

ANSWERS TO THE SHORT QUESTIONS

GENERAL DISCUSSION OF THE PERIODIC TABLE

Q.1 How does the Mendeleev's periodic table help us to correct the atomic masses of some of the elements? (Bahawalpur 2006, Multan 2011)

Ans: 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.

Q.2 How does Moseley's periodic law help to correct the rearrangements of some elements? (Multan 2011)

Ans: 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.

BLOCKS OF ELEMENTS

Q.3 Zn, Cd, Hg were placed with alkaline earth metals in Mendeleev's table. How this confusion is removed in the modern period table? (Multan 2008)

Ans: They are placed in separate group i.e. VIII-A and are the end elements of d-block series. Their outer most orbitals are d.

Q.4 d and f-block elements are called transition elements. Why?

Ans: d- and f-block elements are in between s and p-block elements. Their properties are in between them and they vary from left to the right. It means that their properties show a transition in a systematic way. That is why, they are called transition elements.

Q.5 What are s-block elements and why are they called so?

Ans: The elements of group I-A and II-A are alkali and alkaline earth metals. Their outermost sub-shells are s and have one and two electrons respectively in s-orbitals. So they are called s-block elements.

Q.6 Why the elements of group III-A to group VII-A are called p-block elements?

Ans: The elements of groups III-A to VII-A have such atomic numbers that their outermost sub-shells are p which are in the process of completion. So they are all called p-block elements.

Q.7 Which is the first d-block series and what is the name of the coinage metals in it?

Ans: The first d-block series is 3d in period 4 and ranges from Sc₂₁ to Zn₃₀. The second last element Cu₂₉ is a coinage metal in this series.

Q.8 How Lanthanide contraction controls the atomic sizes of elements of 6th and 7th periods?

Ans: 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_{58} to Lu_{71} , but electrons are being accommodated in same sub-shell. i.e. 4f. This aspect even strongly affects the next p-block elements.

Q.9 Why the elements of groups I-A and II-A are good metals of the Periodic Table?

Ans: 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.

Q.10 Describe essential features of period six of Periodic Table.

(Multan 2008, Bahawalpur 2011)

Ans: Period six contains 32 elements as first two as s-block, next 14 as d-block and last six as p-block elements.

POSITION OF HYDROGEN IN THE PERIODIC TABLE

Q.11 How does hydrogen resemble with alkali metals?

(Guj. 2012, Lahore 2013, D.G. Khan 2013)

Ans: Hydrogen has one electron in s-orbital like alkali metals. Hydrogen and alkali metals show positive oxidation states of +1, give positive ions in solution state, and are deposited at the cathode during the electrolysis of their halides.

Q.12 In what respects does hydrogen differ from halogens? (Multan 2006)

Ans: Hydrogen has outermost s-orbital unlike halogens. Hydrogen is a gas, but Bromine is a liquid while iodine and astatine are solids. H^{\ominus} is unstable but X^{\ominus} are stable. Halogens can show variable valency, but hydrogen cannot.

Q.13 How does hydrogen resemble with elements of group IV-A? (Rwp. 2008)

(Lahore 2010, D.G. Khan 2013)

Ans: The outermost orbitals of elements of group IV-A are half-filled and make the covalent bond with other elements. They resemble in thermodynamic properties and also agree with each other in reduction properties.

ATOMIC SIZES

Q.14 Why the atomic radii decrease from left to the right and increase from top to the bottom in periodic table? (Lahore 2009, Rawalpindi 2010)

Ans: The increase of nuclear charge and no change of shielding effect decrease the atomic radii from left to right. The increasing number of shells and increasing shielding effect increase the atomic radii from top to the bottom.

Q.15 → How the shielding effect is one of the important parameters to determine the size of an atom?

Ans: 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.

Q.16 In spite of increasing the nuclear charge down the group atomic radii increase. Give reasons?

Ans: Actually the shielding effects increase down the groups. Moreover, due to increasing number of shells, the forces of attraction between the nucleus and the outermost electrons decrease. So the atomic radii increase in spite of increasing nuclear charges.

Q.17 Why the ionic radius of a positive ion is smaller than its neutral atom?

Ans: When the electron is removed from the outermost orbital of the atom, then the remaining electrons are pulled with a greater force, so the size decreases. Sometimes the removed electron makes the outermost orbit or shell vacant.

Q.18 Why the ionic radius of a negative ion is greater than its atomic radius? (Lahore Board 2007, Lahore 2008, B. Pur 2009, Mirpur 2009, Gujranwala 2010)

Ans: When the electron is given to the outermost shell of the atom, it becomes negatively charged. Due to greater number of electrons to be accommodated in the outermost shell, it has to expand, so the size of the negative ion is greater.

Q.19 How do you justify that the size of an ion shrinks with the increasing positive charge?

Ans: Greater the amount of the positive charge on the ion, greater the difference of number of protons in the nuclei as compared to the total electrons. So, there is greater force of attraction for the electrons by the nucleus and smaller the size.

IONIZATION ENERGY

Q.20 The ionization energy is measured by taking the atom in the isolated state. Give reasons. (Multan 2011)

Ans: 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.

Q.21 Why the ionization energies decrease down the groups? (Rwp. 2008, Guj. 2008, Multan 2011, Lahore 2012, D.G. Khan 2013)

Ans: The increasing size, increasing number of shells, and increasing shielding effects are the important factors which cause the decreasing ionization energy values down the group.

Q.22 Why the ionization energies increase from left to the right in a period?

(Guj. 2008, Rwp 2008, Lahore 2012)

Ans: The increasing nuclear charges, decreasing sizes and no change in the shielding effects are the important factors which control the increasing ionization energies from left to the right.

Q.23 Why is there a big gap between first and second ionization energies of sodium, but a big gap is observed in second and third ionization energies of magnesium?

Ans: Sodium has only one electron in the outermost orbital $n = 3$, and requires 496 kJ mol^{-1} of energy, but second electron is in $n = 2$. So 4560 kJ mol^{-1} is amount of energy required to remove the second electron. In case of magnesium the principal quantum number changes between second and third ionization energies. So, there is a big gap.

Q.24 How does the nature of orbital influence the value of ionization energies of elements?

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

Q.25 Why the elements of group III-A have less ionization energy values than II-A?

Ans: 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.

Q.26 Why the elements of group VI-A have less ionization energy values than V-A?

Ans: 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.

ELECTRON AFFINITY

Q.27 Why most of the elements release energies when electrons are added in their outermost orbitals?

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

Q.28 Why the addition of electron in the outermost orbitals is studied by taking the atoms in the isolated state?

Ans: When the atom is in the isolated state, its outermost orbitals are not disturbed by the neighbouring atoms or molecules. So we only measure the force of attraction between the nucleus and the incoming electron. It gives us correct electron affinity value.

Q.29 The first electron affinity of oxygen is negative, but the second is positive. Why? (Sargodha 2006)

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

Q.30 Why the second value of E.A. is positive? (Lahore 2008)

Ans: The second electron is repelled by the negative ion and energy is absorbed in this way. The absorbed energy is given positive sign.

Q.31 Why the electron affinities of elements of group II-A are less than those of group I-A?

Ans: The elements of group II-A have fulfilled s-orbitals and the incoming electron has to be accommodated in the next higher p-sub-shell. So energy has to be provided to give them the electron. For this reason their electron affinities are less than those of group I-A.

Q.32 Define electron affinity. How E.A. values vary in Periodic Table?

(Rwp. 2008, Gujranwala 2010, Faisalabad 2011, Lahore 2013)

Ans: It increases from left to right in a period and decreases from top to the bottom in a group. Along the period sizes decrease and along this group sizes of atoms increases.

METALLIC CHARACTER

Q.33 Why the elements on top right of the periodic table are non-metallic in nature? (Sargodha 2008)

Ans: For the non-metallic elements, there is least tendency to loose the electrons and maximum tendency to have the electrons. These two properties are due to greater nuclear charges, small sizes and tightly held electrons. These properties are associated with oxygen, sulphur, fluorine and chlorine.

Q.33A Why is the metallic character increase down the group of s-block elements? (Faisalabad 2012, Multan 2013, Fed. Board 2013, D.G. Khan 2013)

Ans: The sizes increase the value shell becomes, away from nuclei and resuming effect becomes more and more dominant. All these things make the electron removal easier. Hence metallic character enhances down the group. Amount of energy evolved when one mole atoms of an element accept electrons is their outermost orbitals in gaseous state.

MELTING AND BOILING POINTS

Q.34 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? (Lahore 2011)

Ans: 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 unpair 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.

ANSWERS TO THE SHORT QUESTIONS

GENERAL FEATURES

Q.1 Why the elements of group I-A are called alkali metals?

Ans: 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.

Q.2 Why the elements of group II-A are called alkaline earth metals?

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

ORES AND MINERALS OF GROUP I-A

Q.3 What are the most abundant elements among the alkali metals in earth's crust?

Ans: Sodium and potassium are the most abundant among the alkali metals. Each of them contributes about 2.4 % of the earth's crust.

Q.4 Why the alkali metals are not found free in nature? (Lahore 2012)

Ans: 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.

Q.5 What are the important ores and minerals of sodium?

Ans: Sodium is found in the form of

Rock salt (Halite)	NaCl
Chile saltpetre	NaNO_3
Natron	$\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
Trona	$\text{Na}_2\text{CO}_3 \cdot 2\text{NaHCO}_3 \cdot 2\text{H}_2\text{O}$
Borax	$\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$

Q.6 What are the important ores and minerals of potassium? (Rwp 2010)

Ans: The important ores and minerals of potassium are

Carnallite	$\text{KCl} \cdot \text{MgCl}_2 \cdot 6\text{H}_2\text{O}$
Sylvite	KCl
Alumite (alum stone)	$\text{K}_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 4\text{Al}(\text{OH})_3$

PHYSICAL AND CHEMICAL PROPERTIES OF GROUP I-A

Q.7 Why the melting and boiling points of group I-A and II-A decrease down the group?

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

Q.8 Why the alkali metals are strong reducing agents? (Sargodha 2008, Sarg. 2011)

Ans: 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.

Q.9 Why the alkaline earth metals are reducing agents, but less reducing than those of group I-A? (Sarg. 2011)

Ans: 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.

Q.10 What are the flame tests of alkali metals?

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

Q.11 The compounds of alkali and alkaline earth metals are colourless, but some of them are coloured. Give reason:

Ans: Alkali and alkaline earth metals are s-block elements which mostly do not show the colours in their compounds. d-block elements show the colours. 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 to K and oxygen.

Q.12 Lithium only gives a simple oxide with oxygen, but sodium and potassium give peroxide and superoxide. Why?

Ans: 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.

Q.13 When sodium reacts with water, the hydrogen which evolves catches fire: Why?

Ans: 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.

Q.14 Why the ionic hydrides are very good reducing agents?

Ans: Ionic hydrides release H^\ominus in the solution which combines with other species to give its electrons and so it reduces the others.



ABNORMAL BEHAVIOUR OF GROUP Li

Q.15 Which element of group I-A reacts with nitrogen and carbon?

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



Q.16 Why does lithium differ from its own family members?

(Lahore 2013, Faisalabad 2013)

Ans: (i) Li and Li^\oplus have very small sizes.

(ii) Li^\oplus has high charge density and high polarizing power.

Q.17 Which salts of lithium are insoluble in water, but corresponding salts of other alkali metals are water soluble?

Ans: 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.

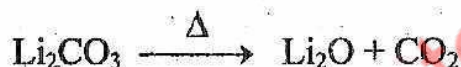
Q.18 What is the effect of heat on hydroxides of alkali metals?

(Faisalabad 2010, D.G. Khan 2013)

Ans: The hydroxides of alkali metals are LiOH, NaOH, KOH etc. They are all stable towards heat and this stability increases down the group.

Q.19 How do you compare the carbonate of lithium with the carbonates of other family members? (D.G. Khan 2013)

Ans: Li_2CO_3 is sensitive to high temperature and decomposes on heating.

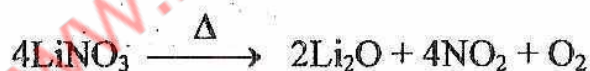


But the carbonates of other alkali metals are stable towards heat.

Q.20 How do you compare LiNO_3 with nitrates of other alkali metals?

(Lahore 2010)

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



ORES AND MINERALS OF GROUP II-A

Q.21 Give the names and formulas for common minerals of beryllium:

Ans: Beryllium has two important minerals:

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

Chrysoberyl Al_2BeO_4

Q.22 Give the names and formulas for the common minerals of magnesium:

(Bahawalpur 2011)

Ans: Some important minerals of magnesium are as follows:

Magnesite MgCO_3

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

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

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

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

Q.23 Give the names and formulas for common minerals of calcium:

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

PHYSICAL AND CHEMICAL PROPERTIES OF GROUP II-A

Q.24 Heat of hydration of alkaline earth metals go on decreasing from upper to the downward direction: Why?

Ans: 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.

Q.25 Mention the flame test of II-A group elements:

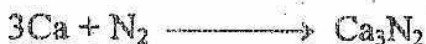
Ans: Beryllium and magnesium do not show any colour to the flame. Calcium shows brick red, strontium shows crimson, barium shows apple green and radium shows red colour.

Q.26 How do you compare the polarizing powers of ions of II-A and that of I-A group elements?

Ans: 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, the ions of II-A are better polarizers.

Q.27 How magnesium and calcium react with nitrogen to give nitrides which on hydrolysis give ammonia?

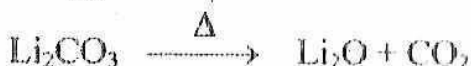
Ans: The reactions are as follows:



COMPOUNDS OF GROUPS I-A AND II-A

Q.28 How do you discuss the effects of heat on the carbonates of group I-A and II-A?

Ans: 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.



Q.29 Solution of Na_2O in water is alkaline. Justify the statement. (Lahore 2011)

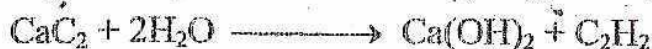
Ans: Na_2O reacts with H_2O in this solution to give a strong alkali NaOH



Q.30 How do you compare the carbide of beryllium with carbide of calcium?

(Faisalabad 2013)

Ans: Be_2C reacts with water to give CH_4 while CaC_2 reacts with water to give C_2H_2



Q.31 What is the trend of changing basicity of oxides down the group?

Ans: 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.

Q.32 How does beryllium react with NaOH to give a salt and evolve hydrogen?

(Faisalabad 2013)

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



Q.32(A) BeO is an amphoteric oxide. Justify it. (Guj. 2010, Faisalabad 2011)

Ans: $\text{BeO} + \text{H}_2\text{SO}_4 \longrightarrow \text{BeSO}_4 + \text{H}_2\text{O}$



Q.33 How KO_2 can be used by mountaineers?

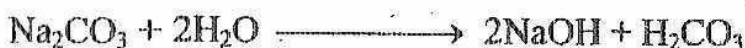
(Multan 2006, Bahawalpur 2011, Lahore 2012, Lahore 2013, Faisalabad 2013)

Ans: 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.

Q.34 Why the aqueous solution of Na_2CO_3 is alkaline in nature.

(Lahore 2008, D.G.K. 2009, B.Pur 2009, Lahore 2010, Sarg. 2010, Multan 2012)

Ans: Na_2CO_3 is a salt made from weak acid and strong base. It undergoes hydrolysis to give NaOH and H_2CO_3 . NaOH is a strong base, but H_2CO_3 is a weak acid. So the solution is alkaline.



Q.35 What is the trend of the solubilities of oxides of alkaline earth metals?

Ans: 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:



Q.36 How do you compare the solubilities of hydroxide of alkaline earth

Q.37 What is lime and lime water?

(Multan 2013)

Ans: 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.

Q.38 What is milk of magnesia and what is its use?

(Guj. 2013)

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

SODA ASH

Q.39 What is the effect of temperature on Na_2CO_3 ?

Ans: 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 .

Q.40 What is difference between soda ash and washing soda?

Ans: 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. They are both prepared by Solvay's process.

LIME WATER

Q.41 What happens when CO_2 gas is passed through lime water?

(Lahore Board 2007, Guj. 2008, Lahore 2013, Guj. 2013, Multan 2013, D.G. Khan 2013)

Ans: Lime water turns milky and CaCO_3 is produced in the lime. CaCO_3 is water insoluble so white suspension is produced and we say that solution of lime turns milky.



Q.42 What happens when excess CO_2 is passed through lime water?

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

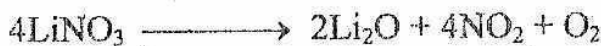
Q.43 Why the lime water turns white after white wash on the walls?

Ans: Lime water is Ca(OH)_2 . It reacts with CO_2 of the air and converts it into CaCO_3 which is a white solid.

NITRATES AND SULPHATES

Q.44 In what respects nitrates of Li, Mg and Ba are related with each other?

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



Q.45 How do you compare the solubilities of sulphates of alkaline earth metals?

Q.46 What is gypsum and how it is related with plaster of Paris?

Ans: 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



COMMERCIAL PREPARATION OF NaOH

Q.47 What are the advantages of Down's cell for the preparation of sodium on commercial scale?

(Faisalabad 2008, Lahore 2012, Faisalabad 2013, D.G. Khan 2013)

Ans: 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.

Q.48 Why CaCl_2 is added in molten NaCl in Down's cell? (Faisalabad 2012)

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

Q.49 Which substances are deposited at cathode and anode in the Nelson's cell?

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

GYPSUM AND PLASTER OF PARIS

Q.50 What is the importance of sulphur for the plants?

Ans: 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.

Q.51 Why the plaster of Paris is called half hydrate?

(Lahore 2013, Multan 2013)

Ans: The formula of plaster of Paris is $(\text{CaSO}_4)_2 \cdot \text{H}_2\text{O}$ or $\text{CaSO}_4 \cdot \frac{1}{2} \text{H}_2\text{O}$. It means that for one molecule of CaSO_4 half water molecule is present in the crystal structure.

Q.52 What do you mean by setting of plaster of Paris? (Guj. 2012, Lahore 2013)

Ans: 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.

Q.53 What are the main uses of plaster of Paris?

(Faisalabad 2012, Guj. 2012, Lahore 2013)

Ans: Plaster of Paris is used,

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

Q.54 What is hard finish plaster?

(Mirpur 2011, Multan 2013)

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

Q.55 What is the use of material which is produced when the plaster of Paris is mixed with wood pulp?

Ans: 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.

Q.56 What is the role of gypsum in cement industry?

(Lahore 2008, Faisalabad 2008, Sarg. 2010, D.G. Khan 2011, Guj. 2013, Multan 2013, D.G. Khan 2013)

Ans: 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.

Q.57 What do you mean by dead burnt gypsum?

Ans: When gypsum is heated at high temperature, 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.

Q.58 What is the function of calcium in the plant growth?

(Guj. 2008, Rwp 2010, Guj. 2012, Faisalabad 2012, D.G. Khan 2013)

Ans: 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.

LIME

Q.59 Indicate the processes in which lime acts as dehydrating reagent:

(Multan 2011)

Ans: 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.

Q.60 What is lime mortar? Give equations for its hardening.

(Mirpur 2006, Multan 2008, Rwp. 2008, Fd. ABad 2009, Mirpur 2009, Faisalabad 2010, Gujranwala 2010, Guj. 2012)

Ans: 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:



ANSWERS TO THE SHORT QUESTIONS

GENERAL FEATURES OF BORON FAMILY

Q.1 How the elements of group III-A show the valency of three?

Ans: 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.

Q.2 Why the heat of sublimation in III-A group elements decrease down the group?

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

Q.3 B^{+3} ion does not exist but Al^{+3} ion does. Why? (Multan 2011, Bahawalpur 2011)

Ans: The size of B^{+3} ion is very small. It has high charged density and immediately forms the covalent bonding due to greater polarizing power.

Al^{+3} ion gives the ionic bonding and its compounds are dissociated in water to give Al^{+3} ions.

Q.4 How the nature of the oxides of the group III-A change from upper to the downward direction? (Bahawalpur 2011)

Ans: 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.

BORON AND BORAX

Q.5 The hydrides of boron have different structures from the hydrides of other family members. How? (Multan 2011)

Ans: Boron gives polymeric hydrides having bridge structures. B_2H_6 and B_4H_{10} have bridge structures and they are electron deficient molecules. The hydrides of other family members are not bridged molecules.

Q.6 Give the names and the formulas of different acids of boron. (Faisalabad 2010, Bahawalpur 2011, F. Abad 2012)

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

(i) Orthoboric Acid, H_3BO_3 or $B_2O_3 \cdot 3H_2O$ also called boric acid

(ii) Metaboric Acid, HBO_2 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 is also called boric acid. It is a stable compound while the other acids are stable in solid state and change to orthoboric acid in solution.

Q.7 How will you convert boric acid into borax and vice versa? (D. G. Khan 2011, Rwp. 2011, Guj. 2012, Lahore 2013, Guj. 2013)

Ans: 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.

SEMICONDUCTOR

Q.47 Which elements and compounds act as semiconductor?

(Sargodha 2008, Multan 2012)

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

Q.48 What is the effect of temperature on semiconductor.

Ans: 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.

Q.49 Define semiconductor. Give one example. (Gujranwala 2010, Multan 2012)

Ans: A semiconductor is a substance which has different resistances for the passage of electrical current under different circumstances.

Examples:

Both elements and compounds can act as semiconductors.

Elements as semiconductors:

- (i) Germanium
- (ii) Selenium
- (iii) Silicon

Compounds as semiconductors:

- (i) Lead sulphide (PbS)
- (ii) Silicon carbide (SiC)
- (iii) Cadmium sulphide (CdS)
- (iv) Lead telluride (PbTe)
- (v) Gallium arsenide (GaAs)
- (vi) Indium antimonide (InSb)

LEAD PIGMENTS

Q.50 What are lead pigments? Give their common names as well.

(Sargodha 2006)

Ans: The important lead pigments are

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

Q.51 How litharge changes its colour?

Ans: Litharge varies in colours from pale yellow to reddish yellow. Actually, it has two forms:

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

Q.52 What is the formula of white lead? Give its properties and uses:

(Sarg. 2011)

Ans: Formula of white lead is $2 \text{PbCO}_3 \cdot \text{Pb(OH)}_2$. It is white amorphous powder, insoluble in water and highly poisonous. It is mixed with linseed oil and has a good covering power.

Q.8 How the solubility of borax changes with the change of temperature?

Ans: Borax is sparingly soluble in cold water. 3 grams is dissolved in 100 grams of water at 10°C. At 100°C, 99.3 grams of H_3BO_3 becomes soluble in 100 grams of water.

Q.9 How does the temperature influence the water of crystallization of borax?

Ans: Below 62°C decahydrated crystals are formed. Above 62°C octahedral crystals of pentahydrated borax are obtained.

Q.10 Justify that the aqueous solution of borax turns red litmus blue.

(Multan 2011)

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

Q.11 How borax can be converted to orthoboric acid?

(Multan 2008, Faisalabad 2011)

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



Q.12 Outline the four use of borax. (Sarg. 2010, Mirpur 2011, Lahore 2012, Multan 2012)

Ans: Borax is used:

- (i) To prepare borate glass, which is heat resistant.
- (ii) In the softening of water.
- (iii) In borax bead test for the detection of metallic cations.
- (iv) In metallurgical operations.
- (v) As a flux in welding.
- (vi) In making washing powders.
- (vii) In leather industry for tanning and dyeing.
- (viii) In cosmetics, soaps, textiles, paints, medicines, match industry and as a preservative.

BORAX BEAD TEST

Q.13 How the glassy mass is produced from borax?

(Lahore 2008, Sargodha 2008, Guj. 2008, Sargodha 2009, Rwp. 2010, Faisalabad 2011, Lahore 2013)

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



glassy mass

Q.14 Which basic radicals give the response to borax bead test?

(Sargodha 2008, Guj. 2008, Rwp. 2010, Lahore 2013)

Ans: 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^{+2} , Ni^{+2} , Cr^{+3} . They have different colours in the cold and hot states in the oxidizing and reducing flames.

Q.15 What is the nature of compounds which give coloured beads in borax bead test?

(Rawalpindi 2010)

Ans: 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 states in the oxidizing and reducing flames.

OXYACIDS OF BORON

Q.16 Give the names and formulas for oxyacids of boron:

Ans: Orthoboric acid H_3BO_3
 Metaboric acid HBO_2
 Tetraboric acid $\text{H}_2\text{B}_4\text{O}_7$
 Pyroboric acid $\text{H}_6\text{B}_4\text{O}_9$

Q.17 How H_3BO_3 can be prepared from colemanite?

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



Q.18 How H_3BO_3 can be prepared from $\text{Na}_2\text{B}_4\text{O}_7$?

Ans: Borax is treated with calculated quantity of conc. H_2SO_4 . When the solution is cooled, H_3BO_3 settles down in the form of precipitate.



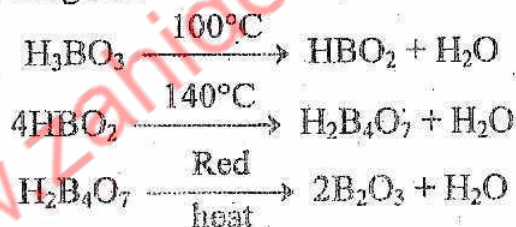
Q.19 How does H_3BO_3 act as an acid? (Mirpur 2011, Lahore 2011, D.G. Khan 2013)

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



Q.20 What is the effect of heat on H_3BO_3 ?

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



Q.20A Give uses of boric acid.

(Rawalpindi 2010)

Ans: Orthoboric acid is used:

- (i) In medicines as antiseptic as dusting powder in boric ointment and as eye-wash.
- (ii) In pottery as a glaze. The reason is that borate glazes are more fusible than silicate glazes. They have high co-efficient of expansion.
- (iii) In candle industry for stiffening of wicks.

CHEMISTRY OF ALUMINIUM

Q.21 What are the important ores and minerals of Al?

(Lahore 2013)

Ans: Some important minerals of aluminium are as follows:

Feldspar	KAlSi_3O_8
Mica (muscovite)	$\text{KH}_2\text{Al}_3(\text{SiO}_4)_3$
Kaolin (china clay)	$\text{H}_2\text{Al}_2(\text{SiO}_4)_2 \cdot \text{H}_2\text{O}$
Bauxite	$\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$
Cryolite	Na_3AlF_6

Q.22 What is anodizing?

(D.G. Khan 2013)

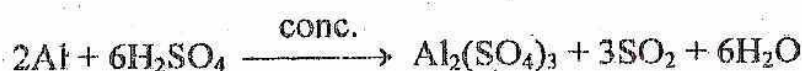
Ans: The layer of Al_2O_3 on the surface of aluminium is very useful. Its thickness

Q.23 Why Al is not found free in nature? (Multan 2008, Faisalabad 2011)

Ans: Aluminium reacts with oxygen vigorously and this reaction is highly exothermic. This heat can be used for the melting of those metals whose oxides are reduced by aluminium powder. This strong affinity of Al for O₂ does not allow Al to be free in nature.

Q.24 How does Al react with dil. and conc. H₂SO₄? (Sarg. 2011, F. Abad 2012)

Ans: Aluminium reacts with dilute and conc. H₂SO₄ as follows:

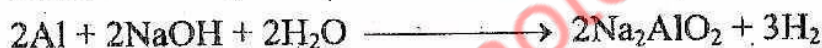


Q.25 How does Al react with conc. HNO₃? (Multan 2013)

Ans: Conc. HNO₃ has no action on aluminium. A protective layer of Al₂O₃ is developed which does not allow aluminium to react with HNO₃ further.

Q.26 How does Al become water soluble by using NaOH. (Multan 2008)

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



GENERAL FEATURES OF CARBON FAMILY

Q.27 How inert pair effect controls the oxidation state of Sn and Pb?

Ans: 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.

Q.28 How carbon on behaves differently from other members of its own group. (Lahore 2010)

- Ans:**
- (i) It is the hardest substance in its family.
 - (ii) It shows allotropy.
 - (iii) It shows catenation.
 - (iv) It is fundamental element in organic chemistry.

Q.29 Mention various allotropic modifications of elements of group IV-A:

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

CO₂ AND SiO₂

Q.30 What are the important ores of SiO₂?

Ans: Important ores of silicon are as follows

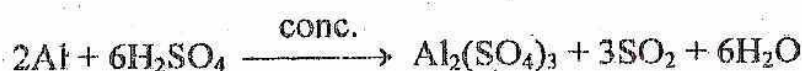
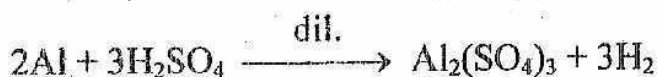
Analcite (a zeolite)	= NaAl(SiO ₃) ₂ · H ₂ O
Asbestos	= Ca Mg ₃ (SiO ₃) ₄
Kaolin (china clay)	= H ₂ Al ₂ (SiO ₄) ₂ · H ₂ O
Zircort	= ZrSiO ₄

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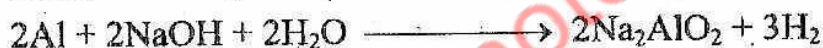


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Zircort	= ZrSiO ₄

Q.31 What are the different forms in which SiO_2 exists in the earth's crust?

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

Q.32 Why diamond is non-conductor of electricity? (Faisalabad 2010)

Ans: Graphite has layered structure. Free electrons are present in them which are responsible for conduction of current. In diamond there are no free electrons.

Q.33 What is quartz and what are its properties?

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

Q.34 Why is CO_2 a gas at room temperature while SiO_2 is a solid?

(Bahawalpur 2006, Sargodha 2006, Rawalpindi 2006, Sargodha 2008, Rwp. 2008, Sarg 2010, Mirpur 2011, Lahore 2012, Guj. 2013, Faisalabad, 2013, Multan 2013, D.G. Khan 2013)

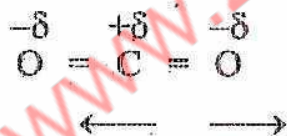
Ans: CO_2 is a gas at room temperature while SiO_2 is a solid. The reason is that CO_2 exists in the form of discrete molecules which exist independently. In case of SiO_2 there is a network structure. It is three dimensional structure giving a giant molecule.

Q.35 Explain: (Bahawalpur 2011)

(a) CO_2 is non-polar in nature.

(b) CO_2 is acidic in character.

Ans: (a) CO_2 is a non-polar in nature. This is due to the linear structure of CO_2 . Both dipoles can cancel the effect of each other and net dipole moment is zero



(b) CO_2 is acidic in nature because it gives carbonic acid after dissolving in water.



SILICATES

Q.36 What is silica glass?

Ans: 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.

Q.37 How sodium silicate is prepared? (Faisalabad 2013)

Ans: 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.

Q.38 What are the properties of water glass? (Faisalabad 2013)

Ans: 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.

Q.39 What are the uses of sodium silicate?

Ans: 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.

Q.40 What is chemical garden?

(Faisalabad 2012, Faisalabad 2013)

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

Q.41 What are the uses of aluminium silicates or clay?

Ans: It is used to make porcelin and china clay. Impure clay is used to make bricks, tiles and stone wares.

Q.42 How the clay is hardened?

Ans: 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.

Q.43 Give the formula of talc or soap stone. Gives its properties and uses:

(Faisalabad 2011)

Ans: $\text{Mg}_3\text{H}_2(\text{SiO}_3)_4$ is the formula of soap stone. It is greasy to touch and is used in making cosmetics and household articles.

Q.44 What is asbestos? Give its uses?

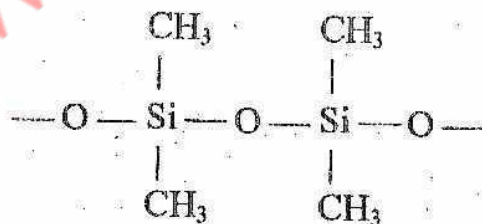
Ans: Asbestos is mixed silicate of Ca and Mg, with formula $\text{CaMg}_3(\text{SiO}_3)_4$. It is used to make incombustible fabrics and hard board.

SILICONES

Q.45 What are silicones? Give their uses.

(Rawalpindi 2008, Lahore 2009, Lahore 2010, Multan 2011, Multan 2012)

Ans: The compounds of silica having long chains through oxygen atoms and suitable number of alkyl groups are called silicones. Methyl silicones are the most important



Silicon oils are used:

- (i) For high temperature oil baths and high vacuum pumps.
- (ii) For low temperature lubrication.
- (v) The methylsilicones of high molar masses resemble rubber. They are used in making rubber like tubing and sheets.
- (vi) As insulating materials for electrical motors.

Q.46 Why are liquid silicones preferred over ordinary organic lubricants?

(Rawalpindi 2006, Guj. 2008, Lahore 2008, B. Pur 2009, Sargodha 2009, Lahore 2010, Sarg. 2011, Mirpur 2011, Fed. 2013)

Ans: 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.

ANSWERS TO THE SHORT QUESTIONS

GENERAL FEATURES OF V-A GROUP ELEMENTS

Q.1 What is the general occurrence of elements of group V-A?

Ans: 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.

Q.2 How allotropy is associated with nitrogen and phosphorus?

Ans: 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 -block (vi) violet

Q.3 How the melting and boiling points for the elements of group V-A vary down the group.

Ans: Melting points increase from upper to the downward direction except antimony and bismuth. Bismuth has lower melting point than antimony.

Q.4 How the involvement of d-orbital increases the oxidation number of phosphorus?

Ans: Phosphorus has available d-orbitals in its outermost shell. Electrons can be promoted from s-orbital to this d-orbital and five unpaired electrons become available. In this way it can show the valency of five.

Q.5 Why the outermost p-sub-shells of group V-A elements are extra stable?

Ans: p-sub-shell has three electrons in the outermost shell of group V-A. This is half-filled. The half-filled orbitals are extra stable.

Q.6 What type of oxides are mostly given by the elements of group V-A?

Ans: The oxides having the general formulas M_2O_3 , M_2O_4 and M_2O_5 are given by the elements of group V-A. Anyhow, nitrogen can give N_2O , and NO as additional oxides which are not given by other elements of this group.

Q.7 Write down the formulas and names of oxyacids of nitrogen, phosphorus, arsenic and antimony with oxidation number +5:

Ans: These compounds are:

HNO_3	Nitric acid
H_3PO_4	Phosphoric acid
H_3AsO_4	Arsenic acid
H_3SbO_4	Antimonic acid

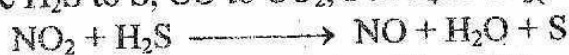
Q.8 How does nitrogen differ from its family members in physical state, atomicity and variety of oxidation states? (Mirpur 2011)

Ans: Nitrogen is a gas but other members are solids. Nitrogen is diatomic while others are tetratomic (P_4 , As_4 and Sb_4). Oxidation states of nitrogen are +1, +2, +3, +4, +5, -1, -2, -3 while other elements donot show the variety of

Q.16 How does NO_2 act as an oxidizing agent?

(Lahore 2008, Faisalabad 2010, Rwp. 2011, Faisalabad 2013, D.G. Khan 2013)

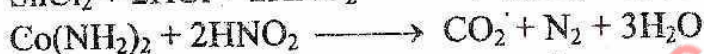
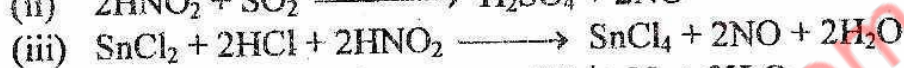
Ans: NO_2 can oxidize H_2S to S , CO to CO_2 , FeSO_4 to $\text{Fe}_2(\text{SO}_4)_3$ and KI to I_2 .



HNO_2

Q.17 How does HNO_2 acts as an oxidizing agent? (Lahore 2012, Guj. 2012)

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



Q.18 How does HNO_2 act as a reducing agent? (Rawalpindi 2008, Multan 2011)

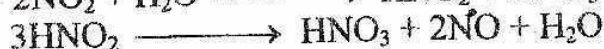
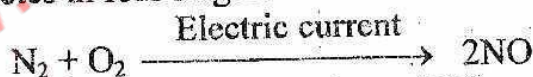
Ans: Certain strong oxidizing agents like acidified KMnO_4 , acidified $\text{K}_2\text{Cr}_2\text{O}_7$ and H_2O_2 are reduced by HNO_2 .



HNO_3

Q.19 Write down the reactions involved in the preparation of HNO_3 by Birkland Eyde's process.

Ans: Reactions completes in four stages:



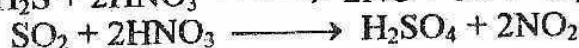
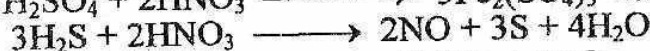
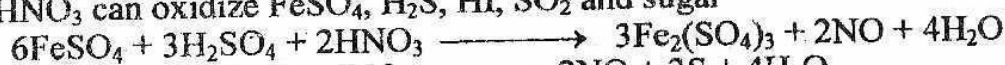
Q.20 How dilute HNO_3 can be concentrated on commercial scale?

Ans: 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 .

Q.21 Gives the reactions of HNO_3 in which it acts as an oxidizing agent:

(Sarg. 2011, Lahore 2011, Faisalabad 2011)

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



Q.22 What is aqua regia and how does it dissolve the noble metals?

(Rwp. 2006, Bhawalpur 2006, Lahore 2007, Faisalabad 2008, Faisalabad 2010, Multan 2011, Bahawalpur 2011, Guj. 2012, F. Abad 2012, Guj. 2013, F. Abad 2013, Multan 2013, D.G. Khan 2013)

Ans: When conc. HCl and conc. HNO_3 are mixed in the ratio of 3:1, the mixture

Q.23 What is meant by fuming nitric acid? (Faisalabad 2008)
Ans: Concentrated nitric acid is a colourless volatile liquid and it fumes strongly in the air. Actually it evolves the NO_2 gas.

Q.24 Describe "Ring test" for the confirmation of the presence of nitrate ions in solution. (Gujranwala 2008, Gujranwala 2010, D. G. Khan 2011)

Ans: Ring test is for NO_3^- ion in aqueous solution. To the salt solution add freshly prepared solution of FeSO_4 . Then add a few drops of conc. H_2SO_4 along the side of the test tube. A brown ring is produced. This is due to $\text{FeSO}_4 \cdot \text{NO}$.

PHOSPHORUS

Q.25 How does phosphorus occur in the form of minerals, in plants and animal tissues?

Ans: The important ores of phosphorus are
 $\text{Ca}_3(\text{PO}_4)_2$ = Phosphate rock
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It also occurs in plants and animal tissues. Phosphorus is found in seeds, yolks of eggs, nerves, brain and bone marrow.

Q.26 How do you compare the properties of white and red phosphorus? (Lahore 2011)

Ans: 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.

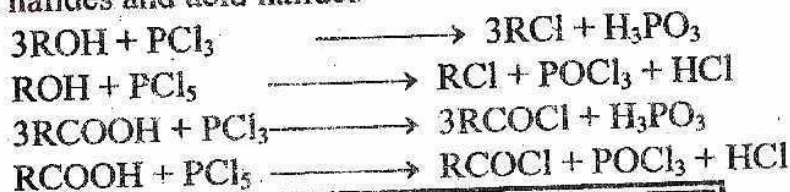
HALIDES OF PHOSPHORUS

Q.27 How do you compare the structures of PCl_3 and NH_3 ?

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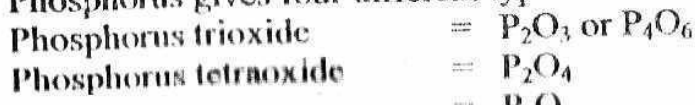
Ans: The phosphorus halides react with alcohols and carboxylic acids to give alkyl halides and acid halides



OXIDES OF PHOSPHORUS

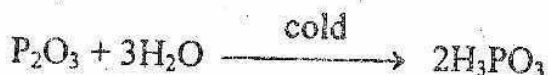
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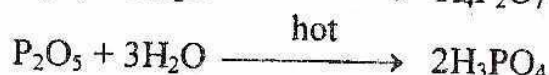
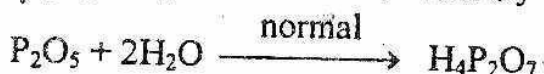
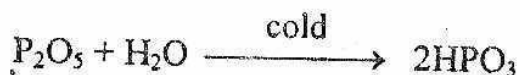
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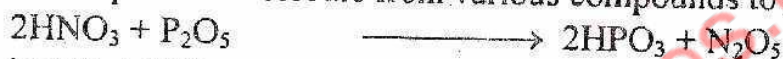
Ans:



Q.32 Justify that P_2O_5 is the dehydrating reagent?

(Sargodha 2008, D.D.K 2009, Rwp. 2010, Rwp. 2011)

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



OXYACIDS OF PHOSPHORUS

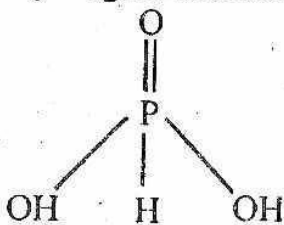
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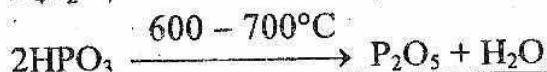
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Ans: When H_3PO_4 is heated at 240°C , it gives perphosphoric acid and on further heating, it finally gives P_2O_5



GENERAL FEATURES OF GROUP VI-A ELEMENTS

Q.37 How do you compare the elements of the group VI-A in their physical states? (Mirpur 2011, Faisalabad 2011)

Ans: Oxygen is a gas while other family members are solids. Anyhow, their melting and boiling points increase down the group. P_6 is a soft substance as compared to Te.

Q.38 How sulphur can increase its oxidation number but oxygen can not?

(Sarg. 2010, Multan 2012, Lahore 2013)

Ans: 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.

Q.39 Mention various allotropic forms for the elements of group VI-A:

Ans: 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 .

Q.40 How does oxygen differ from its own family members especially sulphur? (Mirpur 2011, Faisalabad 2011, Multan 2012, Lahore 2013, D.G. Khan 2013)

Ans: Oxygen has very small size and high electronegativity. d-orbitals are not available for the promotion of electrons. So oxidation number does not increase. Oxygen is highly electronegative as compared to sulphur. O_2 is a gas at room temperature but sulphur is solid.

OCCURRENCE OF OXYGEN AND SULPHUR

Q.41 How does oxygen occur in nature?

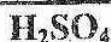
(Guj. 2013)

Ans: 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.

Q.42 How does sulphur occur in nature?

(Guj. 2013)

Ans: Sulphur occurs in the form of compounds like galena (PbS), zinc blend (ZnS) cinabar (HgS), copper pyrite (Cu_2S) and iron pyrites (FeS_2). The organic compounds and vegetables products like onion, garlic, mustard, hair, eggs and proteins contain sulphur in them.



Q.43 Mention the catalytic condition for the manufacture of H_2SO_4 in contact process: (Sarg. 2011)

Ans: V_2O_5 or Fe_2O_3 with the little amount of CuO can be used as catalyst. Anyhow, Pt. metal supported on MgSO_4 can also be used as a catalyst.

Q.44 What are the optimum conditions for the manufacture of H_2SO_4 in the contact tower?

At 400°C to 450°C is maintained at a pressure of 1 atm. A

OXIDES OF NITROGEN

Q.9 Write down the names, formulas and colours of oxides of nitrogen along with the oxidation states of nitrogen in them:

Ans: Nitrogen gives five oxides which are as follows

N_2O	= Dinitrogen oxide	+ 1 (colourless)
NO	= Nitrogen oxide	+ 2 (colourless)
N_2O_3	= Dinitrogen trioxide	+ 3
N_2O_4	= Nitrogen dioxide	+ 4 (reddish brown)
N_2O_5	= Dinitrogen pentaoxide	+ 5

Q.10 How do you justify that N_2O is a supporter of combustion?

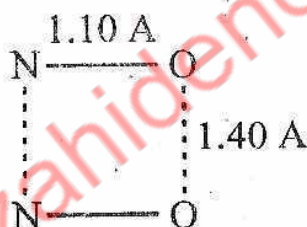
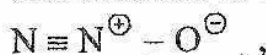
Ans: N_2O reacts with carbon, sulphur, phosphorus, magnesium, sodium and copper to give their oxides and nitrogen gas is set free



Q.11 How do you compare the structures of N_2O and NO ? (Multan 2013)

Ans: N_2O has a linear structure and shows resonance

The structure of NO exists in the form of a dimmer.



Q.12 What is the reaction of NO with $FeSO_4$ solution?

Ans: NO reacts with $FeSO_4$ to give a black compound. When this black compound is heated, NO gas is released



Q.13 Justify that NO acts as an oxidizing agent: (Lahore 2012)

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



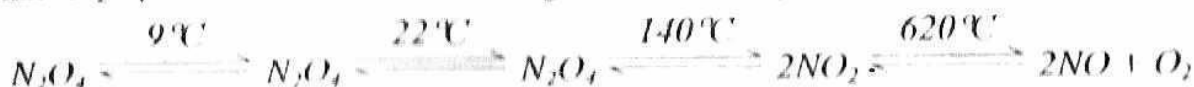
Q.14 How NO_2 is prepared from (Lahore 2010)

(a) $PbNO_3$ (b) Cu and HNO_3



Q.15 What is the effect of temperature on N_2O_4 ? (Lahore 2009)

Ans: N_2O_4 is converted to NO , through the following sequence of reactions.



Q.45 Give the advantages of contact process for the manufacture of sulphuric acid.

(Sarg. 2011)

Ans: Contact process is superior to lead chamber process for the manufacture of H_2SO_4 due to following reasons:

1. A purified form of H_2SO_4 is prepared.
2. Solid catalyst is used like V_2O_5 and Pt., while in the lead chamber process, NO_2 gas is used as a catalyst.

Q.46 Why SO_3 gas is dissolved in H_2SO_4 , but not in water in contact process?

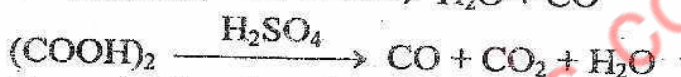
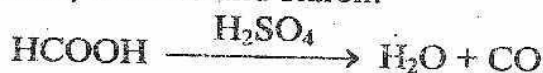
(Multan 2006, Bahawalpur 2011, Lahore 2012, Multan 2013)

Ans: SO_3 is dissolved in H_2SO_4 to form oleum or fuming H_2SO_4 . If SO_3 is dissolved directly in water, then a large amount of heat is evolved. This heat gives a dense form of minute particles of H_2SO_4 . These particles do not easily condense down.

Q.47 How does H_2SO_4 act as a dehydrating reagent?

(Faisalabad 2008, Lahore 2010, D. G. Khan 2011, Lahore 2013, D.G. Khan 2013)

Ans: H_2SO_4 has a strong affinity for water. It dehydrates oxalic acid, formic acid ethyl alcohol, glucose, sucrose and starch.



Q.48 Write down the equation for the reaction between conc. H_2SO_4 and copper and explain what type of reaction is it.

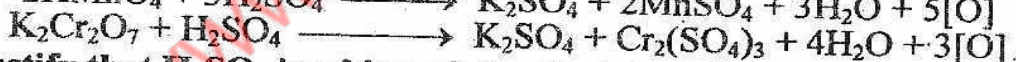
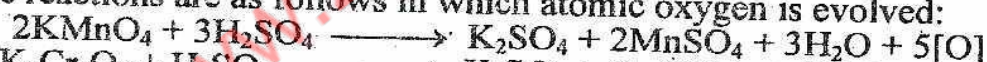
Ans: When concentrated H_2SO_4 in the cold state then no reaction takes place with copper. Anyhow when hot concentrated H_2SO_4 is reacted with Cu metal then SO_2 gas evolves alongwith the formation of CuSO_4 and H_2O .



This is an oxidation reduction reaction. Cu is oxidized and its oxidation number increases from zero to +2. Sulphur is reduced from H_2SO_4 and changes its oxidation number from +6 to +4.

Q.49 How KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ react with H_2SO_4 ?

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

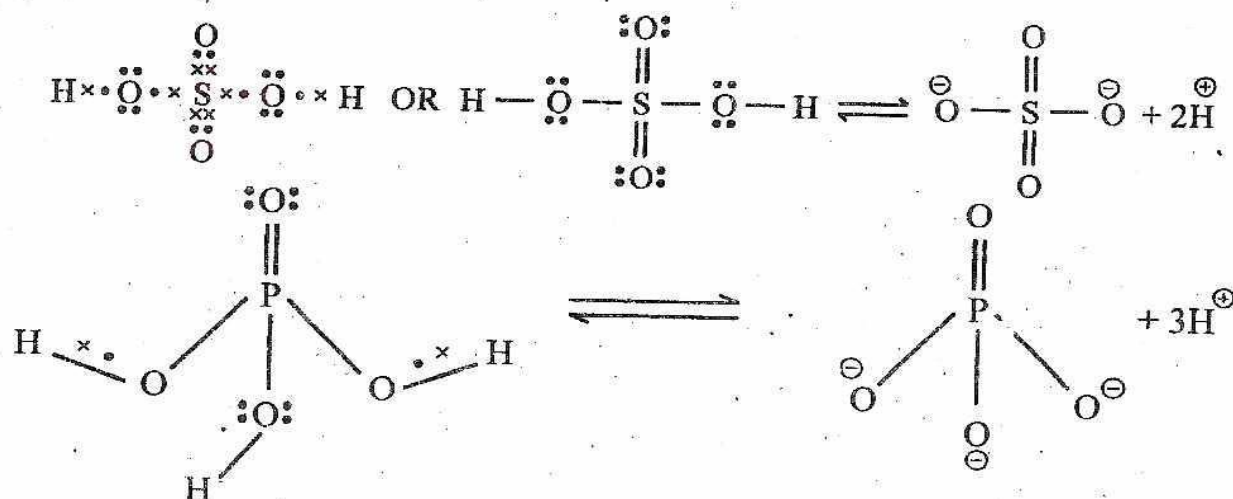


Q.50 Justify that H_2SO_4 is a king of chemicals:

Ans: H_2SO_4 is used in almost all the industries. Industrial development of a country can be best estimated from annual consumption of H_2SO_4 . It is a barometer of industries.

Q.51 Discuss the structure of H_2SO_4 and phosphoric acid:

Ans:



ANSWERS TO THE SHORT QUESTIONS

GENERAL FEATURES OF V-A GROUP ELEMENTS

Q.1 What is the general occurrence of elements of group V-A?

Ans: 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.

Q.2 How allotropy is associated with nitrogen and phosphorus?

Ans: 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

Q.3 How the melting and boiling points for the elements of group V-A vary down the group.

Ans: Melting points increase from upper to the downward direction except antimony and bismuth. Bismuth has lower melting point than antimony.

Q.4 How the involvement of d-orbital increases the oxidation number of phosphorus?

Ans: Phosphorus has available d-orbitals in its outermost shell. Electrons can be promoted from s-orbital to this d-orbital and five unpaired electrons become available. In this way it can show the valency of five.

Q.5 Why the outermost p-sub-shells of group V-A elements are extra stable?

Ans: p-sub-shell has three electrons in the outermost shell of group V-A. This is half-filled. The half-filled orbitals are extra stable.

Q.6 What type of oxides are mostly given by the elements of group V-A?

Ans: The oxides having the general formulas M_2O_3 , M_2O_4 and M_2O_5 are given by the elements of group V-A. Anyhow, nitrogen can give N_2O , and NO as additional oxides which are not given by other elements of this group.

Q.7 Write down the formulas and names of oxyacids of nitrogen, phosphorus, arsenic and antimony with oxidation number +5:

Ans: These compounds are:

HNO_3	Nitric acid
H_3PO_4	Phosphoric acid
H_3AsO_4	Arsenic acid
H_3SbO_4	Antimonic acid

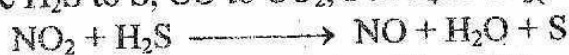
Q.8 How does nitrogen differ from its family members in physical state, atomicity and variety of oxidation states? (Mirpur 2011)

Ans: Nitrogen is a gas but other members are solids. Nitrogen is diatomic while others are tetratomic (P_4 , As_4 and Sb_4). Oxidation states of nitrogen are +1, +2, +3, +4, +5, -1, -2, -3 while other elements donot show the variety of

Q.16 How does NO_2 act as an oxidizing agent?

(Lahore 2008, Faisalabad 2010, Rwp. 2011, Faisalabad 2013, D.G. Khan 2013)

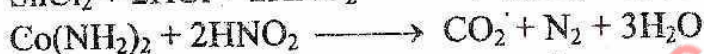
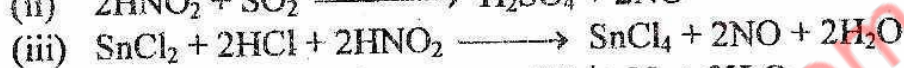
Ans: NO_2 can oxidize H_2S to S , CO to CO_2 , FeSO_4 to $\text{Fe}_2(\text{SO}_4)_3$ and KI to I_2 .



HNO_2

Q.17 How does HNO_2 acts as an oxidizing agent? (Lahore 2012, Guj. 2012)

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



Q.18 How does HNO_2 act as a reducing agent? (Rawalpindi 2008, Multan 2011)

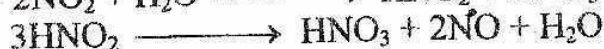
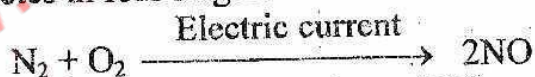
Ans: Certain strong oxidizing agents like acidified KMnO_4 , acidified $\text{K}_2\text{Cr}_2\text{O}_7$ and H_2O_2 are reduced by HNO_2 .



HNO_3

Q.19 Write down the reactions involved in the preparation of HNO_3 by Birkland Eyde's process.

Ans: Reactions completes in four stages:



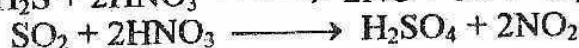
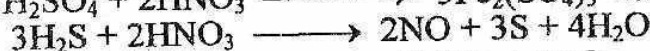
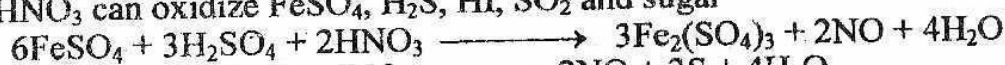
Q.20 How dilute HNO_3 can be concentrated on commercial scale?

Ans: 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 .

Q.21 Gives the reactions of HNO_3 in which it acts as an oxidizing agent:

(Sarg. 2011, Lahore 2011, Faisalabad 2011)

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



Q.22 What is aqua regia and how does it dissolve the noble metals?

(Rwp. 2006, Bhawalpur 2006, Lahore 2007, Faisalabad 2008, Faisalabad 2010, Multan 2011, Bahawalpur 2011, Guj. 2012, F. Abad 2012, Guj. 2013, F. Abad 2013, Multan 2013, D.G. Khan 2013)

Ans: When conc. HCl and conc. HNO_3 are mixed in the ratio of 3:1, the mixture

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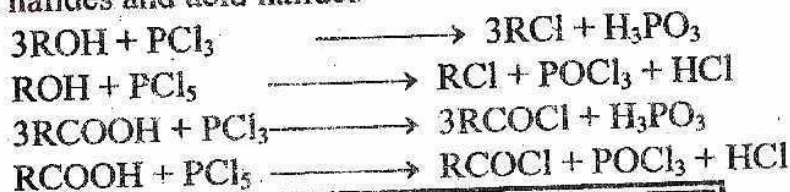
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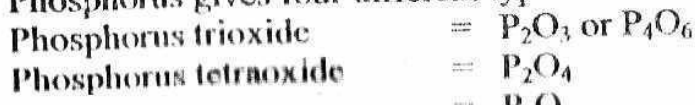
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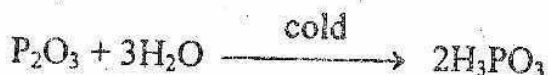
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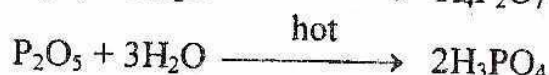
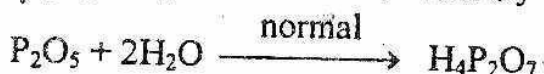
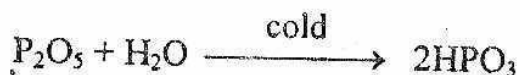
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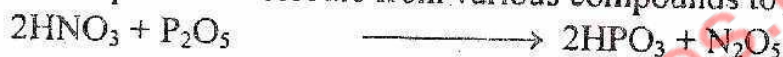
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OXYACIDS OF PHOSPHORUS

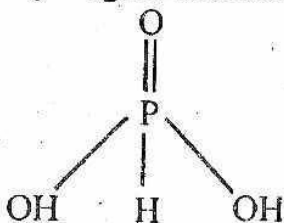
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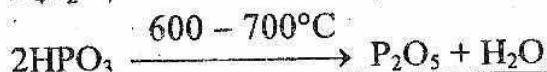
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GENERAL FEATURES OF GROUP VI-A ELEMENTS

Q.37 How do you compare the elements of the group VI-A in their physical states? (Mirpur 2011, Faisalabad 2011)

Ans: Oxygen is a gas while other family members are solids. Anyhow, their melting and boiling points increase down the group. P_6 is a soft substance as compared to Te.

Q.38 How sulphur can increase its oxidation number but oxygen can not?

(Sarg. 2010, Multan 2012, Lahore 2013)

Ans: 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.

Q.39 Mention various allotropic forms for the elements of group VI-A:

Ans: 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 .

Q.40 How does oxygen differ from its own family members especially sulphur? (Mirpur 2011, Faisalabad 2011, Multan 2012, Lahore 2013, D.G. Khan 2013)

Ans: Oxygen has very small size and high electronegativity. d-orbitals are not available for the promotion of electrons. So oxidation number does not increase. Oxygen is highly electronegative as compared to sulphur. O_2 is a gas at room temperature but sulphur is solid.

OCCURRENCE OF OXYGEN AND SULPHUR

Q.41 How does oxygen occur in nature?

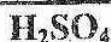
(Guj. 2013)

Ans: 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.

Q.42 How does sulphur occur in nature?

(Guj. 2013)

Ans: Sulphur occurs in the form of compounds like galena (PbS), zinc blend (ZnS) cinabar (HgS), copper pyrite (Cu_2S) and iron pyrites (FeS_2). The organic compounds and vegetables products like onion, garlic, mustard, hair, eggs and proteins contain sulphur in them.



Q.43 Mention the catalytic condition for the manufacture of H_2SO_4 in contact process: (Sarg. 2011)

Ans: V_2O_5 or Fe_2O_3 with the little amount of CuO can be used as catalyst. Anyhow, Pt. metal supported on MgSO_4 can also be used as a catalyst.

Q.44 What are the optimum conditions for the manufacture of H_2SO_4 in the contact tower?

At 400°C to 450°C is maintained at a pressure of 1 atm. A

OXIDES OF NITROGEN

Q.9 Write down the names, formulas and colours of oxides of nitrogen along with the oxidation states of nitrogen in them:

Ans: Nitrogen gives five oxides which are as follows

N_2O	= Dinitrogen oxide	+ 1 (colourless)
NO	= Nitrogen oxide	+ 2 (colourless)
N_2O_3	= Dinitrogen trioxide	+ 3
N_2O_4	= Nitrogen dioxide	+ 4 (reddish brown)
N_2O_5	= Dinitrogen pentaoxide	+ 5

Q.10 How do you justify that N_2O is a supporter of combustion?

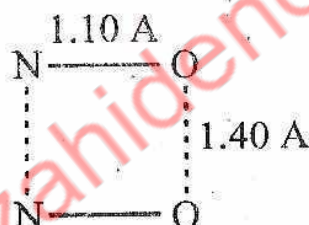
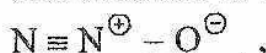
Ans: N_2O reacts with carbon, sulphur, phosphorus, magnesium, sodium and copper to give their oxides and nitrogen gas is set free



Q.11 How do you compare the structures of N_2O and NO ? (Multan 2013)

Ans: N_2O has a linear structure and shows resonance

The structure of NO exists in the form of a dimmer.



Q.12 What is the reaction of NO with $FeSO_4$ solution?

Ans: NO reacts with $FeSO_4$ to give a black compound. When this black compound is heated, NO gas is released



Q.13 Justify that NO acts as an oxidizing agent: (Lahore 2012)

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



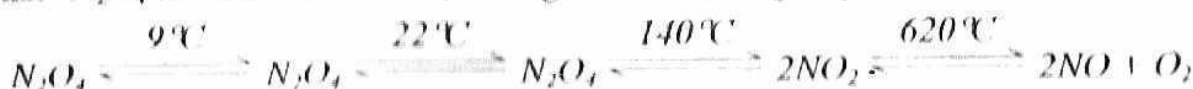
Q.14 How NO_2 is prepared from

(a) $PbNO_3$ (b) Cu and HNO_3



Q.15 What is the effect of temperature on N_2O_4 ? (Lahore 2009)

Ans: N_2O_4 is converted to NO , through the following sequence of reactions.



Q.45 Give the advantages of contact process for the manufacture of sulphuric acid.

(Sarg. 2011)

Ans: Contact process is superior to lead chamber process for the manufacture of H_2SO_4 due to following reasons:

1. A purified form of H_2SO_4 is prepared.
2. Solid catalyst is used like V_2O_5 and Pt., while in the lead chamber process, NO_2 gas is used as a catalyst.

Q.46 Why SO_3 gas is dissolved in H_2SO_4 , but not in water in contact process?

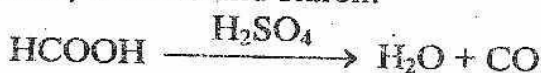
(Multan 2006, Bahawalpur 2011, Lahore 2012, Multan 2013)

Ans: SO_3 is dissolved in H_2SO_4 to form oleum or fuming H_2SO_4 . If SO_3 is dissolved directly in water, then a large amount of heat is evolved. This heat gives a dense form of minute particles of H_2SO_4 . These particles do not easily condense down.

Q.47 How does H_2SO_4 act as a dehydrating reagent?

(Faisalabad 2008, Lahore 2010, D. G. Khan 2011, Lahore 2013, D.G. Khan 2013)

Ans: H_2SO_4 has a strong affinity for water. It dehydrates oxalic acid, formic acid ethyl alcohol, glucose, sucrose and starch.



Q.48 Write down the equation for the reaction between conc. H_2SO_4 and copper and explain what type of reaction is it.

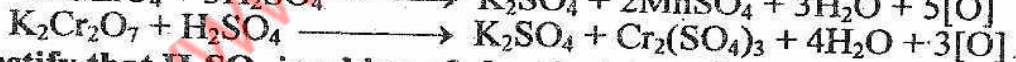
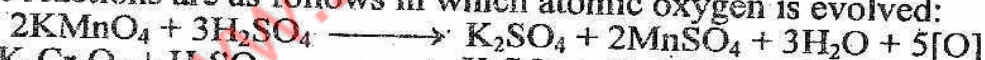
Ans: When concentrated H_2SO_4 in the cold state then no reaction takes place with copper. Anyhow when hot concentrated H_2SO_4 is reacted with Cu metal then SO_2 gas evolves alongwith the formation of $CuSO_4$ and H_2O .



This is an oxidation reduction reaction. Cu is oxidized and its oxidation number increases from zero to +2. Sulphur is reduced from H_2SO_4 and changes its oxidation number from +6 to +4.

Q.49 How $KMnO_4$ and $K_2Cr_2O_7$ react with H_2SO_4 ?

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

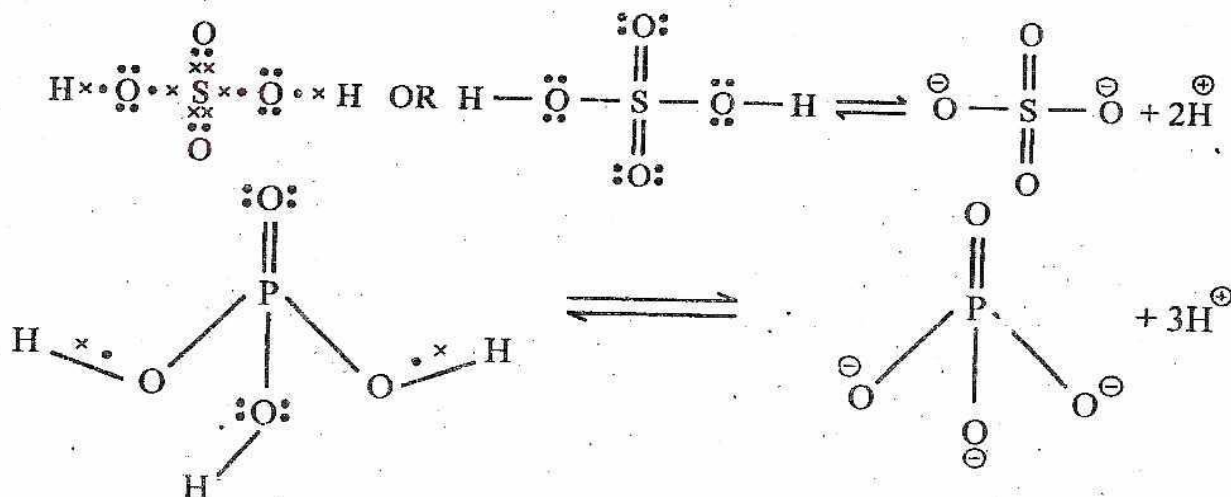


Q.50 Justify that H_2SO_4 is a king of chemicals:

Ans: H_2SO_4 is used in almost all the industries. Industrial development of a country can be best estimated from annual consumption of H_2SO_4 . It is a barometer of industries.

Q.51 Discuss the structure of H_2SO_4 and phosphoric acid:

Ans:



ANSWERS TO THE SHORT QUESTIONS

GENERAL FEATURES OF TRANSITION ELEMENTS

Q.1 What are the d-block elements? Why are they called so?

Ans: 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.

Q.2 What are f-block elements? Why are they called so? (Faisalabad 2008)

Ans: 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.

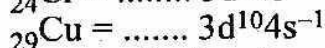
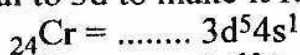
Q.3 Why d- and f-block elements are called transition elements?

(Faisalabad 2008, D.G. Khan 2013)

Ans: 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.

Q.4 Why the electronic distribution of chromium and copper are different from the rest of the elements of 3d series? (Lahore 2010)

Ans: 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.



Q.5 What are typical and non-typical transition elements and why are they called so? (Lahore 2008, D.G.K 2009, Faisalabad 2010)

Ans: 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. The other d-block elements are typical transition elements.

Q.6 How do you distinguish between outer transition and inner transition elements?

Ans: 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.

Q.7 What is lanthanide contraction? (D.G. Khan 2011, Faisalabad 2011)

Ans: No doubt, there is a increasing number of electrons from one d-series to the next but the excessive increase of nuclear charge does not allow the sizes of the elements to increase that much. This is called lanthanide contraction.

PROPERTIES OF TRANSITION ELEMENTS

Q.8 How the atomic radii of d-block elements vary from left to the right in a period?

Ans: 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.

Q.9 How the ionization energy values change from left to the right in d-block elements?

Ans: 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.

Q.10 Justify the variation of binding energies in d-block elements from left to right:

Ans: 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.

Q.11 Why the melting and boiling points are maximum somewhere in the middle of the series of d-block elements?

Ans: 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.

Q.12 What is paramagnetism? What are its units?

Ans: 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.

Q.13 How the property of paramagnetism is developed in the substances?

Ans: 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.

Q.14 Why the maximum paramagnetic strength is associated with the middle elements of d-block series?

Ans: 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.

Q.15 What is the reason for the variations of oxidation states of transition elements?

Ans: 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.

Q.16 What is the reason for the development of the colours in the compounds of transition elements? or What is d-d transition?

(Sargodha 2008, Mirpur 2009, Faisalabad 2010, Faisalabad 2011)

Ans: 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 t_{2g} and e_g orbitals. Electrons are promoted from lower d-orbitals to higher d-orbitals and photons of light are absorbed. The colour of the rest of the compounds depends upon the complementary colour which is absorbed. This is called d-d transition.

Q.17 What are complementary colours? Give examples:

Ans: 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.

Q.18 Why the catalytic properties are associated with the transition elements?

Ans: 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.

Q.19 What are interstitial compounds? Give their examples. (D.G. Khan 2013)

Ans: 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.

Q.20 Give examples of alloys and give their properties: (Rwp. 2011)

Ans: 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.

TRANSITION METAL COMPLEXES

Q.21 How many types of various groups are present in the transition metal complex?

Ans: 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.

Q.22 Give the nature of the ions which are produced in water when $K_4[Fe(CN)_6]$ and $[Cu(NH_3)_4] SO_4$ are dissolved in water:

Ans: $K_4[Fe(CN)_6]$ gives $4K^+$ and $[Fe(CN)_6]^{-4}$.

$[Cu(NH_3)_4] SO_4$ gives $[Cu(NH_3)_4]^{+2}$ and SO_4^{-2} .

Q.23 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) $[Ag(NH_3)_2] Cl$

Ans: In (i) iron is in +2 oxidation state

In (ii) iron is in +3 oxidation state

In (iii) silver is in +1 oxidation state

Q.24 Give three examples of each:

(i) Monodentate neutral ligands

(ii) Bidentate ligands.

Ans: (i) $H_2\ddot{O}$, $\ddot{N}H_3$, $\ddot{P}H_3$

(ii) $\ddot{N}H_2$, $\ddot{N}H_2$, SO_4^{2-} , $|$ COO^-

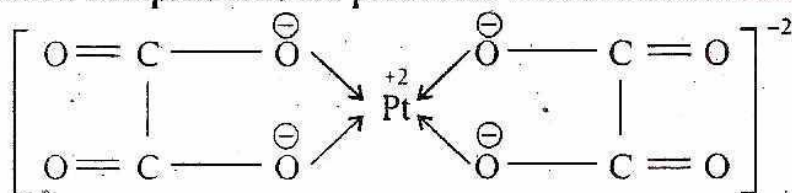
Q.25 What is co-ordination number and co-ordination sphere of a complex compounds? (Gujranwala 2006)

Ans: 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.

Q.26 What are chelates?

(Lahore Board 2007, Multan 2009, Guj. 2010, Multan 2012, Lahore 2012)

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



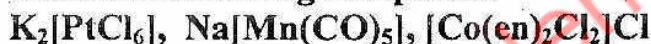
Dioxalato platinate (II) ion

Q.27 While naming the complex compounds, how do you end with negatively charged ligands, positively charged ligands and neutral ligands?

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

Q.28 Name the following complexes.

(Sarg. 2010)



Ans: Potassium hexachloroplatinate (IV); Sodium pentacarbonyl managanese (–I) Dichlorobisethylene diamine cobalt (III) chloride. Potasium tetracyano cuprate (II), Pentacarbonyl iron (0).

Q.29 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:

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

IRON AND ITS VARIOUS FORMS

Q.30 Give the names and formulas for important ores of iron:

Ans: The important ores of iron are as follows:

Magnetite	Fe_3O_4
Haematite	Fe_2O_3
Limonite	$\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$
Copper iron pyrite	CuFeS_2

Q.31 How do you compare the cast iron, wrought iron and steel with respect to the percentage of carbon? (Rawalpindi 2010)

Ans: Cast iron , carbon = 2.5 – 4.5 %
Wrought iron , carbon = 0.1 – 0.25 %
Steel , carbon = 0.25 – 2.5 %

Q.32 What are the uses of wrought iron?

Ans: It is extremely tough and used for the manufacture of those articles which

Q.33 How do you compare the wrought iron and steel with respect to carbon, sulphur, manganese and phosphorus?

Ans:	Wrought iron	Steel
% age of carbon	0.12 – 0.25	0.1 – 1.5
% age of sulphur	0.2 – 0.15	0.1 – 4.0
% age of manganese	upto 0.25	0.02 – 0.2
% age of phosphorus	0.04 – 0.2	0.04 – 0.07

STEEL

Q.34 How do you compare mild steel, medium carbon steel and high carbon steel with respect to their carbon contents and their properties?

Ans:	% age of carbon
Mild steel	0.1 – 0.2
Medium carbon steel	0.2 – 0.7
High carbon steel	0.7 – 1.5

Q.35 What is the role of acidic and basic lining in the open hearth process for the manufacture of steel?

Ans: 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.

Q.36 Discuss the general shape of Bessemer's converter:

Ans: 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.

Q.37 How do you remove the entrapped gases from the steel?

(Lahore 2008, Gujranwala 2010)

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

Q.38 How do you compare the cast iron, steel, and wrought iron keeping in view their hardness, malleability and melting points?

Ans:	Cast iron	Steel	Wrought iron
Carbon	2.5 – 4.5 %	0.25 – 2.5 %	0.12 – 0.25 %
Hardness	hard	medium	soft
Malleability	brittle	malleable and brittle	malleable

CORROSION OF IRON

Q.39 Why the corrosion of metals is more rapid in the presence of water?

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

Q.40 How does electrochemical theory explain the corrosion of aluminium in the presence of copper? (Faisalabad 2008, Sarg. 2010)

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

Q.41 How does the metallic coating prevent the corrosion? (Bahawalpur 2011)

Ans: 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,

Q.42 What do you mean by cathode coating?

Ans: 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.

CHROMATES AND DICHROMATES

Q.43 What are chromates and dichromates?

Ans: Chromates are the salt of H_2CrO_4 and dichromates are the salts of $\text{H}_2\text{Cr}_2\text{O}_7$ and these are two acids of chromium.

Q.44 How the acidic medium develops an equilibrium between chromate and dichromate ion? (F. Abad 2013, Multan 2013)

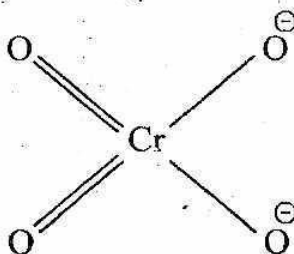
Ans: When the medium is acidic, then CrO_4^{2-} ion changes to $\text{Cr}_2\text{O}_7^{2-}$ ion and equilibrium lies in the favour of $\text{Cr}_2\text{O}_7^{2-}$.



In basic medium the equilibrium is shifted to the backward direction.

Q.45 Give the uses of potassium chromate and its structure?

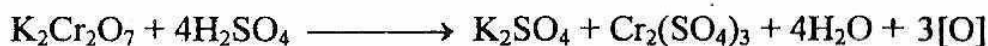
Ans: K_2CrO_4 is used for the manufacture of pigments, as a corrosion inhibitor, in dyeing and tanning of leather and as an indicator in AgNO_3 titrations. The structure of K_2CrO_4 is that of CrO_4^{2-} ion which is tetrahedral in shape



Q.46 How does $\text{K}_2\text{Cr}_2\text{O}_7$ act as an oxidizing agent in the presence of H_2SO_4 ?

(Faisalabad 2012, Guj. 2013)

Ans: $\text{K}_2\text{Cr}_2\text{O}_7$ reacts with H_2SO_4 to give atomic oxygen which can oxidize other substances:



Q.47 How the mixture of $\text{K}_2\text{Cr}_2\text{O}_7$ and H_2SO_4 oxidizes H_2S gas and FeSO_4 separately?

Ans: The atomic oxygen released by acidified $\text{K}_2\text{Cr}_2\text{O}_7$ oxidizes H_2S to S and FeSO_4 to $\text{Fe}_2(\text{SO}_4)_3$:



Q.48 What is chromyl chloride test?

(Rawalpindi 2010, Lahore 2010, Multan 2011, Sarg. 2011, Lahore 2013)

Ans: 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.



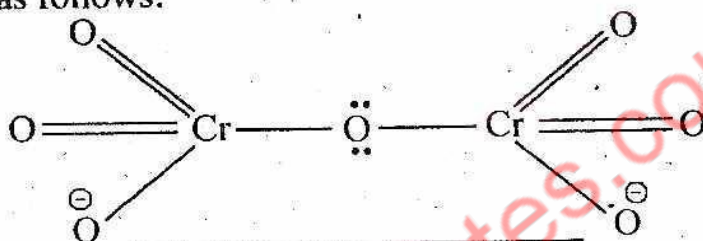
This test is used to check the presence of Cl^- radical.

Q.49 Give the uses of $K_2Cr_2O_7$:

Ans: It is used for the dyeing of many substances and in leather industry for chrome tanning. It acts as an oxidizing agent. It is used in calcoprinting and used in volumetric analysis of redox titration.

Q.50 Give the structure of dichromate ion:

Ans: Structure is as follows:



KMnO₄ AND K₂MnO₄

Q.51 How do you compare $KMnO_4$ and K_2MnO_4 ?

Ans: 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.

Q.52 How $KMnO_4$ and H_2SO_4 act as oxidizing agents?

Ans: They react with each other to release atomic oxygen which can oxidize other substances.



Q.53 How $KMnO_4$ oxidizes SO_2 to H_2SO_4 ?

Ans: The reaction is as follows:



Q.54 How $KMnO_4$ can be prepared by electrolytic method? (Lahore 2010)

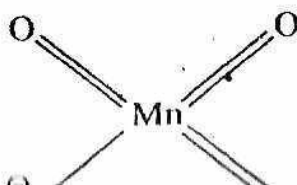
Ans: By the electrolytic oxidation K_2MnO_4 , we get $KMnO_4$. When electrical current is passed, water decomposes. Hydrogen is collected at the cathode and oxygen at the anode. The oxygen liberated at the anode oxidizes MnO_4^{2-} ion to MnO_4^{-} ion. The oxidation number of the manganese increases from +6 to +7



$KMnO_4$ is obtained in the form of purple solution.

Q.55 Write down the structure of MnO_4^- ion:

Ans: The structure is tetrahedral and negative charge of oxygen resonates on the whole ion.



ANSWERS TO THE SHORT QUESTIONS

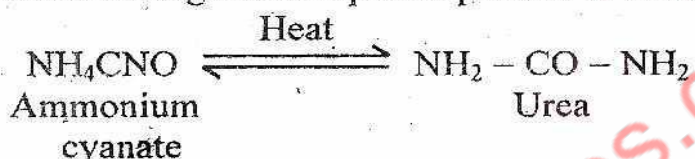
GENERAL FEATURES OF ORGANIC COMPOUNDS

Q.1 What is vital force theory? Who discarded this theory? (Gujranwala 2010)

Ans: First of all, it was thought that the organic compounds were synthesized in the bodies of plants and animals in the presence of vital force, which is present in plants and animals as well. This concept is called vital force theory. W.F. Wholer discarded it by preparing urea in the laboratory.

Q.2 Which organic compound was first of all prepared in the laboratory? (Faisalabad 2010, Multan 2013)

Ans: In 1828, F. Wholer prepared urea by heating ammonium cyanate in the laboratory. Urea is an organic compound present in the animal urine



So, Wholer's work opened the way to prepare organic compounds in laboratory.

Q.3 What is the modern definition of organic chemistry and which of the elements other than carbon and hydrogen may be present in organic compounds?

Ans: The study of the compounds containing carbon is called organic chemistry. The elements other than carbon and hydrogen present in various organic compounds are oxygen, sulphur, nitrogen, phosphorus, halogens and a few metals.

Q.4 Mention those compounds of carbon which are not organic in nature?

Ans: The following compounds have carbon in them, but they are not thought to be organic in nature. These compounds are CO, CO₂, CS₂, HCN, metal cyanides, metal carbides, carbonates and bicarbonates of metals.

Q.5 Catenation is the property which makes carbon different from other elements of the periodic table. Justify it: (Bahawalpur 2011)

Ans: Carbon has property to link with other atoms of carbon. This property of self-linkage is called catenation. Due to this property, a separate branch of chemistry called organic chemistry is developed.

Q.6 How the phenomenon of isomerism makes the organic compounds greater in number?

Ans: The existence of more than one structures and having different physical and chemical properties with the same molecular formula is called isomerism. Butane has two isomers. Pentane has three and hexane has five. In this way, the number of possible molecules increases.

Q.7 Organic compounds mostly give slow reactions as compared to inorganic compounds. Give reasons:

Ans: Organic compounds are mostly covalent in nature and insoluble in water. Their polarity is not so much pronounced, so the reactions are slow.

Q.8 Organic compounds are mostly non-ionic in character. Give reasons:

Ans: Organic compounds are made up of such elements which have small differences of electronegativities. The bonds are very close to the covalent character and hence non-ionic.

Q.9 Which are most important solvents and are used to dissolve organic compounds?

Ans: The important solvents are ether, methanol, ethanol, benzene, carbon tetrachloride, chloroform, acetone and petroleum ether.

Q.10 How the organic compounds are closely associated with the human body?

Ans: The substances like our food, clothing, medicines, vitamins, antibiotics, insecticides, hormones, pigments, paper, ink, perfumes, soaps, detergents, petroleum and plastics etc. are needed by the human beings and they are all organic substances.

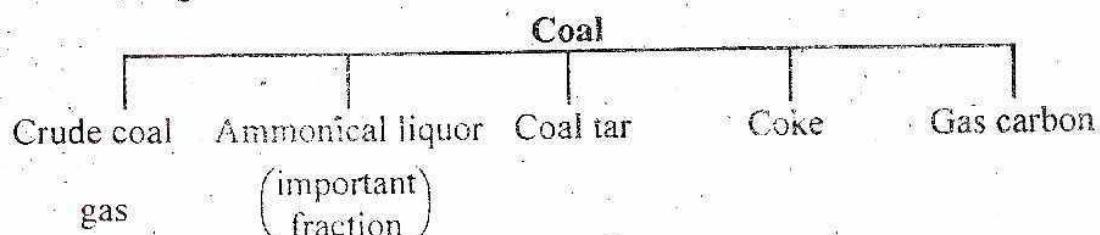
SOURCES OF ORGANIC COMPOUNDS

Q.11 Coal is one of the major sources of organic compounds. How do you justify it?

Ans: Coal has plant origin and one of its fractions is coal tar. A large number of organic compounds are present in coal tar. More than 215 organic compounds can be extracted from four fractions of coal tar.

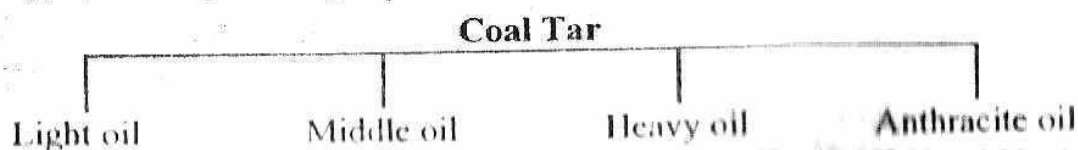
Q.12 Indicate five fractions which are obtained from destructive distillation of coal: (Sarghoda 2011)

Ans: When coal undergoes destructive distillation between $1000 - 1400^{\circ}\text{C}$, the following five fractions are obtained.



Q.13 What is coal tar? Give its fractions:

Ans: Coal tar is one of the fractions obtained from destructive distillation of coal. When it undergoes fractional distillation, four fractions are obtained having approximately 215 organic compounds.



Q.14 What is the composition of natural gas?

Ans: Natural gas is consisted of 80 – 95 % methane. It has small amounts of C_2H_6 , C_3H_8 and C_4H_{10} . It also contains CO_2 , H_2S and nitrogen gas.

Q.15 Give important uses of natural gas:

Ans: Natural gas is used as a fuel to produce carbon black and acts as a raw material for the manufacture of urea. It is also used for power generation in cement and fertilizer industries.

Q.16 What is petroleum? Give its origin.

(F. Abad 2013)

Ans: Petroleum is naturally occurring, brown or greenish black viscous oily liquid which is obtained from the earth's crust. It has biological origin and is formed due to decay and decomposition of marine animals.

Q.17 Name the fractions which are obtained by fractional distillation of petroleum:

(Faisalabad 2011, Faisalabad 2013)

Ans: When petroleum undergoes fractional distillation, various fractions are natural gas, petroleum ether, light naphtha, gasoline, kerosene oil, diesel oil, lubrication oil and asphalt.

Q.18 What is an oil refinery? Mention oil refineries in Pakistan. (F. Abad 2013)

Ans: The industries which purify petroleum and separate different components are called oil refineries. In Pakistan, we have Attock oil refinery at Rawalpindi, Pak-Arab refinery at Multan and two refineries at Karachi.

CRACKING

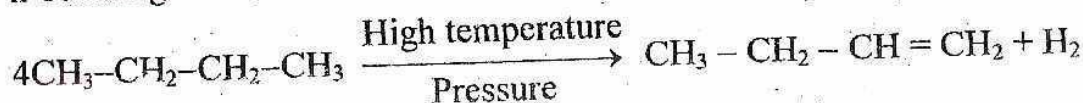
Q.19 What is cracking of petroleum? Why do we need cracking of petroleum?

(Sargodha 2008, D. G. Khan 2011, Lahore 2012, F. Abad 2013, D.G. Khan 2013)

Ans: The process of decomposition of less volatile higher hydrocarbons into more volatile lower hydrocarbons with the applications of heat and catalyst is called cracking. Fractional distillation of petroleum only gives 20 % gasoline. The rest of the deficiency is compensated by cracking. Approximately 50 % of gasoline is now prepared by this method.

Q.20 Give the products by the cracking of n-butane: (Lahore 2012)

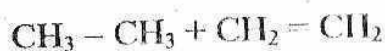
Ans: n-butane gives seven different types of products on cracking.



1-Butene



2-Butene



Ethane

Ethene



Propene

Methane

Q.21 What is thermal cracking?

(Lahore Board 2007, 2010, Rwp. 2011, Mirpur 2011, Multan 2011, Multan 2013)

Ans: That cracking which is carried out by the application of heat and pressure is called thermal cracking. In liquid phase the temperature of $475 - 530^{\circ}\text{C}$ is maintained with a pressure of $7 - 70$ atm. In vapour phase cracking, the temperature is 600°C and the pressure is $3.5 - 10.5$ atm.

Q.22 What is catalytic cracking? (Lahore Board 2007, Faisalabad 2010, Multan 2011)

Ans: The type of cracking of hydrocarbons which is done in the presence of catalysts like SiO_2 and Al_2O_3 is called catalytic cracking.

Q.23 What is steam cracking? (Sarg. 2010, Multan 2011)

Ans: Higher hydrocarbons are converted to vapours and mixed with steam. This mixture is heated for a short time to about 900°C and then cooled rapidly. This cracking gives us lower unsaturated hydrocarbons.

KNOCKING

Q.24 What do you mean by knocking of petroleum?

Ans: Knocking is the metallic sound during the combustion of gasoline in internal combustion engines. The gasoline having lower octane number produces knocking.

Q.25 How do you define octane number and how it can be improved?

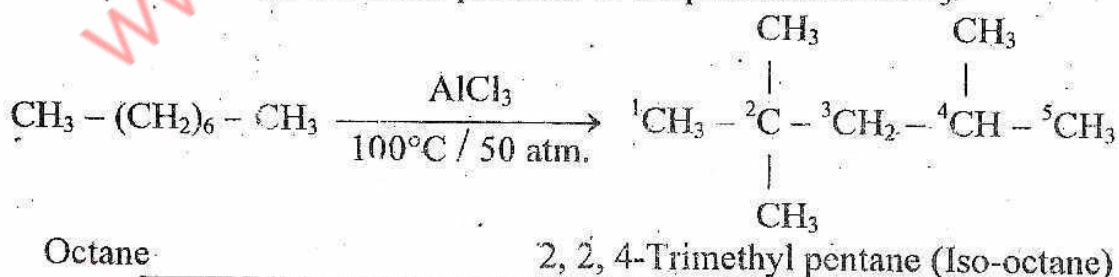
(Multan 2006, Lahore 2009, Rwp. 2010, Lahore 2012)

Ans: Octane number is the % age by volume of iso-octane and n-heptane which has the same knocking property as the fuel being tested under the similar experimental conditions in the special test engine. If we have greater % age of iso-octane the octane number is improved.

Q.26 What is reforming of petroleum? Give one example:

(Sarghoda 2011, Faisalabad 2011, Faisalabad 2012, Lahore 2012, Lahore 2013)

Ans: Reforming is the process of conversion of straight chain alkanes into branched chain alkanes. n-octane can be converted into iso-octane, when it is heated at 100°C and at 50 atm pressure in the presence of AlCl_3 .

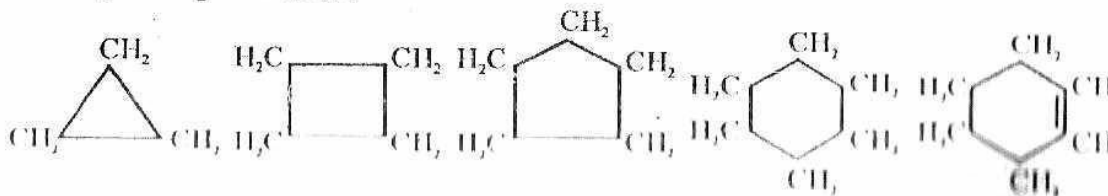


TYPES OF ORGANIC COMPOUNDS

Q.27 Give at least five compounds which are homocyclic, but are not aromatic.

(Sargodha 2006, Multan 2008, Lahore 2008, Guj. 2010, Lahore 2011, Mirpur 2011, Bahawalpur 2011, Guj. 2012, Guj. 2013)

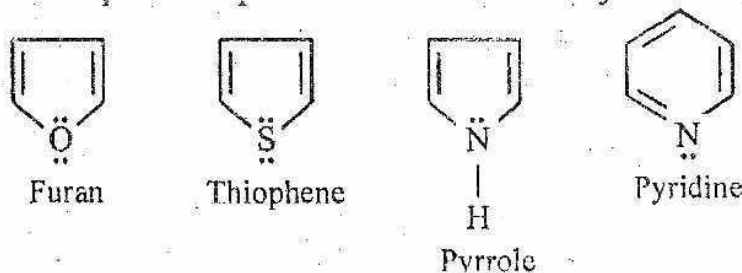
Ans: These compounds are



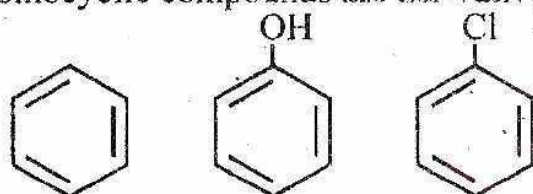
Q.28 Give four examples of aromatic heterocyclic compounds and two examples of homocyclic aromatic.

(Sargodha 2006, Faisalabad 2008, Multan 2008, Sarg. 2009, Multan 2009, Mirpur 2009, Lahore 2010, Faisalabad 2010, Bahawalpur 2011, Guj. 2012, Multan 2012, Guj. 2013)

Ans: The best and simple examples of aromatic heterocyclic compounds are



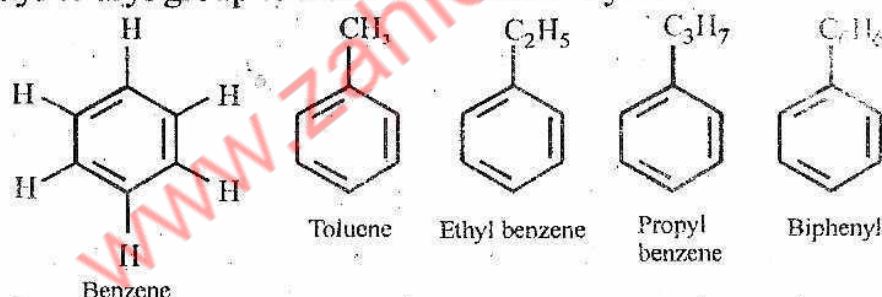
The aromatic homocyclic compounds are derivatives of benzene



Q.28A What are aromatic hydrocarbons? Give two examples. (Sarg. 2010)

Ans: Those organic compounds which contain at least one benzene ring with an alkyl or aryl group are called aromatic hydrocarbons.

Aromatic compounds have alternate single and double bonds. In the case of benzene ring any one of the hydrogen or all the hydrogens can be substituted by alkyl or aryl group to make the aromatic hydrocarbons.



Broadly speaking there are certain compounds which are aromatic but their aromaticity is due to a ring or rings other than benzene.

Q.29 What is meant by functional group? Name and represent two functional groups containing oxygen. (Lahore 2008, Rwp. 2008, Multan 2011, Multan 2012)

Ans: An atom or a group of atoms in a molecule which gives characteristic properties to a compound is called a functional group.

Name	Functional Group	Name	Functional Group
Alcoholic	-OH	Carbonyl	$\begin{array}{c} \text{O} \\ \\ \text{-C-} \end{array}$
Carboxylic	$\begin{array}{c} \text{O} \\ \\ \text{-C-OH} \end{array}$		

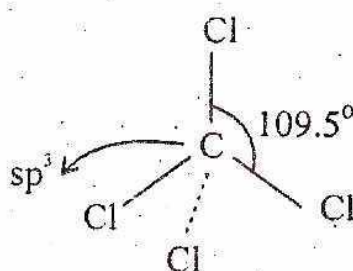
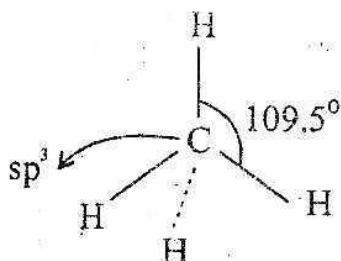
Q.30 Give characteristics of homologous series:

Ans: The members of homologous series contain same elements and same functional group. They have the same general formula and the members differ by $\text{-CH}_2\text{-}$ units. Their properties and preparations are identical and

STRUCTURES OF ORGANIC COMPOUNDS

Q.31 Draw the structure of CH_4 and CCl_4 , indicating the hybridization of central atom.

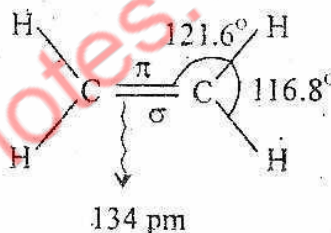
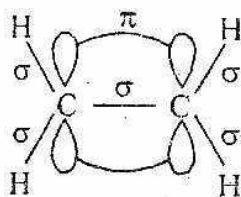
Ans:



Both are perfectly tetrahedral.

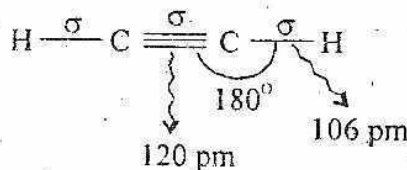
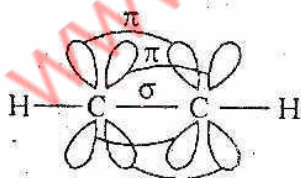
Q.32 Draw the structure of C_2H_4 and indicate the bond lengths and bond angles:

Ans:



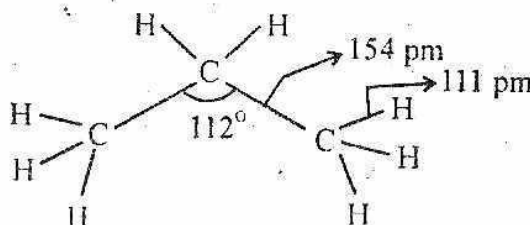
Q.33 Draw the structure of C_2H_2 and indicate the bond length and bond angles:

Ans:



Q.34 Why all the bond angles of propane are not equal?

Ans: The atoms attached with carbon atoms in propane are not identical. They have different sizes and different repulsive effects, so the angles are different.



STRUCTURE ISOMERISM

Q.35 What is isomerism? Give the names of four structural isomerism:

(F. Abad 2012)

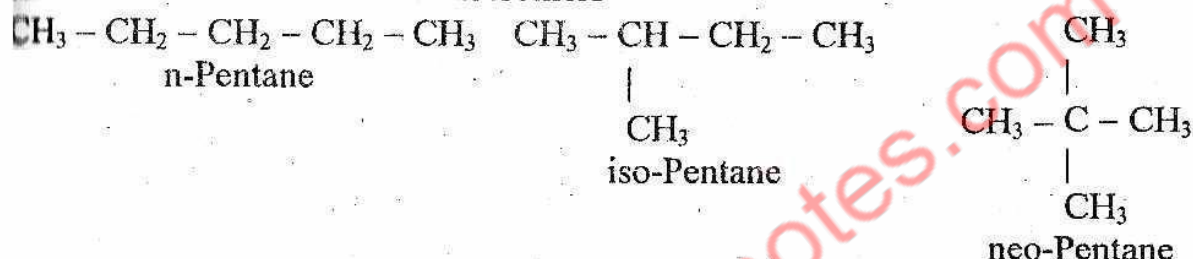
Ans: That phenomenon in which two or more than two compounds have the same molecular formulas, but differ at least in some physical or chemical properties is called isomerism.

There are five types of structural isomerisms:

- | | |
|---|---------------------------|
| (i) Chain isomerism or skeletal isomerism | (ii) Positional isomerism |
| (iii) Functional group isomerism | (iv) Metamerism |
| (v) Tautomerism | |

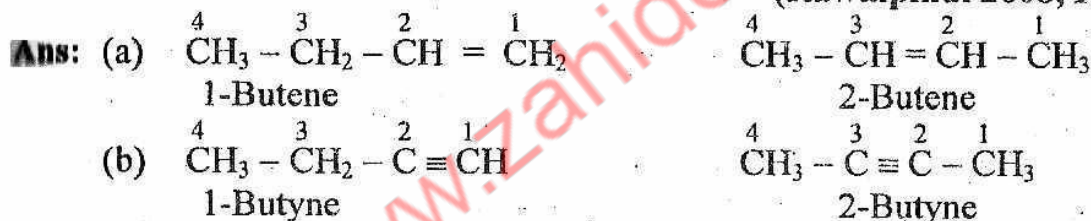
Q.36 Give the examples of chain isomers of a an alkane having three chain isomers.

Ans: n-Pentane has three chain isomers

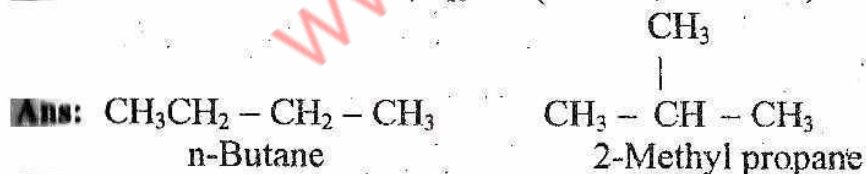


Q.37 Give examples of positional isomers in alkenes and alkynes.

(Rawalpindi 2008, Rwp. 2011)

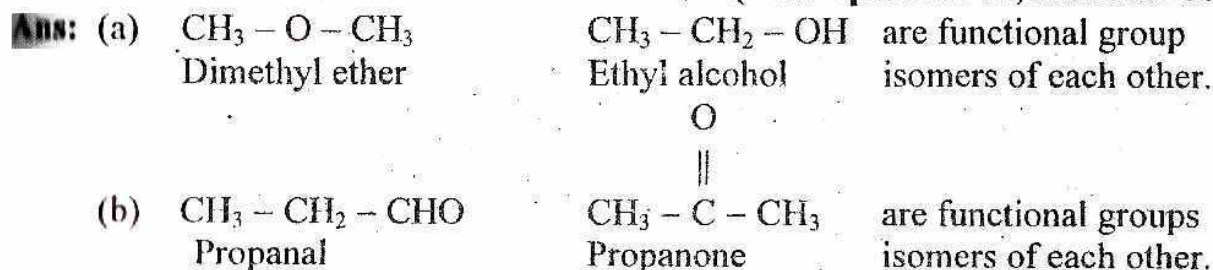


Q.38 Write isomers of C_4H_{10} . (Faisalabad 2008, Rwp. 2010, Multan 2011)



Q.39 Give two examples of functional group isomers?

(Rawalpindi 2008, Multan 2008)

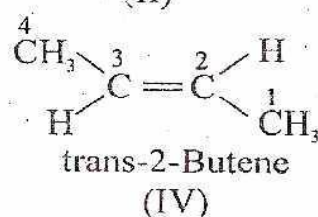
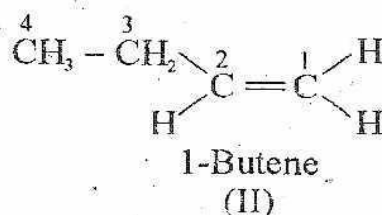
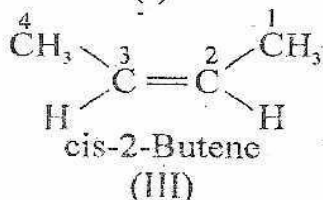
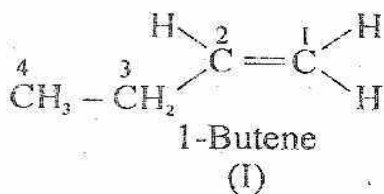


GEOMETRICAL ISOMERISM

Q.40 1-Butene does not show geometrical isomerism, but 2-Butene does. Give reasons: (Rwp. 2010, Mirpur 2011, D.G. Khan 2013)

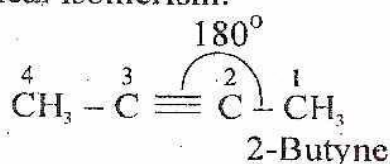
Ans: In 1-butene, two similar hydrogen atoms are present at the double bonded

Both (I) and (II) are similar compounds.

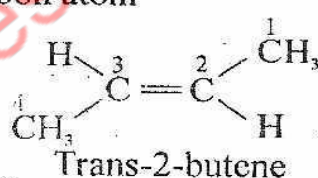
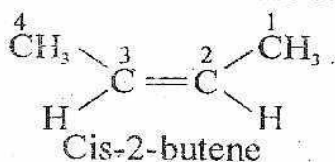


Q.41 2-Butyne does not show geometrical isomerism, but 2-butene does. Give reasons: (Bahawalpur 2011)

Ans: In 2-butyne only one group is attached with sp -hybridized carbon atom. So it can not show geometrical isomerism.



In 2-butene there are two groups at each sp^2 -carbon atom

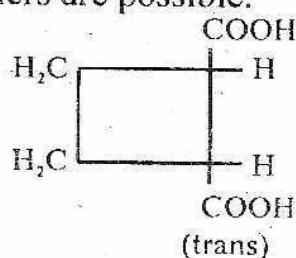
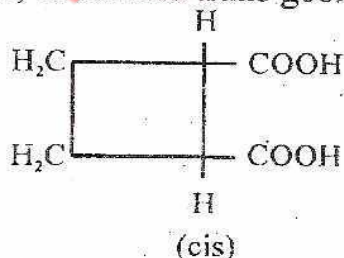


Q.42 Why is restricted rotation necessary to show the geometrical isomerism. (D. G. Khan 2011, Rwp. 2011, Mirpur 2011, Guj. 2012, Lahore 2013)

Ans: The bonds are always rotating, so a molecule can attain any conformation. If there is a double bond then the presence of π -bond does not allow the sigma bond to rotate and the rotation is hindered. In this way cis and trans geometrical isomers can exist.

Q.43 How the restricted rotation of the cyclic compounds gives birth to the geometrical isomerism?

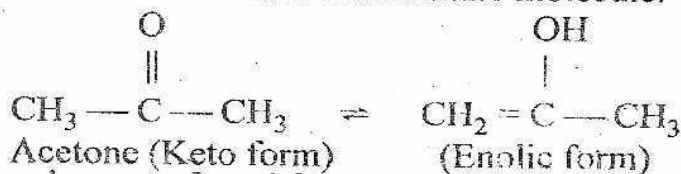
Ans: The bond which are making the cyclic rings are not rotatable due to cyclic structure, so cis and trans geometrical isomers are possible.



Q.44 Define tautomerism with an example.

(Guj. 2010, Faisalabad 2011, Lahore 2012, Lahore 2013)

Ans: It is that type of isomerism in which an atom is transferred from one part of the molecule to the other within same molecule.



H-atom has transferred from carbon to oxygen atom.

ANSWERS TO THE SHORT QUESTIONS

GENERAL FEATURES OF OPEN CHAIN HYDROCARBONS

Q.1 What are hydrocarbons? Give one example of each type:

Ans: Those organic compounds which are made up of carbon and hydrogen only are known as hydrocarbons. These are of two types, when we keep in view their cyclic or open chain structures.

(i) Acyclic ethane, ethene and ethyne are acyclic. (ii) Cyclic. cyclopropane, cyclobutane, cyclohexane and benzene etc. are cyclic hydrocarbons.

Q.2 Give the general formulas for alkanes, alkenes and alkynes. (Multan 2013)

Ans: General formulas are C_nH_{2n+2} for alkanes, C_nH_{2n} for alkenes and C_nH_{2n-2} for alkynes.

Q.3 Explain why alkanes are less reactive than alkenes?

(Guj. 2008, Faisalabad 2010, F. Abad 2012, Multan 2013)

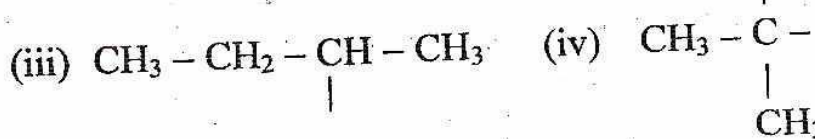
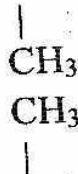
Ans: Alkanes do not have any functional group. All the carbon atoms are sp^3 hybridized. C-C bonds are σ in nature. These bonds are chemically inert. There are no multiple bonds. Due to these reasons alkanes have least tendency to react with acids, bases, oxidizing agents and reducing agents. Alkenes have carbon carbon double bonds. The electrons of the π bond are diffused. They are easily available to the electrophiles. So alkenes give the addition reactions while alkanes give substitution reactions.

Q.4 What is the effect of branching on the melting points of alkanes?

Ans: Branched chain alkanes have low boiling points as compared to linear chain alkanes.

Q.5 How many alkyl groups can be generated by an alkane with molecular formula C_4H_{10} ? Give the names of alkyl groups:

Ans: C_4H_{10} is butane and four different types of alkyl groups can be generated. These alkyl groups are n-butyl, iso-butyl, sec-butyl and tertiary butyl.



Q.6 Why some hydrocarbons are saturated and other unsaturated? What type of reactions are characteristics of them?

Ans: A saturated hydrocarbon has sufficient hydrogens in it but in unsaturated hydrocarbons double and triple bonds are there. They give addition reactions. While saturated hydrocarbons give substitutions reactions.

Q.7 How do you justify that the bond angles in propane and butane between carbon-carbon bonds are greater than 109.5° ?

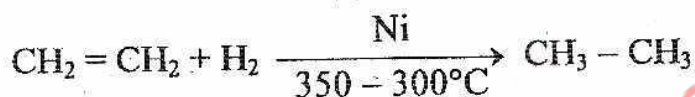
Ans: When the groups of different sizes are attached with the sp^3 -hybridized carbon atom, all the bond angles are not equal. Greater the sizes of the groups, greater the bond angles.



PREPARATIONS OF ALKANES

Q.8 What is Sabatier-Sendern's reaction?

Ans: It is a catalytic hydrogenation of alkenes into alkanes. Ni is used as a catalyst at $250 - 300^\circ\text{C}$. π -bond is broken and sigma bonds are produced. In this way, we saturate the alkenes.



Q.9 What is the importance of hydrogenation of unsaturated compounds?

Ans: (a) We can do the quantitative measurement of unsaturation in the compound and find the number of double bonds in it.

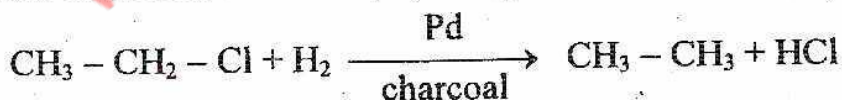
(b) Oils are converted into vegetable ghee by the saturation process.

Q.10 What are the reduction products of alkyl halides. Indicate the important reducing agents for this purpose?

Ans: Alkyl halides upon reduction give corresponding alkanes. The important reducing agents are $\text{Zn} + \text{HCl}$, $\text{C}_2\text{H}_5\text{OH} + \text{Na}$, HI , $\text{P} + \text{HI}$ and $\text{Zn} - \text{Cu}$ couple + HCl .

Q.11 What is hydrogenolysis? (D.G. Khan 2013)

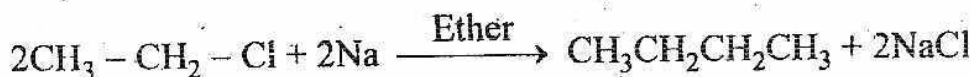
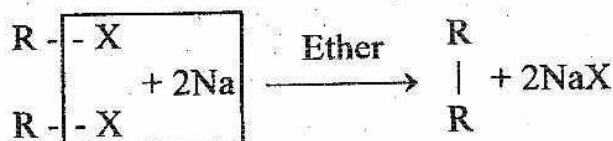
Ans: It is a hydrogenation accompanied by bond cleavage. In this reaction, alkyl halides are converted to alkanes, by using Pd and charcoal as a catalyst.



LiAlH_4 can also be used as a reducing agent.

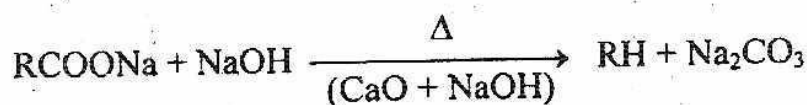
Q.12 What is the importance of Wurtz synthesis for the manufacture of alkanes? Prepare n-Butane. (Faisalabad 2010, Multan 2012, Lahore 2013)

Ans: Alkyl halides when treated with Na metal in the presence of ether, give alkanes with double number of carbon atoms present in the alkyl halide. So, we can lengthen the carbon chain. Anyhow, this is a suitable reaction to get the alkanes with even number of carbon atoms.



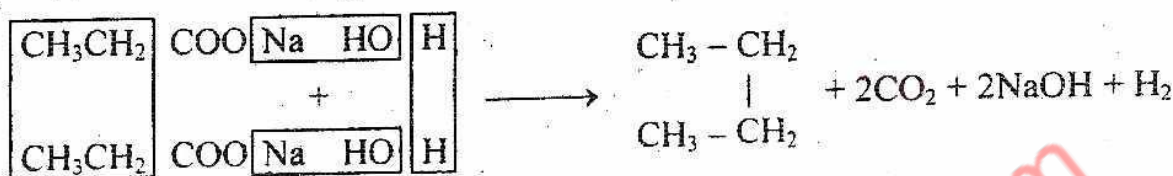
Q.13 What do you mean by decarboxylation of carboxylic acids? (Guj. 2008, 2010)

Ans: The removal of the carboxylic group from the acid to produce an alkane is called decarboxylation. It is carried out by treating sodium salts of the acids with NaOH, in the form of soda lime which is a mixture of CaO and NaOH



Q.14 Give the nature of the products when sodium salt of propanoic acid is electrolysed in Kolbe's electrolysis: (Lahore 2012)

Ans: Two ethyl groups of two molecules of sodium salt of propanoic acid join with each other to give butane.



Moreover CO_2 , NaOH and hydrogen gas are also produced. Butane is collected at the anode while H_2 and NaOH are collected at the cathode.

Q.15 Write the equation for the conversions of aldehyde and ketones into corresponding alkanes: (Sarg 2010, Multan 2011)

Ans: Clemmensen's reduction and Wolf-Kishner reduction convert the carbonyl groups of ketones and aldehydes into $-\text{CH}_2-$ group. So ketones and aldehydes are converted into corresponding alkanes. They are carried out in the presence of $\text{Zn/Hg} + \text{HCl}$ and $\text{N}_2\text{H}_4 + \text{KOH}$ respectively.

Q.16 How the reactions of Grignard's reagent with active hydrogen compounds give alkanes with the same number of carbon atoms as present in the alkyl group of Grignard's reagent?

Ans: The active hydrogen compounds are HOH , ROH , RCOOH etc. They give their hydrogen to the alkyl group of Grignard's reagent to give alkanes and the carbon atoms do not increase.



CHEMICAL PROPERTIES OF ALKANES

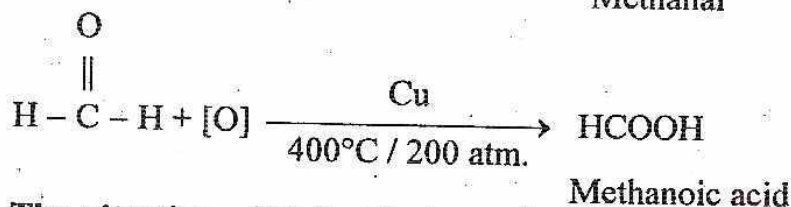
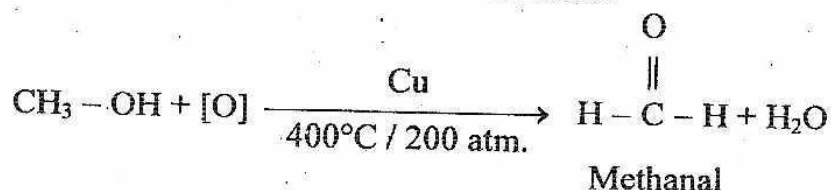
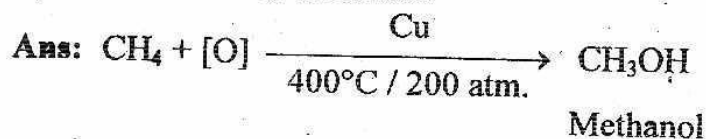
Q.17 Reason out the low reactivity of alkanes among the hydrocarbon family. (Multan 2008, D. G. Khan 2011, Lahore 2011)

Ans: Alkanes are saturated compounds having all sigma bonds. Sigma bonds are very stable. So alkanes are less reactive than alkenes and alkynes. These families have weaker π -bonds in them.

Q.18 Why the saturated hydrocarbons act as good fuels?

Ans: The reaction of alkanes with oxygen are highly exothermic. The amount of heat evolved which is called the heat of combustion of alkanes, is used for many purposes. So they act as fuels.

Q.19 Give the nature of products in the chemical equations by catalytic oxidation of methane. (Lahore 2013)



Q.20 The nitration of higher hydrocarbons breaks the carbon carbon bond. How HNO_3 reacts with CH_4 ? (Lahore 2013)

Ans: When higher alkanes, say butane and pentane are reacted with conc. HNO_3 at $400 - 500^\circ\text{C}$, the nitro-derivatives are obtained by the substitution of hydrogen of alkanes by nitro groups. Due to high temperature, carbon carbon bond is also broken. But in case of CH_4 , no $\text{C}-\text{C}$ bond breaks and following reaction happens



Q.21 The reaction of chlorine with CH_4 has a free radical mechanism. Justify it.

Ans: This reaction happens in the presence of U.V. light, diffused sunlight or at $300 - 400^\circ\text{C}$ temperature. Molecule of Cl_2 is broken up into its free radicals which further produces the free radicals. In this way, chloroderivatives of methane are produced.

GENERAL FEATRUES OF ALKANES

Q.22 Why alkenes are called olefins?

Ans: Alkenes gives oily liquids when treated with halogens like Cl_2 and Br_2 . The word "olefiant" means oil forming.

Q.23 What are monoenes, dienes and polyenes? Give one example of each:

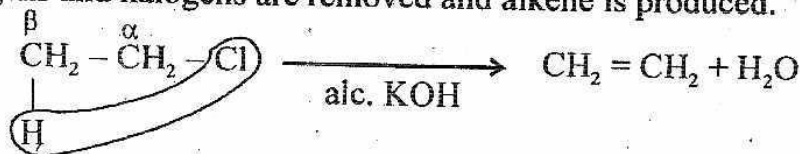
Ans: The alkenes having only one double bond like ethene ($\text{CH}_2 = \text{CH}_2$) are called monoenes. The alkenes having two double bonds like $\text{CH}_2 = \text{CH} - \text{CH} = \text{CH}_2$ are called dienes. The alkenes having more than two double bonds are called polyenes.

PREPARATION OF ALKENES

Q.24 Justify that dehydrohalogenation of alkyl halides give alkenes.

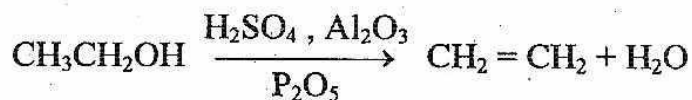
(Lahore 2013, Guj. 2013)

Ans: When we remove halogens from α -carbon and one of the hydrogens from β -carbon, a double bond is created between $\text{C} - \alpha$ and $\text{C} - \beta$. In this way, hydrogens and halogens are removed and alkene is produced.



Q.25 What are the most important dehydrating reagents to convert alcohols into alkenes? (Guj. 2012, Lahore 2013)

Ans: Those reagents which can remove water molecules from alcohols are called dehydrating reagents. These are conc. H_2SO_4 , Al_2O_3 , P_2O_5 and H_3PO_4 .



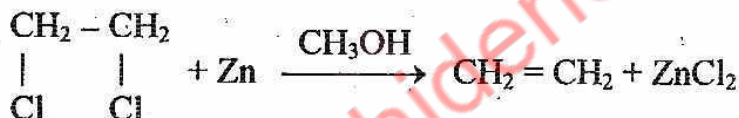
Q.26 Justify that the order of reactivity of alcohols for dehydration purposes is as follows:

Ter. alcohol > Sec. alcohol > Prim. alcohol

Ans: The dehydration of alcohols completes through the formation of carbonium ions. Tertiary alcohols give a stable carbinum than that of secondary than primary. So, this order determines the reactivity of alcohols.

Q.27 Give the reaction conditions and the reagents which are necessary for dehalogenation of vicinal dihalides:

Ans: When Zinc dust is reacted with vicinal dihalides in the presence of anhydrous solvent like $\text{CH}_3 - \text{OH}$ or CH_3COOH , the alkenes are produced. Double bond is created between those two carbon atoms from which the halogens are removed.



Q.28 How Kolbe's electrosynthesis gives us ethane from sodium succinate?

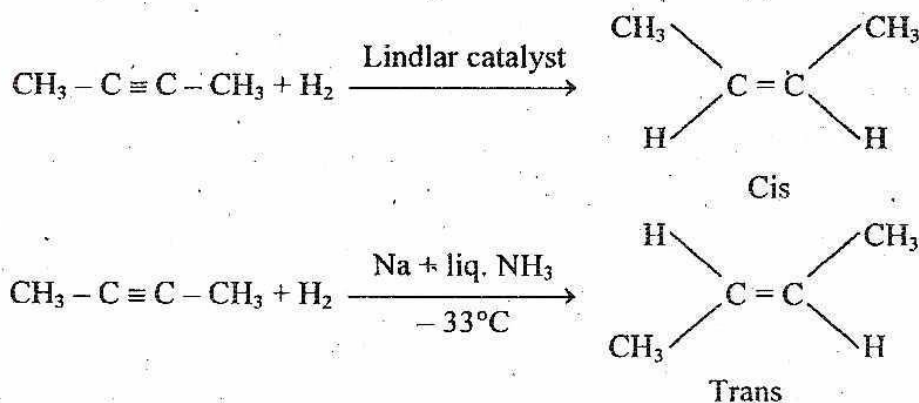
Ans: When the sodium salt of succinic acid is electrolysed in solution, decarboxylation takes place and the double bond is created between two carbon atoms. Ethene is collected at the anode, while hydrogen is collected at the cathode.



Q.29 How do you convert alkynes into cis and trans alkenes?

(Lahore 2010, Rwp. 2010)

Ans: When alkynes are reacted with hydrogen in the presence of Lindlar catalyst, then cis alkenes are produced. When they are treated with sodium in liquid ammonia, then trans alkenes are produced at -33°C .



CHEMICAL PROPERTIES OF ALKENES

⇒ **Q.30** Why the π -bond is more reactive than σ -bond?

(Guj. 2006, Sargodha 2008, D.G. Khan 2013)

Ans: The electrons of the π -bonds are more diffused as compared to the electrons of the σ -bonds. The reagents which want to react with alkenes attack the π -electrons and break it down.

Q.31 What is Raney nickel and where is it used?

(Multan 2009, Guj. 2010, D.G. Khan 2011, Multan 2012, D.G. Khan 2013)

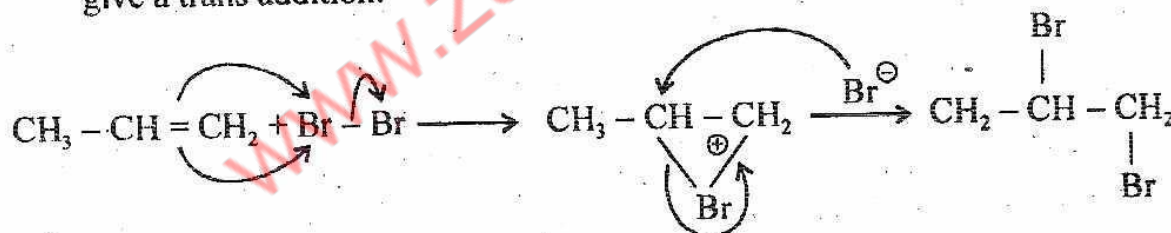
Ans: Raney nickel is prepared by treating an alloy of Ni and Al with caustic soda. Ni is obtained in the powder form and has high surface activity. This is called as Raney nickel. It functions better at 100°C and pressure of 3 atm.

Q.32 What are the applications of hydrogenation of unsaturated compounds to saturated compounds in the laboratory and industry? (Guj. 2013)

Ans: In the laboratory, we use this reaction as one of the synthetic methods to convert unsaturated hydrocarbons into saturated ones. It is a quantitative reaction and helps us to measure the amount of unsaturation in the alkenes. On industrial scale, vegetable oils are converted into vegetable ghee.

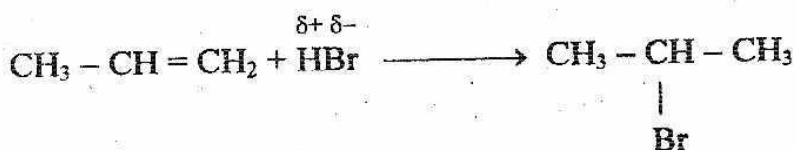
Q.33 Indicate the mechanism for the addition of a bromine on propene:

Ans: A bromonium ion is produced as an intermediate and Br^\ominus attacks on it to give a trans addition.



Q.34 What is Markownikoff's rule? Give its applications for the addition of HBr on propene. (Faisalabad 2008, 2010, 2011, Multan 2011, Lahore 2012, Lahore 2013, D.G. Khan 2013)

Ans: When an unsymmetrical molecule is added to unsymmetrical alkene, the positive part of adding molecule goes to that carbon atom which has already greater number of hydrogen atoms

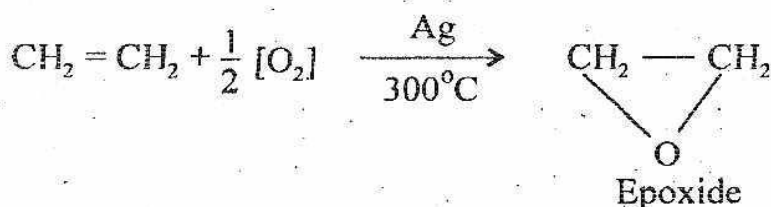


Q.35 How the alkenes can be converted into alcohols?

Ans: Alkenes add one water molecule in the presence of dil. H_2SO_4 at 100°C to give alcohols. The reaction takes place according to Markownikoff's rule.

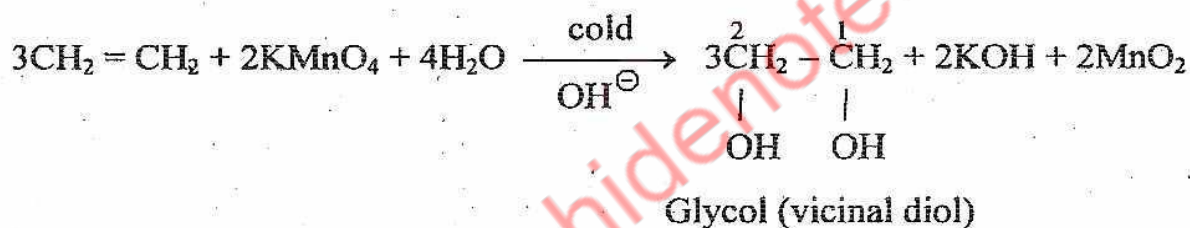
Q.36 How the alkenes are converted into epoxide and what are their applications?

Ans: When alkenes are reacted with oxygen or air and passed over silver catalyst at high temperature, then epoxides are produced. These are three membered cyclic compounds.



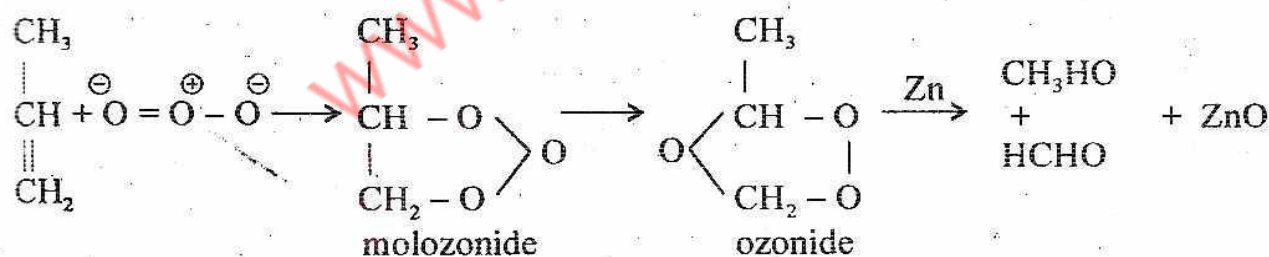
Q.37 What is Baeyer's test to check the presence of carbon carbon double bond? (Sargodha 2006, Rwp. 2006, Lahore 2008, Faisalabad 2010, Lahore 2013)

Ans: When alkenes are reacted with alkaline KMnO_4 at low temperature, then two hydroxyl groups are added up at the double bond and the colour of aqueous KMnO_4 is discharged. This helps us to check the presence of double bond. So, ethene is converted to glycol.



Q.38 Give the mechanism of ozonolysis of propene. (Gujranwala 2008)

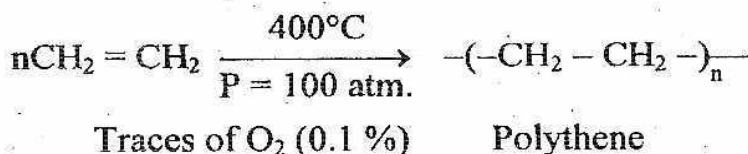
Ans:



In this way, we can locate the position of a double bond in an alkene.

Q.39 Give the equations and necessary conditions for the polymerization of ethene into polythene:

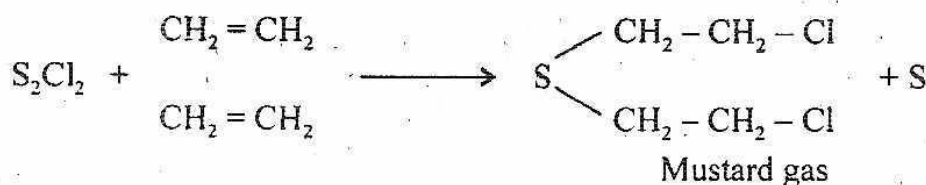
Ans: The reaction is as follows:



If we want to have good quality polythene, then $\text{Al}(\text{C}_2\text{H}_5)_3$ and TiCl_4 can be used as catalysts.

Q.40 How mustard gas is prepared? Give its properties and uses:

Ans: The reaction is as follows:

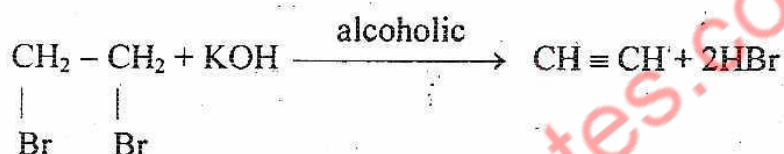


It is a powerful vesicant and is blistering agent. It is used in warfare.

PREPARATION OF ALKYNES

Q.41 How vicinal dihalides are converted into corresponding alkynes?

Ans: When vicinal dihalides are reacted with alc. KOH, two molecules of halogen acid are eliminated and triple bond is produced

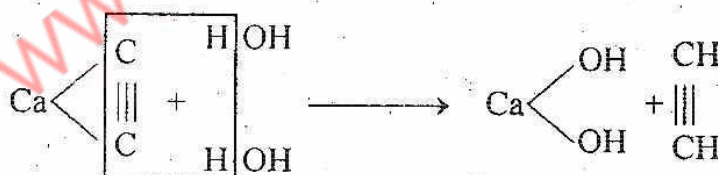


Q.42 How ethyne can be prepared by Kolbe's electrolysis?

Ans: When we do the electrolysis of potassium salts of maleic acid, acetylene is collected at the anode, while KOH at the cathode.

Q.43 How ethyne can be prepared commercially from calcium carbide?

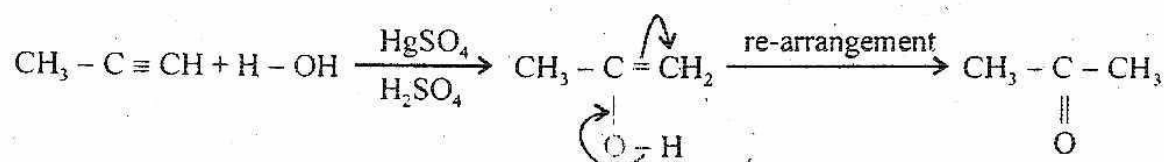
Ans: When calcium carbide is reacted with water, calcium hydroxide and acetylene is produced:



CHEMICAL PROPERTIES OF ALKYNES

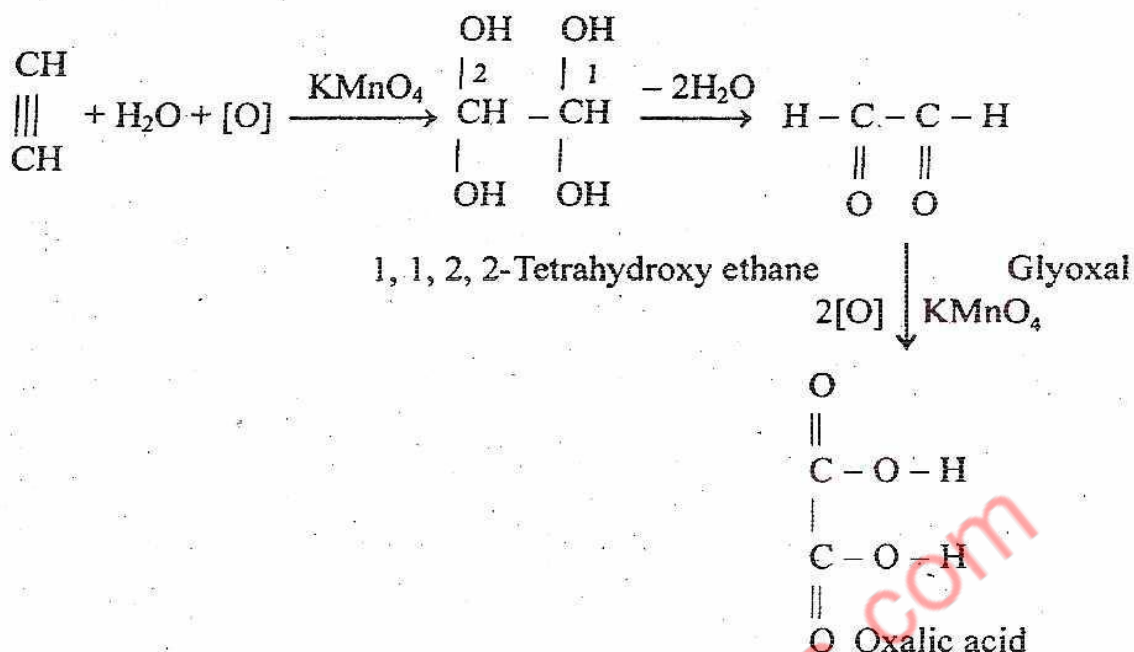
Q.44 Give the equations and the reaction conditions for the addition of water at propyne:

Ans: Water adds at propyne in the presence of HgSO_4 and H_2SO_4 to give α and β unsaturated alcohols. This alcohol undergoes tautomeric shift and acetone is produced



Q.45 How ethyne reacts with alkaline KMnO_4 ?

Ans: Ethyne is oxidized into oxalic acid:



Q.46 What is the role of combustion of ethyne in daily life?

Ans: Ethyne burns in oxygen to give oxyacetylene flame which is used for welding purposes because a temperature of 3500°C is produced.

Q.47 How chloroprene is produced by the polymerization of acetylene?

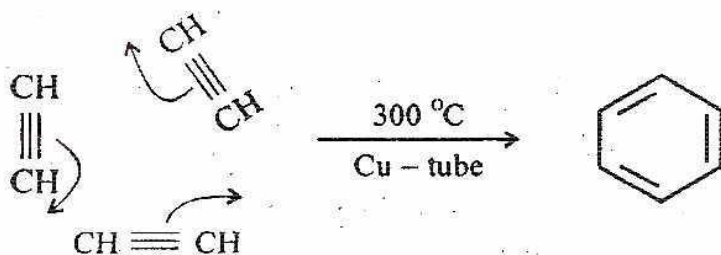
(Sarg. 2010)

Ans: Two molecules of acetylene give vinyl acetylene in the presence of Cu_2Cl_2 and NH_4Cl . Vinyl acetylene adds HCl to give chloroprene which on polymerization gives synthetic rubber.

Q.48 Benzene can be prepared commercially from acetylene. Give reaction conditions.

(Rawalpindi 2008)

Ans: When acetylene gas is passed through copper tube at 300°C , benzene is produced:



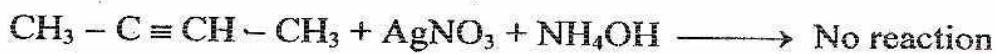
Q.49 How does sodamide react with alkynes? What are the applications of this reaction?

(Mirpur 2009, Lahore 2010)

Ans: Sodamide substitutes the acidic hydrogens by sodium metal to give sodium salts of alkynes. They are used to get higher alkynes by reacting with alkyl halides.

Q.50 How ammonical solution of AgNO_3 can be used to distinguish between 1-butyne and 2-butyne. (Sargodha 2009, Lahore 2010)

Ans: Ammonical solution of AgNO_3 reacts only with those alkynes which have acidic hydrogen in them. 1-Butyne will give the white precipitate of silver salt, but 2-butyne will not.



Q.51 How ammonical solution of Cu_2Cl_2 can be used to distinguish between 1-butyne and 2-butyne. (Lahore 2012)

Ans: 1-Butyne has acidic hydrogen which gives red ppt. with this reagent, but 2-butyne does not give the reaction.

Q.52 What are the applications of ammonical solution of AgNO_3 and Cu_2Cl_2 ?

Ans: Both these reagents react with terminal alkynes to give precipitate. So, terminal alkynes can be distinguished from other alkynes, alkenes, and alkanes and many other families of organic compounds.

Q.53 Give the uses of acetylene. (Mirpur 2011)

Ans: Acetylene is used for welding purposes, preparing many organic compounds, manufacture of synthetic polymer and for the artificial ripening of fruits.

DISTINCTIONS

Q.54 How do you distinguish between ethene and ethyne?

(Lahore 2008, Faisalabad 2011, F. Abad 2013)

Ans: Ammonical solution of Cu_2Cl_2 and of AgNO_3 give red and white precipitates respectively with ethyne, but not with ethene.

Q.55 How do you distinguish between an alkane and alkyne? (F. Abad 2013)

Ans: Alkynes decolourize bromine water. They decolourize alkaline KMnO_4 . They give red precipitate with ammonical solution of Cu_2Cl_2 and white precipitate with ammonical solution of AgNO_3 . Alkanes do not give all these four reactions.

ANSWERS TO THE SHORT QUESTIONS

POLYMERS

Q.1 Why is industry necessary for a country?

Ans: The people of a country need resources for their livings. Natural resources are exhausting every moment. This is due to growing population. High standard of living also needs the industrial products.

Q.2 What is a need for fertilizers?

(Multan 2006, Multan 2008, Lahore 2011, Multan 2012, Multan 2013)

Ans: Fertilizers stimulate the process of metabolism in plant cells. They help the growth of plants and give additional supply of the food. They also maintain the pH of the soil between 7 – 8.

Q.3 What are micronutrients? Give their names.

(Multan 2008, Sargodha 2011, Lahore 2011, Lahore 2012, Lahore 2013)

Ans: Those elements which are required in very small amount for the growth of plants are called micronutrients. These elements are B, Cu, Fe, Mn, Zn, Mo and Cl_2 .

Q.4 What are macronutrients? Give their names.

(Mirpur 2006, Multan 2008, Faisalabad 2008, Mirpur 2011, Sargodha 2011, Lahore 2012, Lahore 2013, Guj. 2013)

Ans: Nutrients which are required in large amounts for the growth of plants are called macronutrients. The elements are carbon, hydrogen, oxygen nitrogen, phosphorus, potassium, calcium, magnesium and sulphur.

Q.5 Give the important properties of fertilizer.

(Lahore 2012, Multan 2012, Lahore 2013, Multan 2013)

Ans: The derived elements of fertilizers should be water soluble. Fertilizers should be stable in the soil. It should be cheap to manufacture and should not be injurious to plants. Moreover, they should be stable enough to stand for a long time.

NITROGEN FERTILIZER

Q.6 Give the names and formulas of important nitrogenous fertilizers:

Ans: Important nitrogen fertilizers are:

$(NH_4)_2SO_4$, NH_4NO_3 , NH_4Cl , $Ca(NO_3)_2$, $CaCN$, NH_3 , $NH_2CO NH_2$.

Q.7 Why nitrogen is important for plants?

(Faisalabad 2008, Rwp. 2011, D.G. Khan 2013)

Ans: Nitrogen is essential for the rapid growth of plants. It is the main constituent of proteins. It gives green colour to the leaves and increases the yield and quality of plants.

Q.8 How NH_3 is given to the plants?

Ans: Ammonia contains 82 % nitrogen. It is gas at ordinary temperature and is directly injected 6 – 8 inches in the form of liquid under the surface of the soil, so that it may not seep out.

Q.9 What are the important steps for the manufacture of urea?

(Lahore 2011, D.G. Khan 2011)

Ans: Urea is prepared in six steps:

- (i) Preparation of hydrogen
- (ii) Preparation of NH_3
- (iii) Preparation of ammonium carbamate

- (iv) Preparation of urea
- (v) Concentration of urea
- (vi) Prilling.

Q.10 What do you mean by prilling of urea? (Faisalabad 2011)

Ans: Molten urea is sprayed at the prilling tower. It is done by means of prilling buckets. The molten urea is cooled by air which rises upwards. The molten droplets of urea solidify in the form of prills.

Q.11 What are the properties of ammonium nitrate as a fertilizer?
(Sargodha. 2011, Bahawalpur 2011, D.G. Khan 2013)

- Ans:**
- (i) It is used as a fertilizer for many crops except paddy rice.
 - (ii) It is also used in the combined form with limestone.
 - (iii) It is hygroscopic in nature.

PHOSPHORUS FERTILIZERS

Q.12 What are the types of phosphorus fertilizers? (Guj. 2012)

Ans: There are two important water soluble phosphorus fertilizers:

- (i) Calcium superphosphate, CaH_2PO_4
- (ii) Di-ammonium hydrogen phosphate, $(\text{NH}_4)_2 \text{HPO}_4$.

Q.13 What is the importance of phosphorus for the plants? (F. Abad 2008)

- Ans:**
- (i) Phosphorus stimulates the early growth of plants.
 - (ii) It accelerates the seed and fruit formation.
 - (iii) It increases the resistance to diseases and frosts.

Q.14 What is di-ammonium hydrogen phosphate? Give it uses:

(Guj. 2010, Lahore 2011, F. Abad 2013)

Ans: It is prepared by the reaction of ammonia with H_3PO_3 . It contains 16 % nitrogen and 48 % P_2O_5 . This product contains 75 % of the plant nutrients.

POTASSIUM FERTILIZER

Q.15 What is the importance of potassium fertilizer? (Mirpur 2011)

- Ans:**
- (i) Potassium is needed for the formation of starch, sugar and fibrous material of plants.
 - (ii) It increases the resistance to diseases.
 - (iii) It gives healthy root development.
 - (iv) It helps in the ripening of seeds, fruits and cereals.

Q.16 How potassium nitrate is prepared? Give its composition:

Ans: KNO_3 is prepared on the industrial scale by double decomposition reaction of KCl and NaNO_3 . It contains 13 % nitrogen and 44 % potash.

Q.17 What is the position of fertilizer industry in Pakistan?

Ans: There are approximately 14 plants in private as well as public sector. The total production of urea in Pakistan upto 2002 is 56,30100 metric tones per annum.

CEMENT INDUSTRY

Q.18 What is historical background of Portland cement?

Ans: An English mason Joseph Aspdin heated a mixture of limestone and clay with water and allowed to stand. The matter was hardened like a stone. This hardened mass resembled with Portland rock.

Q.19 How do you define cement? Give the essential constituents of cement.

(Sargodha 2008, Multan 2012, Lahore 2012)

Ans: The cement is a material which is obtained by burning an intimate mixture of calcareous and argillaceous material at sufficiently high temperature to produce clinker. This clinker is consequently ground to a fine powder. The essential constituents of cement are lime, silica and alumina.

Q.20 Mention three important raw materials for the manufacture of cement:

(Bahawalpur 2011, Lahore 2012)

Ans: The important raw materials used for the manufacture of cement are:

- (i) Calcareous material
- (ii) Argillaceous material
- (iii) Another raw material like gypsum, water and fuel.

Q.21 How do you compare the wet and dry process for the manufacture of cement and on what grounds one of them is chosen? (Sargodha. 2011)

Ans: Dry process needs excessive fine grinding so this process is employed. Then the material is hard. Wet process is free from dust, grinding is easier and the composition of the cement can be easily controlled.

Q.22 What are the five steps in the manufacture of Portland cement?

(Lahore 2012)

- Ans:**
- (i) Crushing and grinding
 - (ii) Mixing in correct proportion
 - (iii) Heating the rotary kiln.
 - (iv) Grinding the clinker.
 - (v) Mixing and grinding of clinker with gypsum.

Q.23 What is the role of rotary kiln in the cement manufacture?

Ans: Rotary kiln heats the material to high temperature to produce the cement clinker. This clinker is crushed to fine powder to get cement.

Q.24 Give different zones in the rotary kiln and their temperature ranges.

(Lahore 2008, Faisalabad 2011, Lahore 2013)

Ans: In preheating zone, the temperature is 500°C. In the decomposition zone, the temperature goes up 800°C. In the burning zone, temperature rises up to 1500°C.

Q.25 What are clinker?

(Faisalabad 2011, Guj. 2013)

Ans: It is the final product from the rotary kiln. These are small greenish black or grey coloured balls. Their sizes vary from small nuts to peas.

Q.26 How the clinker are converted into cement at the final stage?

Ans: Clinker are cooled by air. Gypsum is ground to fine powder and mixed with clinker up to 5 %. This mixture is ground to fine powder.

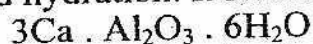
Q.27 What do you mean by setting of cement?

(Rwp. 2008, Faisalabad 2010, Multan 2011, Mirpur 2011, F. Abad 2012, D.G. Khan 2013)

Ans: The reaction of cement with water with the passage of time is called setting of cement, and setting time is noted.

Reactions taking place in first 24 hours:

- (ii) After a short time of the paste formation, tri-calcium aluminate absorbs water. This is called hydration. It forms a colloidal gel of composition.



- (iii) This gel starts crystallizing slowly. It reacts with gypsum having the formula $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$. It gives the crystals of calcium sulpho-aluminate. Its formula is as follows:



Q.28 Mention the cement industry in Pakistan:

Ans: There are 22 cement factories in private as well as public sector. Some of them work on the basis of wet process and other on the dry process.

PAPER INDUSTRY

Q.29 Define paper. Give important raw material for the manufacture of paper? (Multan 2011, Rwp. 2011, F. Abad 2012, F. Abad 2013)

Ans: Paper is a sort of material made up of a network of natural, celluloic fibre which have been deposited from aqueous structure. The raw material is of two types:

- (i) Woody raw material (ii) Non-woody raw material

Q.30 What is N.S.S.C. method for paper manufacture? What physical operations are performed?

Ans: It is neutral sulphite semi chemical process and following four physical operations are performed:

- (i) Dry cleaning
(ii) Washing
(iii) Heat treatment
(iv) Physical process for dewatering.

Q.31 What do you mean by dry cleaning in paper manufacture? (Rwp. 2006)

Ans: The air is blown into the raw material. It removes unwanted particles. Wheat grains are separated in the primary dry cleaners. In the secondary dry cleaning, we remove the lumps, dust and sand particles.

Q.32 What process is carried out during digestion in paper manufacture?

(Multan 2008, Rwp. 2011)

Ans: Na_2SO_3 is buffered with Na_2CO_3 and soda ash to have a pH of 7 – 9. The digester is closed carefully and it revolves at 2.5 rotation per minute. The temperature maintained is 160 – 180°C.

Q.33 What is lignin?

Ans: It is an aromatic polymer and it causes the paper to become brittle. It is consisted of 17 – 33 % of dry weight of wood.

Q.34 What are commonly used bleaching agents in paper manufacture?

(Rwp. 2010, Sargodha 2010, Guj. 2012, D.G. Khan 2013)

- Ans:** (i) Oxygen (ii) NaClO
(iii) H_2O_2 (iv) Ozone
(v) Chlorine (vi) ClO^\ominus

Q.35 What are the requirements to get high brightness of pulp during paper manufacture?

Ans: Enough chlorine is required for this purpose. The residence time for chlorine is 45 – 60 minutes and the temperature should be maintained at 45°C. After chlorination, the pulp is washed with hard water at 60°C.

Q.36 What are the major components of paper machine?

Ans: It is consisted of:

- (i) Flow spreader.
- (ii) Head box.
- (iii) Fourdrinier table.
- (iv) Press section.
- (v) Drier section.

Q.37 Mention the paper industry in Pakistan:

Ans: There are more than 30 paper and pulp industries in private as well as in the public sector.

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ANSWERS TO THE SHORT QUESTIONS

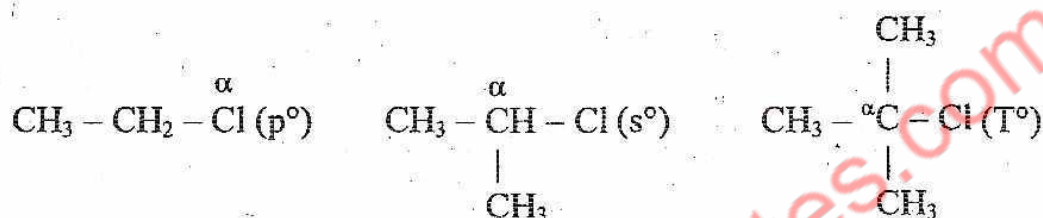
GENERAL FEATURES OF ALKYL HALIDES

Q.1 What are alkyl halides? Give their general formula and name two monohaloalkenes. (Sarg. 2010)

Ans. Those organic compounds which are derived from the hydrocarbons by the replacement of one or more hydrogen atoms by halogen atoms are called alkylhalides. They are represented by $R-X$ and the general formula is $C_nH_{2n+1}-X$. CH_3Cl , C_2H_5Br , C_3H_7I are mono halo alkanes.

Q.2 What are primary, secondary and tertiary alkyl halides? Give examples of each. (Faisalabad 2008, Multan 2012, Multan 2013, D.G. Khan 2013)

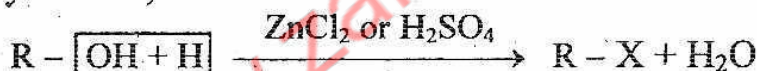
Ans. In primary alkyl halides, α -carbon has at least two hydrogen atoms, in secondary alkyl halides, α -carbon has only one hydrogen and in tertiary alkyl halides α -carbon has no hydrogen.



PREPARATIONS OF ALKYL HALIDES

Q.3 What are the necessary conditions to convert alcohols into alkyl halides by using halogen acids? (Lahore 2008, Lahore 2010, Lahore 2012, F. Abad 2013)

Ans. Alcohols are reacted with halogen acids in the presence of $ZnCl_2$ or H_2SO_4 to get alkyl halides,

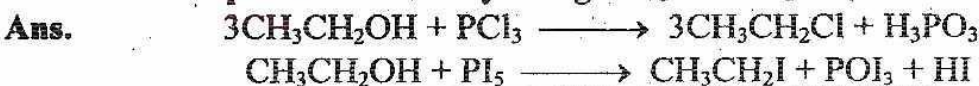


Q.4 $SOCl_2$ is the best reagent to get alkyl halides from alcohols. Which solvent is necessary to complete this reaction?

(Lahore 2008, Guj. 2010, Lahore 2012)

Ans. Alcohols react with $SOCl_2$ to give alkyl chlorides in the presence of pyridine. HCl and SO_2 are gaseous products which are evolved automatically and pure alkyl chloride is obtained. So, this is one of the best methods.

Q.5 Convert to get alkyl chlorides to get alkyl chlorides ethyl alcohol into their respective halides by using PCl_3 and PI_5 . (Lahore 2008, Lahore 2012)

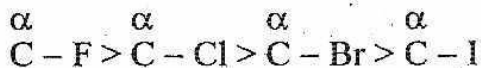


REACTIONS OF ALKYL HALIDES

Q.6 Which two factors are responsible for reactivity of alkyl halides as compared to alkanes? (Faisalabad 2010, Guj. 2012)

Ans. (i) Bond dissociation energy (ii) Polarity

The bond dissociation energy of $C - X$ bond is in the order.



α
It means C – I bond can be broken very easily, so iodides are very reactive substances. In alkanes there is no polarity.

Q.7 Define and give one example of each. (i) Nucleophile (ii) Leaving group

Ans. Nucleophile: (F. Abad 2012, Lahore 2013, D.G. Khan 2013)

Those species which are electron efficient and they donate their electron pairs to make a covalent bond are called nucleophiles.

Examples:

$\text{Cl}^\ominus, \text{Br}^\ominus, \text{I}^\ominus, \text{OH}^\ominus, \text{CN}^\ominus, \text{NO}_2^\ominus, \text{HS}^\ominus, \text{C}_2\text{H}_5\text{O}^\ominus, \text{CH}_3\text{O}^\ominus, \text{SCN}^\ominus, \text{H}_2\text{O}, \text{NH}_3, \text{NH}_2^\ominus$ etc.

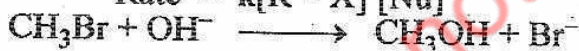
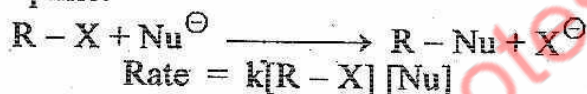
Leaving group or nucleophile:

The halogen ion which breaks the bond from α -carbon is called leaving group or nucleophile.

Q.8 Give the general pattern of the reaction of SN_2 -mechanism. What is its rate expression? Give examples.

(Lahore Board 2007, Guj. 2008, Rwp. 2010, D. G. Khan 2011, Guj. 2012, Multan 2013)

Ans. SN_2 reaction takes place in one step in which the attack of the attacking nucleophile and the leaving of the leaving nucleophile takes place simultaneously. Its rate depends upon the concentration of substrate and the attacking nucleophile.



Q.9 Give the general pattern of reaction of SN_1 mechanism. Why tertiary alkyl halides give this mechanism? (Multan 2006, Guj. 2013)

Ans. In SN_1 mechanism, the reaction takes place in two steps.

In the first step $\text{C}^\alpha - \text{X}$ bond breaks and in the second step, the attacking nucleophile attacks the carbonium ion. Tertiary carbonium ion is more stable than secondary and primary, so tertiary alkyl halides can give this mechanism.

Q.10 What is the role of steric hinderance to decide about SN_1 and SN_2 mechanisms?

Ans. If big groups are attached at the α -carbon of alkyl halides, the backside attack for the attacking nucleophile becomes difficult. For this reason, SN_2 mechanism is favoured rather than SN_1 .

Q.11 What is the role of stability of carbonium ion for determining SN_1 or SN_2 mechanism? (Guj. 2006)

Ans. Greater the stability of the carbonium ion, greater the possibility for two step mechanism which is SN_1 . These alkyl halides which can provide unstable carbonium ion give SN_2 mechanism, which is a single step reaction.

Q.12 How do you compare SN_1 and SN_2 mechanism?

Ans. SN_1 mechanism is in two steps, while SN_2 is in a single step. The rate of SN_1 is controlled by only one molecule. Tertiary alkyl halides mostly give SN_1 while primary give SN_2 .

Q.13 What are elimination reactions? Give examples of E_1 and E_2 .

(Bahawalpur 2006, Sargodha 2008, F. Abad 2008, Multan 2008, Lahore 2012)

Ans. E_1 stands for elimination unimolecular and tertiary alkyl halide give this reaction to give alkenes. E_2 is elimination of bimoleculars in which primary alkyl halides gives alkenes in one step.

Q.14 How tetraethyl lead can be prepared from an alkyl halide?

(Faisalabad 2008)

Ans. When ethyl chloride is reacted with Na_4Pb , tetraethyl lead is produced.



GRIGNARD'S REAGENT

Q.15 How the nature of alkyl group changes when alkyl halide is converted to Grignard's reagent? (Sargodha 2011, D.G. Khan 2013)

Ans. In alkyl halides, the alkyl group is electrophilic in character because the α -carbon bears the partial positive charge. When it is converted to Grignard's reagent, the α -carbon develops the partial negative charge and the alkyl group becomes nucleophilic in character.

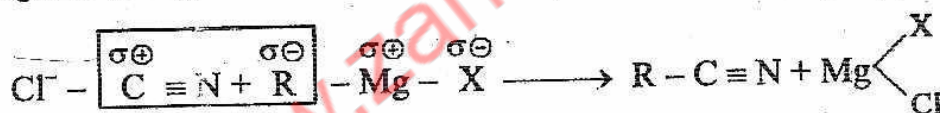
Q.16 Why dry ether is necessary for the preparation of Grignard's reagent?

(Multan 2012, D.G. Khan 2013)

Ans. If ether is wet, the water molecules react with Grignard's reagent to give alkanes and so Grignard's reagent is destroyed. Actually water is an active hydrogen compound for Grignard's reagent.

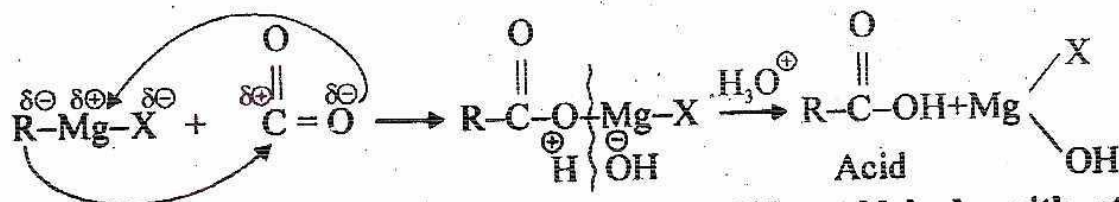
Q.17 How do we get alkyl nitriles from Grignard's reagent? (F. Abad 2012)

Ans. When $\text{Cl}-\text{CN}$ is reacted with Grignard's reagent, the alkyl group of the Grignard's reagent combines with $-\text{CN}$ group to give alkyl nitrile.



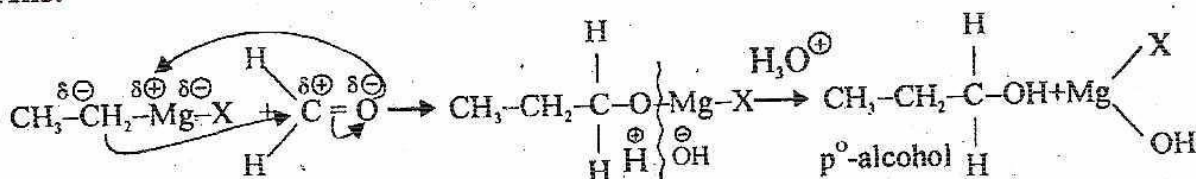
Q.18 Give the mechanism for the addition of Grignard's reagent at CO_2 to give carboxylic acids. (Mirpur 2006, F. Abad 2012, Multan 2013)

Ans. The mechanism is as follows:



Q.19 Give the mechanism for the reaction of formaldehyde with ethyl magnesium bromide. (Lahore 2008, F. Abad 2012, F. Abad 2013, D.G. Khan 2013)

Ans.



[illegible]
$$\begin{array}{c} \delta^- \delta^+ \delta^- \delta^+ \\ \text{R}-\text{Mg}-\text{X} \end{array} + \begin{array}{c} \text{CH}_3 \\ \diagup \\ \text{C}=\text{O} \\ \diagdown \\ \text{CH}_3 \end{array} \longrightarrow \begin{array}{c} \text{CH}_3 \\ | \\ \text{R}-\text{C}-\text{O} \\ | \\ \text{CH}_3 \end{array} \left\{ \begin{array}{c} \oplus \\ \text{H} \end{array} \right\} \begin{array}{c} \ominus \\ \text{OH} \end{array} \text{Mg}-\text{X} \longrightarrow \begin{array}{c} \text{CH}_3 \\ | \\ \text{R}-\text{C}-\text{OH} \\ | \\ \text{CH}_3 \end{array} + \begin{array}{c} \text{X} \\ | \\ \text{Mg} \\ | \\ \text{OH} \end{array}$$

T°-alcohol

$$\begin{array}{c}
 \delta^- \quad \delta^+ \\
 R-Mg-X + CH_2-CH_2 \longrightarrow R-CH_2-CH_2-O-\left\{ \begin{array}{l} Mg-X \\ H^+ \quad OH^- \end{array} \right. \\
 \downarrow \\
 R-CH_2-CH_2-OH-Mg \begin{cases} X \\ OH \end{cases} \\
 \text{p}^\circ\text{-alcohol}
 \end{array}$$

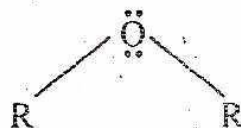
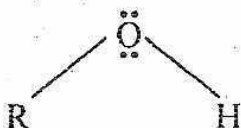
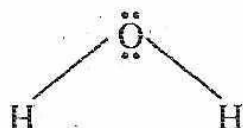
ANSWERS TO THE SHORT QUESTIONS

GENERAL FEATURES

Q.1 What is the similarity of water with alcohols, phenols and ethers?

(Guj. 2006, Faisalabad 2008)

Ans: In all these compounds, the central oxygen is sp^3 -hybridized and two lone pairs are present on oxygen. They have bent structures.



Q.2 Define and give examples for each of monohydric, dihydric and trihydric alcohols.

(Guj. 2006, Multan 2011, Lahore 2012, Multan 2013, D.G. Khan 2013)

Ans:

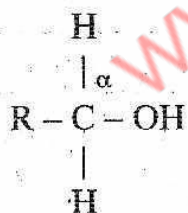
(i) Monohydric alcohols have only one-OH group as (CH_3-OH , C_2H_5-OH).

(ii) Dihydric alcohols have two-OH groups, as glycol $\begin{pmatrix} CH_2 - CH_2 \\ | \quad \quad | \\ OH \quad \quad OH \end{pmatrix}$

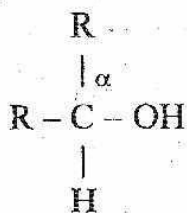
(iii) Trihydric alcohols have three-OH groups, as glycerol $\begin{pmatrix} CH_2 - CH - CH_2 \\ | \quad \quad | \quad \quad | \\ OH \quad \quad OH \quad \quad OH \end{pmatrix}$.

Q.3 How primary, secondary and tertiary alcohols are different from each other in structures? (Multan 2011, Lahore 2012, Lahore 2013, D.G. Khan 2013)

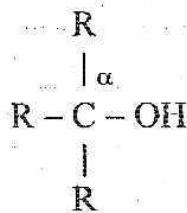
Ans: The structures are as follows:



p° -alcohol



S° -alcohol



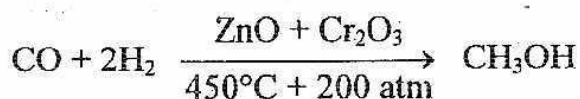
T° -alcohol

PREPARATION OF CH_3OH AND CH_3CH_2OH

Q.4 How water gas is converted into methyl alcohol, on commercial scale?

(Lahore 2012, Lahore 2013)

Ans: Water gas is obtained from coke and steam at $1000^\circ C$. This water gas is treated with ZnO and Cr_2O_3 , at $450^\circ C$ and 200 atm. pressure to give CH_3-OH on commercial scale.



Q.5 What is fermentation of alcohols? Give the necessary conditions for fermentation.

(Bahawalpur 2006, F. Abad 2008, Guj. 2008, Mirpur 2011, F. Abad 2012, Multan 2013)

Ans: The process of conversion of starch and sugar to ethyl alcohol under the influence of yeast is called fermentation. There should be proper aeration. The solution should be dilute and there should be no preservative for fermentation purposes.

Q.6 What is raw material for the manufacture of ethyl alcohol on the commercial scale? (Mirpur 2011)

Ans: Ethyl alcohol can be prepared by the fermentation of cane juice, beets, dates, molasses and fruit juices. These substances have fermentable sugars.

Moreover, potatoes, rice, barley and maize contain starch which give alcohol on fermentation.

Q.7 Absolute alcohol cannot be prepared by fermentation process. Why?

(Sargodha 2008, Multan 2009, Lahore 2009, Faisalabad 2010, D.G. Khan 2011, Mirpur 2011, Faisalabad 2011, Lahore 2012, F. Abad 2013)

Ans: Absolute alcohol cannot be prepared by fermentation process. Actually 14% alcohol is obtained in fermentation process which can be concentrated up to 95%. 95% alcohol forms azeotropic mixture which cannot be further concentrated by distillation. Anyhow, lime is used to concentrate alcohol further.

Q.8 What is rectified spirit, commercial alcohol and absolute alcohol?

(Sargodha 2008)

Ans: 95% ethyl alcohol is called rectified spirit. It is also called commercial alcohol. It is converted to 99.9% alcohol by distilling it in the presence of CaO. This is called absolute alcohol.

Q.9 What do you mean by denaturing of alcohol?

(D. G. Khan 2011, Guj. 2012, D.G. Khan 2013)

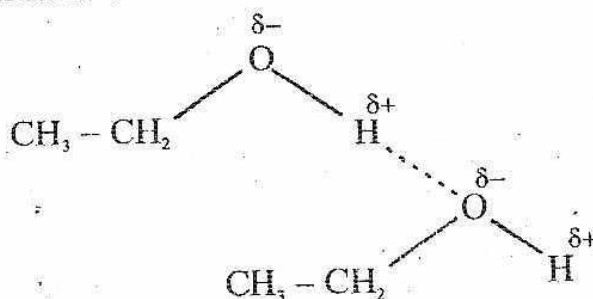
Ans: Alcohol is denatured by the addition of 10% methanol. In this way, it becomes poisonous and becomes unfit for drinking purpose. This is called methylated spirit. A small quantity of pyridine or acetone may be added for denaturing.

REACTIONS OF ALCOHOLS

Q.10 Ethyl alcohol is a liquid while ethyl chloride is a gas. Give reason.

(Rwp. 2008)

Ans: Ethyl alcohol has OH group in it which is responsible for hydrogen bonding among the molecules of alcohols.



In case of ethyl chloride there is no hydrogen bonding. Hydrogen bonding is responsible to make ethyl alcohol liquid at room temperature. But ethyl chloride remains a gas.

Q.11 Why ethanol has higher boiling point than diethyl ether.

Ans: Ethanol has a hydrogen bonding among the molecules. For this reason it has a higher boiling point than that of ether. Ether is a non-polar molecule and there is no hydrogen bonding in it.

Q.12 Why alcohols are miscible with water? (Faisalabad 2008)

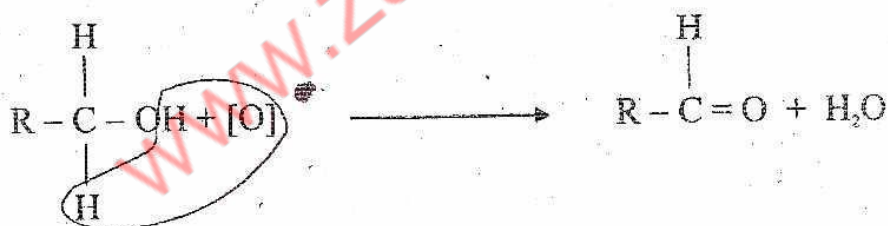
Ans: Water has two partial positive hydrogen atoms and alcohol have one. So, there is hydrogen bonding in them which makes them miscible.

Q.13 What is esterification? Give the reaction conditions for this reaction: (Bahawalpur 2011)

Ans: The reaction of carboxylic acids with alcohols in the presence of an acid as a catalyst give us esters and water. This is a reversible reaction and is called esterification.

Q.14 How the strong oxidizing agents affect the primary and secondary alcohols? (Mulan 2011, Multan 2012)

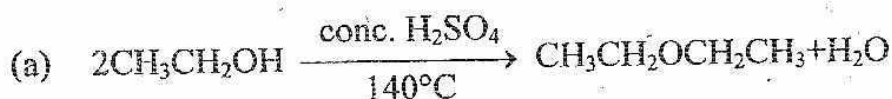
Ans: The strong oxidizing agents like acidified KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ release atomic oxygen. That atomic oxygen converts primary alcohols into aldehydes, secondary alcohols into ketones and tertiary alcohols into alkenes.



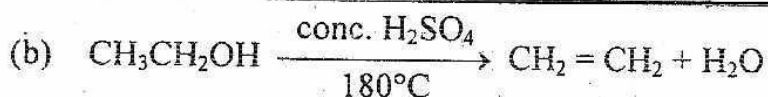
Here $\text{R} = -\text{CH}_3$ or $-\text{CH}_2\text{CH}_3$

Q.15 Ethanol gives different products with conc. H_2SO_4 under different conditions. (Rawalpindi 2008, Sargodha 2011, F. Abad 2012, Guj. 2013)

Ans: Ethanol gives two types of products when treated with concentrated H_2SO_4 .



In this way diethyl ether is produced at 140°C .



In this way ethene is produced by the removal of water from single molecule of alcohol.

Q.16 What are the dehydrogenation products of primary and secondary alcohols in the presence of copper?

Ans: When primary and secondary alcohols are heated at 300°C in the presence of copper, primary alcohols are converted into aldehydes, secondary alcohols into ketones and tertiary alcohols into alkenes.

Q.17 What is Lucas test, which is used to distinguish between primary, secondary and tertiary alcohols? (Gujranwala 2010, Sarg. 2010)

Ans: When primary, secondary and tertiary alcohols are treated with HCl in the presence of ZnCl_2 , tertiary alcohols give the oily liquids immediately. Secondary alcohols give the reaction within 5 – 10 minutes and primary alcohols do not give the reaction at room temperature.

DISTINCTIONS

Q.18 How haloform reaction can be used to distinguish between certain alcohols? (Rwp. 2011, Bahawalpur 2011, Lahore 2012)

Ans: All those primary or secondary alcohols which on oxidation give methyl aldehyde or methyl ketones give the haloform reaction, e.g: $\text{C}_2\text{H}_5\text{-OH}$, $\text{CH}_3\text{-CH(OH)-CH}_3$ etc. give the haloform reaction.

|
OH

Q.19 How iodoform test can be used to distinguish between methyl alcohol and ethyl alcohol?

(Guj. 2006, Rwp. 2008, Lahore 2008, 2011, Bahawalpur 2011, Lahore 2012)

Ans: Ethyl alcohol upon oxidation give CH_3CHO . It is an aldehyde having $-\text{CH}_3$ with $-\text{C}=\text{O}$ group and can give the iodoform reaction. Methyl alcohols

give formaldehyde, on oxidation so it will not give haloform reaction. It has no methyl group which can be converted to iodoform.

USES OF ALCOHOLS

Q.20 Give the uses of methyl alcohol?

Ans: Methyl alcohol is used as a solvent for oils, fats, paints and varnishes. It is antifreeze for automobile radiators. It is used for the denaturing of alcohols. It is used for the manufacture of formaldehyde, drugs and perfumes.

Q.21 Give the uses of ethyl alcohol?

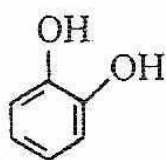
(Guj. 2012)

Ans: It is used as a solvent for paints, drugs, oils, perfumes, dyes, varnishes, medicines and gums. It is used for the preservations of biological specimens and as an antifreeze for automobile radiators. It is used as a petrol substitute and as a fuel in spirit lamps and stoves.

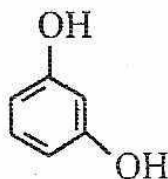
PHENOLS

Q.22 What are three important dihydroxy benzenes? Give their IUPAC names and old names:

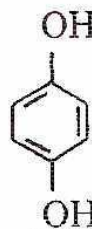
Ans:



1, 2-Dihydroxybenzene
(Catechol)



1, 3-Dihydroxybenzene
(Resorcinol)



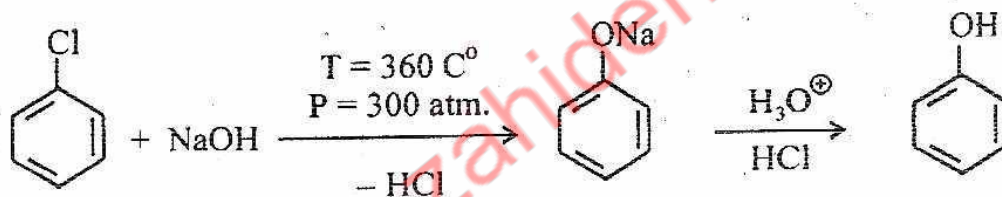
1, 4-Dihydroxybenzene
(Hydroquinone)

PREPARATION OF PHENOL

Q.23 How chlorobenzene is converted into phenol?

(Bahawalpur 2011, Faisalabad 2011, Lahore 2012)

Ans:

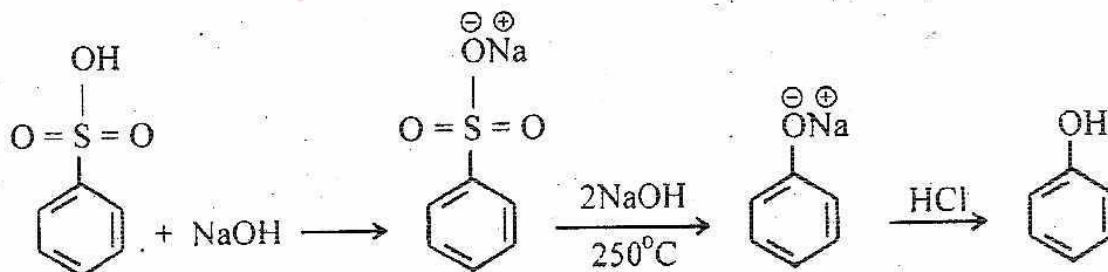


(Down's process)

Q.24 How benzene sulphonic acid can be converted into phenol?

(Rwp. 2008, Bahawalpur 2011)

Ans:



PHYSICAL PROPERTIES

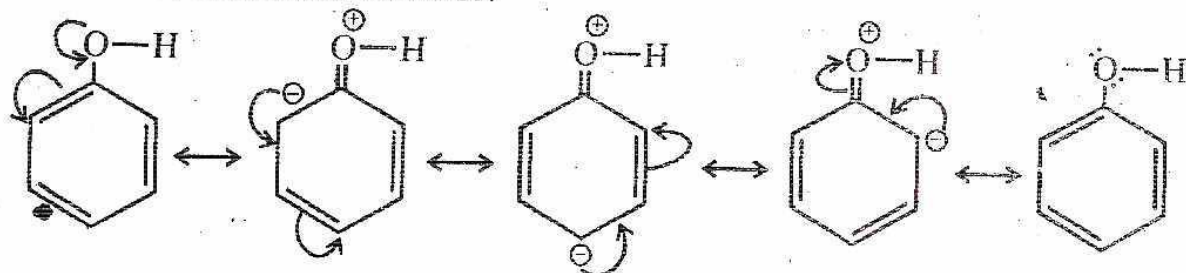
Q.25 Give physical properties of phenol:

Ans: It is colourless hygroscopic crystalline solid, melts at 4°C and boils at 182°C. It is partially miscible with water and readily soluble in alcohol. It is a poisonous substance and produces painful blisters in contact with the skin.

ACIDIC NATURE

Q.26 Why phenol is acidic, but alcohol is not? (F. Abad 2006, Fed. 2006, Sargodha 2006, Sargodha 2008, Guj. 2008, Lahore 2008, Multan 2008, Mirpur 2009, Fd. Abad 2009, Lahore 2010, Sargodha 2011, Mirpur 2011, F. Abad 2012, Multan 2012, F. Abad 2013)

Ans: The resonance structure of phenol develop the positive charge on oxygen which repels the partial positive hydrogen. In this way, phenol acts as an acid. Alcohol can not do so.



Q.27 How the resonance structures of phenoxide ion make phenol acidic?

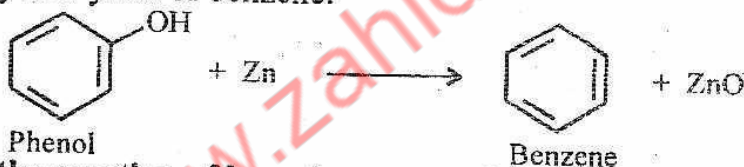
Ans: When phenol gives the protons, phenoxide ion which is produced develops the five resonance structures and attains the stability. It favours the reaction to the forward direction and makes the phenol to release the proton.

PROPERTIES OF PHENOL

Q.28 How phenol can be converted into benzene?

(Multan 2008, F. Abad 2008, Sargodha 2011, Guj. 2012)

Ans: When phenol is distilled with zinc dust, benzene is produced. This reaction has a very low yield of benzene.



Q.29 What is the reaction of bromine water with phenol?

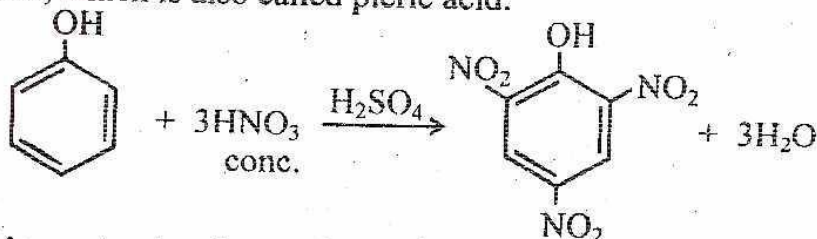
How it helps to distinguish between phenol and alcohol?

(Multan 2008, Guj. 2010)

Ans: When bromine water reacts with phenol, tribromophenol is produced which settles down in the form of white ppt. So phenol can be distinguished from other substances by this reaction.

Q.30 Conc. HNO_3 reacts with phenol to give picric acid? How?

Ans: When conc. HNO_3 at 100°C is reacted with phenol, trinitrophenol is produced, which is also called picric acid.



Q.31 What important polymer is produced by the reaction of phenol with methanal?

(Lahore 2007, Sargodha 2008, Multan 2012, Guj. 2013)

Ans: When phenol is reacted with methanal solution, ortho and para positions of phenols are occupied by $-\text{CH}_2-\text{OH}$ group. These compounds condense with each other to give a polymer called bakelite.

Q.32 Give the uses of phenol.

(Lahore 2008)

Ans: Phenol is used to produce bakelite drugs, phenolphthalene and explosives. It is used as a wood preservative, in herbicides and in antiseptic.

Q.33 How do you compare phenol and ethyl alcohol?

(Rawalpindi 2006, Multan 2006, Mirpur 2011)

Ans: NaOH and FeCl_3 react with phenol but not with alcohol. Phenol does not react with carboxylic acids and halogen acids but alcohols do. Phenols react with diazonium salts to give dyes, but alcohols do not give this reaction.

ETHERS

Q.34 What is Williamson's synthesis of ethers?

(Guj. 2010, Multan 2011, D.G. Khan 2013)

Ans: When alcohols and alkyl halides are reacted with sodium metal, ethers are produced.



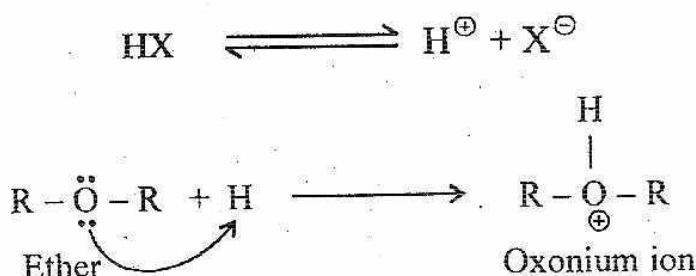
Q.35 How silver oxide reacts with alkyl halides to give ethers?

Ans: Reaction is as follows:

Q.36 How do acids react with ethers to give oxonium ions?

(Mirpur 2011, D.G. Khan 2013)

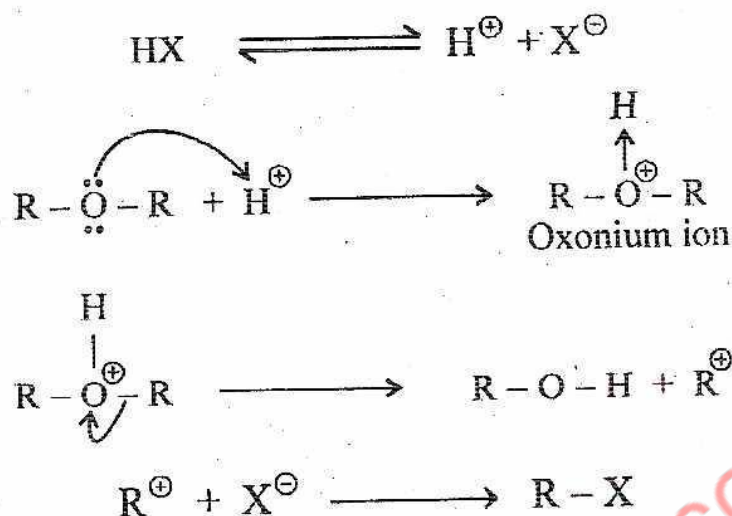
Ans: The one pair present on the oxygen of ether is donated to H^+ and oxonium ion is produced.



Q.37 Give the mechanism of the reaction of halogen acids with ethers:

(Mirpur 2011, Lahore 2012, D.G. Khan 2013)

Ans:



Q.38 Give the uses of diethyl ether:

Ans: Ether is used as a general anaesthetic and as refrigerant. It can act as a solvent for the extraction of organic compounds, and can dissolve fats, oils and resins. It is a substitute of petrol by mixing with alcohol. It is used as a perfumery and the manufacture of smokeless gun powder.

Q.39 What are mixed ethers? Give examples.

(Sarg. 2010)

Ans: Those ethers in which two alkyl or aryl groups attached with oxygen atom are not alike are called mixed ethers.



Q.40 Ethers belong to an inert class of organic compounds. Discuss.

(Lahore 2011)

Ans: Ethers and alcohols are alkyl derivatives of water. Ethers have least hydrogen bonding and little tendency break C - O bond as compared to alcohols and water, which have O - H bonds in them. Actually alkyl groups are dominants and they show their properties.

Q.41 Ethers are less reactive than alcohols. Justify.

(D. G. Khan 2011)

Ans: Ethers and alcohols are alkyl derivatives of water. Ethers have least hydrogen bonding and little tendency break C - O bond as compared to alcohol and water which have O - H bonds in them.

ANSWERS TO THE SHORT QUESTIONS

GENERAL FEATURES OF ALDEHYDES AND KETONES

Q.1 How aldehydes and ketones occur in nature?

Ans: (a) Aldehydic group is present in most of the sugars.

(b) Aldehydes are the principal constituents of a number of essential oils

(c) The essential oils are used as fragrances and flavours.

Q.2 What are those factors which make aldehydes more reactive than ketones? (Sargodha 2010)

Ans: The presence of hydrogen atom with the carbonyl group in aldehydes makes less steric hinderance as compared to ketone.

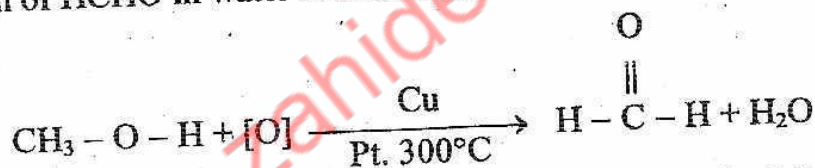
In ketones, the alkyl groups are electron-donating and they decrease the electrophilic character of carbonyl carbon atom.

PREPARATION OF ALDEHYDES

Q.3 How formalin is prepared on the commercial scale from methyl alcohol?

(Lahore 2011, Multan 2011, F. Abad 2012, Lahore 2013, D.G. Khan

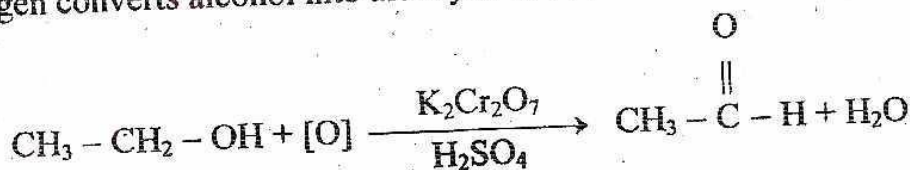
Ans: Mixture of methyl alcohol vapours and air is passed over platinized asbestos at 300°C. Sometimes, copper and silver catalysts are also used. The 40% solution of HCHO in water is called formalin:



Q.4 How acetaldehyde is prepared from ethyl alcohol in the laboratory?

(Multan 2011, F. Abad 2012, Multan

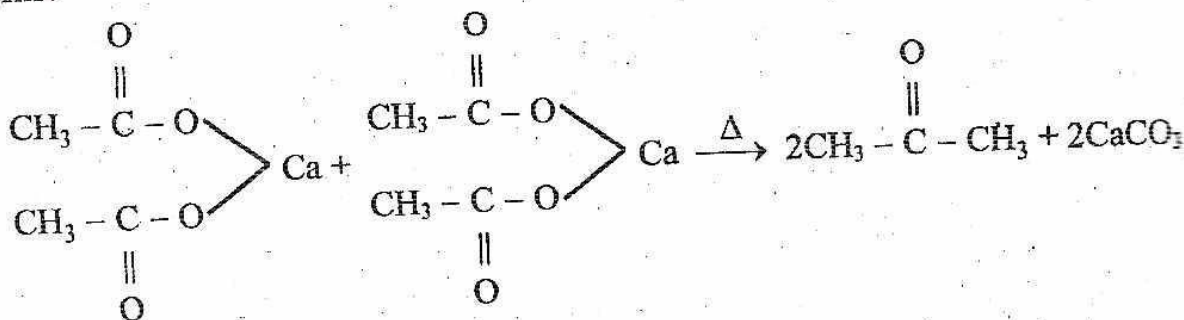
Ans: The oxidizing agents for ethyl alcohol is acidified $\text{K}_2\text{Cr}_2\text{O}_7$. The atomic oxygen converts alcohol into aldehyde at 500°C:



Q.5 Which product is obtained by heating calcium acetate?

(F. Abad 2012, Guj.

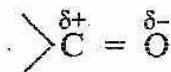
Ans:



PROPERTIES OF ALDEHYDES AND KETONES

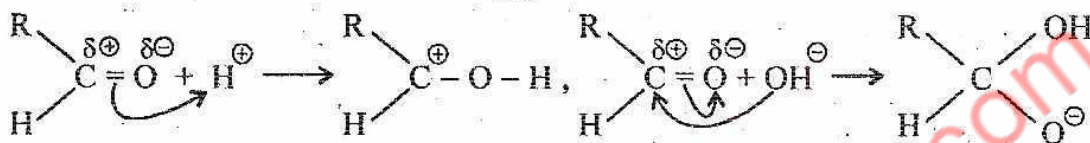
Q.6 What type of polarity is present in carbonyl group?

Ans: Carbonyl group is polar due to the difference of electronegativity between carbon and oxygen. so carbon becomes electrophilic center and the oxygen as nucleophilic center.



Q.7 How acids and bases acting as catalysts increase the reactivity of aldehydes and ketones? (Faisalabad 2010, Lahore 2013)

Ans: The H^+ ion of the acid attacks the nucleophilic oxygen of the carbonyl group and makes the carbonyl carbon atom as strong electrophilic center. It increases the reacting power of the carbonyl group. Similarly, bases increase the nucleophilic character of oxygen.



ADDITION REACTIONS

Q.8 Addition of HCN on aldehydes and ketones is a base catalyzed reaction. How? (Multan 2008, Sargodha 2009, 2010, Rwp. 2011)

Ans: Base dissociates the weak acid HCN to give CN^- . This CN^- attacks the carbonyl carbon atom of aldehydes and ketones to give addition compounds.

Q.9 HCN is not directly used in aldehydes and ketones. Give reasons.

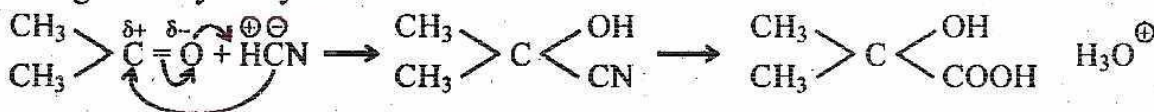
(D.G. Khan 2013)

Ans: HCN is a poisonous gas and it is difficult to handle it. NaCN and HCl are directly added to aldehydes and ketones which generate HCN in the vessel and is immediately consumed for the addition purposes.

Q.10 How α -hydroxy acids are produced from aldehydes and ketones?

(Multan 2008, Guj. 2010, Rwp. 2010, Bahawalpur 2011, Lahore 2012, Lahore 2013, D.G. Khan 2013)

Ans: HCN is added at the aldehydes and ketones. α -hydroxy cyanides are produced. These hydroxy cyanides are hydrolyzed with an acid or a base to give α -hydroxy acids.



Q.11 The addition product of an aldehyde and a ketone with NaHSO_3 is very useful reaction. Justify it; (Guj. 2012)

Ans: Bisulphite addition compounds of aldehydes and ketones are white ppts. So these ppts. are separated, treated with acids and are regenerated. In this way, separation can be done. Moreover, we can distinguish between methyl ketones and other ketones by this reaction.

Q.12 Why NaHSO_3 does not give the reaction with 2-pentanone?

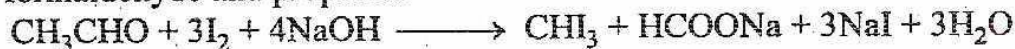
Ans: 2-Pentanone is such a ketone in which both the alkyl groups are big sized. Due to steric hinderance, NaHSO_3 feels difficulty for adding at such a ketone.

HALOFORM REACTION

Q.18 How iodoform is prepared from ethanol and acetaldehyde?

(Lahore 2010, Multan 2011, Guj. 2012, D.G. Khan 2013)

Ans: Acetaldehyde has one methyl group attached with the carbonyl group which is converted into iodoform. No such methyl group is present in formaldehyde and propanal.



Actually ethanol is first oxidized to CH_3CHO with I_2 and NaOH .

Q.19 Only methyl ketones are able to give haloform reaction, but other ketones do not. Give reasons: (Faisalabad 2011)

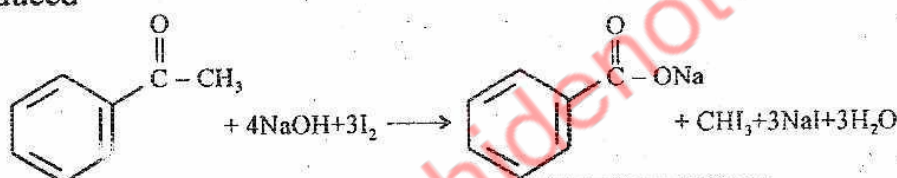
Ans: The $-\text{CH}_3$ group attached with the carbonyl group is converted to CHX_3 . Other methyl groups cannot be converted into such compounds.

Q.20 With the haloform reaction we can decrease the number of carbon atoms in aldehydes and ketones. Give reasons:

Ans: One of the carbon atoms of aldehydes and ketones which is present in the form of CH_3 -group is detached from the molecule and CHX_3 is produced. The rest of the portion of the molecule is converted to carboxylic acids with one carbon atom less than the original aldehyde or ketone.

Q.21 How acetophenone can be converted into sodium salts of benzoic acid?

Ans: When acetophenone undergoes haloform reaction, sodium benzoate is produced



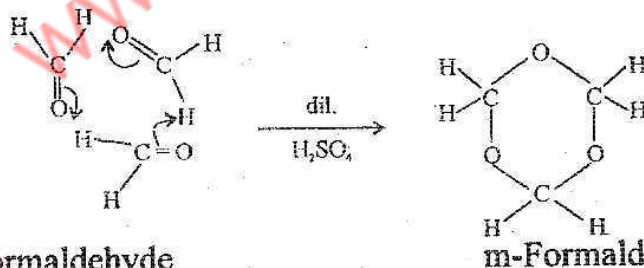
POLYMERIZATION REACTIONS

Q.22 Polymerization of formaldehyde gives six membered cyclic compounds.

Justify it.

(Multan 2012, Guj. 2013)

Ans:

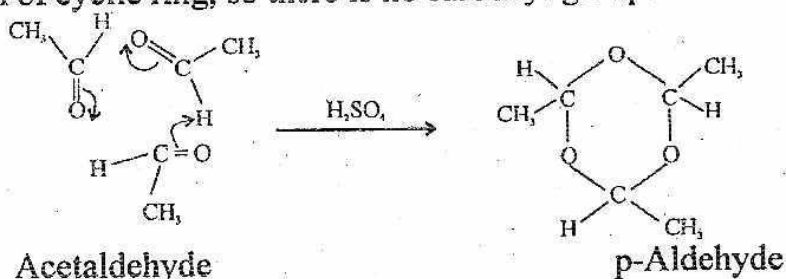


Formaldehyde

m-Formaldehyde

Q.23 Justify that the carbonyl group of acetaldehyde is no more there is its polymer i.e. paraldehyde. (Multan 2012)

Ans: Actually, the double bond of the carbonyl functionality helps in the formation of cyclic ring, so there is no carbonyl group.



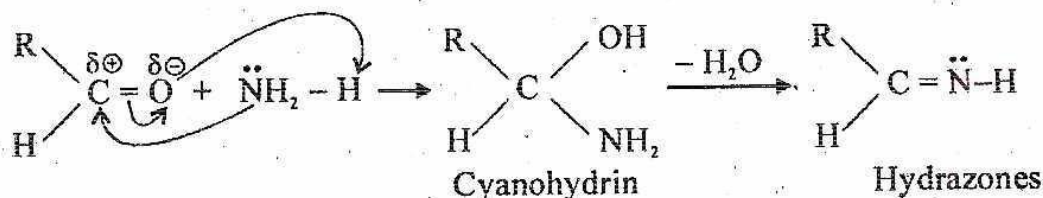
Acetaldehyde

p-Aldehyde

REACTIONS WITH NH₃ AND ITS DERIVATIVES

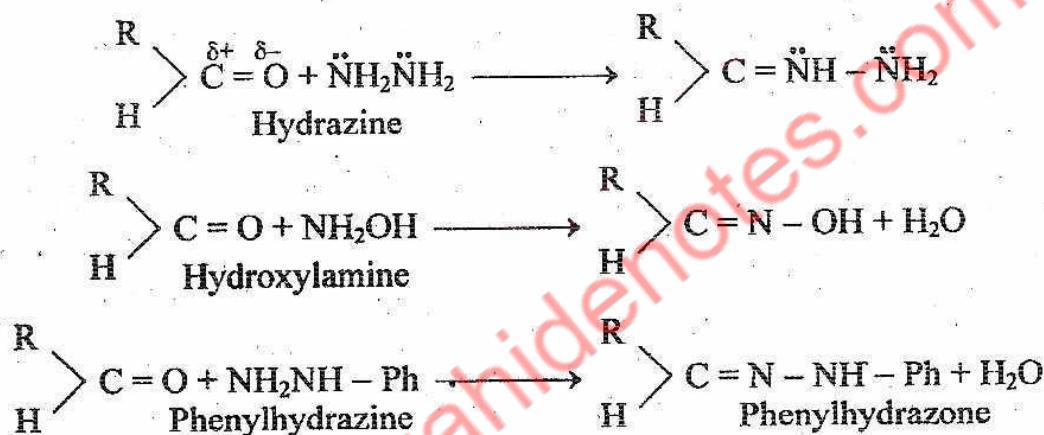
Q.24 NH₃ reacts with aldehydes and ketones to give cyanohydrins and then hydrazones. Justify it:

Ans:



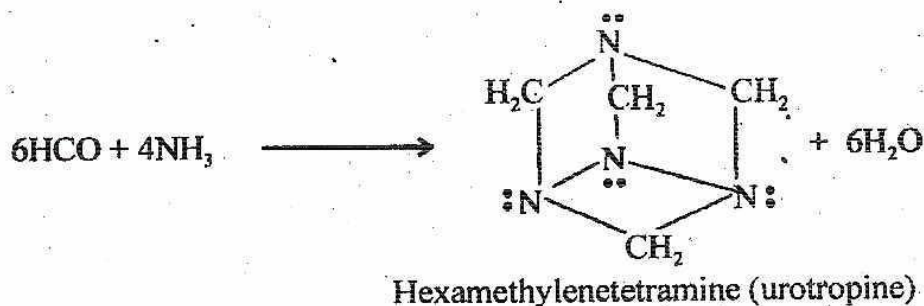
Q.25 The reactions of hydroxylamine, hydrazine and phenyl hydrazine with aldehydes and ketones are just like the reactions of NH₃ with aldehyde and ketone?
(Guj. 2008, Mirpur 2011, Lahore 2013)

Ans:



Q.26 NH₃ reacts with formaldehyde in different manner from other aldehydes and ketones. Justify it.

Ans: NH₃ reacts with formaldehyde to give hexamethylenetetramine.



Q.27 2, 4-Dinitrophenylhydrazine can be used to have a distinction between aldehydes and ketones from other organic compounds:

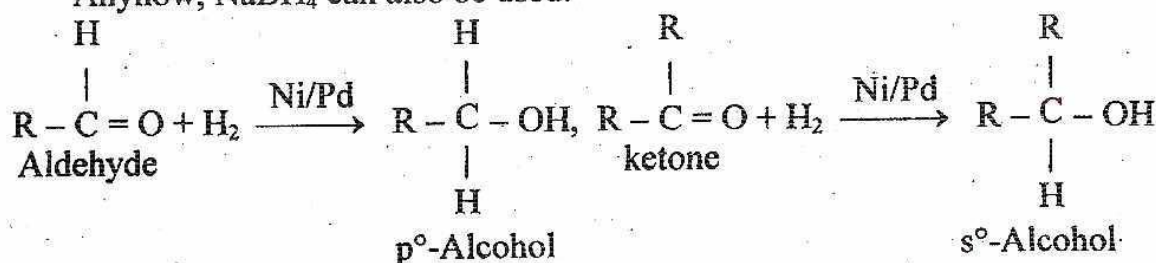
Ans: 2, 4-Dinitrophenyl hydrazine reacts with aldehydes and ketones to give deep yellow colour ppt., but other compounds can not do so.

REDUCTION REACTIONS

Q.28 How the reduction process of aldehydes and ketones give alcohols?

(Lahore 2013)

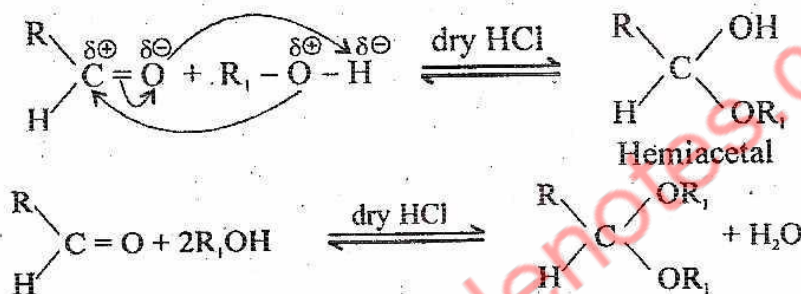
Ans: When aldehydes and ketones are reduced with hydrogen in the presence of a catalyst, primary and secondary alcohols are produced respectively. Anyhow, NaBH_4 can also be used.



Q.29 How aldehydes react with alcohols to give hemiacetals and acetals.

(F. Abad 2013, D.G. Khan 2013)

Ans:



OXIDATION OF ALDEHYDES AND KETONES

Q.30 Which are those weak oxidizing agents which can oxidize aldehydes but not the ketones?

(Rawalpindi 2006, Sargodha 2008, Faisalabad 2010, Lahore 2013)

Ans: Tollen's reagent, Fehling's solution and Benedict's solution are weak oxidizing agents. They can oxidize aldehydes into corresponding carboxylic acids and ppts. are produced. Ketones do not give such reactions.

Q.31 Tollen's test is also called silver mirror test. Justify it.

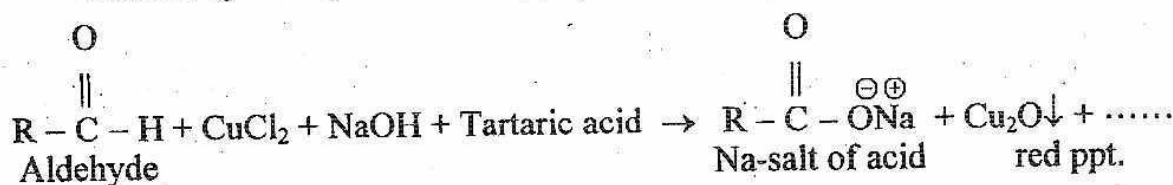
(Raw. 2006, Sargodha 2008, Bahawalpur 2011, Lahore 2013, Guj. 2013, F. Abad 2013, Multan 2013, D.G. Khan 2013)

Ans: Tollen's reagent is the ammonical solution of AgNO_3 and it is weak oxidizing agent. It is itself reduced into silver metal by aldehydes and silver metal is deposited in the form of mirror on the inner side of test tube.

Q.32 Fehling's solution reacts with aldehydes to give red ppt. Justify it:

(Sargodha 2008, Guj. 2008, Bahawalpur 2011, Lahore 2012, F. Abad 2012, Lahore 2013, F. Abad 2013)

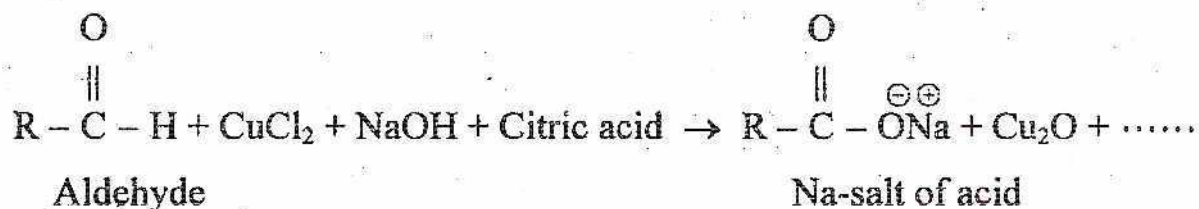
Ans: Fehling's solution is a mixture of CuCl_2 , NaOH and tartaric acid. It is reduced by aldehydes and red ppt. of Cu_2O is produced



Q.33 Benedict's solution reacts with aldehydes to give red ppt. Justify it:

(Sargodha 2008, D.G. Khan 2013)

Ans: Benedict's solution is consisted of CuCl_2 , NaOH and citric acid. It is reduced into Cu_2O as red ppt. by aldehydes.



USES

Q.34 Give the uses of formaldehyde:

(Multan 2012, Guj. 2013)

Ans: Formaldehyde is used for the manufacture of Bakelite and dyes. It is used to prepare formalin, which is used as the antiseptic, disinfectant, germicide, fungicide and preservation of biological specimens. It is also used in the silvering of mirrors and many medicines.

Q.35 Give the uses of acetaldehyde.

(D.G. Khan 2013)

Ans: Acetaldehyde is used for the production of acetic acid, acetic anhydride, n-butanol, ethanol, vinyl acetate, paraldehyde and ethyl acetate. Moreover, we can prepare chloralhydrate and phenolic resins.

COMPARISONS

Q.36 How do you compare formaldehyde and acetaldehyde? (Lahore 2013)

Ans: Formaldehyde gives Cannizzaro's reaction, but acetaldehyde gives aldol condensation. Formaldehyde gives bakelite, but acetaldehyde can not do so.

Formaldehyde does not give haloform reaction, but acetaldehyde does.

Q.37 How do you compare aldehydes and ketones?

(D.G. Khan 2011, Sargodha 2011)

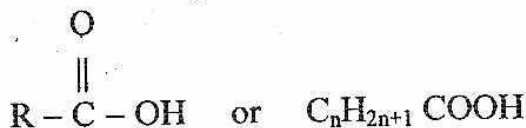
Ans: Aldehydes give silver mirror test, give red ppt. with Fehling's solution, and red ppt. with Benedict's solution, but ketones can not give these reactions. Moreover, aldehydes can polymerize but ketones cannot.

ANSWERS TO THE SHORT QUESTIONS

GENERAL FEATURES OF CARBOXYLIC ACIDS

Q.1 What are carboxylic acids? Give their general formula:

Ans: Those organic compounds which contain carboxyl function group in them are called carboxylic acids. Their general formula is:



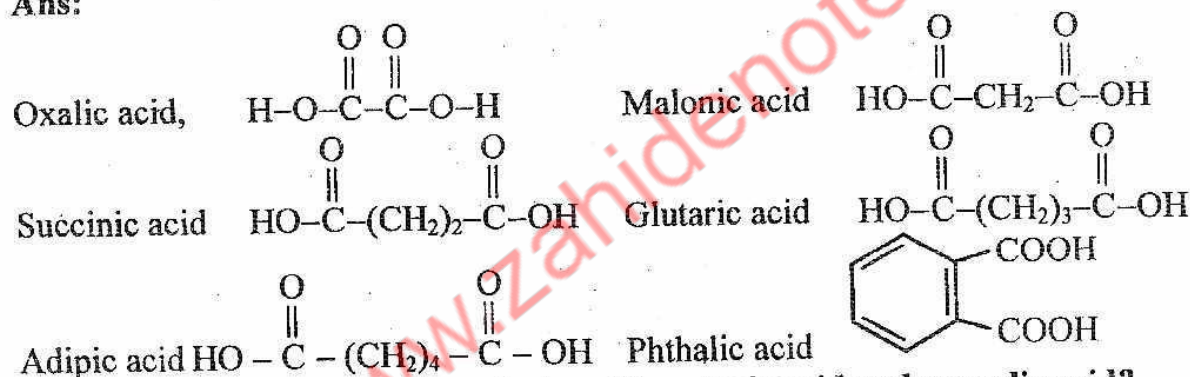
Q.2 How two functional groups create one functional group in carboxylic acids?

Ans: $-\text{COOH}$ is made up of $-\text{C}(=\text{O})-$ group and $-\text{OH}$ group. That is why, it is called carboxyl. This word is made up of carbonyl and hydroxyl.

Q.3 Name at least five dicarboxylic acids and give their formulas.

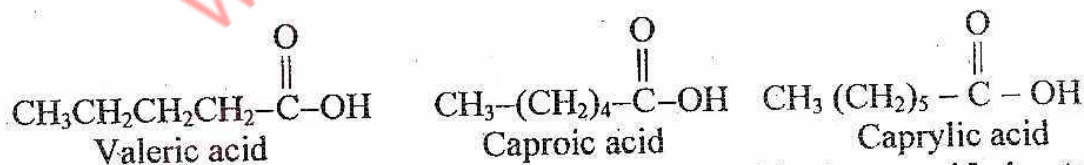
(Lahore 2012, Lahore 2013, D.G. Khan 2013)

Ans:



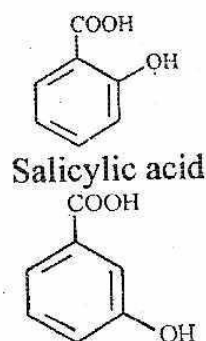
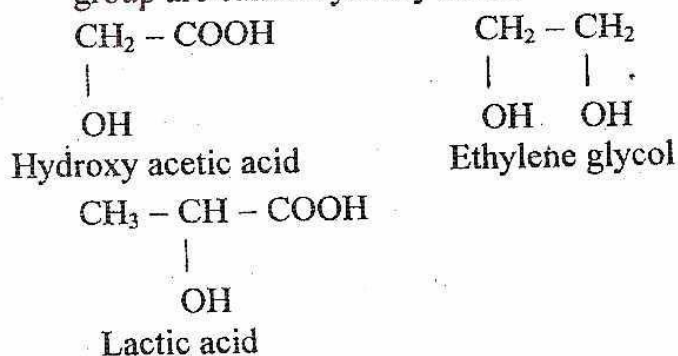
Q.4 Write the formulas for valeric acid, caproic acid and caprylic acid?

Ans:



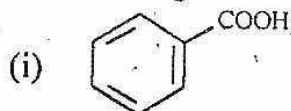
Q.5 What are hydroxy acids? Give four examples of hydroxy acids i.e. two from open chain and two from closed chain: (Sargodha 2010, Lahore 2012)

Ans: Those compounds in which $-\text{OH}$ group is present along with the carboxylic group are called hydroxy acids.

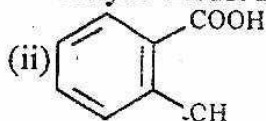


Q.6 What are aromatic carboxylic acids?

Ans: Those compounds in which $-\text{COOH}$ group is attached directly with the benzene ring are called aromatic carboxylic acids. For example



Benzoic acid



Salicylic acid

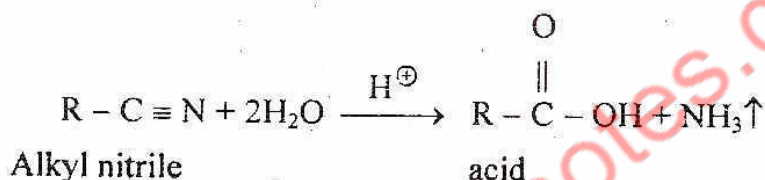
Q.6A What are fatty acids?

Ans: Those acids which are present in fats and oils. They have long chains of alkyl groups.

PREPARATION OF CARBOXYLIC ACIDS

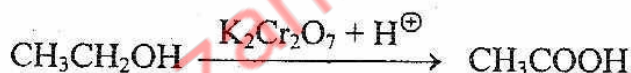
Q.7 How the hydrolysis of nitriles give carboxylic acids?

Ans: The hydrolysis of nitriles can be carried out in the presence of an acid or a base.



Q.8 How ethanol is converted to CH_3COOH .

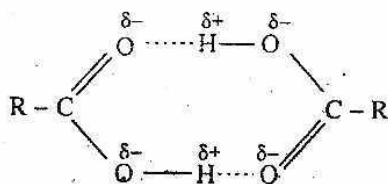
Ans: Simple oxidation of a p° -alcohol to corresponding acid takes place, with $\text{K}_2\text{Cr}_2\text{O}_7$ and an acid



PROPERTIES OF CARBOXYLIC ACIDS

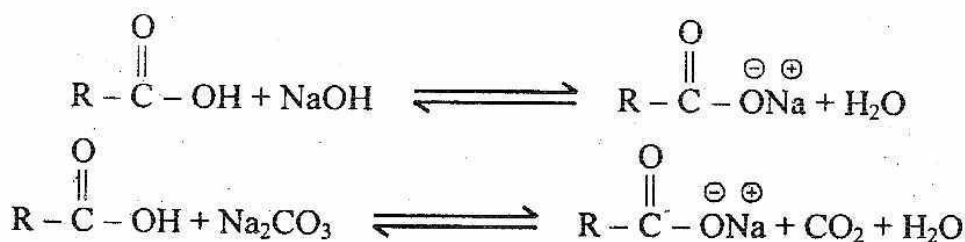
Q.9 What are dimers of carboxylic acids? Give examples: (Sargodha 2011)

Ans: Due to hydrogen bonding, two molecules of a carboxylic acid make eight-membered ring as follows:



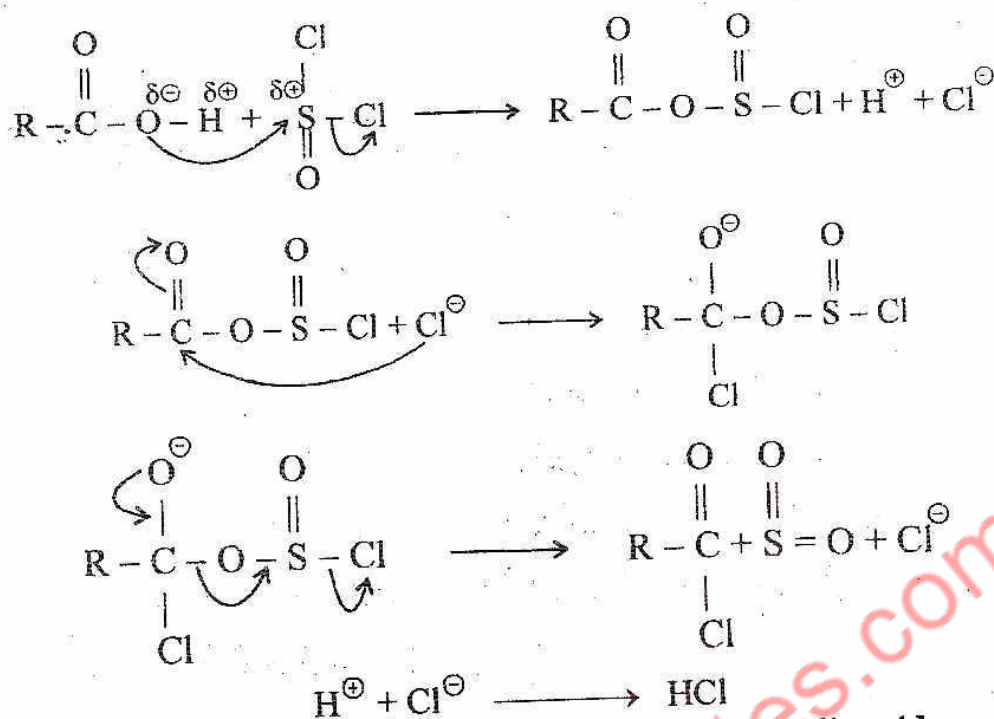
Q.10 Give two reactions of carboxylic acids which show their acidic nature:

Ans: Carboxylic acids react with metal hydroxide and metal carbonates to give the metal salts of carboxylic acids



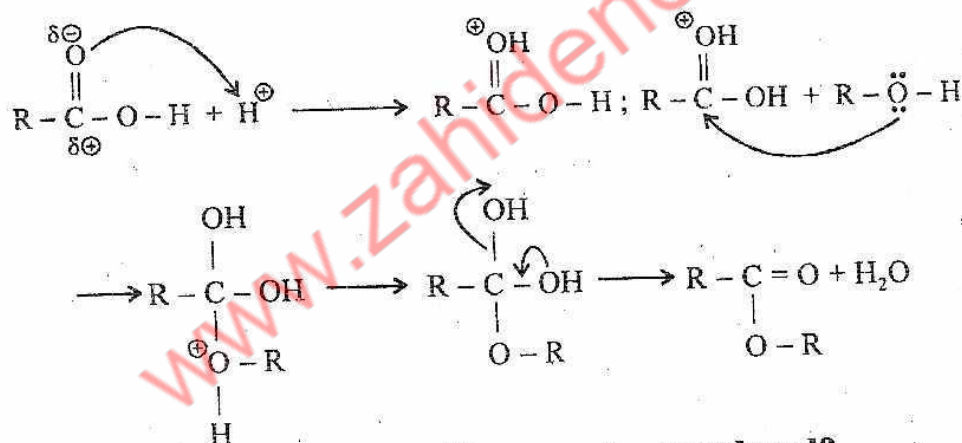
Q.11 Give the mechanism for the reaction of carboxylic acids with SOCl_2 to give acid chlorides. (Lahore 2010, Rwp. 2011)

Ans:



Q.12 Give the mechanism for the esterification of carboxylic acid:

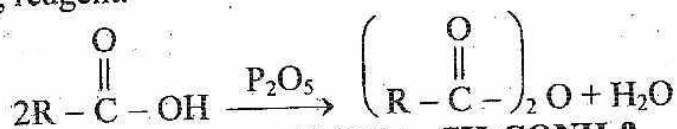
Ans:



Q.13 What are acid anhydrides and how are they produced?

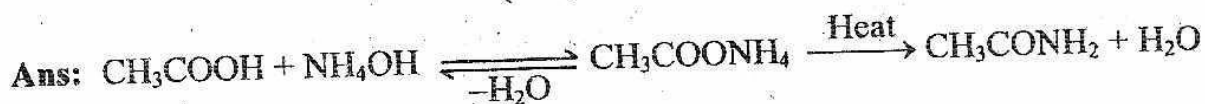
(Guj. 2010, Rwp. 2011, Lahore 2013)

Ans: Acid anhydrides are those compounds in which a water molecule is eliminated from two carboxylic groups of the same molecule or different molecules. They are produced by the reaction of carboxylic acids with dehydrating reagent.



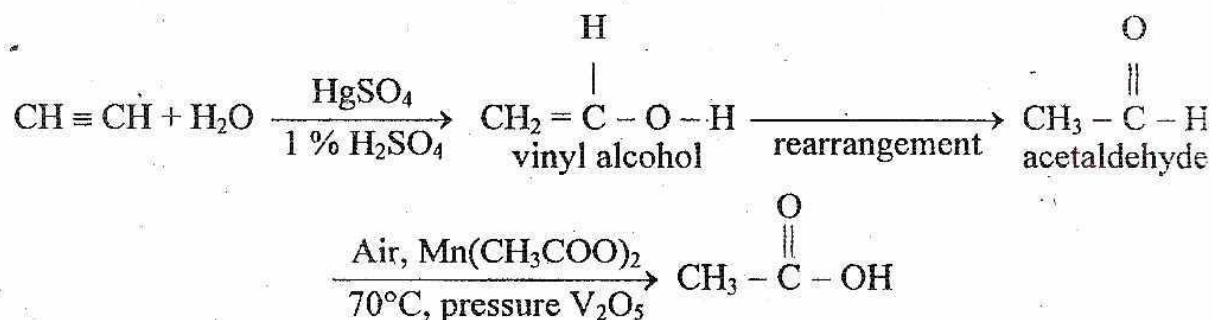
Q.14 How would you convert CH_3COOH to CH_3CONH_2 ?

(Lahore 2008, Lahore 2012, D.G. Khan 2013)



Q.15 How acetic acid is prepared on the commercial scale from acetylene?

Ans: Acetylene is bubbled through 20 % H_2SO_4 at 80°C in the presence of 1 % HgSO_4 which acts as a catalyst:



Q.16 Why the B.P. of aliphatic carboxylic acid is relatively high.

Ans: Aliphatic carboxylic acid produce H-bonding which is responsible for high boiling point.

AMINO ACIDS

Q.17 What are amino acids?

(Multan 2011, Guj. 2012)

Ans: Those carboxylic acids, in which one of the hydrogen atoms of the alkyl group of the carboxylic acid is substituted by $-\text{NH}_2$ group are called amino acids.

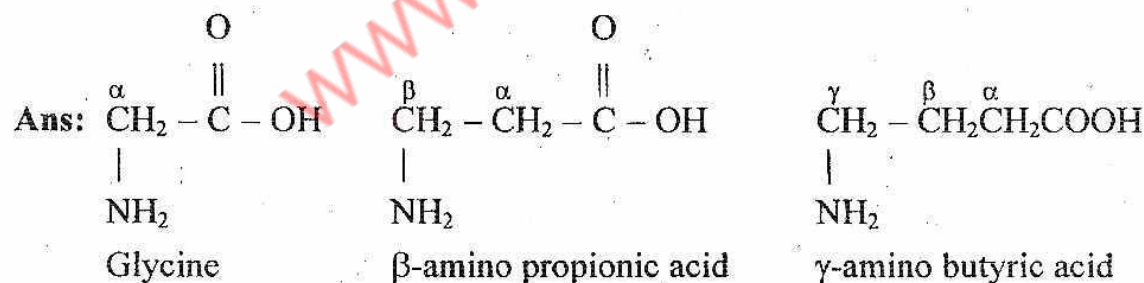
Q.18 What are essential and non-essential amino acids?

(Faisalabad 2008, Multan 2009, Faisalabad 2010, Faisalabad 2011)

Ans: Those amino acids which the body is not able to synthesize are called essential amino acids. These are supplied to our body by our diet.

Those amino acids which the body can synthesize are called non-essential amino acids.

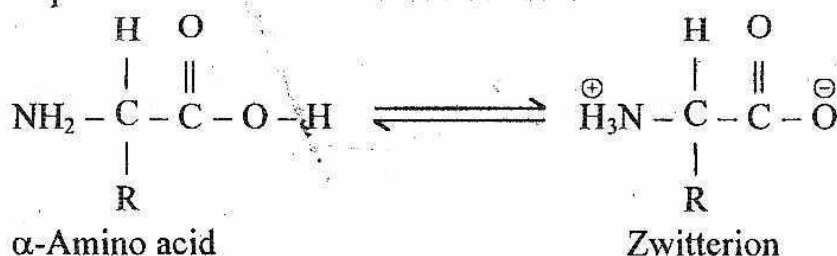
Q.19 Give an example of each i.e. α -amino acid, β -amino acid and γ -amino acid:



Q.20 What is Zwitterion?

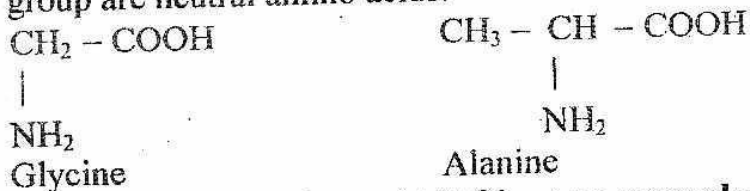
(Guj. 2008, Faisalabad 2009, Rwp. 2010, Lahore 2012, Guj. 2013, Multan 2013, Fed. 2013, D.G. Khan 2013)

Ans: An amino acid, transfers its protons from $-\text{COOH}$ group to $-\text{NH}_2$ group to give a di-polar ion which is called Zwitterion.



Q.21 What are neutral amino acids? Give two examples. (Sargodha 2006)

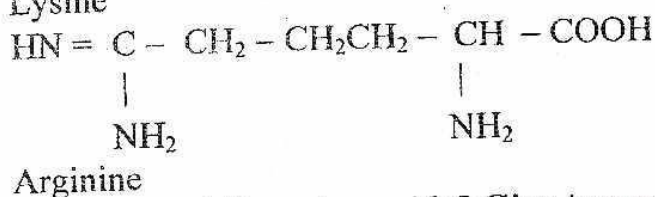
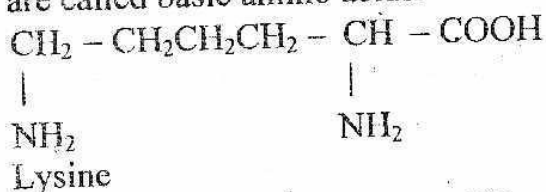
Ans: Those α -amino acids which have equal number of amino and carboxyl group are neutral amino acids.



Q.22 What are basic amino acids? Give two examples.

(Sargodha 2006, Lahore 2011, D. G. Khan 2011)

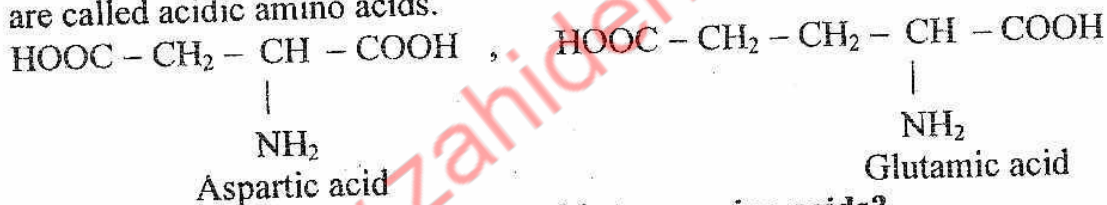
Ans: Those α -amino acids which contain more amino groups than carboxyl group are called basic amino acids:



Q.23 What are acidic amino acids? Give two examples:

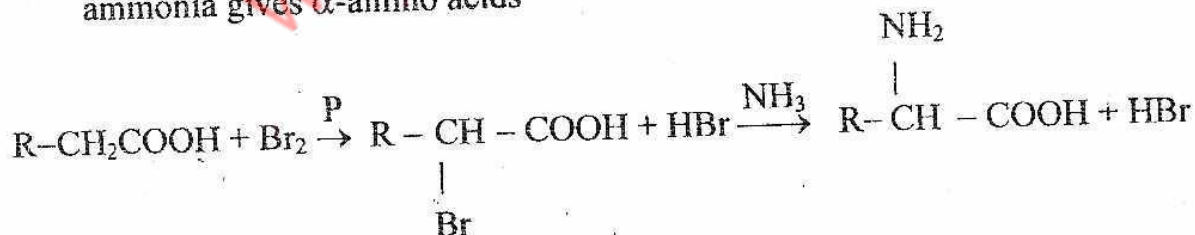
(D. G. Khan 2011, Lahore 2011, Multan 2013)

Ans: Those amino acids which contain more carboxyl groups than amino groups are called acidic amino acids.



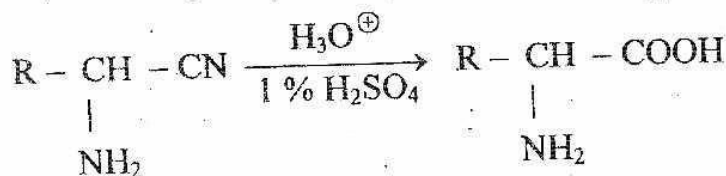
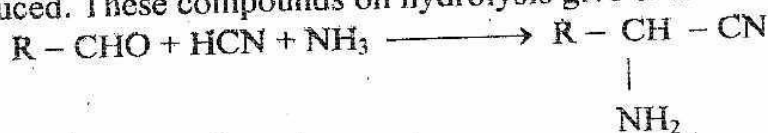
Q.24 How carboxylic acids are converted into α -amino acids?

Ans: The α -hydrogen atom of the carboxylic acid is substituted by bromine in the presence of phosphorus to give α -bromo derivatives which on reaction with ammonia gives α -amino acids



Q.25 What is Strecker's synthesis?

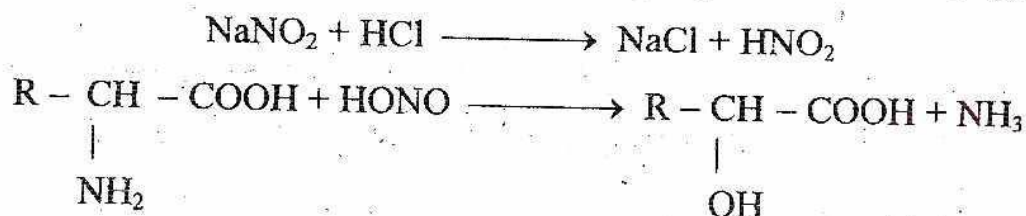
Ans: When HCN is added to aldehyde, in the presence of NH_3 , α -amino cyanides are produced. These compounds on hydrolysis give α -amino acids:



Q.26 How α -amino acid can be converted into α -hydroxy acids?

(Faisalabad 2010)

Ans: In order to convert $-\text{NH}_2$ group into $-\text{OH}$ group we can use $\text{NaNO}_2 + \text{HCl}$



Q.27 What is ninhydrin test?

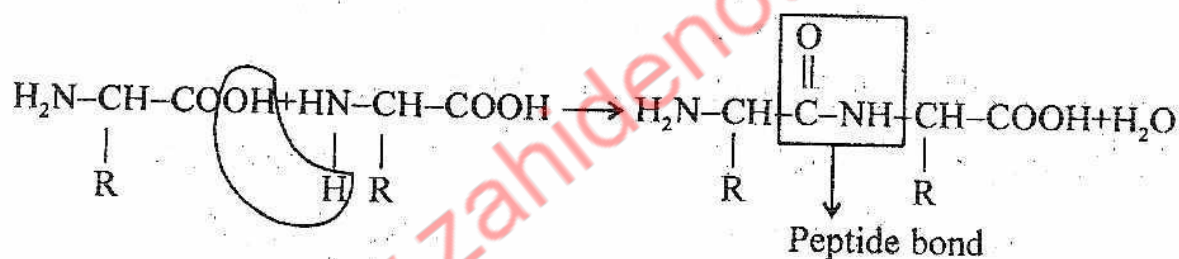
(Sargodha 2010)

Ans: Ninhydrin is a complex organic compound. It reacts with amino acids to form an intensely coloured bluish violet product. So, this reagent can be used to check the presence of amino acids.

Q.28 What are peptides and peptide linkages?

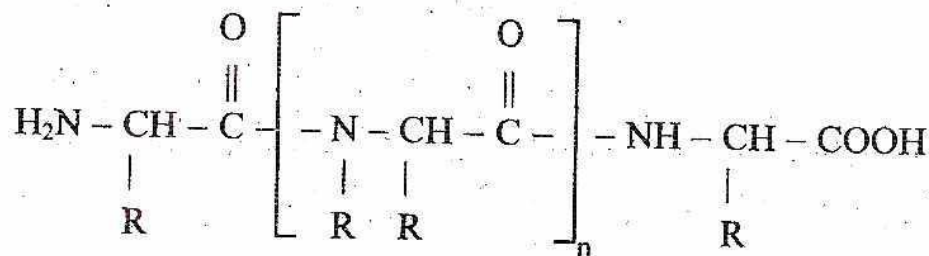
(Multan 2008)

Ans: When two amino acid molecules react with each other, hydrogen atom of amino group combines with the $-OH$ group of $-COOH$ group to produce peptide bond or peptide linkage



Q.29 What is polypeptide?

Ans: When large number of amino acids are joined by a peptide bond, the polypeptide produced is called polypeptide



Q.30 How do you differentiate between protein and polypeptide? (F. Abad 2012)

Ans: A molecule which is produced by the condensation of large number of amino acids to form a polypeptide is called a protein. Actually, that polypeptide whose molar mass is more than 10,000 is called protein otherwise it is polypeptide.

ANSWERS TO THE SHORT QUESTIONS

POLYMERS

Q.1 What are macromolecules? Give five examples. (Guj. 2008, Lahore 2013)

Ans: Molecules of high molar mass usually greater than 10,000 are called macromolecules. The substances like natural and synthetic polymers as carbohydrates, proteins, lipids, enzymes, steroids, cholesterol are macromolecules.

Q.2 What are polymers? What is their classification?

Ans: The polymers are macromolecules and may be inorganic or organic in nature. The inorganic polymers are diamond, graphite and sand etc. Organic polymers contain bio-polymers like lipids, proteins, carbohydrates, and nucleic acids. Synthetic organic polymers are plastic, rubber and synthetic fibre.

Q.3 What is the classification of polymer by keeping in view their structural aspects? (Lahore 2013)

Ans: The polymers are produced due to the repetition of monomers. This repetition can be linear, branched or network.

Q.4 What is the degree of polymerization? Give two examples. (Lahore 2013)

Ans: The number of repeating units in the chain which determines the length of the polymer chain is called degree of polymerization. It is abbreviated as D. P.

Q.5 How the degree of polymerization helps to determine the molar mass of the polymer? (Mirpur 2009, Faisalabad 2010)

Ans: The sum of atomic masses of all the atoms present in the molecule of a polymer is molar mass of that polymer.

$$\text{Molar mass of a polymer} = \text{molar mass of monomer} \times \text{degree of polymerization.}$$

Q.6 Classify the polymer on the bases of varieties of monomers.

(Guj. 2006, Faisalabad 2008, Sargodha 2008, Rwp. 2011)

Ans: In a homopolymer, polymerization takes place among the monomers of single type. In copolymer, more than one types of monomers are there and in terpolymers, three different types of monomers are there.

Q.7 How the polymers are classified on the bases of heat effects?

(Lahore 2013, Multan 2013)

Ans: Thermoplastic polymers soften on heating and become rigid again on cooling like PVC, nylon etc. Thermosetting polymers become hard on heating and softness can not be gained. Polyurethanes or epoxy resins are the best examples.

Q.8 How do you classify the process of polymerization on the basis of reaction mechanism?

Ans: Polymerization can be addition and condensation. Addition polymerization can involve the free radicals or the ions in them.

Q.9 Give the brief description of free radical addition polymerization for the formation of polythene:

Ans: Dibenzoyl peroxides acting as catalysts generate the free radical and polythene is formed by free radical mechanism.

Polystyrene is used in the packing of electrical equipment, insulation of heat, manufacture of food container and preparation of cosmetic bottles. It is also used to prepare television cabinets and plastic cups.

Q.15 What are acrylic resins? Give their uses:

Ans: Various types of monomers are used to prepare acrylic resins. For example, Methyl methacrylate, acrylic acid and butyl acrylate give the acrylic resins. Acrylic resins are used for the manufacture of plastics, paints, for car industry and water based weather resistant paints.

Q.16 What are epoxy resins? Give their uses: (Bahawalpur 2011, F. Abad 2012)

Ans: Epoxy resins are polymers. They are called so, because the starting material in them is epoxide. They are prepared by the condensation polymerization of chloroepoxy alkane with dihydric phenol.

BIOPOLYMERS OR CARBOHYDRATES

Q.17 How do you define biopolymers? Give the major classes of such polymers:

Ans: Bio-polymers are life molecules and they are built up from the skeleton of carbon atoms. They are carbohydrates, lipids, proteins and nucleic acids.

Q.18 What are carbohydrates? Why are they called so?

(Faisalabad 2011, D.G. Khan 2013)

Ans: Carbohydrates are the compounds of carbon, hydrogen and oxygen with the general formula. $C_x(H_2O)_y$. 'x' and 'y' can be equal or different.

They may be called hydrate of carbon.

Q.19 Give the classification of carbohydrates and give an example of each:

(Faisalabad 2006, Faisalabad 2011)

Ans: Carbohydrates may be monosaccharides, like glucose, oligosaccharide like sucrose and polysaccharides like starch.

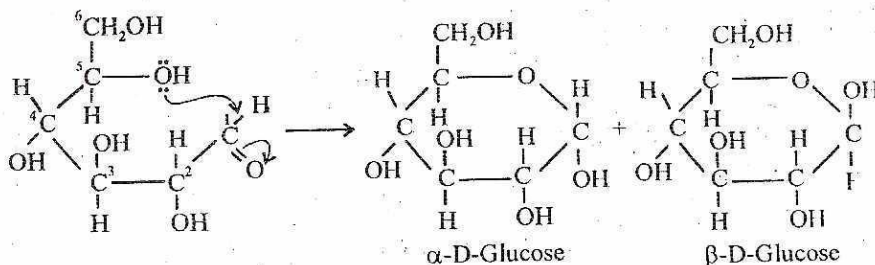
Q.20 What are aldohexose and aldoketoses? Give examples:

Ans: Those monosaccharides which have aldehydic group in them are called aldoses like glucose. Those monosaccharides which have ketonic group in them are called aldoketoses like fructose.

Q.21 How do you justify the cyclic structure of glucose from its open chain structure?

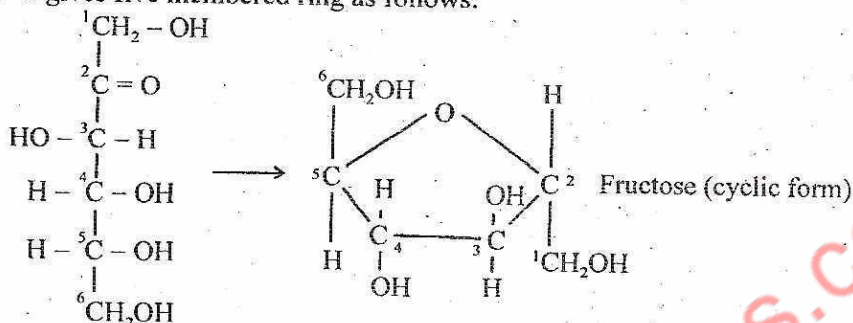
(Rawalpindi 2008, Multan 2011, F. Abad 2013)

Ans: Open chain form of glucose cyclizes to give α -D-glucose and β -D-glucose as follows:



Q.22 How do you justify the cyclic structure of fructose from its open chain structure? (Multan 2011)

Ans: It gives five membered ring as follows:



Q.23 What are disaccharides? How are they produced from monosaccharides? (Rawalpindi 2008)

Ans: When two molecules of monosaccharide units join with each other, they give a disaccharide. The best examples are sucrose, lactose and maltose.

Q.24 What is lactose? To which class does it belong?

Ans: Lactose is called milk sugar and it is found in the milk of all animals. It is present in cow's milk between 4-6% and human milk contains 5 – 8%.

STARCH

Q.25 What are polysaccharides? Give examples.

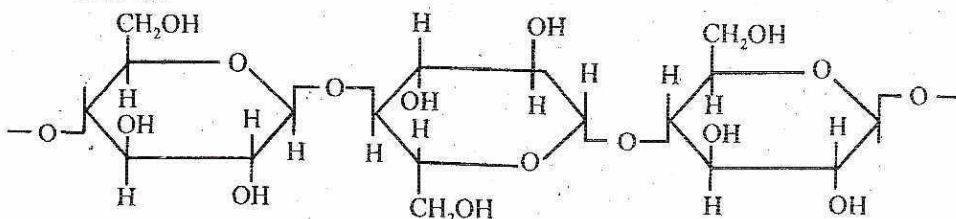
Ans: Polysaccharides are naturally occurring polymers. Some important polysaccharides are starch, cellulose, glycogen, insulin and dextrin.

Q.26 Where is starch found? How is its structure made up? (Lahore 2013)

Ans: Starch is found in wheat, rice, maize, potatoes and barley. Actually it is a mixture of two polysaccharides i.e. amylose and amylopectin.

Q.27 Where is cellulose found? What is its structure? (Lahore 2013)

Ans: Cellulose is present in cotton and other plant kingdom. Its structure is as follows:



Q.28 What is glycogen? Give its structure and properties.

Ans: Glycogen is the animal starch. It is the reserve carbohydrate of animals. It is found in liver, muscles, yeast and mushrooms.

PROTEINS

Q.29 What are proteins, and which elements are present in them?

(Mtn. 2008, D. G. Khan 2011, F. Abad 2013)

Ans: Proteins are the high molecular weight materials, which upon complete hydrolysis give amino acids. Proteins have carbon, hydrogen, oxygen, nitrogen and sulphur.

Q.30 How proteins are classified?

Ans: Keeping in view the physical and chemical properties, proteins have three types i.e. simple protein, compound or conjugated proteins and derived proteins.

Q.31 What are simple proteins? Give their examples: (F. Abad 2013)

Ans: Those proteins which give only one amino acid upon hydrolysis are called simple proteins.

Albumens, globulins, lactoglobulins and legumin are the best examples.

Q.32 What are compound or conjugated proteins? (Guj. 2010)

Ans: Conjugated proteins are those which upon hydrolysis give an amino acid and non-protein group. This non-protein group is called prosthetic group. Phosphoproteins are conjugated with phosphoric acid.

Q.33 What are derived proteins? (Guj. 2010)

Ans: Those proteins, which are derived from simple and conjugative proteins are called derived proteins. For example, peptone and poly-peptides are the derived proteins.

Q.34 How do you classify the proteins, according to their function?

Ans: Keeping in view the functions of proteins, these are structural proteins, hormones and enzymes.

Q.35 What information do we get from the secondary structure of proteins?

Ans: We come to know about the shape in which the large amino acid chain exists. Sometimes the amino acid chains are coiled into a spiral, which is called helix. This helix can be right handed or left handed.

Q.36 What do you mean by tertiary structure of proteins?

Ans: According to their tertiary structures, the helix of a protein is thought to be a piece of rope. This piece of rope is free to bend, twist and fold.

Q.37 What do you mean by the denaturalization of proteins?

(Mirpur 2011, F. Abad 2012, Guj. 2013)

Ans: It is the disruption of structure of proteins by heat, by change of pH or by using strong oxidizing and reducing agents. Albumin is a protein and when egg albumin is heated, it hardens and this change is irreversible.

Q.38 Give the brief summary of importance of proteins.

(Sargodha 2011, D.G. Khan 2013)

Ans: Proteins help in the formation of protoplasm. They can act as catalyst, or carriers of oxygen and act as hormones. In industry, they are used for tanning of hides.

LIPIDS

Q.39 What are lipids? What are their types?

(Bahawalpur 2006, Faisalabad 2011, Lahore 2012)

Ans: Lipids are naturally occurring organic compounds of animal and plants which are soluble in organic solvents and belong to very heterogeneous group of substances. Simple lipids are of two types (i) fats and oils. (ii) waxes

Q.40 What are the characteristics of lipids?

Ans: Lipids are insoluble in water, but soluble in ether, chloroform and benzene. They are the primary building blocks of fatty acids, glycerol and sterols. They can be used by living organisms.

Q.41 How do you justify that the fats and oils are the sources of other substances?

Ans: Fats and oils have three major food factors required for the human body i.e. proteins, carbohydrates, fats and oils.

Q.42 What are the major sources of fats and oils? (Lahore 2011)

Ans: Animals, plants and marine organisms are the sources of fats and oils. Butter and ghee are the fats which are obtained from milk.

Q.43 What are simple glycerides and mixed glycerides?

Ans: Glycerides are the esters of a fatty acid with glycerol. In simple glycerides, all the alkyl group attached with the carbonyl group are identical.

Q.44 How do you classify the oils and fats on the basis of phase?

(F.Abad 2008, Lahore 2011, Bahawalpur 2011, Mirpure 2011)

Ans: Those glycerides which have carbon-carbon double bond present in them are normally liquids at room temperature. Glyceryl trioleate is liquid and has melting point of -5°C . If the alkyl portion of the glyceride is saturated, it is called a fat and it is solid at room temperature. Glyceryl tristearate is one of the examples.

Q.45 What do you mean by hydrolysis of fats and oils?

Ans: Fats and oils are hydrolyzed by enzymes which acts as catalysts. These enzymes are called lipases. This hydrolysis takes place in the digestive tract of the human beings and animals.

Q.46 What is saponification? (Lahore 2008, Guj. 2013)

Ans: It is the hydrolysis of triglycerides by alkalies to produce glycerol and soap.

Q.47 Classify the lipids into various types:

Ans: Lipids are classified into three types:

(i) Simple lipids (ii) Compound lipids (iii) Derived or associated lipids.

Q.48 What do you mean by hardening of oils? (Rwp. 2011, D. G. Khan 2011)

Ans: The conversion of unsaturated glycerides by passing hydrogen through that in the presence of nickel into a saturated fat is called hardening of oil.

Q.49 What is saponification number?

(Sargodha 2006, D. G. Khan 2011, Mirpure 2011, Bahawalpur 2011, Lahore 2012, Guj. 2013)

Ans: It is number of milligram of KOH which is required to saponify, one gram of fat and oil. General formula is;

$$\text{Saponification number} = \frac{168000}{\text{molar mass of fat}}$$

Q.50 What do you mean by the rancidity of oils and fats? (Multan 2008, Lahore 2013)

Ans: The spoilage of fats and oils to give an odour is called rancidity. It is due to hydrolytic reaction or oxidative reaction. In both reactions, a foul smell of aldehyde and fatty acid is given.

Q.51 What do you mean by iodine number?

(Sargodha 2006, Multan 2006, Lahore 2008, Lahore 2011, Mirpure 2011, Rwp. 2011, Guj. 2012)

Ans: It is the number of grams of iodine which will react with 100 grams of fats and oils. Actually iodine saturates the double bond and from the amount of iodine absorbed, we can calculate the amount of unsaturation.

Q.52 What is the acid number of the fats? (Lahore 2013)

Ans: It is the number of mg of KOH which is required to neutralize one gram of a fat. It gives us informations about the amount of fatty acids present in it. It also tells us about the extent of rancidity.

ANSWERS TO THE SHORT QUESTIONS

GENERAL FEATURES OF AROMATIC COMPOUNDS

Q.1 What do you mean by term "aromatic"?

Ans. Benzene and many derivatives of benzene had "aroma" type smell. The word "aroma" means "fragrant". So all these compounds were called aromatic by Kekule. This thing enabled the scientists to distinguish between derivatives of benzene from aliphatic compounds.

Q.2 What are nonbenzoid aromatic compounds?

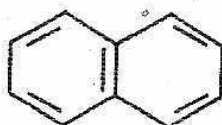
Ans. Those aromatic compounds, whose stabilities are just like benzene or derivatives of benzene but they do not have the benzene ring in them. The best examples are pyridine, pyrrol, furan, thiophene and their derivatives.

Q.3 What are the characteristics of aromatic compounds?

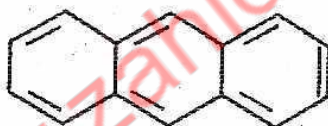
Ans. They are cyclic in nature, planar, unsaturated, give substitution reactions rather than addition and they have low heat of hydrogenations and heat of combustions.

Q.4 Give three examples of condensed aromatic hydrocarbons and give their names? (Lahore 2009, Sargodha 2009, Mirpur 2009, Rwp. 2010, Lahore 2011, Multan 2012, Guj. 2012, Multan 2012)

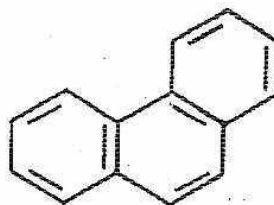
Ans. Following are three examples:



Naphthalene



Anthracene



Phenanthrene

STRUCTURE OF BENZENE

Q.5 Write the reactions which give the evidence for the ring structure of benzene. (Guj. 2012, Lahore 2013)

Ans. When H_2 and Cl_2 react separately with benzene, cyclohexane and benzene hexachloride are produced, which are cyclic compounds. We get only one mono-substituted derivative and three di-substituted derivatives of benzene.

Q.6 What informations do we get from x-ray analysis of benzene?

(Lahore 2008, Rwp. 2010, Guj. 2012, Lahore 2013)

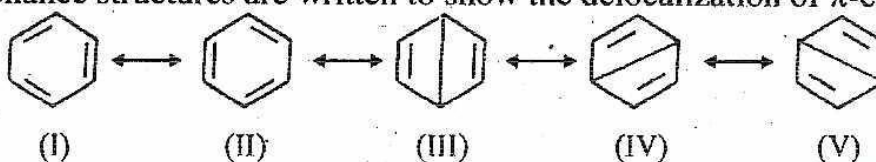
Ans. It shows that benzene is six membered planar molecule. All the bond lengths of C-C and C-H are all equal with the values of 139 pm and 109 pm respectively.

Q.7 There are three alternate double bonds in the benzene ring, but why all the carbon-carbon bonds are of equal length? (Guj. 2012)

Ans. Since, there is conjugated system of double bonds, so resonance starts and six π -electrons are completely delocalized. In this way, the status of all the C-C bonds become equal and they are 139 pm in length.

Q.8 Which orbitals in benzene give stability to benzene, but not to alkenes? (Mirpur 2009, D.G.K 2009, B.Pur 2009, Sarg. 2010)

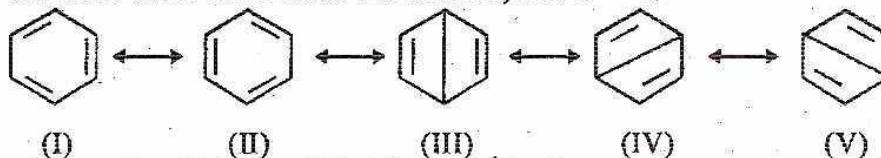
Ans. Six p-orbitals in benzene having one electron each are completely delocalized. This delocalization gives stability to benzene. For this reason, benzene undergoes substitution reactions rather than addition reactions. Five resonance structures are written to show the delocalization of π -electrons.



Q.9 Write down the resonance structures of benzene and indicate their relative contributions towards the actual structure of benzene.

(Lahore 2013, D.G. Khan 2013)

Ans. Benzene has five resonance structures. First two structures contribute 80% and the next three structures contribute, 20%.



Q.10 How do you justify that $150.5 \text{ kJ mol}^{-1}$ is the resonance energy of benzene? (Multan 2011)

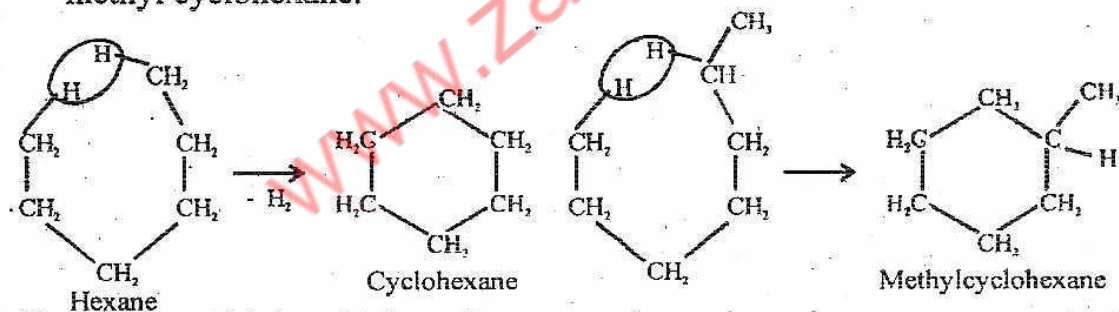
Ans. If each double bond of benzene ring behaves independently, benzene should have been $358.5 \text{ kJ mol}^{-1}$ more unstable than cyclohexane. Experimentally it is 208 kJ mol^{-1} more unstable. The difference of these two values is $150.5 \text{ kJ mol}^{-1}$, which is the amount of energy evolved due to stability of the benzene.

PREPARATION OF BENZENE

Q.11 How hexane and heptane can give benzene and toluene respectively?

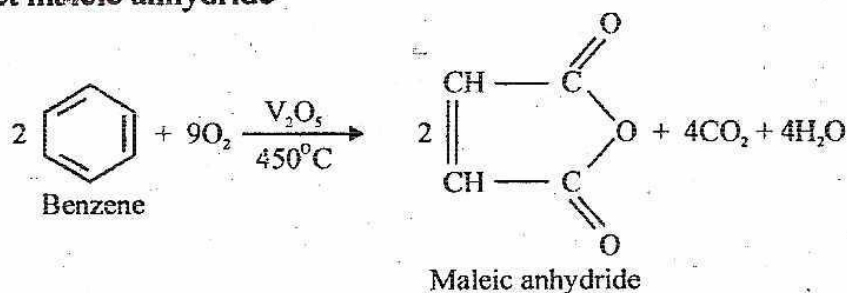
(Lahore 2008, 2010, Lahore 2012, Multan 2013)

Ans. When hexane and heptane are treated with $\text{Cr}_2\text{O}_3 + \text{Al}_2\text{O}_3 + \text{SiO}_2$ at 500°C , the required products are obtained through the formation of cyclohexane and methyl cyclohexane.

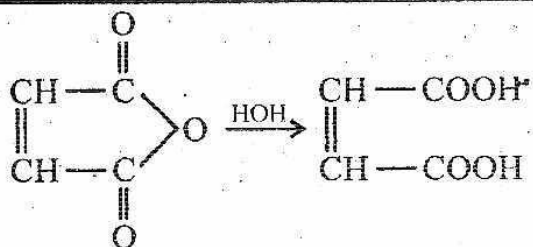


Q.12 Prepare maleic acid from benzene. (Rwp. 2010, F. Abad 2012, Lahore 2012)

Ans. When benzene is oxidized with air in the presence of V_2O_5 at 450°C , then we get maleic anhydride



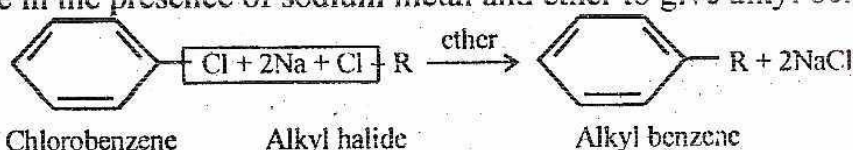
This is commercial method for the preparation of maleic anhydride. Maleic anhydride is hydrolyzed to give maleic acid. Benzene is not oxidized by KMnO_4 or $\text{K}_2\text{Cr}_2\text{O}_7$.



Q.12A What is Wurtz-Fitting reaction?

(Guj. 2013, D.G. Khan 2013)

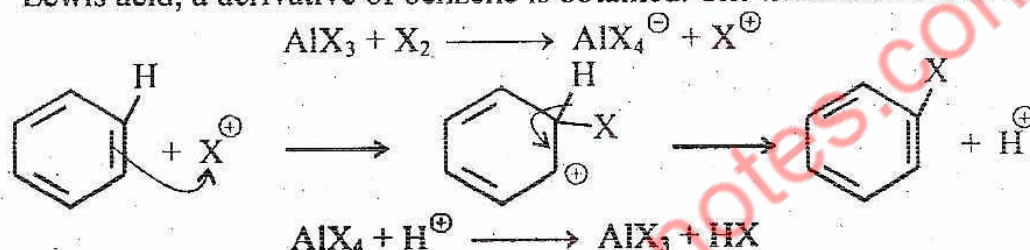
Ans. In this reaction, the haloderivatives of benzene are reacted with an alkyl halide in the presence of sodium metal and ether to give alkyl benzene.



Q.13 What do you mean by electrophilic substitution reactions of benzene? Give general mechanism.

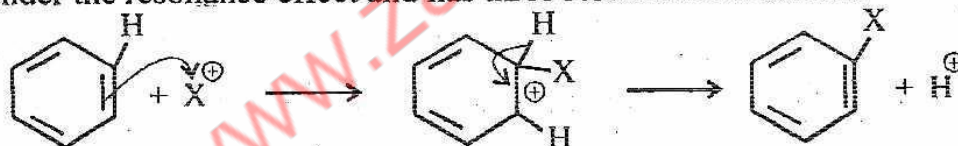
(Sargodha 2008, Lhr. 2010, Faisalabad 2010, Sarg. 2010, Lahore 2012)

Ans. When an electrophile substitutes the electrophile H^+ in the presence of Lewis acid, a derivative of benzene is obtained. The mechanism is as follows:



Q.14 What is sigma complex and how does it get the stability?

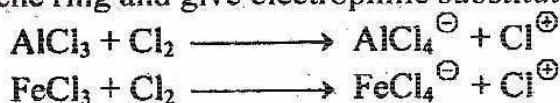
Ans. When an electrophile attacks the benzene ring, positively charged cyclic ring, which is called sigma complex is produced. It is called so because π -bonds of the benzene ring are broken to give sigma bond. It is stabilized under the resonance effect and has three resonance structures.



Q.15 What is the role of FeCl_3 and AlCl_3 in electrophilic substitution reaction of benzene?

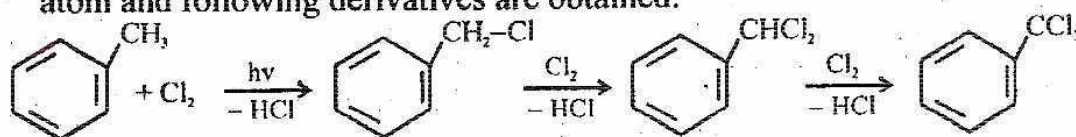
(D.G.K 2009, Guj. 2010)

Ans. FeCl_3 and AlCl_3 are Lewis acids. They generate the electrophiles which can attack the benzene ring and give electrophilic substitution reactions.



Q.16 What are the major products when chlorine reacts with toluene in the presence of sunlight?

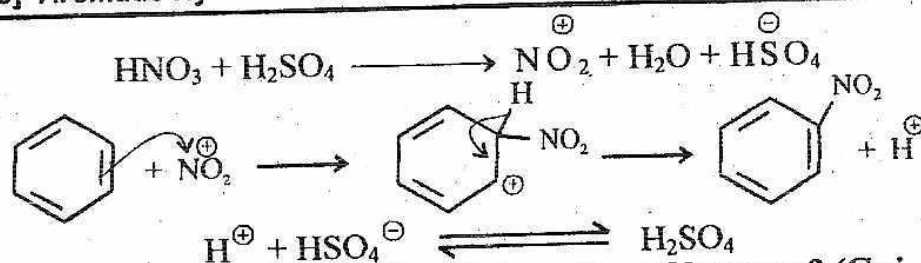
Ans. The hydrogen atoms of CH_3 group in toluene are substituted by chlorine atom and following derivatives are obtained:



Q.17 Give the mechanism of nitration of benzene.

(Multan 2008, Sarg 2009, Guj. 2010)

Ans. NO_2^+ obtained from nitrating mixture, attacks the benzene ring as follows.



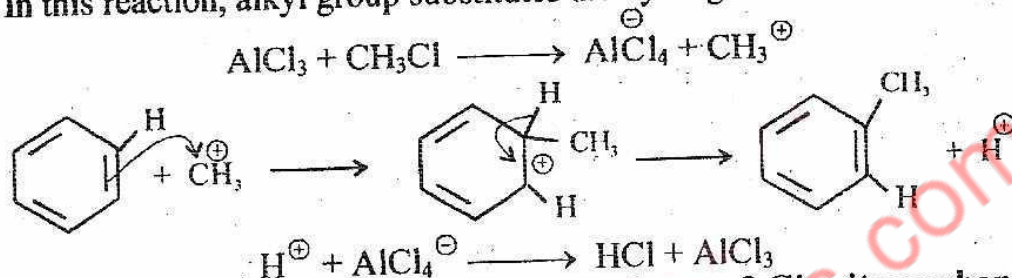
Q.18 Why oleum is required for the sulphonation of benzene? (Guj. 2006)

Ans. Oleum is consisted of $\text{H}_2\text{S}_2\text{O}_7$ in which SO_3 gas is dissolved in H_2SO_4 . SO_3 , after protonation, becomes strong electrophile and attacks the benzene ring to give electrophilic substitution reaction.

Q.19 Give the general mechanism of Friedal Craft's alkylation:

(Lahore Board 2007, Sargodha 2011)

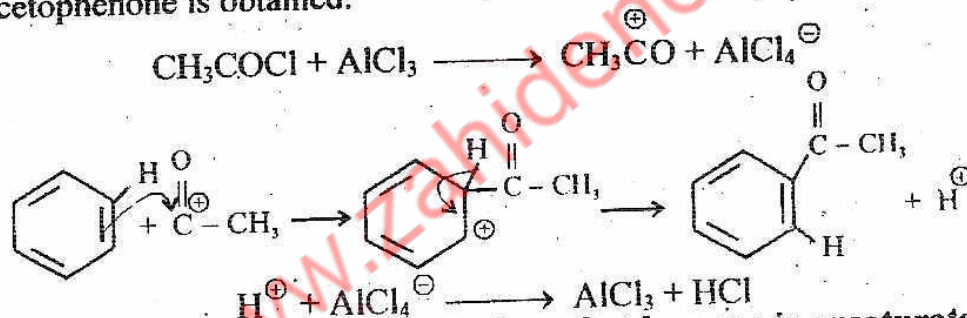
Ans. In this reaction, alkyl group substitutes the hydrogen of benzene as follows:



Q.20 How benzene can be converted to acetophenone? Give its mechanism:

(Bahawalpur 2011, Lahore 2012, Multan 2012, Multan 2013)

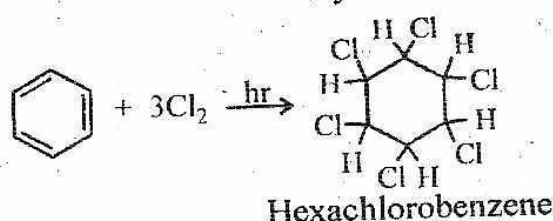
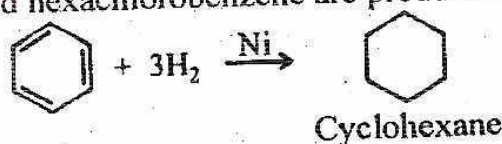
Ans. When CH_3COCl is reacted with benzene in the presence of AlCl_3 , acetophenone is obtained:



Q.21 What are those reactions which show that benzene is unsaturated hydrocarbon?

(Multan 2008, Faisalabad 2009, Lahore 2010, Guj. 2010, Mirpur 2011, Rwp. 2011, Lahore 2012)

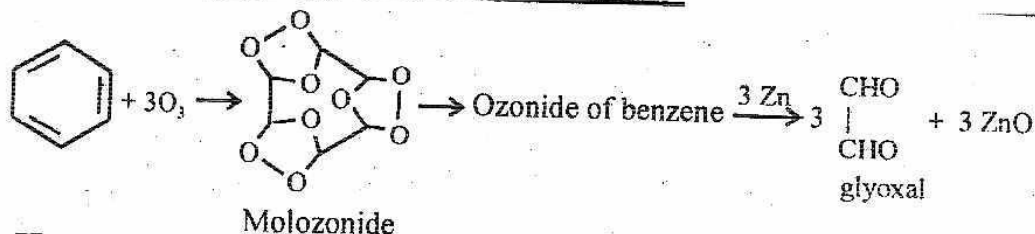
Ans. Benzene adds three H_2 molecules and three Cl_2 molecules at its ring to give cyclic saturated compounds. It means that it has three double bonds. Cyclohexane and hexachlorobenzene are produced.



Q.22 How does ozone affect benzene to give glyoxal?

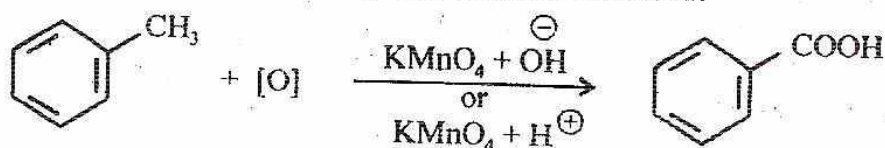
(Sargodha 2008, Multan 2008, Sarg. 2010)

Ans. Benzene adds three molecules of ozone to give triozone which upon reaction with zinc dust, gives three molecules of glyoxal.



Q.23 How toluene can be converted to benzoic acid? (D.G. Khan 2013)

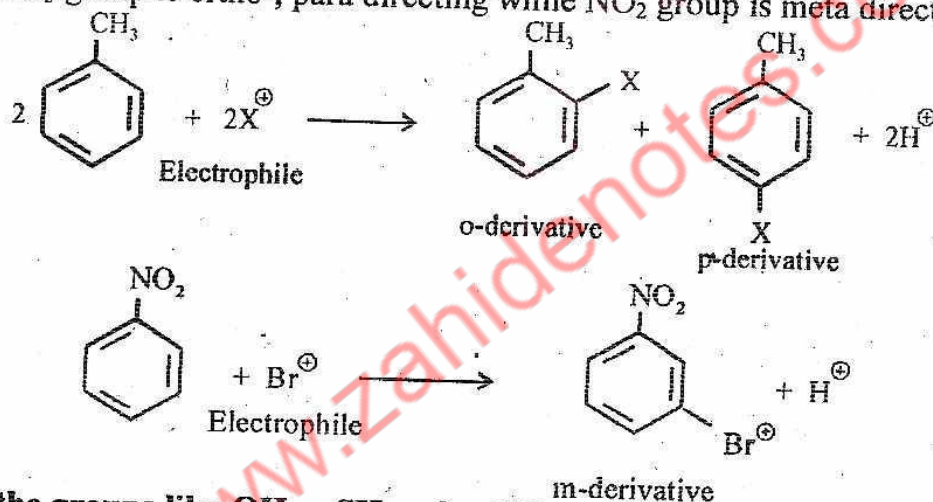
Ans. When toluene or alkyl derivatives of benzene are reacted with alkaline KMnO_4 and acidified KMnO_4 , side chain is oxidized.



ORIENTATION AND REACTIVITY OF BENZENE

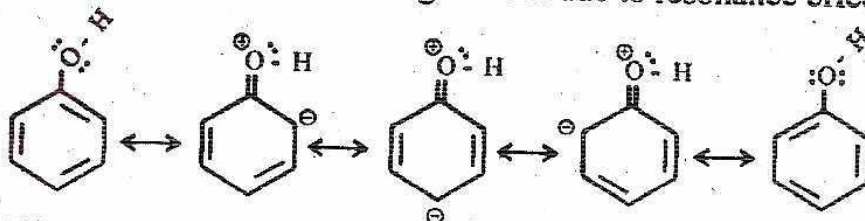
Q.24 Nitration of toluene gives ortho and para nitrotoluene, while the bromination of nitrobenzene gives m-bromonitro benzene. Give reasons?

Ans. $-\text{CH}_3$ group is ortho-, para directing while NO_2 group is meta directing. (Lahore 2011)



Q.25 If the groups like $-\text{OH}$, $-\text{SH}$ and $-\text{NH}_2$ are present on the benzene ring, the ring is activated and ortho, para products are obtained. Give reasons:

Ans. All those groups which have lone pairs in them and these lone pairs are in conjugation with the benzene ring, the groups become ortho, para directing with the activation of benzene ring. This is due to resonance effect:



Q.26 If $-\text{COOH}$ or $-\text{CN}$ groups are present on the benzene ring, they deactivate the ring and meta products are obtained. Give reasons.

Ans. Both these groups are meta-directing with deactivation of the benzene ring. Both these groups have multiple bonds in them which are in conjugation with the benzene ring. The conjugated multiple bonds create electron deficiencies at o- and p-positions, and the ring becomes overall inactive. (F. Abad 2013)

ANSWERS TO THE SHORT QUESTIONS

ENVIRONMENTAL CHEMISTRY

Q.1 What is the environmental chemistry and which aspects do we study in this branch?

Ans: *That branch of chemistry which deals with the chemical and other pollutants in the environment is called environmental chemistry. In this branch of chemistry, we study sources, reactions, transportation of chemicals and transportation of toxic substances.*

Q.2 What are the components of environment?

(Faisalabad 2010, Sargodha 2011, Mirpur 2011, D.G. Khan 2013)

Ans: Environment is consisted of following four components:

- (i) Atmosphere
- (ii) Hydrosphere
- (iii) Lithosphere
- (iv) Biosphere/Ecosphere

ATMOSPHERE

Q.3 What is the composition of atmosphere and its thickness?

Ans: Atmosphere is composed of 78 % N_2 , 21 % O_2 , 0.9 % Ar, 0.03 % CO_2 , and some trace amounts of H_2 , O_3 , CH_4 , CO and noble gases. The concentration of water vapours changes with time.

Q.4 How atmosphere behaves with different types of radiations from the sun?

Ans: Atmosphere absorbs most of the cosmic rays and U.V. rays, but the radiations whose wavelengths lie between 300 – 2500 nm are not absorbed and they include near U.V., visible and near I.R.

Q.5 Mention the utilities of gases of atmosphere:

Ans: (i) Oxygen is required for breathing

(ii) CO_2 for photosynthesis

(iii) N_2 for fixation of bacteria

(iv) Water vapours for various forms of life

Moreover, the atmosphere maintains the heat balance on the earth due to water vapours.

Q.6 How water in the hydrosphere is distributed in different parts?

(Faisalabad 2010)

Ans: Hydrosphere contains water and the major water resources are oceans, rivers, streams, lakes, polar ice caps, glaciers and ground water reservoirs.

97 % of the water is in the oceans and 2 % in polar ice caps and glaciers, 1 % of the total is fresh water.

Q.7 What is lithosphere? Give its composition:

(Lahore 2007)

Ans: Lithosphere is the component of environment which is consisted of rigid rocky crust of earth. 99.5 % of the lithosphere has the composition as 46.6 % oxygen, 27.72 % silicon, 8.13 % aluminium, 5 % Fe and rest are some other metals.

Q.8 What is biosphere/ecosphere?

Ans: The component of the environment which includes the region of earth which is capable of supporting life is called biosphere. It is consisted of lower atmosphere, oceans, river, lakes, soils and solid sediments.

POULLTANTS

Q.9 What are environmental pollutants and what is the reason for environmental pollution?

Ans: Any substance in the environment which has adverse effects on human health, quality of life and natural functioning of ecosystem is called environmental pollutants.

The rapid growth of population, urbanization, industrialization and transportation are the main factors which are responsible for environmental pollution.

Q.10 What are the primary air pollutants? (D.G. Khan 2011, Guj. 2012)

Ans: The primary pollutants are:

- (i) Waste products which escape from chimneys of industrial units.
- (ii) Exhausts of automobile.
- (iii) The gases like SO_2 , SO_3 , oxides of nitrogen, CO, hydrocarbons and radioactive materials are the primary pollutants.

Q.11 What are the secondary air pollutants? (Guj. 2012)

Ans: The following substances are the secondary air pollutants. These are H_2SO_4 , N_2O , H_2CO_3 , HF, P.A.N, ozone, aldehydes and ketones.

CARBON MONOXIDE

Q.12 What are the main sources of CO?

Ans: Volcanic eruption, natural gas emission, oxidation of CH_4 , forest fires of wood, fossil fuel burning and burning of agricultural products are the major sources of CO. 75 % of total CO is from motor vehicles, railways and aircrafts.

Q.13 How CO is produced in different reactions? CO is produced by:

Ans: (i) Incomplete combustion of any fuel.

(ii) Reaction between CO_2 and carbon.

(iii) Dissociation of CO_2 at high temperature.

Q.14 How do you discuss the poisoning of CO? (Rwp. 2010)

Ans: It combines with the haemoglobin to give carboxylhaemoglobin. It is scarlet red in colour, and it is much more stable. It decreases the oxygen carrying capability.

Q.15 What happens to the human body, when it is exposed to CO? (Rwp 2010)

Ans: It creates the following problems:

(i) Headache

(ii) Fatigue

(iii) Unconsciousness.

(iv) Eventual death.

OXIDES OF NITROGEN

Q.16 Which oxides of nitrogen are air pollutants? What are their sources?
(Sargodha 2010, D.G. Khan 2013)

Ans: NO and NO₂ are air pollutants. They are mostly produced from:

- (i) Combustion of coal
- (ii) Combustion of oil
- (iii) Combustion of natural gas.

OXIDES OF SULPHUR

Q.17 What are the main source of SO₂, as air pollutants?

- Ans:**
- (i) Volcanoes (76%)
 - (ii) Oxidation of sulphur
 - (iii) Combustion of coal
 - (iv) Burning of crude oil
 - (v) Burning of fossil fuel.
 - (vi) Petroleum industries.

Q.18 What are aereosoles. What type of illness do they cause?

Ans: SO₂ and SO₃ give various reactions in the atmosphere, and they form sulphate aereosoles. They can penetrate in the human body through lungs.

HYDROCARBONS

Q.19 What are the sources of methane as air pollutants?

- Ans:**
- (i) Emitted by different trees and plants in the atmosphere.
 - (ii) Paddy fields produce large amount of methane in the atmosphere.
 - (iii) Anaerobic decomposition of organic matter.
 - (iv) Domestic animal also produce methane

ACID RAIN

Q.20 What is the acid rain or acid deposition?

(Guj. 2008, Lahore 2009, 2010, Lahore 2011, Multan 2013)

Ans: The dissolution of CO₂, SO₂ and NO₂ in rain water create acids. These acids reach the surface of the earth. It is called acid rain.

Q.21 How the acid rain produces pollution problem?

(Guj. 2008, Lhr. 2009, Guj. 2010, Lahore 2010)

Ans: The acid rain does not care for the natural boundaries of a country. The oxides of sulphur and nitrogen may be emitted in one country and converted into acid rain in another country.

Q.22 What is the effect of acid rain on earth?

(Guj. 2008, Lahore 2009, Sarg. 2009, Guj. 2010, Lahore 2010)

- Ans:**
- (i) It makes the soil, river and lakes slightly acidic.
 - (ii) The acidic soil leaches the metals like Al, Hg, Pb and Ca.
 - (iii) The high concentration of Al is harmful for the fish.

SMOG

Q.23 What is reducing smog? Give its sources:

(Sargodha 2008, F. Abad 2008, F. Abad 2009, Lahore 2010)

Ans: Smog is a combination of smoke and fog. It contains high contents of SO_2 and if it has reducing property that it is called reducing smog. Combustion of coal and the chemical reaction of pollutants in the air are the source of smog.

Q.24 What is photochemical smog? Give its properties?

(Mirpur 2006, F. Abad 2006, Faisalabad 2011)

Ans: Photochemical smog is consisted of high concentration of oxygen like ozone. It is also called oxidizing smog. It is yellowish brown, grey, hazy and has unpleasant odour. The main reactants of photochemical smog are NO and unburnt hydrocarbons.

Q.25 What is overall result of photochemical smog?

Ans: It builds up the oxidizing agent like H_2O_2 , HNO_3 , P.A.N and ozone. P.A.N is eye irritant and toxic to the plants.

Q.26 What are the conditions for the formation of smog?

Ans: (i) There should be sufficient NO, hydrocarbons and volatile organic compounds.
(ii) The movements of air must be little, so that the reactions are not disturbed.

OZONE

Q.27 What is the purpose of ozone and what is the ozone hole?

Ans: Ozone filters most of the harmful U.V. rays present in the sunlight. The place where the ozone layer becomes thin is called ozone hole.

Q.28 How does ozone act as a pollutant?

Ans: It damages eyes, aggravates asthma and decreases the elasticity of the lung tissues. It increases the coughing and creates chest discomfort. It is harmful for the plants and attacks rubber.

Q.29 How the concentration of ozone varies on the earth?

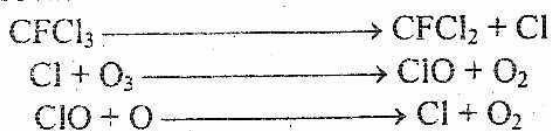
Ans: It has low concentration close to the equator. In sub-polar regions, its average concentration is 450 D.U. Its concentration also changes with seasons. It has the highest level in the early spring and the lowest in September to November.

Q.30 How does ozone protect the earth from U.V radiations?

Ans: It absorbs U.V radiation and increases the temperature on the upper part of the ozone layer. U.V radiation is very dangerous for the living beings.

Q.31 How chlorofluorocarbons destroy the ozone layer? or What is ozone layer depletion? (Bahawalpur 2006, Lahore 2008)

Ans: The following reaction show that how ozone layer is destroyed by chlorofluoro carbon:



CONTAMINATION OF WATER

Q.32 What are the various sources which contaminate water?

Ans: (i) Live stock waste. (ii) Land fills.
(iii) Agriculture. (iv) Pesticides.
(v) Oil leaks. (vi) Spills.
(vii) Disposal of industrial effluents. (viii) Water bodies.
(ix) Septic tanks.

Q.33 How live stock waste become responsible for water pollution?

Ans: Bacteria is present in the live stock waste. It contaminates the surface and ground water. It cause the diseases like dysentery typhoid, and hepatitis.

Q.34 What is oil spoilage? (Multan 2008, Rwp. 2010, F. Abad 2013)

Ans: When petroleum is transported from one place to another, then it may be lost on the way due to the one reason or the other. This is called oil spoilage.

Q.35 How water is polluted by petroleum? (Rwp. 2010, F. Abad 2013)

Ans: Water gets polluted by:

(i) Accidental oil spills. (ii) Leakage from cargo oils tankers.
(iii) Pipe line leakage (iv) Leakage of underground storage tanks.

Q.36 How the animal life is affected by hydrocarbons? (Multan 2008, Rwp. 2010)

Ans: Many petroleum products are poisonous and create serious health problems to humans, animals and aquatic life.

Q.37 What are detergents? What are their various types?

(Multan 2008, Guj. 2010, Rwp. 2011, Bahawalpur 2011)

Ans: Detergents are the sodium salts of benzene sulphonates and are used as clearing agents in houses and industries. There are various types of surfactants in the detergents. These are anionic, cationic and amphoteric. Most common type of surfactants are sodium salts of organic sulphonates. They are threat to animal life by decreasing dissolving oxygen in H_2O .

Q.38 What are pesticides? Give their types:

Ans: Those substances which directly kill unwanted organisms are controlled by interfering with its reproduction process are called pesticides. There are of three types i.e. insecticides, herbicides and fungicides.

Q.39 Which diseases have been irridicated by pesticides?

Ans: (i) Malaria (ii) Yellow fever.
(iii) Bubonic plague. (iv) Sleeping sickness.

Q.40 How pesticides contaminate the soil?

Ans: Pesticides affect the agricultural food products and drinking water. They are all poisonous.

Q.41 How the chlorinated hydrocarbons are dangerous for health?

Ans: Chlorinated hydrocarbons can create the following problems.

(i) Nausea (ii) Dizziness
(iii) Tremors (vi) Blindness
(v) Skin eruption (vi) Effect on central nervous system

Q.42 Which are the metal pollutants of industry?

Ans: The following metals are pollutants present in the industrial wastes.
Pb, Cd, Cr, Hg, As and Sb.

BOD AND COD

Q.43 What is BOD? (Multan 2006, Guj. 2006, Multan 2008, Multan 2011, Lahore 2013)

Ans: It is an abbreviation of biochemical oxygen demand. The value of BOD is the amount of oxygen consumed as a result of biological oxidation of dissolved organic matter in the sample.

Q.44 What is COD? (Guj. 2006, F. Abad 2012)

Ans: It is the abbreviation of chemical oxygen demand COD is the organic contents of water which consumes oxygen during chemical oxidation and it is evaluated by its chemical oxygen demand.

Q.45 How COD is measured? (Guj. 2006, F. Abad 2012)

Ans: It is determined directly by treating with dichromate ion which is a powerful oxidizing agent. The organic matter in the water is oxidized while the remaining dichromate is determined by volumetric method.

PURIFICATION OF WATER

Q.46 What are the stages of water treatments? (Sargodha 2010)

Ans: There are four stages

- (i) aeration to settle down the suspended matter.
- (ii) wagelation of small particles.
- (iii) Precipitation and removal of solid matter.
- (iv) treatment of water with chlorine to kill viruses and bacteria

Q.47 What do you mean by aeration of raw water? (Rawalpindi 2006)

Ans: When H_2S gas is removed, some of organic matter is oxidized. Fe^{+2} ions are oxidized to Fe^{+3} , which gives insoluble $\text{Fe}(\text{OH})_3$.

Q.48 How the suspended impurities can be coagulated with water?

(Sargodha 2010, Multan 2012, Multan 2013)

Ans: The important coagulating agents are $\text{Al}_2(\text{SO}_4)_3$ or potash alums. Geletenous white precipitate of $\text{Al}(\text{OH})_3$ is produced and suspended impurities are absorbed on its surface. More than 80% of suspended impurities can be removed.

Q.49 How can we do the chlorination of water to purify it? (Sargodha 2010)

Ans: Chlorine is passed through water which produces HClO . It kills the micro-organism by passing through their cell membranes.

Q.50 What are the harmful effects of chlorination of water?

Ans: Chlorine reacts with NH_3 to give NH_4Cl , NHCl_2 and NCl_3 . These compounds are powerful eye irritants. Chlorinated water can cause cancer in the bladder and rectum.

SOLID WASTE MANAGEMENT

Q.51 What is the solid waste management?

Ans: It is the process in which the disposal of the domestic refuse commercial and industrial solid wastes and semisolid materials are burried is called solid waste management.

Q.52 What are landfills and how do you choose the height of landfills?

Ans: Landfills are large hole in the ground, where the things are dumped. The factors like topography, location of ground, water table, nature of solid waste and the type of soil and rocks can help us to choose the site. .

Q.53 What is incineration of municipal solids waste?

Ans: The solid waste is burnt at high temperature ranging from 900–1000°C.

Q.54 What are the side effects of incineration?

- Ans:**
- (i) It produces air pollution.
 - (ii) It gives toxic ash.
 - (iii) This ash is a source of dioxane, which is carcinogenic.
 - (iv) The oxides of nitrogen and sulphur are produced which cause the acid rain.

RECYCLING OF WASTES

Q.55 What is the recycling of the wastes?

Ans: Recycling is a process in which the used or waste materials are not discarded after their initial use, but they are processed so that they can be used again.

Q.56 What is recycling of papers?

Ans: The chlorine and other bleaching acids, along with other organic solvents are released. In order to improve its whiteness, it is blended with virgin newspaper.

Q.57 What is the recycling of the plastics?

Ans: The recycling of plastic is done in three ways:

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