remains of organic matters found between the sedimentary rocks. When extracted from rocks

"it appears like a liquid of blackish colour known as crude oil.

Differentiate between Acyclic and Cyclic compounds?

Acyclic Compounds. This type of compounds contain an open chain of carbon atoms. The chains may be branched or non branched. The open chain compounds are also called aliphatic compounds.

Cyclic Compounds. These compounds contain closed chains or rings of atoms and are known as cyclic or ring compounds. These are of two types,

(a) Homocyclic (b) Heterocyclic

Different between Homocyclic and Heterocyclic compounds.

Homocyclic or carbocyclic Compounds. These compounds contain the ring consists of only carbon atoms. These are of two types,

(i) Alicyclic Compounds (ii) Aromatic Compounds.

Heterocyclic Compounds. The compounds in which the ring consists of atoms of more than one kind are called heterocyclic compounds.

Heterocyclic compounds contain N, S or O in addition to C in the ring.

Differentiate between Alicyclic and Aromatic Compounds?

Alicyclic. The homocyclic compounds which contain a ring of three or more carbon atoms and resemble aliphatic compounds are called Alicyclic Compounds.

Aromatic. These Carbocyclic compounds contain at least one benzene ring, six carbon atoms with three alternate double and single bonds.

2-butene has Cis-trans isomerism while 1-butene does not, explain.

In 2-butene two different groups are present at the same carbon atom which is linked with double bond. In case of 1-butene, two similar atoms are present on one side of double bond carbon atom.

Why there is no free rotation around a double bond and a free rotation around a single bond?

In case of alkane only sigma bonds are present. In case of alkene, two type of bonding is present, sigma and Pi bond. Due to parallel overlapping of P-orbitals in Pi bond no free rotation is present. So these double bonds are called restricted bonds. Due to restriction of rotation in alkene, they have geometrical isomerism.

Why tetraethyl lead acts as knock inhibitor in gasoline?

Tetra ethyl lead acts as negative catalyst and it reduces the speed of combustion of the fuel, hence less knocking is produced.

Why number of chain isomers of pentane are greater than butane?

As the number of carbon atom increase, number of possible arrangement also increases. Butane has two chain isomers while pentane has three isomers.

Butanone does not show metamerism, explain?

In metamerism, alkyl group varies on both sides of functional group. In 2-butanone two alkyl groups (methyl, ethyl) are present on both side of carbonyl carbon.

By rearranging the alkyl groups, the structure remains same. Also the name of ketones remains same.

Cracking process is used to increase the yield of gasoline, explain it?

Fractional distillation of petroleum yields only 20% gasoline. Due to its greater demand, deficiency of gasoline is recovered by converting higher hydrocarbons to lower hydrocarbon (gasoline) by cracking process.

What is Cis-trans isomerism?

Such compounds which possess the same structural formula, but differ with respect to the positions of the identical groups in space are called Cis-trans isomers and the phenomenon is known as cis-trans isomerism? 2 Butane Can exist in Cis and Trans forms,

CHAPTER 8

Explain why alkanes are less reactive than alkenes?

Ans. In alkanes, C atoms are sp^3 hybridized. Sigma bonds are present between C-H and C-C. Four valence of carbon are fully saturated. In alkene Pi bond is also present in carbon-carbon double bonds. Pi bond is weaker than sigma bond. Less energy is required to break Pi bond. So alkenes are more reactive than alkanes.

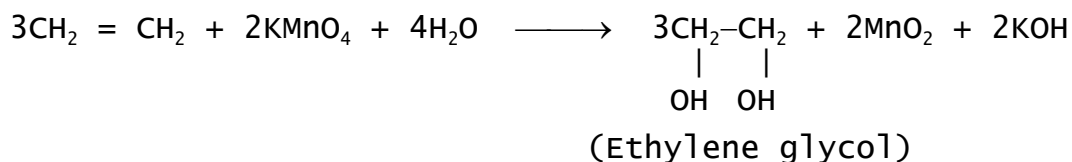
What is the effect of branching on the melting point of alkanes?

Branched chain alkanes have low boiling points as compare to straight chain alkanes.

2 - Methyl -1-butene < 2- pentene

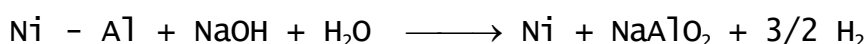
What is Hydroxylation?

When alkenes are treated with mild oxidizing agent like Baeyer's reagent (1% alkaline $KMnO_4$) at low temperature, hydroxylation of double bond occurs resulting in the formation of vicinal alcohol and pink colour of $KMnO_4$ discharged.



What is Raney Nickel?

It is Nickel obtained by treating Ni - Al alloy with Caustic soda



It is used in hydrogenation of alkenes at 100°C and 3 atm. Pressure.

Why benzene is more reactive than ethane?

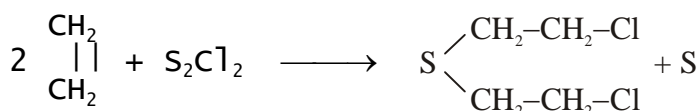
In ethane, all C - C and C - H bonds are sigma bonds while benzene contain sigma bonds and Pi bonds. Pi bonds are weaker than sigma bond and are more reactive. Hence presence of Pi bonds make the benzene ring more reactive.

Why ethene is more reactive than benzene?

In ethene, Pi bond is localized between two specific carbon atoms while Pi bonds in benzene ring are delocalized due to resonance effect. This delocalization of Pi electrons make benzene ring less reactive than ethane.

What is mustard gas?

Mustard name comes from its mustard like odour. It is not a gas but a high boiling liquid that is dispersed as a mist of tiny droplets It is a powerful vesicant, causes blisters. It was used as a chemical weapons during world war- 1.



sulphide

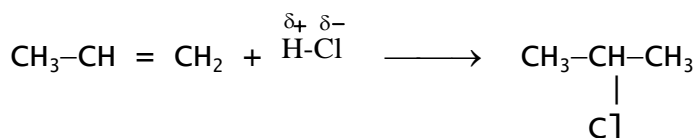
(Sulphur Monochloride)

β, β' -dichloroethyl

(Mustard gas)

What is Markownikov's - Rule?

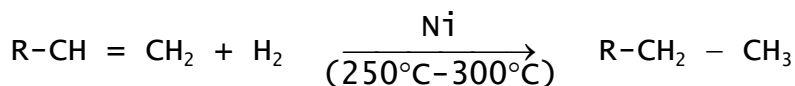
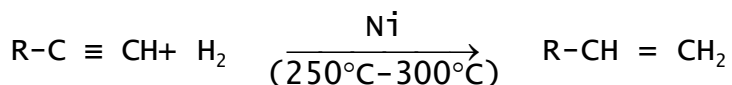
When a polar reagent is added to an unsymmetrical alkene, the negative part of the adding reagent goes to that Carbon which has least number of hydrogen atoms.



(2-chloro propane)

What is Sabatier and Sendern's reaction?

In this reaction hydrogenation of alkenes or alkynes is carried out in the presence of Ni as Catalyst at a temperature of 200 - 300°C.

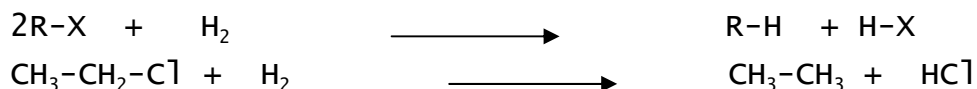


What is hydrogenolysis?

Hydrogenolysis:

Hydrogenation accompanied by bond cleavage (breaking) is called hydrogenolysis.

Alkyl halide can be reduced to an alkane by reacting it with H_2 in the presence of (Pd - Charcoal) catalyst. This reaction is hydrogenolysis.

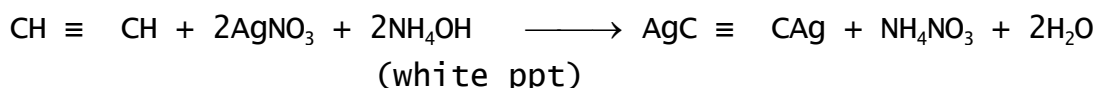


Why Raney Nickel is more effective than ordinary Nickel?

Raney nickel is more effective due to its greater surface area. It is porous and its surface is greater.

How will you distinguish between 1 - butyne and 2 - butyne?

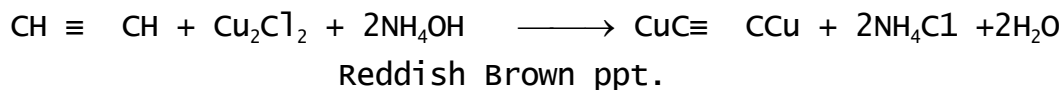
1 - Butyne reacts with ammonical AgNO_3 to form white precipitate of silver acetylide.

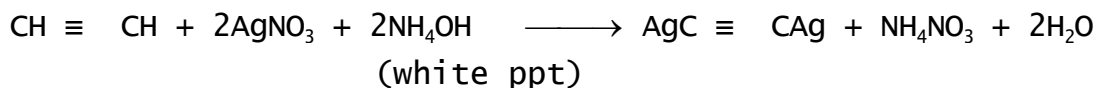


2 - Butyne, No acidic hydrogen is present and does not react with ammonical silver nitrate,

How will you distinguish between ethane and ethyne?

Ethyne reacts with ammonical silver nitrate to form white precipitate of silver acetylide. It also gives red ppt. of copper acetylide with ammonical cuprous chloride.

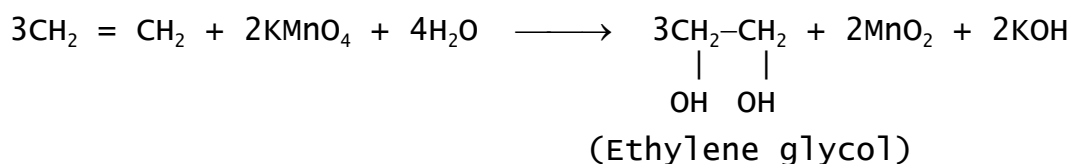
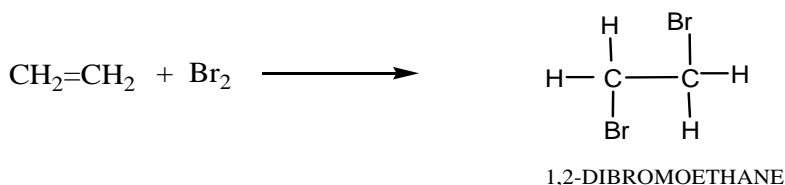




Ethane does not react with ammonical AgNO_3 and

How will you distinguish between ethene and ethane?

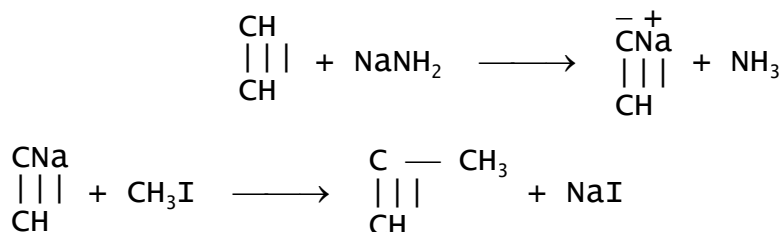
Ethene reacts with Br_2 and KMnO_4 and their colour is discharged



Ethane does not give these tests.

Ethyne have acidic hydrogen, explain?

In alkyne triple bond is present between C - C atoms. Carbon atoms in alkyne bonded by triple bonds are sp hybridized and have one sigma and two Pi bonds. Due to greater overlapping distance between C - C is reduced. Due to greater attraction carbon has partial negative and hydrogen attached to sp - hybridized carbon is slightly positive.



Alkanes give substitution reactions, explain?

In alkanes four valence of each carbon atom, are fully saturated. Strong sigma bonds are present between C - C and C - H. More energy is required to break these bonds So alkanes give substitution reactions in which H atoms are replaced by other groups.

Alkenes usually undergo addition reactions, why?

In alkenes double bond is present. C atoms bonded by double bond are sp^2 hybridized and form one sigma and one Pi bond. Four valence of these carbon atoms are not fully saturated. Pi bond is comparatively weaker bond it easily break to give electrons to attacking electrophile and form addition product with it.

What are initiation, Propagation and termination steps in any mechanism?

First step in which free radical are produced is called initiation step. Second step in which a same radical is consumed and evolved is called propagation step. Third step in which final product is produced by combination of two different free radicals is called Termination step.

CHAPTER 9

What are aromatic compounds?

The organic compounds which contain at least one benzene ring are called aromatic compounds. The term aromatic has been taken from the Greek word 'aroma' meaning 'fragrant', Aromatic compounds have low Hydrogen to carbon ratio in their molecule.

Aromatic compounds burn with sooty flame, why?

Aromatic compounds have high percentage of carbon as compared to hydrogen. Aromatic compound, benzene contains six carbons and six hydrogen atom C_6H_6 , where aliphatic compound with six carbon atoms have 14 hydrogen atoms (C_6H_{14}). Aromatic compounds due to greater percentage of carbon give sooty flame or smoke.

why benzene-gives few addition reactions as compare to alkenes?

Benzene has delocalized Pi electrons, where Pi electrons of alkenes are available at fixed positions. Therefore Pi bonds of benzene can not be broken down easily. Pi bonds of alkenes can be broken easily and very small amount of energy is required. Benzene gives addition reactions with H_2 and Cl_2 only.

what product will be form when benzene reacts with Cl_2 (i) in the presence of sunlight (ii) in the presence of iron catalyst.

(i) In presence of sunlight, benzene gives addition reaction and benzene hexachloride is formed.

(ii) In presence of $FeCl_3$ Catalyst, benzene gives substitution reaction with chlorine

Justify cyclic structure of benzene.

Following facts support cyclic structure for benzene C_6H_6 .

(i) It has one mono substituted product.

(ii) It has three di-substituted products.

(iii) It can add three molecule of Cl_2 and three molecules of H_2 . It means it has three double bonds.

Bond length in benzene is intermediate between alkanes and alkenes, explain.

X-rays analysis has shown that C-C bond length in benzene is in between double and single bond.

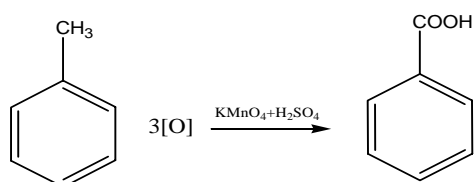
In alkane C-C bond length is 1.564 \AA

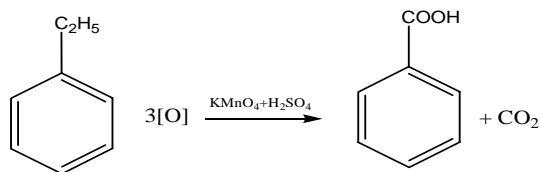
In alkene C-C bond length is 1.34 \AA

In benzene C-C bond length is 1.397 \AA

what products are obtained by the oxidation of toluene (Methyl benzene) and ethyl benzene?

In the presence of acidified $KMnO_4$, alkyl group 'R' of benzene is oxidized to -COOH group irrespective to the number of carbon atoms in the alkyl group. Therefore both methylbenzene and ethyl benzene give benzoic acid on oxidation.

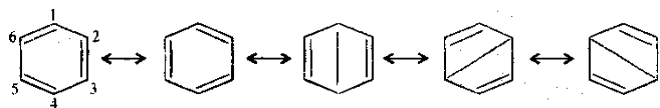




What is resonance? Explain with reference to benzene.

The possibility of different pairing schemes of valence electrons of an atom is called resonance and different structures thus obtained are called resonance structures. The resonance is represented by a double-headed arrow (\leftrightarrow). The following different pairing schemes of the fourth valence of carbon atoms are possible in benzene.

The different resonance structures for benzene molecules are as follows:



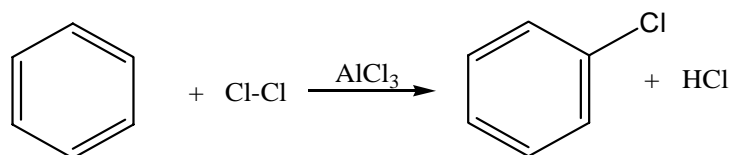
Kekulé's structures

Dewar Structure

How can we justify that benzene is a saturated compound?

All those reactions in which the benzene ring remains intact and only substitution takes place explain the stability and saturated nature of benzene.

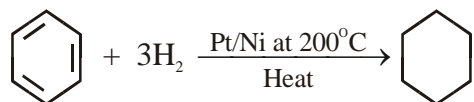
(X = Cl, Br)



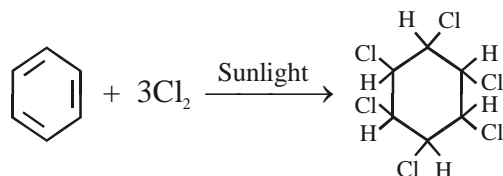
How can we justify that benzene is an unsaturated compound?

Unsaturated nature of benzene is explained by the addition reactions of benzene.

Benzene reacts with H_2 in the presence of Ni catalyst at high temperature or in the presence of Pt in acidic solvent (acetic acid) to form cyclohexane.



Benzene reacts with Cl_2 in the presence of sunlight to give benzene hexachloride.



How can you compare the reactivities of alkanes, alkenes and benzene?

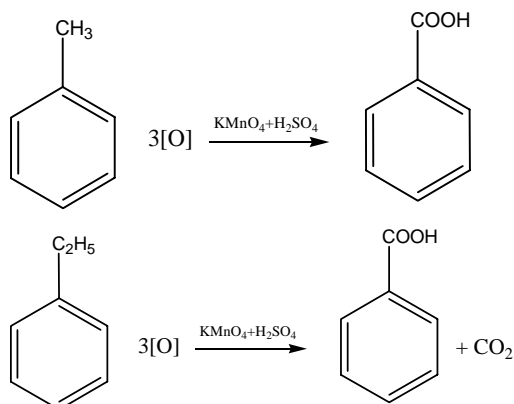
Benzene is more reactive than alkane and less reactive than alkene.

Alkene > Benzene > Alkane

In alkene Pi bond is present which is responsible for the reactivity of alkene. In benzene Pi electrons are present but become less reactive because of resonance. The alkanes are unreactive due to its non polar nature the inertness of sigma bond.

How will you identify alkyl benzene?

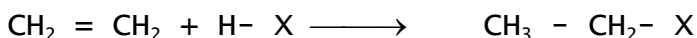
Alkyl benzene decolorize KMnO_4 solution. In this reaction alkyl groups are oxidized to one carboxylic group whatever the length of alkyl group.



CHAPTER 10

What is the order of reactivity of H - X with ethene for preparation of alkyl halides?

Ethene reacts with H - X to form ethyl halide



The order of reactivity of HX is $\text{HI} > \text{HBr} > \text{HCl} > \text{HF}$

Which is more reactive with a nucleophile, CH_3I or CH_3Cl ?

The bond dissociation energy of C - I is less than C - Cl due to less electronegativity of iodine. Therefore CH_3I is more reactive than CH_3Cl .

Secondary alkyl halides undergo $\text{S}_{\text{N}}1$ or $\text{S}_{\text{N}}2$ reactions, while primary alkyl halides have $\text{S}_{\text{N}}2$ and tertiary alkyl halides have $\text{S}_{\text{N}}1$ reactions, explain.

The reaction kinetics depends upon the size of alkyl group and nature of solvent used. If alkyl groups have higher size $\text{S}_{\text{N}}1$ reaction takes place due to steric hindrance. Polar solvents also favour $\text{S}_{\text{N}}1$ mechanism. If alkyl groups have smaller size (alkyl or ethyl) then $\text{S}_{\text{N}}2$ reaction takes place in single step. -No polar solvent also favours the $\text{S}_{\text{N}}2$ mechanism. In sec. Alkyl halide two alkyl groups are attached with the α -carbon. Therefore due to above reasons it gives $\text{S}_{\text{N}}1$ or $\text{S}_{\text{N}}2$ reaction where prim. Alkyl halide gives $\text{S}_{\text{N}}2$ and Tert. Gives $\text{S}_{\text{N}}1$ reaction.

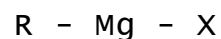
Why reactants and solvent ether must be absolutely dry and pure for Grignard's reagent?

Grignard's reagent are very reactive. They react with moisture or any impurity present in reactants or solvent as a result of which we are not able to obtain pure Grignard's reagents. Therefore, all the reactants and solvent ether should be absolutely dry and pure.

Why Grignard's reagents are so reactive?

The reactivity of Grignard's reagents is due to the nature of C - Mg bond,

which is highly polar



Mg is more electropositive than carbon and therefore C - Mg bond is highly polar covalent in nature. The alkyl carbon atom acquires a partial negative charge which is an unusual character. This makes the alkyl groups highly reactive towards electrophilic centers. Most reactions of Grignard's reagent are exothermic.

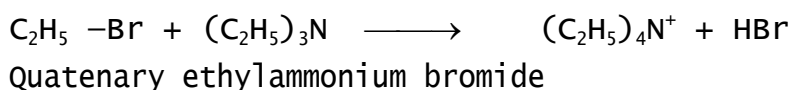
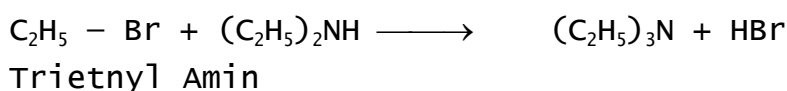
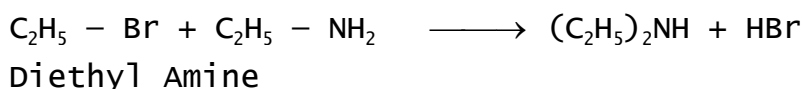
What are SN₁ reactions?

Nucleophilic substitution reactions of alkyl halides involved two main process, the breakage of C - X bond and the formation of C - Nu bond. If the bonds breaks first followed by the formation of new bond, this mechanism is called SN₁. It is given by Tertiary alkyl halide.

What are SN₂ reactions?

Nucleophilic substitution reactions of alkyl halides which involve the simultaneous breakage of C - X bonds and the formation of C - Nu bond is called SN₂ reaction. This mechanism is called SN₂. It is given by Primary alkyl halide.

What product formed when alkyl halide react with ammonia?
Reaction with Ammonia



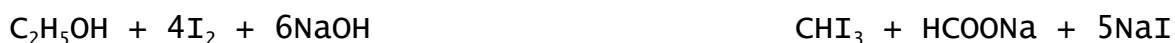
CHAPTER 11

How can you distinguish between Prim., Sec., and Tert. Alcohols?

When conc. HCl and ZnCl₂ are added to alcohols, corresponding alkyl halide as precipitate are formed. If turbidity appears immediately the alcohol is of tertiary nature. If turbidity appears slowly often some time, then it is secondary alcohol if turbidity does not appear, then it is primary alcohol.

How methyl alcohol may be distinguished from ethanol?

Ethanol give iodoform test, when ethanol is treated with NaOH and I₂ yellow ppt of iodoform is produced.



Methyl alcohol does not give this test.

How can you distinguish between phenol and ethanol?

i) Phenol gives purple colouration with FeCl₃ solution Ethanol does not give this test.

ii) Phenol gives no reaction with carboxylic acid. Alcohol gives esters which have a fruity smell

What is Fermentation? what compounds are obtained on industrial scale by formation?

Fermentation is a biochemical process which occurs in the presence of certain enzymes secreted by micro organism such as yeast. In this process starch or sugar is converted into ethyl alcohol, In this process sugar, glucose, ethanol can be obtained on industrial scale from starch.

What do you mean by denaturing of alcohols.

Methanol is poisonous in nature. 10% methanol is added to ethanol to avoid its use for drinking purpose. Such alcohol is called 'methylated spirit'. This addition of methanol to ethanol is called 'Denaturing of alcohol'.

Explain why ethyl alcohol is a liquid while ethyl chloride is a gas?

Ethyl alcohol like water is a polar compound. In addition to polarity, there exists a strong hydrogen bonding between alcohol molecules. Due to this boiling point of alcohol rises. Ethyl chloride has no such hydrogen bonding. Therefore it is a gas.
Ethanol has higher boiling point than diethyl ether, explain.

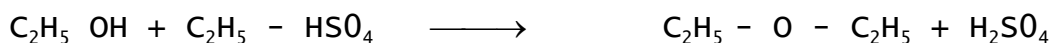
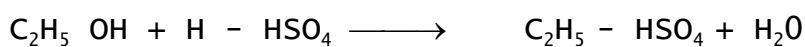
Diethyl ether does not show hydrogen bonding where ethanol like water show hydrogen bonding between molecules. Due to this reason boiling point of ethanol is higher than diethyl ether.

Explain that Absolute alcohol cannot be prepared by fermentation process.

Absolute alcohol is 100% Ethanol where fermented alcohol is only 12% ethanol and this percentage never exceeds 14% because beyond this limit the enzymes become inactive. Therefore it is not possible to get absolute alcohol directly by fermentation. It can only be obtained by distilling fermented alcohol. First we get 95% rectified spirit and then by redistillation of rectified spirit in presence of CaO, which absorbs its moisture, 100% ethanol or absolute alcohol is obtained.

Ethanol gives different products with Cone. H₂SO₄ under different condition explain.

a) Alcohol, when taken in excess amount at low temperature reacts with Cone. H₂SO₄ to give ethyl hydrogen sulphate. Ethyl hydrogen sulphate reacts with excess amount of ethanol to produce ether.



b) When ethanol reacts with excess of cone. H₂SO₄ at 180°C, water is eliminated from alcohol to produce alkene.



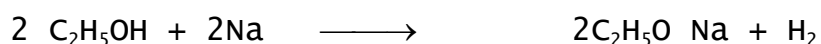
Why water has higher boiling point than ethanol?

Alcohol molecules have . hydrogen bonding like water. But intensity of hydrogen bonding and polarity of molecules is greater in water as compared to alcohol. Due to this reason water has higher boiling point than ethanol.

How will you prepare ethers by Williamson synthesis.

i) **Williamson's synthesis.**

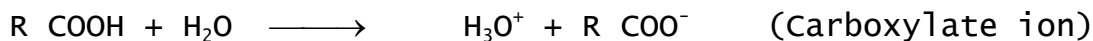
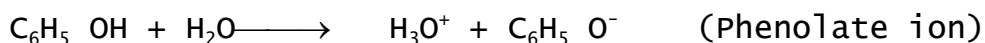
Alcohols are reacted with metallic sodium to form alkoxide The alkoxide ion is strong electrophile and readily, reacts with alkyl halide to produce ether.





Carboxylic acids are more acidic than Phenol, why?

Strength of any acid depends upon its dissociation or the stability of conjugate base of an acid. Carboxylate ion (Conjugate base) is more stable than Phenolate ion.



How will you distinguish between carboxylic acid and Phenol?

Phenol does not react with Na HCO_3 . Carboxylic acid evolves CO_2 with effervescence when reacted with Na HCO_3 .



Phenol is acidic while ethanol is not, although both have - OH group in them, why?

The strength of an acid depends upon the stability of conjugate base of an acid. Phenolate ion is somewhat stable due to resonance in it, while ethoxy ion is not stable and does not lose protons.

Ether is less reactive than alcohol, explain.

In case of alcohol, one hydrogen atom is directly linked with highly electronegative atom oxygen and bond is polar in nature.



In case of ether, no hydrogen is linked with oxygen atom directly, therefore, ethers are not reactive like alcohols. Ethers do not react with sodium metal, dilute acids, oxidizing agents or reducing agents.

How will you distinguish between ethanol and diethyl ether?

alcohols react with sodium metals to give alcoxide and H_2 gas is evolved.



Ethers do not give this test.

What are essential conditions and optimum temperature required for Fermentation process?

Optimum temperature for fermentation process is $25 - 35^\circ\text{C}$. Proper aeration, dilution of solution and the absence of any preservative are essential conditions required for fermentation process.

Phenol with one - OH group is partially soluble, in water, while ethanol with one - OH group is completely soluble, why?

Phenol has large hydrocarbon part ($-\text{C}_6\text{H}_5$) but only one - OH group which is unable to attract sufficient water molecules to get it solvated. Hence it is partially soluble. Ethanol with smaller hydrocarbon part ($-\text{C}_2\text{H}_5$) is easily solvated, hence soluble.

CHAPTER 12

What is the difference between symmetrical and unsymmetrical ketones?

The ketones having similar alkyl or aryl group on both sides of carbonyl group is called symmetrical ketone

Example



Dimethyl ketone (acetone)



Diphenyl ketone

The ketone in which two different alkyl groups are attached with carbonyl group is called unsymmetrical ketone.

$\text{CH}_3\text{-CO-C}_2\text{H}_5$ Ethyl methyl ketone

Why the reactions given by carbonyl compounds are mostly addition?

In carbonyl compounds, the carbonyl group is the reactive part of the molecule, The carbonyl group has a sigma (σ) bond and a Pi (π) bond. Due to the presence of π bond, the most reagents react with the carbonyl group of the carbonyl compounds by adding to it

How carbonyl compounds can be separated from non carbonyl present as impurities?

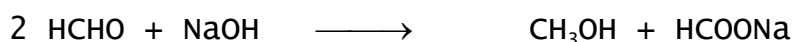
Carbonyl compounds reacts with sodium bisulphate to form a crystalline white precipitate of sodium bisulphate addition compounds while non carbonyl compound do not reacts. The white ppt. is separated by filtration and then heated with a dilute mineral acid (HCl or H_2SO_4) to regenerate the original carbonyl compound.

What is the effect of presence of base as a catalyst in nucleophilic addition reaction?

The role of a base in nucleophilic addition reaction of carbonyl compounds is to remove the hydrogen atom from reagent in the form of H^+ ion, This will increase the nucleophilic character of the reagent.

What is Disproportionation reaction?

The reaction in which half compound is oxidized and half is reduced are called self oxidation reduction reaction or disproportionation reaction .



Disproportionation reaction is also called cannizzaro's reaction,

Which compounds give cannizzaro's reaction?

The compounds having no α - hydrogen undergo cannizzario's reaction.
Example HCHO Formaldehyde

$\text{C}_6\text{H}_5\text{CHO}$ Benzaldehyde

Which substances gives haloform reaction?

The compounds having $\text{CH}_3 - \text{C} -$ group in them undergo haloform reactions. Acetaldehyde and all methyl ketones give this reaction,

What is iodoform test? what is its important use?

Acetaldehyde, methyl ketones, ethanol, and secondary alcohols containing OH group on the second carbon atom when treated with I_2 and aqueous NaOH to give yellow crystalline solid iodoform. This test is called iodoform test, it is used to distinguish between

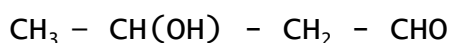
(i) Methyl ketone and other ketones

(ii) Ethanal and other aldehydes,

(iii) Ethanol from methanol and other prim - alcohols.

What is aldol?

the compounds which contain one aldehyde and one hydroxyl group in it is called 'aldol'



3 - Hydroxy butanal

Why aldehydes are oxidized even by mild oxidizing agents?

In aldehydes, one hydrogen atom is attached with carbon atom of Carbonyl group. This hydrogen is very reactive. It is oxidized by mild oxidizing agents to OH group.

Why oxidation of Ketones is comparatively difficult?

In Ketones carbon atom of carbonyl group is attached with carbon atoms on both sides. For oxidation, ketones has to break carbon - carbon bond which is very strong. Therefore, ketones are not oxidized with mild oxidizing agent. It require strong oxidizing agents like. $K_2Cr_2O_7 / H_2SO_4$ or $KMnO_4 / H_2SO_4$

What are mild oxidizing agents?

Those reagent which can oxidized only very reactive compounds having weaker bond are called mild oxidizing agent, Tollen's reagent, Fehling's solution and Benedict's solution are some examples of mild oxidizing agents, These can, oxidized aldehydes only.

What are strong oxidizing agents?

Those reagents which oxidized even very stable compounds having strong bonds are called strong oxidizing agents, Examples $K_2Cr_2O_7 / H_2SO_4$, $KMnO_4 / H_2SO_4$ and cone, HNO_3 . These can oxidize organic compounds like alcohols, aldehydes and ketone ate, as well as inorganic compounds like Ferrous Sulphate, Oxalic acid etc.

What is sodium bisulphite test?

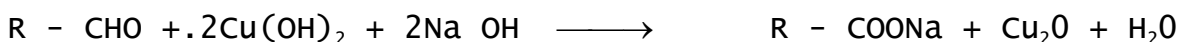
In this test aldehydes and small methyl ketones form a white crystalline precipitate with saturated sodium bisulphate solution.

What is 2,4, Dinitrophenyl hydrnzine (DNPH) test?

When aldehyde and ketones react with 2,4 dinitro phenyl hydrazine, yellow or orange ppt. of 2,4 - dinitrophenylhydrazone (2,4 - DNPH) is formed,

What is Fehling's solution test?

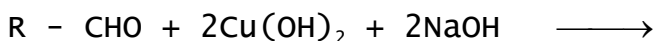
Aliphatic aldehydes on boiling with Fehling solution form brick red ppt. of cuprous oxide,

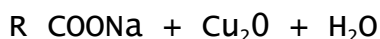


Brickred ppt.

What is Benedict's solution test?

Aliphatic aldehydes on boiling with Benedict's solution form brick red ppt of cuprous oxide.





What is silver mirror test?

Aldehyde solution is warmed with Tollen's reagent in test tube. A silver mirror is formed on the inside of the test tube.

What is sodium nitroprusside test?

Ketones produce a orange red colour on adding alkaline sodium nitroprusside solution dropwise. Aldehydes do not give this test.

CHAPTER 13

What are fatty acids?

Higher members of carboxylic acid series are obtained by the hydrolysis of fats and oils. They are called fatty acid. They have open chain structure with long chains of carbon atoms.

Example: Stearic acid, Palmitic acid

What is vinegar?

A very dilute solution of acetic acid is called vinegar.

What is glacial acetic acid?

The pure acetic acid freezes to an ice like solid at 17°C . Therefore it is called glacial acetic acid.

Why the bite of an ant cause irritation to skin?

The bite of an ant cause irritation over the skin due to formic acid present in the sting of ant. It can be cured by treating with baking soda. The baking soda NaHCO_3 neutralizes the effect of formic acid.

Why the first four members of aliphatic acids are very soluble in water?

The high solubility of first four members of aliphatic acids in water is due to the presence of hydrogen bonding between water and acid molecules.

In non Polar solvent like benzene, the molecular mass of a carboxylic acid becomes double, explain. . In non polar solvents like benzene, Carboxylic acids exist in dimeric form. When molecular mass is determined, that dimer behave like a single particle and molecular mass becomes double.

Dimer of a carboxylic acid

The boiling points of carboxylic acids are relatively high, explain.

The boiling points of carboxylic acids are relatively high due to intermolecular hydrogen bonding. The molecular mass determination 'in non polar solvent like benzene shows that carboxylic acids exist as cyclic dimers.

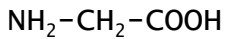
Explain how the melting points of carboxylic acids varies with increase in molecular mass?

The melting points of carboxylic acid increases irregularly with the increase in molecular mass. It has been observed that the melting points of carboxylic acids containing even number of carbon atoms is higher than the next lower and higher members containing odd number of carbon atoms.

What are α - amino acids?

Those amino acids in which amino group is present on α - Carbon atom

relative to the carboxyl group are called α - amino acids.



Almost all the natural occurring amino acids are α - amino acids. These amino acids are very important because these are building blocks of protein. Protein are very important for human body growth.

What are non-essential amino acids?

About twenty amino acids have been identify as the constituents of most of the animal and plant protein. Out of these twenty, the human body can synthesize only ten. These amino acids are called non-essential amino acids.

What are essential amino acids?

Those amino acids which the human is not able to synthesize are called essential amino acids. The essential amino acids must be supplied to our bodies through our diet because they are required for proper health and growth. The deficiency of essential amino acids may cause diseases.

What are acidic amino acids?

Those amino acids which contain two carboxyl groups and one amino group are called acidic amino acids.

Example: Aspartic acid , Glutamic acid

What are basic amino acids?

Those amino acids which contain two amino groups and one carboxyl group are called basic amino acids.

Example: Lysine , Histidine

What is Zwitter ion ?

Amino acids exist as dipolar ion called Zwitter ion. It has positive as well as negative ends within the same molecule. In the formation of Zwitter ion, the proton goes from the carboxyl group to amino group. The zwitter ion structure of an amino acid may be written as Neutral structure

The dipolar structure is also called internal salt. All alpha-amino acids exist largely as a dipolar ionic structure.

What is ninhydrin test?

It is a confirmatory test for amino acids. Ninhydrin reacts with amino acid to form an intensely coloured bluish violet product. The ninhydrin reaction is widely used to visualize amino acids separated by paper chromatography.

What are peptides?

Compounds formed by the condensation of two or more, same or different α - amino acids, are called peptides. Then condensation occurs between amino acids with the elimination of water. In this case, the carboxyl group of one amino acid and amino group of another amino acid get condensed with elimination of water. The resulting - CO - NH - linkage is called a peptide linkage.

How will you differentiate between Polypeptide and Protein?

A peptide having molecular mass up to 10,000 is called a polypeptide. A peptide having a molecular mass more than-10,000 is called a Protein.

CHAPTER 14

What are biopolymers?

The macromolecules which are present in living things are called biopolymers.

Example: Carbohydrates, proteins, enzymes, fats, oils, and nucleic acids.

What is degree of polymerization?

The number of repeating units in the chain is known as degree of polymerization (DP)

How molecular mass of a polymer can be calculated?

The molecular mass of the polymer is the product of molecular mass of the repeating unit and the degree of polymerization (DP).

Molecular mass of polymer = Molecular mass of repeating unit \times DP

What is the effect of degree of polymerization on physical properties of a polymer?

The number of repeating units or monomers of a chain is called degree of polymerization. By increasing DP, the molecular masses of polymers increase and as a result, melting point, boiling point and density also increase.

What is Nylon-6, 6?

Nylon - 6,6 is obtained by heating adipic and hexa methylene diamine. Nylon - 6,6 derives its name from its starting materials adipic acid and hexamethylene diamine, both of which have six carbon atoms. It is the most important polyamide.

What are epoxy resins?

The epoxy resins are fundamentally poly ethers but retain their name on the basis of their starting materials and the presence of epoxide group in the polymer. The epoxy resin is made by condensing epichlorohydrin with diphenylol propane.

From where the term carbohydrates was derived?

The first compound of this group, which was studied has empirical formula $C_x(H_2O)_y$. So this group of compounds was named as Hydrate of carbon (Carbohydrate).

What is the difference between thermoplastics and thermosetting plastics?

A thermoplastic polymer is one which can be softened repeatedly when heated and hardened when cooled with little change in properties. Example PVC pipes, plastic toys.

The polymer which become hard on heating and can not softened again are called thermosetting plastic.

How plants and animals store glucose?

Plants store glucose as starch while animals store glucose in the form of highly branched polymers known as glycogen. Glycogen is stored in the livers and muscles.

What is the nature of starch?

Starch is not a pure compound. It is a mixture of two polysaccharides, amylose and amylopectin which can be separated from one another.

What is the difference between monosaccharides and oligosaccharides?

the carbohydrates which cannot be hydrolysed are called monosaccharides. Example: glucose, Fructose, mannose and galactose. The carbohydrates which on hydrolysis give two to nine monosaccharides are called oligosaccharides. Example: sucrose, maltose, Raffinose.

What is the difference between peptide linkage and glycoside linkage?

Linkage of similar or dissimilar monosaccharides with the elimination of H_2O is called glycoside linkage (C - O - C). The linkage of amino acids to form poly peptides or proteins with the elimination of H_2O is called peptide linkage (-CO - NH-)

What are conjugated proteins?

If protein is attached or conjugated to some non-protein groups, then it is called compound or conjugated proteins. For example phosphoproteins are conjugated with phosphoric acid. Lipoproteins are conjugated with lipid substances like lecithin, cholesterol and fatty acids.

What is denaturation of proteins?

The structure of proteins can be disrupted easily by heat, change in pH and under strongly oxidizing or reducing conditions. Under such conditions the proteins undergo denaturation. Example change of condition that take place in albumin, the principal component of egg white, when it is cooked,

What is difference between glucose and fructose?

Glucose is Pentahydroxy hexanal or it is polyhydroxy aldehyde. While fructose is polyhydroxy ketone or Penta hydroxy 2 - hexanone.

What is the difference between cellulose and starch?

Both cellulose and starch are polysaccharides. Both starch and cellulose on hydrolysis give glucose. In cellulose monomers are (β - D - glucose while in starch, monomers are α - D - glucose.

What products are obtained by the hydrolysis of lactose and sucrose?

Lactose on hydrolysis changes to glucose and galactose.

Lactose + H_2O \longrightarrow glucose + galactose

Sucrose on hydrolysis changes to fructose and glucose.

Sucrose + H_2O \longrightarrow glucose - Fructose ,

What is the difference between simple protein and compound protein?

The protein which give only amino acids on hydrolysis are called simple proteins, Example Albumin, Globulin, legumin etc. The protein which on hydrolysis give amino acids and some other non - protein portion are called compound or conjugate protein. Example phosphoprotein, lipoprotein.

What is Rancidity of fats?

Fats and oils are liable to spoilage and give off an odour known as rancidity, It is due to the hydrolytic or oxidative reactions which release foul smelling aldehydes and fatty acids,

What is Saponification number?

The number of milligrams of KOH required to saponify one gram of fat or oil is called Saponification number. Example: one mole of glyceroltripalmitate (Mol, Mass = 836) require 168,000 mg of KOH for

Saponification, Therefore me grams of fat will require 168000/836mg of KOH, Hence Saponification number of glycerol tripalmitate is 208,

What is iodine number?

The number of grams of iodine which are required to react completely with 100 grams of fats or oils is called iodine number, Iodine number is used to determine the unsaturation of fats or oils, A fat with has zero iodine number is a saturated fat .

Which enzyme can be used for cancer treatment?

Many enzymes are used for cancer treatment. For example L - asparaginase has proved very useful in the treatment of blood cancer in children. Thrombin is used locally to stop bleeding.

Enzymes are specific in their action, explain

Enzymes are specific in their action which means that an enzyme will act only on one substrate. For example Hexokinase Catalyses the conversion of hexoses like glucose, fructose and mannose to their 6 - Phosphate derivatives but glucokinase is specific for glucose only.

What are isoenzymes?

These are the enzymes from the same organisms which catalyze the same reaction but are physically and chemically distinct from each other.

What are activators?

The substances which increase the enzyme activity, are called activators. For example Mg^{+2} and Zn^{+2} ions are the activators for Phosphatase and Carbonic anhydrase enzymes respectively.

What are inhibitors?

Those substance which' reduce the enzyme activity are called inhibitors.

Which amino bases are present in RNA and DNA?

In DNA, four amine bases cytosine, thymine, guanine and adenine are present. In RNA four bases cytosine, uracil, guanine and adenine are present. Thymine of DNA is replaced by uracil in RNA.

In the body nucleic acids occur as part of the conjugated .proteins called nucleoproteins. The nucleic acid direct the synthesis of proteins.

What are the three major differences between DNA and RNA.

DNA carries the genetic information and RNA is involved in putting this information to work in the cell. They differ in three ways.

- (1) The sugar in RNA is Ribose while sugar in DNA is 2-deoxyribose
- (2) Four different bases are found in DNA, Cytosine (C), thymine (T) adenine (A) and guanine (G). In RNA, thiamine does not occur and it is replace by uracil (U)
- (3) DNA is nearly always double standard while RNA is usually single standard.

CHAPTER 15

If micro nutrients are supplied in large quantity, what will be the effect over plant growth?

Only minute amounts of the micronutrients are needed for healthy.growth of plant. In larger quantity these elements are poisonous to plants?

What are macro nutrient?

those nutrients which are required in a larger amount for plant growth, are called macro nutrients. Nitrogen, Phosphorous and Potassium are macronutrients. The quantity required per acre is 5 - 200Kg

why prilled urea is more better than the fine powder?

The conversion of urea into granules is called prilling. Prilled urea spread on crops more easily than the fine powder. Powder can stay over leaves of plants while granules do not.

write the names and formulas of nitrogenous fertilizers.

Ammonia (NH_3), Ammonium nitrate (NH_4NO_3), Ammonium chloride (NH_4Cl), Ammonium sulphate ($(\text{NH}_4)_2\text{SO}_4$) are urea (NH_2CONH_2)

Ammonium nitrate is not useful fertilizer for paddy rice, why?

Paddy rice required greater quantity of water. Microbial bacteria in flooded fields decompose the ammonium nitrate into nitrogen gas,

write the name and chemical formulas of the phosphorous fertilizer.

(i) Calcium super phosphate $\text{Ca}(\text{H}_2\text{PO}_4)_2$

(ii) Diammonium phosphate (Triple Phosphate) $(\text{NH}_4)_2\text{HPO}_4$

what is the requirement of a fertilizer?

Every compound of the desired element cannot be a fertilizer. The desired element should be present in the compound in a water soluble form. The compound used as fertilizer should be stable in soil as well as in storage. It should be cheap to manufacture.

what is the role of nitrogen in plant growth?

(i) It is required during the early stage of plant growth for the development of stem and leaves.

(ii) It is main constituent of protein.

(iii) It imparts green colour to the leaves (iv) It enhances the yield and quantity of the plant

write different steps involved in preparation of ammonia?

Following steps are involved in the manufacture of urea.

(1) Preparation of Hydrogen (2) Preparation of Ammonia

(3) Preparation of Ammonium Carbamate (4) Preparation of urea

(5) Prilling

what is the role of Phosphorous in plant growth?

1. It stimulates early growth

2. It accelerates the seed and fruit formation during the later stages of growth.

3. It also increases resistance to diseases.

what is liming of the soil?

The addition of lime to the soil to control its acidity at regular intervals is called liming of the soil. All the nitrogen fertilizers except calcium nitrate sodium nitrate make the soil acidic. This acidity is easily controlled by liming of the soil.

How seeping of the ammonia from the surface of the soil is prevented?

In order to prevent the seeping out of the ammonia from the surface of

soil, ammonia is injected about 6 inches under the surface of the soil
What are the functions of potassium fertilizer in plant growth?

1. Potassium is essential for the formation of starch sugar and fibrous material of the plant
2. Potassium fertilizers increase resistance to diseases and make the plants strong by helping in healthy root development.
3. They also help in ripening of seeds, fruits and cereals.
4. Tobacco, coffee, potato and corn required more potassium fertilizer.

Which raw material are used for cement manufacture?

Important raw material for cement industry are as follows.

1. **Calcareous material** Lime stone, marble, chalk, marine shell
2. **Argillaceous material**, (clay, shale, slate, blast furnace slag)
3. **Gypsum**

What is the function of calcareous materials?

Calcareous materials are the source of lime (CaO) which is major component of the cement. The calcareous materials include lime stone, marble, chalk and marine shell. These are basic in nature.

What is the function of argillaceous materials?

Argillaceous material provide acidic components, such as aluminates and silicates. The argillaceous material include clay, shale, slate, blast furnace slag.

Why we call cement as Portland cement?

In 1824, Joseph Aspdin, an English Mason prepared cement by heating lime stone and clay. When it is mixed with water, it changes to a hard mass. This hard mass has resemblance with Portland rock, a famous building stone of England. Since then the name Portland cement is given to the mixture of lime, silica, iron oxide and alumina.

Is cement a mixture or a compound?

Cement is a mixture of many compounds (mostly oxides) and each compound has its own characteristic properties. Final properties of cement depends upon the composition of cement.

What is slurry?

A homogenous mixture which is obtained by mixing powdered lime stone and clay paste in proper proportion (Limestone 75% and Clay 25%) is called slurry.

Name two methods for preparation of cement? Which process is mostly used in Pakistan?

There are two methods for manufacture of cement
1. **Dry method** 2. **Wet method.**

The choice of dry or wet process depends upon the following factors

- i Physical conditions of the raw materials
- ii Local climatic condition of the factory
- iii The price of the fuel

In Pakistan, mostly wet process is used. Wet process is free from dust, grinding is easier and composition of cement can easily be controlled.

Write different stages in the manufacturing of cement by wet process.

In wet process grinding is done in the presence of water. There are five stages in the manufacturing of Portland cement by wet process.

- i. Crushing and grinding of the raw material
- ii. Mixing the material in correct proportion
- iii. Heating the prepared mixture in a rotary kiln,
- iv. Grinding the heated product known as klinker.
- v. Mixing and grinding of cement klinker with gypsum

Write the name of processes which are used for pulp making,

- 1) Kraft process (alkaline)
- 2) Sulphite Process (Acidic)
- 3) Neutral sulphite semi chemical process (NSSC)

In Pakistan, Pulp and paper industry mostly used neutral sulphite semi chemical process.

Write the name of woody and non woody raw materials used for pulp making.

Non woody raw materials.

wheat straw, Rice straw, Bagasse, Bamboo, Rag, Cotton stalk, Cotton linter, Kahi grass, Grasses

Woody Raw Materials

Poplar (Hard wood), Eucalyptus (Hard wood), Douglas fir (Soft wood)

Which bleaching agents are used to bleach the pulp in Pakistan.

Pulp obtained from digester is brown in colour due to residual lignin and not suitable for printing and writing papers, which require a bright white pulp. The brown pulp is bleached with chlorine (Cl_2) or sodium hypochlorite ($NaClO$).

What is the role of additives in paper making? Write names of some additives used for paper making.

Additives increase the mechanical strength of paper and reduce the pores of the papers. They increase the glaze of the paper. Some common additives used in paper making are titanium oxide, precipitated calcium carbonate, starch, alum etc.

Why NSSC process has come to occupy the dominant position?

The neutral sulphite semi chemical process (NSSC) for paper pulp making has come to occupy the dominant position because of the advantages in chemical recovery and pulp strength.

What is the use of head box in paper making fourdriner's machine?

Head box discharges a uniform jet of pulp suspension on a fabric or fourdriner screen. Water from pulp is removed.

What is calendaring in paper making?

Thickness of paper sheet is reduced by the help of nip rolls. Surface of the paper becomes smooth and pores are reduced. This process is called calendaring.

What is the percentage of moisture in the final paper product?

The dried paper is wound in the form of a reel, It has final moisture of about 6-8%

What are the prospects of paper industry in Pakistan?

There was no pulp and paper industry in Pakistan in 1947. The paper consumption per head in Pakistan is around 5Kg per person per year. It is far less than other countries. Now Pakistan has enough source of non woody material. At present more than 30 paper industries are working in Pakistan.

CHAPTER 16

Write down the names of components of environments.

Ans. Environment consists of the following components.

- i) Atmosphere ii) Hydrosphere iii) Lithosphere
iv) Biosphere or ecosphere

What is atmosphere?

The layer of gases surrounding of the earth is called atmosphere. It consists of following gases in different proportion, N₂ (78%), O₂ (21%), Ar (0.9%), CO₂ (0.03%) and traces amounts of H₂, O₃, CH₄, CO, He, Ne, Kr and Xe). It also contains varying amount of water vapours. Its thickness is about 1000km above the surface of earth and half of its mass is concentrated in lower 5-6km.

What is hydrosphere?

All water bodies (resources) present under and on the surface of earth are called hydrosphere. It includes oceans, rivers, streams, lakes, polar ice caps, glaciers and ground water reservoirs. Oceans contain 97% of earth's water. But, because of high salt contents, this water cannot be used for human consumption. The polar ice caps and glaciers consist of 2% of the earth's total water. Only 1% of the total earth's water resources is available as fresh water, which is used for agriculture (69%), for industry (23%) and for domestic purpose (8%).

What is Lithosphere?

It consists of rigid rocky crust of earth and extends to the depth of 100km. The mantle and core are the heavy interior of earth. The 99.5% mass of the lithosphere is made of 11 elements which are oxygen 46.6%, Si 27.72%, Al (8.12%), Fe (5.0%), Ca (3.63%), Na (2.83%), K (2.59%), Mg (2.09%) and Ti, H₂ and P (total mass less than 1%). The elements present in traces are C, Mn, S, Ba, Cl, Cr, F, Zr, Ni, Sr, and V. These elements mostly occur in the form of minerals.

How environmental pollution is spreading all over the world?

Environmental pollution is spreading in almost every city of the world, with continuous rapid growth in population, urbanization, industrialization and transportation.

What are primary pollutants?

The waste products given out from chimneys of industrial units and exhaust of automobiles are called primary pollutants. The primary pollutants include SO, SO₃, CO₂, NH₃, oxides of nitrogen, hydrocarbons, compounds of fluorine and radioactive materials.

What are secondary pollutants?

Those compounds which are formed from primary pollutant in atmosphere

through various reactions are called secondary pollutant. Examples sulphuric acid, Nitrogen monoxide, Carbonic acid, Hydrofluoric acid, Peroxyacetyl nitrate (PAN), Ozone, aldehydes Ketones and Peroxybenzoyl

What is reducing smog?

If smog contains high contents of SO_2 , it is chemically reducing in nature and is known as reducing smog, The main cause of reducing smog is combustion of Coal which contains sulphur, The sulphur on combustion produce ~~SO_2~~

What is oxidizing or photochemical smog?

Photochemical smog consists of higher concentrations of oxidants like ozone, It is also called oxidizing smog. It is a yellowish brownish gray haze which formed in the presence of water droplets and chemical reactions of pollutant in the air. It has unpleasant odour because of its gaseous components.

In which region of atmosphere, ozone is present? what is thickness of ozone layer?

Ozone layer is present in stratosphere region, 25km above the surface of earth. Thickness of ozone layer is 25 - 28km.

What is the role of ozone in nature?

Ozone absorbs ultraviolet radiations of the sun. These radiations are harmful to plants, and other material like rubber, plastic.

In which region ozone is produced? what is its concentration in stratosphere?

Ozone produced in the tropical region due to photochemical reactions of oxygen, From tropical region it is transported to the polar regions. The concentration of ozone in stratosphere is 350 DU (Dobson Unit)

How is ozone act as a pollutant? .

Ozone acts as a pollutant and causes various health problems. It damages eyes, and aggravates, asthma, decreases the elasticity of lungs tissues, coughing, chest discomfort etc, it is harmful to plants and other materials.

It attacks rubber, reduces durability and appearance of paint and cause fabric dyes to fade

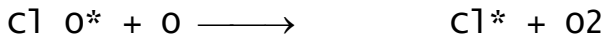
What is ozone hole or ozone depletion?

Am, The decrease in the thickness of ozone layer in the atmosphere is termed as ozone hole or ozone depletion. The thickness of ozone layer has been decreasing over Antarctic region during the spring time since mid 1970s. By the mid 1980's loss in ozone at some altitudes over Antarctica resulted in about 50% depletion of the total overhead amount, The region in which ozone deplete, substantially in every year during ~~spring~~ NO_x is now termed as 'ozone hole'

What is the rule of chlorofluorocarbons (CFCs) in destroying ozone?

(CFCs) chlorofluorocarbons, used as refrigerants in air conditioning and air aerosol sprays, are inert in the troposphere but slowly diffuse into stratosphere. In this region they are subjected to UV - radiation producing Cl free radicals. This free radical reacts with ozone according to following reactions





Chlorofluorocarbons (CFCs) play an effective role in removing ozone in the stratosphere. A single chloride free radical can destroy up to 100,000 ozone molecules.

What are main sources of water pollution?

Ground water becomes polluted due to the following reasons

- i) Live stock water
- ii) Land fills
- iii) Agriculture pesticides
- iv) Disposal of industrial waste
- v) Oil leakage from tankers
- vii) Petroleum and natural gas products,
- viii) Septic tanks

Spilled oil damages the marine life, explain.

Seawater is being polluted by accidental oil spills and leakage from the cargo oil tankers. Spilled oil damage the marine life. Oil layers effects the transmission of light through surface of water, and process of photosynthesis is reduces or stops. Amount of dissolved oxygen decreases in the marine water and it cause death to aquatic life.

What is the main pollutant of leather tanneries and how it can be removed?

The main pollutant of leather tanneries is chromium VI which is highly toxic and carcinogen. The waste water is treated with reducing agent to change, chrome VI chromium III. Trivalent chrome III is treated with

alkali to form $\text{Cr}(\text{OH})_3$ which is precipitated out.

What is dissolved oxygen (DO)?

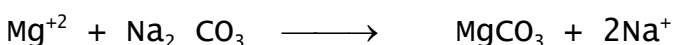
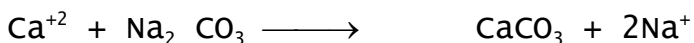
The amount of dissolved molecular oxygen present in water is called dissolved oxygen (DO). It is parameter to determine the quality of water The normal value of dissolved oxygen ranges from 4 - 8ppm. If the value of DO is less than 4ppm, it means that water is polluted.

Name different processes by which quality of water can be improved?

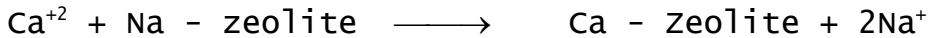
- i) Aeration: In this process air is passed through water
- ii) Coagulation: In this process colloidal particles which are suspended in water are removed.
- iii). Removal of hardness: in this process Ca^{+2} and Mg^{+2} . ions of hard water are removed.
- iv) Chlorination: This is method is used to kill bacteria and germs by passing chlorine or reaction with HOCl .

Give two methods to remove hardness of water?

- i Calcium and magnesium ions of water can be removed by adding washing soda in water.



- ii) Ca^{+2} and Mg^{+2} ions of water can also be removed by ion exchange method. Water is passed through sodium zeolite which exchanges Ca^{+2} ion and Mg^{+2} ion of hard water by Na^+ ions



What is solid waste management? What methods are usually used for disposal of solid waste?

The disposal of domestic, commercial, agricultural, industrial solid waste is called solid waste management. Following methods are used for this purpose

- i. Dumping of waste in sea or river
- ii. Landfill
- iii. Incineration
- iv. Recycling

What is incineration?

It is solid waste treatment process. In this process solid waste are heated & treated process. In this process solid waste and heated at high temperature from 900 - 1000°C. The burning of solid waste in the incinerator consumes all combustible materials leaving behind the non combustible materials and the ash residues which is disposed of on the landfills.

What are advantages of incineration process?

1. The incineration may reduce the volume of waste by two third.
2. The combustible components of garbage such as paper, plastics and wood provide fuel for the fire.
3. In incineration, the heat of combustion may be used to produce steam which runs turbines to produce electricity.

What is leachate?

The ground water which seeps in the land fill and liquid form waste or percolate through the refuse is called leachate. Leachate contains many suspended particles, bacteria, heavy metals, many inorganic salts and many volatile and non volatile organic compounds.

How formation of toxic compounds can be avoided?

To avoid the formation of toxic compounds with chlorine, ozone or chlorine dioxide can be used for disinfection of water.

What is recycling? What substances can be recycled? What are different methods used for recycling?

The process in which solid wastes are not discarded-but after processing it is used again is called recycling. In our country, glass, paper, plastic and metals like copper, aluminium and iron are recycled. Different methods used for recycling are

- i. Reprocessing
- ii. Depolymerization
- iii. Transformation

What is reprocessing?

The processing in which used plastics are remelted and used again for manufacturing of toys, trays etc. is called reprocessing,

Example: Polystyrene on reprocessing, mostly used for manufacturing of toys, trays etc,

What is Depolymerization?

It is a process in which the used plastics are converted back into its original components, monomers by a chemical or thermal process and then polymerize again, is called depolymerization.

Example: Polyethylene terephthalate can be depolymerized thermally in the presence of catalyst.

What is transformation?

It is a process in which used plastic are converted into low quality substances. These low quality substances are further used for the production of other metals.

Example: The cracking of polyethylene at high temperature gives its monomers which are used for the manufacture of lubricants.