Question Bank 2020-21
Std – 10
Chemistry

Chapter 1.
The Periodic Properties of elements…..

Question 1: Name the elements of first transition element.

Answer: Scandium

Question 2: Who gave modern periodic law? What is meant by a Group in the Periodic Table?

Answer: Henry Moseley. Vertical column in a Periodic Table are called groups.

Question 3: How many vertical columns are there in the modern periodic table ? State whether the ionization potential increases or decreases on going down a Group.

Answer: 18. Ionization potential decreases on going down a group.

Question 4: How many elements are in the second period of modem periodic table ? Write the names of first and last elements of second period.

Answer: There are eight elements in the second period of the periodic table. Lithium (Li) and Neon (Ne) are the first and last element of the second period.

Question 5: How many elements are in the third period of modern periodic table ? Write the names of first and last elements of third period.

Answer: Eight elements in the third period of the periodic table. Sodium (Na) and Argon (Ar) are the first and last elements of the third period.

Question 6: Which period is the shortest one ? In which period maximum number of elements are present?

Answer: The first period is the shortest period in the periodic table as it have only two elements i.e., H and He. The period in which the maximum number of elements are present in 6th period. It is the longest period of the periodic table as it have 32 elements.

Question 7: Give the number of the group and the period, of the clement having three shells with three electrons in valence shell?

Answer: The element having three shells with three electrons in valence shell belong to 13th group and 3rd period.

Question 8: What are the main characteristic of the last elements in the Periodic Table? What is the general name given to such elements?

Answer: The main characteristic of the last elements in the periods is the presence of 8 electrons in their valence shell (i.e., octet is complete). The general name of such elements are noble gases or inert gases or rare gases or aerogens.

Question 9: What are typical elements ?

Answer: Na, Mg, Al, Si, P, S, Cl, Ar all elements present in third short period in Periodic Table. These elements are known as typical elements.

Question 10: What are iso-electronic ions ? Account for the decrease in size of the following iso-electronic ions:
$O^{2-} > F^{-} > Mg^{2+} > Al^{3+}$

Answer: Iso-electronic ions are of different elements having the same number of electrons but differ from one another in magnitude of nuclear charge.

Ions	O^{2-}	>	F^{-}	>	Na^{+}	>	Mg^{2+}	>	Al^{3+}
Nuclear charge	+8		+9		+11		+12		+13

On moving from left to right, the nuclear charge goes on increasing and the electrons are pulled more and more strongly decreasing the size of the ions.

Question 11: (i) What is the common feature of the electronic configurations of the elements at the end of Period 2 and Period 3?
(ii) If an element is in Group 7 (or Group 7A) is it likely to be metallic or non-metallic character?
(iii) Supply the missing word from those in brackets.
If an element has one electron in its outermost energy level (shell) then it is likely to be (metallic/non-metallic)

Answer: (i) The atoms of the elements at the end of period 2 and Period 3 contains 8 electrons in their outermost shell.
(ii) Non-metallic.
(iii) Metallic.

Question 12: An element Z has atomic number 16. Answer the following questions on Z:
(i) State the period and group to which Z belongs.
(ii) Is Z a metal or a non-metal?
(iii) State the formula between Z and Hydrogen.
(iv) What kind of a compound is this?

Answer: (i) 3rd period, 16th group.
(ii) Z is a non-metal.
(iii) H_2Z
(iv) Covalent compound.

Question 13: What is similar in the electronic structure of Li, Na and K?

Answer: The electronic configuration of Li = 2, 1.
The electronic configuration of Na = 2, 8, 1.
The electronic configuration of K = 2, 8, 8, 1.
All the three have one electron in the outermost shell which they lose to form positively charged species, i.e., Li^{+}, Na^{+} and K^{+}.

Question 14: Answer the following questions regarding group 17 i.e., halogens of the periodic table. (i) What are halogens?
(ii) Which group and sub-group are they placed in?
(iii) What is their valency?
(iv) Why are they called halogens?
(v) Why do they not occur free in nature?

Answer: (i) Halogens are the members of VII A group which have seven electrons in the outermost shell.
(ii) They are placed in group VII and sub-group A.
(iii) Their valency is —1.
(iv) They are called halogens because chlorine which is a halogen, in the form of sodium chloride is the most abundant salt in nature. Halogen means salt producer.

(v) They do not occur free in nature because they all are very reactive as they need just one electron to complete their outermost shell and every member of the halogen group tries to attain stable electronic configuration.

Question 15: State the factors which affect or influence the atomic size of the elements in a periodic table.

Answer: These are:
(i) Magnitude of nuclear charge
(ii) Number of shells

Question 16: What do you know about metallic character of an element ?

Answer: It is the character of an element to have no more than three electrons in its outermost shell and its ability to form positive ions by loosing these electrons.

Question 17: Arrange the following elements as directed
(i) Ar, He, Ne (in increasing order of electron shells) (ii)
Li, F, C, O (in increasing order of electron affinity) (iii) Cl,
Mg, P, Na (in increasing order of atomic size) (iv) Cl, Li, F,
N (in increasing order of electronegativity)
(v) Cl, S, Al, Na (in increasing order of ionisation potential)
(vi) Increasing order of atomic size.
(vii) Increasing non-metallic character
(viii) Increasing ionisation potential. (ix)
Increasing electron affinity.
(x) Decreasing electronegativity.

Answer: (i) Increasing order of number of electron shells: He, Ne, Ar
(ii) Increasing order of electron affinity: Li, C, O, F
(iii) Increasing order of atomic size: Cl, P, Mg, Na
(iv) Increasing order of electronegativity : Li, N, Cl, F
(v) Increasing order of ionisation potential : Cl, S, Al. Na.

(vi) F>Cl>Br>I.
(vii) I<Br<Cl<F.
(viii) I<Br<Cl<F.
(ix) F<Cl<Br<I.
(x) F>Cl>Br>I.

Question 18: (I) Arrange I, Cl and Br in an increasing order of their atomic size.
(ii) Arrange the following in the increasing order of their ionisation potential?
Li, Be, B, C, N, O, F.

Answer: (i) Cl<Br<I.
(ii) Li<Be<B<C<N<O<F.

Question 19: How does the chemical reactivity of alkali metals and halogens vary ?

Answer: The reactivity of alkali metals increases as we move down the group. As the atomic number increases, the atomic racfcus also increases and the single electron in the valence shell is located further away from the nucleus. Hence, Li is least reactive and Francium is the most reactive. In case of halogens, the reactivity gradually decreases as we move down the group. All of them require one electron to

complet, the outermost shell and the nuclear attraction is greater on the nearest shell (i.e., Ilnd shell in F) than in the fathest shell (i.e., vith shell in iodine). Hence, F is most reactive and I is least reactive.

Question 20: How do the following change, on going from left to right in a period of the Periodic Table ? Give example in support of your answer.
(i) Chemical reactivity of elements. (ii) Nature of oxides of the elements.

Answer: (i) The alkali metals are highly reactive. The chemical reactivity of elements decreases from left to right in a period of the Periodic Table, e.g., in the 3rd period, the order of chemical reactivity is: Na> Mg >Al>Si>P>S>Cl
The order of chemical reactivity is the reverse of the order of electronegativity.
(ii) Oxides of elements in a particular period become less and basic and finally becomes acidic in character, e.g., oxides of third period:

Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	Cl_2O_7
Strongly basic	Basic	Amphoteric	Feebly acidic	Acidic	More acidic	Most acidic

Question 21: Strongly basic Basic Amphoteric Feebly acidic Acidic More acidic Most acidic The elements of one short period of the Periodic Table are given below in order from left to right:
Li Be B C O F Ne
(i) To which period do these elements belong ?
(ii) One element of this period is missing. Which is the missing element and where should it be placed ?
(iii) Which one of the elements in this period shows the property of catenation ?
(iv) Place the three elements fluorine, beryllium and nitrogen in the order of increasing electronegativity.
(v) Which one of the above elements belongs to the halogen series ?

Answer: (i) 2nd period
(ii) Nitrogen. It should be placed between carbon and oxygen
(iii) Carbon
(iv) Beryllium < Nitrogen < Fluorine
(v) Fluorine

Question 22: (i) For each of the following pairs, predict which one has greater ionization energy and greater electron affinity ?
(a) 1,1^- (b) B, C (c) Li, Li^+
(ii) Select the correct order of radii of three species : Ca, Ca^+ and Ca^{2+}: (a) Ca > Ca^+ > Ca^{2+} (b) Ca^{2+} > Ca^+ > Ca
(c) Ca^+ > Ca > Ca^{2+} (d) Ca^+ > Ca^{2+} > Ca
Assign suitable reason.

Answer: (i)

Ionisation Energy		Electron Affinity	
(a)	I^- > I	(i)	I > I^-
(b)	C > B	(ii)	C > B
(c)	Li^+ > Li	(iii)	Li > Li^+

(ii) The correct order of radii is (a), i.e., Ca > Ca^+ > Ca^{2+}.
This is because due to the loss of electron, the effective nuclear charge per electron increases, the electrons are more strongly attracted and pulled towards the nucleus. This causes a decrease in the size of the positive ion.

Question 23: (i) The elements calcium, strontium and barium were put in one group or family on the basis of their similar properties:
(a) What are those similar properties?
(b) What is the usual name of the group or family?
(ii) Chlorine, bromine and iodine elements were put in one group on the basis of their similar properties:
(a) What are those similar properties?
(b) What is the common name of this group or family?

Answer: (i) (a) All the three have the same number of valence electrons in their outermost shell, i.e.,

2. So they tare reactive, non-metallic, have low ionisation energy and low electron affinity.
(b) The name of this group is alkaline earth metals.
(ii) (a) All are non-metals and bad conductors of heat and electricity; diatomic in the gaseous state, form ionic compounds with non-metals.
(b) They are called halogen.

Question 24: (i) An element has an atomic number 16. State
(a) the period to which it belongs. (b) the number of valence electronš.
(c) whether it is a metal or non-metal.
(ii) Within a Group where would you expect to find the element with:
(a) The greatest metallic character? (b) The largest atomic size?

Answer: (1) (a) 3rd period (b) Six electrons (c) Non-metal
(ii) (a) At the bottom of the group. (b) At the bottom of the group.

Question 25: With reference to the first three periods of the modern periodic table, answer the questions given below:
(i) Write the formula of the sulphate of the element with atomic number 13.
(ii) Name the clement which has the highest ionisation potential.
(iii) What features of the atomic structure accounts for the similarities in the chemical properties of the elements in group VIIA of the periodic table?
(iv) How many electrons arc present in the valence shell of the element with atomic number 18?
(v) What is the electronic configuration of the element in the third period which gains one electron to change into an anion?
(vi) What is the name given to the energy released when an atom in its isolated gaseous state accepts an electron to form an anion?
(vii) What type of bonding will be present in the oxide of the element with atomic number 1?

Answer: (i) $Al_2(SO_4)_3$
(ii) Helium
(iii) Seven electrons in their valence shells
(iv) Eight
(v) 2, 8, 7 (vi) Electron affinity
(vii) Covalent bonding

Figure/Table Based Questions

Question 1: Consider the section of the periodic table given below :

Group Numbers	IA	HA	IIIA	IVA	VA	VIA	VIIA	0
	1	2	13	14	15	16	17	18
	Li		D			O	J	Ne
	A	Mg	Y	Si		H	Y	
	B	C		F	G			L

In this table B does not represent Boron
C does not represent Carbon
F does not represent Fluorine H does not represent Hydrogen

K does not represent Potassium
You must see the position of the element in the periodic table. Some elements are given in their own symbol and position in the periodic table. While others are shown with a latter. With reference to the

table :
(i) Which is the most electronegative ?
(ii) How many valence electrons are present in G ?
(iii) Write the formula ofrthe compound between B and H.

Answer: (i) J (ii) Five (iii) B_2H

Question 2: Given below is the part of Periodic Table:

Li	Be	B	C	N	O	F
Na	Mg	Al	Si	P	s	Cl

(i) How does metallic character of an element change as one moves from.
(a) Left to right in period ? (b) Top to bottom in group ?
(ii) How does the valency of elements change with respect to hydrogen as one moves from left to right in period ?
(iii) (a) What is the valency of element silicon ?
(b) Will it form a covalent or electrovalent bond with hydrogen ?
(iv) Which are the most metallic and the most non-metallic elements in above table.

Answer: (i) (a) As one moves from left to right in period, the metallic character of an element decreases and then it changes to non-metallic character.
(b) As one moves from top to bottom in period, the metallic character of the elements increases.
(ii) The valency of elements with respect to hydrogen is stated as under:
I group +1
II group +2
III group +3
IVgroup -4
V group -3
VI group -2
VII group -1
(iii) (a) The valency of element silicon is -4
(b) Silicon will form a covalent compound with hydrogen.
(iv) Sodium is the most metallic arid chlorine is most non-metallic element.

Question 3: In the portion of the Periodic Table given below, the letters A, B, represent the elements in periods 2 and 3 and groups 1, 2,13,14,15,16,17 and 18 which are not die usual symbols of the elements.

	1	2	13	14	15	16	17	18
Period 2	A	B	C	D	E	F	G	H
Period 3	I	J	K	L	M	N	O	P

Q	R	S	T	U

Study the table and answer the following questions :
(i) Which is the most electropositive element ?
(ii) Which is the most electronegative element ?
(iii) Which elements have properties that are similar to those of the element O ?
(iv) Which elements are the noble gases ?
(v) Which elements have a valency of 4 ?
(vi) Which is more metallic, Q or R ?
(vii) Which is more non-metallic, E or M ?
(viii) What is the collective name for the elements G, O, and S ? (ix)
Which elements are represented by the letters I, J, N, and O ?

Answer: (i) T, (ii) G, (iii) G and S, (iv) H and P, (v) D and L, (vi) Q, (vii) E, (viii) The halogens, (ix) I : Sodium, J : Magnesium; N: Phosphorus; O: Chlorine.

Question 4: Study the table above and answer the following questions carefully:

Elements	A	B	C
Mass number	23	20	35
Number of neutrons	12	10	18

(i) Write the atomic number and electronic configuration of elements A, B and C.
(ii) To which groups do A.. B and C belong?
(iii) To which periods do A, B and C belong?
(iv) Which anìongst A, B and C is (1) an alkali metal (ii) noble gas (iii) halogen?

Answer:

(i) Atomic number of A = (Mass number – no. of neutrons

$= 23 - 12$

$= 11 \Rightarrow \begin{pmatrix} 2 & 8 & 1 \\ K' & L' & M \end{pmatrix}$

Atomic number of B = (Mass number – no. of neutrons)

$= 20 - 10$

$= 10 \Rightarrow \begin{pmatrix} 2 & 8 \\ K' & L \end{pmatrix}$

Atomic number of C = (Mass number – no. of neutrons)

$= 35 - 18$

$= 17 \Rightarrow \begin{pmatrix} 2 & 8 & 7 \\ K' & L' & M \end{pmatrix}$

(ii) A belong to IA group, B belong to zero group, C belongs to VIIA group, Criterion: no. of valence electrons.
(iii)A belongs to 3rd period, B belongs to 2nd period, C belongs to 3rd period, Criterion => no. of shells.
(iii) A is an alkali metal, B is a noble gas,c is a halogen.

Reasoning Based Questions

Question 1: Explain why the elements placed in the same group of the Periodic Table have the same chemical properties ?

Answer: It is because they have the same number of valence electrons in the outermost shell of their atoms.

Question 2: Why group IA elements are called Alkali metals ?

Answer: Group IA elements are called alkali metals because their hydroxides are soluble in water and form strong bases.

Question 3: Why sodium is a metal while sulphur is a non-metal ?

Answer: Sodium has a larger atomic radii and lower ionization potential than sulphur. Hence sodium is a metal while sulphur is a non metal.

Question 4: Alkali metals are good reducing agents.

Answer: Alkali metals are good reducing agents because alkali metals have one valence electron which they lose to attain stability. Hence, they themselves undergo oxidation causing reduction of others and are good reducing agents.

Question 5: Why are the elements sodium and chlorine in the same period of the Periodic Table ?

Answer: Because the atoms of both the elements have three shells containing the electrons.

Question 6: Sodium atom, Na forms the positive ion Na^+, but chlorine atom Cl, does not form the positive Cl^+ ion.

Answer: Sodium is the first element of period 3 whereas chlorine is the last but one element of the same period. Since ionization potential increases across a period, the ionization potential of Na is much smaller than that of Cl. Hence, Na can lose an electron to form Na^+ ion whereas Cl cannot lose an electron to form Cl^+ ion.

Question 7: Potassium atom is larger than sodium atom. Why ?

Answer: Potassium is placed below sodium in group 1. It, therefore has one more electron shell. Na atom has three electron shells (2, 8,1); K atom has four (2, 8, 8,1). So, potassium atom is bigger than sodium atom.

Question 8: Magnesium atom is smaller than calcium atom. Why ?

Answer: Magnesium atom precedes calcium atom in the same group, i.e., group 2. Magnesium atom has got three electron shells (2, 8, 2) whereas calcium atom has four electron shells (2, 8, 8, 2). So, calcium atom is larger than the sodium atom.

Question 9: Magnesium atom is smaller than sodium atom. Why ?

Answer: Magnesium come after sodium in the same period. Atoms of both elements have three electron shells (Na : 2, 8, 1 : Mg : 2, 8, 2). But the nuclear charge of sodium is + 11 and that of magnesium is + 12. Hence, the electron shells are pulled inward more strongly in Mg atom than in Na atom. Hence, Mg atom is smaller than Na atom.

Question 10: Which is larger Na^+ or K^+ ? Why ?

Answer: K^+ is larger than Na^+ because the ionic radius increases in a particular group on moving from top to bottom due to increase in the principle energy shell though the number or electrons in the valence shell remain the same.

Question 11: Mg^{2+} ions is smaller than O^{2-} ion although both are iso-electronic. Explain.

Answer: Mg^{2+} ion is smaller than O^{2-} ion though both are iso-electronic. The nuclear charge in Mg^{2+} is + 12 and O^{2-} is + 8, so with the increase in nuclear charge the size decreases and, hence $O^{2-} > Mg^{2+}$.

Question 12: Why the atomic size decreases in a period as we move from left to right ?

Answer: As we move from left to right across a period, the number of shells remain the same. As the atomic number increases, the nuclear charge increases and there is a greater attraction between the nucleus and the electrons. The atomic size, therefore, decreases across a period.

Question 13: The reducing power of elements increases as one goes down a group ?

Answer: When an atom loses an electron then the element is said to be a reducing agent. The reducing power of an element depends upon how quickly it can lose electrons. In case of electrons held very loosely by the nucleus such element can easily lose their valence electrons and hence, higher reducing agent.

Question 14: The reducing power of elements decreases as on one move from left to right in a period ?

Answer: The reducing power of an element depends upon, how quickly it can lose electrons in the valence shell. As one moves from left to right in Periodic Table, the electrons in valence shell are held more tightly because of increase of nuclear charge. Thus, the tendency of atoms to lose their electrons gradually decreases and so does the reducing power.

Question 15: Why the oxidising power of elements increases on moving from left to right along a period in the periodic table ?

Answer: Because on moving from left to right along a period in the periodic table the electron affinity of elements increases.

Question 16: Why ionization potential of the element increases across a period ?

Answer: Ionization potential of an element is the amount of energy required to remove one or more electrons from the outermost shell of an isolated gaseous atom.
Across a period, the atomic radii decreases due to increase in nuclear charge due to addition of electrons which results in greated attraction of valence shell electrons. Hence, I.P. increases.

Question 17: Why the second ionization energy of an element is greater than its first ionization energy ?

Answer: More energy is required to remove an electron as it holds more firmly by the unipositive ion.

Question 18: Why is ionisation energy of O less than that of N ?

Answer: Ionisation energy of O is less than that of N because it is very easy to remove electrons from oxygen than from nitrogen. Hence, ionisation energy of O is less than that of N.

Question 19: Noble gases have zero electron affinity values.

Answer: Noble gases have zero electron affinity values because they have stable electronic configuration and have no tendency to take an additional electron. Hence, no energy is released and their electron affinity is zero.

Question 20: Why elements with low ionization potential exhibit metallic properties ?

Answer: Metallic character increases with decrease in ionization potential. Lower the value of ionization potential, the greater is the tendency of an atom to lose electrons.

Chapter - 2
Chemical Bonding

Short Questions

Question 1: Write the general characteristics of electrovalent compounds.

Answer: The general characteristics of electrovalent compounds are:

(i) Electrovalent compounds are mostly crystalline in nature.

(ii) Electrovalent compounds form hard crystals. These crystals are usually brittle.

(iii) Electrovalent compounds have high density with high melting and boiling points.

(iv) Electrovalent compounds are soluble in polar solvents.

(v) Electrovalent compounds exhibit isomorphism.

(vi) They react very fast.

Question 2: What are the salient features of electrovalent bond?

Answer: Some salient features of electrovalency are mentioned below :

(i) An electrovalent bond is formed by loss or gain or transfer of electrons. (ii) Ions are formed during the formation of an electrovalent bond.

Positive ions —> Cations (Na^+, K^+, Ca^{2+}, etc.)
Negative ions —> Anions (Cl^-, O^{2-}, N^{3-}, etc.)

(iii) An electrostatic force of attraction exist between the oppositely charged ions.

(iv) There is one fixed direction in space among the ions.

Question 3: Write important general characteristics of covalent compounds.

Answer: The important general characteristics of covalent compounds are as follows:

(i) Usually covalent compounds exist in gaseous, liquid or amorphous state.

(ii) Covalent compounds have low melting or boiling points.

(iii) Except for graphite, covalent compounds are bad conductors of electricity.

Question 4

: (i) Name the charged particles which attract one another to form electrovalent compounds.

(ii) In the formation of electrovalent compounds, electrons are transferred from one element to another. How are electrons involved in the formation of a covalent compound ?

(iii) The electronic configuration of nitrogen is 2, 5. How many electrons in the outer shell of a nitrogen atom are not involved in the formation of a nitrogen molecule ?

(iv) In the formation of magnesium chloride (by direct combination between magnesium and chlorine), name the substance that is oxidised and the substance that is reduced.

Answer: (i) Cation and anion

(ii) There is a mutual sharing of electrons

(iii) 2

(iv) Magnesium is oxidised and chlorine is reduced.

Question 5: In the formation of compound XY_2, atorix X gives one electron to each Y atom. What is the nature of bond to XY_2 ? Give four properties of XY_2.

Answer: The bond in XY_2 is ionic.

Properties:

(i) It is hard and brittle.
(ii) It is soluble in water.

(iii) It has high melting and boiling point.

(iv) It does not conduct electric current in the solid state but conducts electric current in the molten or dissolved state.

Question 6: There are three elements E, F, G with atomic numbers 19, 8 and 17 respectively.
(i) Classify the elements as metals and non-metals.

(ii) Give the molecular formula of the compound formed between E and G and state the type of chemical bond in this compound.

Answer:

(i)

	Z	EC	
E	19	2, 8, 8, 1	Metal
F	8	2, 6	Non-metal
G	17	2, 8, 7	Non-metal

(ii) E – 2, 8, 8, 1

$E - 1e^- \rightarrow E^{1+}$

G – 2, 8, 7

$G + 1e^- \rightarrow G^{1-}$

E^{1+} G^{1-}
E G $\Rightarrow$ EG

Type of bond $\Rightarrow$ Ionic bond.

Question 7: (i) Give one property of hydrogen chloride which agrees with it being a covalent compound.

(ii) Give one property of magnesium chloride which agrees with it being an ionic compound.
(iii) Name one compound which is covalent, but on dissolving in water conducts electricity ?
(iv) Which property of the above compound agrees with the being of a covalent compound ?

Answer: (i) Hydrogen chloride is a gas at room temperature and in dry state it is a bad conductor of electricity.

(ii) Magnesium chloride in the molten state or in aqueous solution is a good conductor of electricity and therefore is an ionic compound.

(iii) Hydrogen chloride.

(iv) Hydrogen chloride is a gas. In dry state, it is bad conductor of electricity. Hence, it is a covalent compound.

Question 8: A compound has the formula H_2Y (Y = Non-metal). State the following :
(i) the outer electronic configuration of Y.

(ii) the valency of Y.

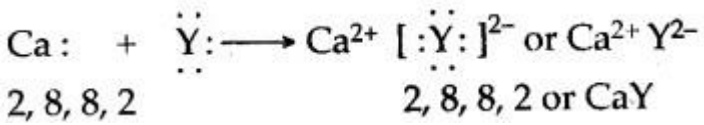
(iii) the bonding present in H_2Y.

(iv) the formula of the compound formed between calcium $^{40}_{20}Ca$ and Y.

Answer: (i) Y has six electrons in its valence shell.
(ii) 2

(iii) Covalent

(iv)

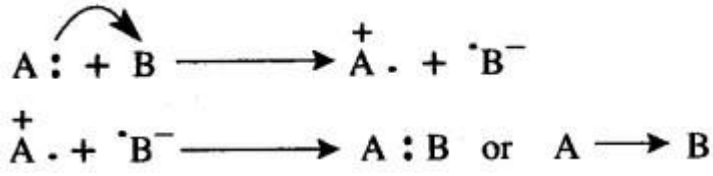


Question :9 How is a co-ordinate bond formed?

Answer: The formation of co-ordinate bond between two atoms to occur in the following two steps:

E.g. two atoms are A and B—in the first step the donor atom A transfers one electron of its lone pair to the acceptor atom B. This result in that atom A develops unit positive charge and atom B develops a unit negative charge. This charge is known as formal charge. This is similar to the formation of ionic bond.

In the second step the two electrons, one each with A and B- are shared by both the ions. This is similar to the formation of covalent bond.



Thus, a co-ordinate bond is equivalent to a combination of an electrovalent bond and a covalent bond. Hence it is also called a semipolar bond or dotive bond.

Question10:: What are the characteristics of co-ordinate compounds?

Answer: The general characteristics of co-ordinate compounds are as follows:
(i) Co-ordinate compounds are identical to normal covalent compounds.

(ii) It is rigid and has directional properties.

(iii) These compounds are soluble in non-polar solvents and insoluble in polar solvent.
(iv) These compounds behave as non-conductors of electricity.

(v) The melting and boiling points are higher than covalent compounds and lower than ionic compounds.

(vi) These are stable compounds.

Question 11: What is lone pair effect ? In what kind of compound does this effect occur ?

Answer: When the unshared pair of electrons around an atom in the middle of a molecule is completely shared by another atom or an ion, it is called lone pair effect. Lone pair effect is shpwn by polar covalent compounds such as HCl and NH_3.

Question 12: (i) Which of the following is not a common characteristic of an electrovalent compound ?

(a) High melting point

(b) Conducts electricity when motten

(c) Consists of oppsitely charged ions

(d) Ionises when dissolved in water

(ii) What are the terms defined below:

(a) A bond formed by a shared pair of electrons with both electrons coming from the same atom.

(b) A bond formed by a shared pair of electrons, each bonding atom contributing one electron to the pair.

Answer: (i) (d)

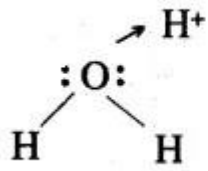
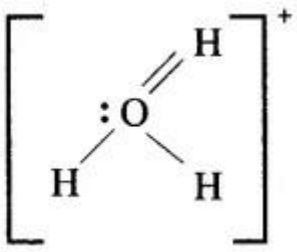
(ii) (a) Co-ordinate bond. (b) Covalent bond.

Question 13: (i) Acids dissolve in water to produce positively charged ions. Draw the structure of these positive ions.

(ii) Explain why Carbon tetrachloride does not dissolve in water.

(iii) Elements Q and S react together to form an ionic compound. Under normal conditions, which physical state will the compound QS exist in ?

(iv) Can Q and S, both be metals ? Justify your answer.

(i)  *Or* 

(ii) Because carbon tetrachloride is non-polar covalent compound whereas water is a polar covalent solvent.

(iii) Solid state.

(iv) No. Because to form an ionic compound if one element gives electrons, the other element should accept electrons. Metals can only lose electrons to provide +ve ions.

Question 14: Predict the type of bonding in the following molecules :
(i) Oxygen (ii) Calcium oxide

(iii) Water (iv) Methane

(v) Ammonium ion (vi) Nitrogen

(vii) Magnesium chloride (viii) Carbon dioxide

(ix) Carbon tetra chloride (xi) Hydrogen cyanide (x) Hydrogen chloride

Answer: (i) Covalent bond (ii) Ionic bond

(iii) Covalent bond (iv) Covalent bond

(v) Covalent bond (vi) Ionic bond

(vii) Covalent bond (viii) Covalent bond

(ix) Covalent bond (xi) Covalent and co-ordinate bonds (x) Covalent bond

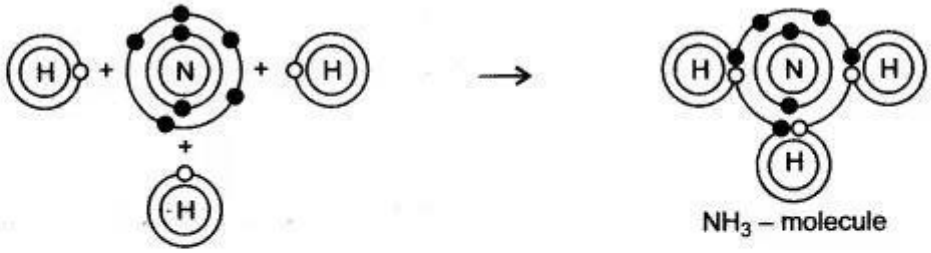
Figure/Table Based Questions

Question 1: Draw orbital structure to illustrate the structure of the molecules of: (i) Ammonia (ii) Carbon dioxide

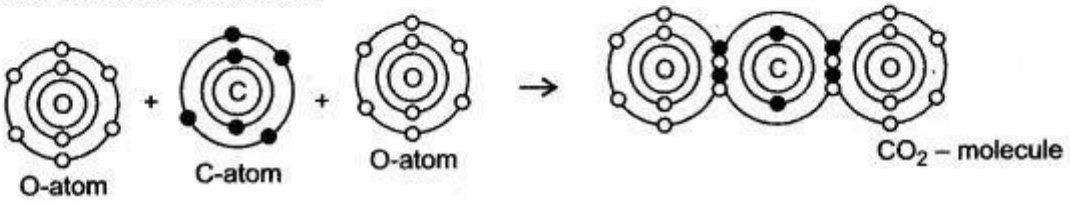
(iii) Methane (iv) Water

Answer:

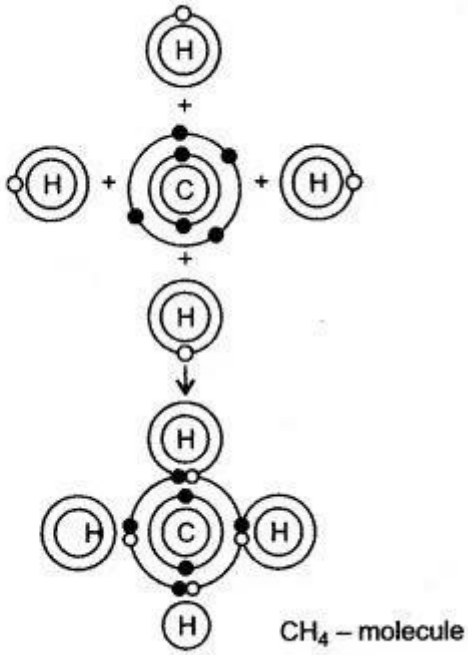
(i) Ammonia molecule



(ii) Carbon dioxide molecule

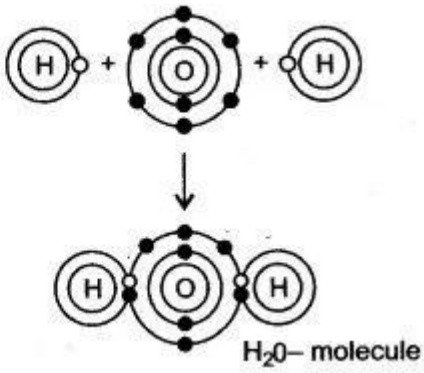


(iii) Methane molecule



CH_4 – molecule

(iv) Water molecule



H_20– molecule

Question 2: Give the electron dot structures of:

(i) NaCl (ii) $MgCl_2$ (iii) CaO (iv) Cl_2 (v) H_2O (iv) NH_3

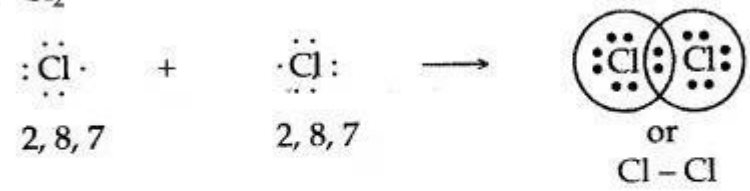
Answer:

(i) NaCl

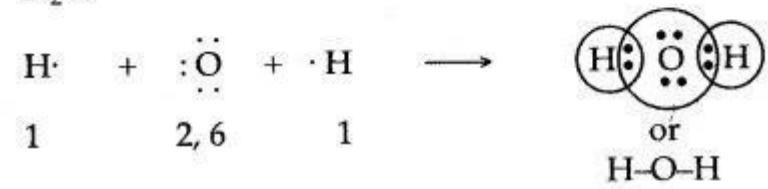
(ii) $MgCl_2$

(iii) CaO

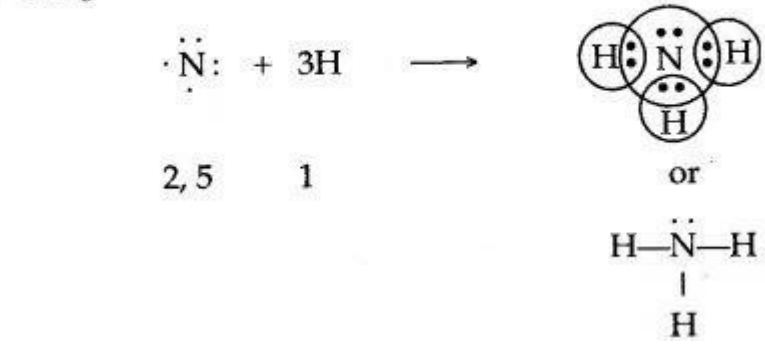
(iv) Cl_2



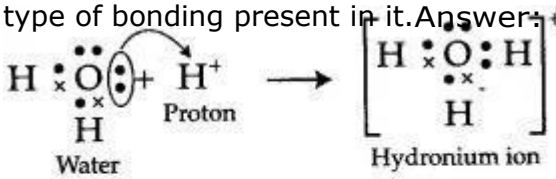
(v) H_2O

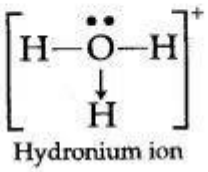


(vi) NH_3



Question 3: Draw an electron dot diagram to show the structure of hydronium ion. State the type of bonding present in it.Answer: Formation of hydronium ion:

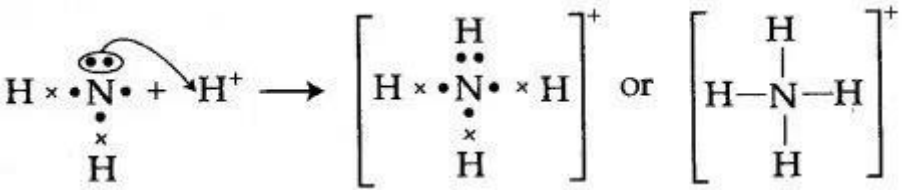




The type of bonding present in hydronium ion is co-ordinate bonding.

Question 8: By drawing an electron dot diagram, show the lone pair effect leading to the formation of ammonium ion from ammonia gas and hydrogen ion.

Answer:



NH_3 has one lone pair of electrons which is donates to hydrogen atom forming a co-ordinate bond. The arrow represents a co-ordinate bond. The arrow points from donor to acceptor atom.

Reasoning Based Questions

Question 1: Why atoms combine with one another ?

Answer: The cause of chemical combination between atoms of the various elements is their tendency to acquire nearest stable noble gas configuration of octet of electrons and duplet of electrons in case of hydrogen atoms in their outermost shells.

Question 2: Why do certain elements form ions ?

Answer: Every particle (molecule, atom or ion) has the tendency to attain the state of lowest energy. As atoms of all elements except the noble gases, have one to seven electrons in their outermost shell, therefore, they are not in the state of minimum energy. They are reactive. In order to attain a minimum state of energy, i.e., to acquire a duplet or octet structure in their valence shell, they either donate or accept electrons. In this process, they become charged particles or ions.

Question 3: Why are all atoms other then noble gas atoms, reactive ?

Answer: Because they are short of octet in their outermost shell. They tend to attain eight electrons in their outermost shell to acquire nearest inert gas electronic configuration.

Question 4: Why a molecule of hydrogen is more stable than the uncombined atoms ?

Answer: When a molecule of hydrogen is formed from the atoms, energy is released (104 kcal/ mol). The molecules possessing lower energy are more stable, than the

atoms. Hence molecule of hydrogen is more stable than uncombined atoms.Question 5: Why is hydrogen ion called proton?

Answer: An atom of hydrogen has one proton in its nucleus and one electron in its valence shell. It donates its valence electron, the residual ion consists of a single proton. It is on account of this fact, that hydrogen ion is called proton.

Question 6: A cation is smaller than the atom from which it is formed. Why ?

Answer: In the formation of a cation, the atom loses the electrons of its outer shell. Thus, the cation has one electron shell less than the atom, from which it is formed. So, it is smaller than the atom.

Question 7: An anion carries negative charge. Why ?

Answer: When an atom forms an anion, it gets one or more electrons (from another atom) in its outer shell. As the number of electrons in the outer shell is increased, the repulsion between them increases. This makes the shell expand outward. Further, since the number of protons remains the same as in the neutral atom, the nucleus attracts the increased number of electrons less strongly. For these reasons the anion is bigger than the parent atom.

Question 8: Why electrovalent compounds form hard crystals ?

Answer: The crystals of electrovalent compounds are made up of crystal lattice containing oppositely charged ions. Each cation is surrounded by a definite number of anions and vice- versa. Their is a great electrostatic force of attraction among these oppositely charged ions and as a result, ionic compounds form hard crystals.

Question 9: Why electrovalent compounds have high melting, boiling points and low volatility

?

Answer: There is a strong force of attraction among the oppositely charged ions in the crystals of electrovalent compounds. Therefore, a large amount of energy is required to separate them. Due to these strong forces of attraction, ionic compounds have high melting and boiling points and low volatility.

Question 10: Why electrovalent compounds in crystalline state do not conduct electricity ?

Answer: Electrovalent crystalline solids do not conduct electricity because the oppositely charged ions in them are held together by a strong electrostatic force of attraction. These ions occupy fixed position in the crystals and do not move when an electric field is applied. .

Question 11: Why do electrovalent compounds usually dissolve in water and molecular compounds dissolve in organic solvents ?

Answer: Water is polar molecule.%It hydrates ions by its polar attraction and pulls the ions apart. In covalent compounds the polar charge on molecules is weak and does not have that much of attractive force on the molecules, organic solvents exert a greater polar attraction on covalent molecules and hence dissolve them.

Question 12: Why ionic compounds are generally soluble in water, but insoluble in organic solvents ?

Answer: The water molecules have high dielectric constant thus, water molecules easily break the ionic bonds between the ions. The ions drift in water in all possible directions and hence,ionic compounds dissolve in water, while organic solvents are non-polar in nature and hence, cannot break the ionic bonds. Thus, the ionic compounds do not dissolve in them.

Question 13: Why molten NaCl conduct electricity but, CCl_4 does not ?

Answer: Molten NaCl contains Na^+ and Cl^- ions, which are free to move, hence it conducts electricity. Whereas Liquid CCl_4 does not contain any charged particles to conduct electricity.

Question 14: Why is sodium ion (Na^+) not reactive, but sodium metal is very reactive ?

Answer: Sodium ion has eight electrons in its valency shell and it is the minimum state of energy, while the sodium metal has one electron in valency shell, so the sodium metal is very reactive.

Question 15: Why covalent compounds are generally liquids or gases ?

Answer: In covalent compounds, the molecules are held together by weak Van der Waal's forces. In liquids, the molecules are weakly attracted whereas in gases, these forces are almost non¬existent. Hence, they are generally liquids or gases.

Question 16: Why all covalent compounds are bad conductor of electricity ?

Answer: The covalent compounds do not have positive or negative ions in their fused state. Thus, when electric potential is supplied, no ions migrate to opposite poles and hence no conduction of electric current takes place.

Question 17: Why covalent compounds have low melting point and boiling point ?

Answer: The force of attraction between the molecules is very weak and so the amount of energy needed to separate them is small, consequently they have low melting points and boiling points.

Question 18: Why most of the covalent compounds have density less than that of water ?

Answer: The covalent molecules are held very weakly by van der Waal's forces. Thus, there are large inter molecular spaces between the molecules. In other words the number of molecules per unit volume is less. Thus mass per unit is also less and hence, covalent compound have low density.

Question 19: Why do covalent compounds exist as gases, liquids or soft solids ?

Answer: Covalent compounds exists as gases, liquids or soft solids because they have weak forces of attraction between their molecules.

Question 20: Why hydrogen chloride can be termed as a polar covalent compound ?

Answer: Pure covalent bond exists between two elements which have similar electronegativities. In hydrogen chloride, chlorine being more electronegative attracts the shared pair of electrons towards itself. As a result hydrogen acquires partial positive charge and chlorine gets partial r negative charge. Thus, hydrogen chloride can be termed as a polar covalent compound.

Question 21: Why is methane molecule regarded as a non-polar covalent compound ?Answer: It has been found that a methane molecule has a three dimensional tetrahedral structure. The four carbon hydrogen tetrahedral structure. The four carbon hydrogen bonds are directed towards the four corners of tetrahedron. In such a configuration, none of the participating atoms is more electrically charged as compared to other atoms. Hence methane molecule is a non polar covalent compound.

Question 22: Why the melting and boiling points of co-ordinate compounds are higher than covalent compounds and lower than ionic compounds ?

Answer: A co-ordinate bond is a union of one electrovalent and one covalent bond, the volatility of these compounds lies between that of covalent and ionic compounds. Thus their melting and boiling points are higher than covalent compounds and lower than ionic compounds.

CHAPTER 3-
ACIDS, BASES AND SALTS

Short Questions:

Question1:

Solution A is a strong acid, solution B is a weak acid, solution C is a strong alkali.

(i) Which solution contains solute molecules in addition to water molecules.

(ii) Which solution could be a solution of glacial acetic acid ? (iii) Give an example of a solution which is a weak alkali.

Answer:

(i) B
(ii) B
(iii) Ammonium hydroxide

Question2:

Name the kind of particles present in:

(i) Sodium hydroxide solution.
(ii) Carbonic acid
(iii) Sugar solution.

Answer:

(i) Sodium ions and hydroxide ions.

(ii) Carbonic add molecules, carbonate ions and hydronium ions. (iii) Sugar molecules and water molecules.

Question3:

Solution A is a sodium hydroxide solution. Solution B is a weak acid. Solution C is dilute sulphuric add. Which solution will

(i) liberate sulphur dioxide from sodium sulphite.

(ii) give a white precipitate with zinc sulphate solution. (iii) contain solute molecules and ions ?

Answer:

(i) C
(ii) A
(iii) B

Question4:

(i) What is the pH of:

(a) Pure water

(b) Milk

(c) Human blood.

(ii) The pH value of three solutions is given below. Which one of them is acidic, neutral and alkaline in nature ?

(a) pH = 7

(b) pH = 10

(c) pH = 3.

Answer:

(i) The pH of:

(a) Pure water is 7

(b) Milk is 6.6

(c) Human blood is 7.3

(ii)(a) Neutral

(b) Alkaline

(c) Acidic

Question5:

(i)A is a soluble acidic oxide, B is a soluble base compared to the pH of pure water, what will be the pH

of:

(a) a solution of A

(b) a solution of B.

(ii) Taking sodium carbonate as an example, give the meaning of the following terms:

(a) Water of crystallisation

(b) Anhydrous

(c) Efflorescence.

Answer:

(i) (a) The pH is less than 7

(b) The pH is more than 7

(ii) (a) Water of crystallization is that definite number of water molecules which are to a crystal when it is crystallizing out from an aqueous solution, e.g. Sodium carbonate crystal contains 10 molecules of water i.e. $Na_2CO_3.10H_2O$.

(b) When $Na_2CO_3.10H_2O$is heated, the water of crystallization is evaporated leaving

anhydrous sodium carbonate Na_2CO_3.

(c) The loss of water by a hydrate on exposure to air is called efflorescence, e.g. Na_2CO_3.

$10H_2O$on exposure to air, looses 9 molecules of water of crystallization. $Na_2CO_3.10H_2O$—> $Na_2CO_3.H_2O$+ $9H_2O$.

Question6:

A solution has a pH of 7 explain how you would :

(i) (a) Increase its pH (b) Decrease its pH.

(ii) If a solution changes the colour of litmus red to blue what can you say about its pH ? (iii) What can you say about the pH of a solution that liberates carbon dioxide from sodium carbonate.

Answer:

(i) (a) pH is increased by adding any caustic alkali to solution

(b) pH is decreased by adding any mineral acid to solution

(ii) pH of solution is more than 7

(iii) pH of solution is less than 7

Question7:

You are provided with the following chemicals :

Ammonium hydroxide, chlorine, copper oxide, iron, lead nitrate and dilute sulphuric acid; using only chemicals of this given list, write equation for the following salt preparations:

(i) A salt by direct combination.

(ii) A soluble salt by neutralisation of an alkali. (iii) A soluble salt from an insoluble base.

(iv) A salt by double decomposition
(Precipitation). (v) A soluble salt from a metal.

Answer:

(i) $2Fe + 3Cl_2 \longrightarrow 2FeCl_3$ (Ferric chloride.)

(ii) $2NH_4OH + H_2SO_4 \longrightarrow (NH_4)_2SO_4 + 2H_2O.$

(iii) $CuO + H_2SO_4 \longrightarrow CuSO_4 + H_2O$
(Insoluble base) (Soluble salt)

(iv) $Pb(NO_3)_2 + H_2SO_4 \longrightarrow PbSO_4 \downarrow + 2HNO_3$ (ppt.)

(v) $Fe + H_2SO_4 \longrightarrow FeSO_4 + H_2$
Soluble Salt
(Ferrous sulphate)

Question8:

Zinc sulphate is called a "salt", sulphur dioxide an "acidic oxide" and lead monoxide a "basic oxide". What is meant by these terms ?

Answer:

(i) Zinc sulphate is a salt, because it is formed by the complete replacement of the hydrogen of sulphuric acid by zinc.

$Zn + H_2SO_4 \text{—>} ZnSO_4$(Zinc sulphate) $+ H_2$

(ii) Sulphur dioxide is an acidic oxide, because it is an oxide of non-metal, which dissolves in water to form an acidlcnown as sulphurous acid. It reacts with a base to form salt and water. $SO_2 + H_2O \text{—>} H_2SO_3$(Sulphurous acid)

$SO_2 + 2NaOH \text{ —>} Na_2SO_3$(Sodium sulphite) $+ H_2O$

(iii) Lead monoxide is a basic oxide, because it is a metallic oxide and it reacts with an acid to form salt and water only.

$PbO + 2HCl \text{ —>} PbCl_2$(Lead chloride) +
H_2O

Question9:

(i) From the list of substances given below, choose the pair required to prepare the salt (a) to (c) in laboratory and write down the relevant equations.

The substances are:

Chlorine, iron, lead, le&d nitrate solution, sodium nitrate solutions, iron (III) carbonate, lead carbonate, iron (III) chloride, sodium hydroxide solution and dilute hydrochloric add.

The salts are :

(a) Sodium chloride

(b) Lead chloride

(c) Anhydrous iron (III) chloride.

(ii) All ammonium salts are decomposed on heating. What other properties do ammonium salts have in common ?

Answer:

(i) (a) Hydrochloric acid and sodium hydroxide solution react to form sodium chloride. $HCl + NaOH \longrightarrow NaCl + H_2O$

This reaction represent the formation of a salt by the acid base neutralization.

(b) Lead chloride prepared by adding dilute hydrochloric acid to a solution of lead nitrate. $Pb(NO_3)_2 + 2HCl \longrightarrow PbCl_2 + 2HNO_3$

(c) Anhydrous iron (III) chloride is obtained from action of dry Cl_2 gas over heated powdered

iron in a pyrex tube.

$2Fe + 3Cl_2(dry) \longrightarrow 2FeCl_3$

(ii) On heating, ammonium salt dissociates into ammonia and HCl. The other property of ammonium salt is that when heated with alkali, NH_3 is formed.

$NH_4Cl + NaOH \longrightarrow NaCl + H_2O + NH_3$

Question10:

Name, from the list of substances given below, the substance which you would use to prepare each of the following salts named in Part (i) to (iv).

The substances are:

Dilute sulphuric acid, copper, lead, dilute nitric acid, dilute hydrochloric acid, copper oxide, lead carbonate, sodium carbonate, sodium and zinc.

(i) Lead sulphate. (ii) Copper sulphate. (iii) Sodium sulphate. (iv) Zinc sulphate.

(v) What are the two steps necessary to change lead carbonate into lead chloride ?

(vi) Give the name of a soluble lead salt and write the equation for the action of heat on this salt.

Answer:

(i) For lead sulphate lead carbonate and dilute sulphuric acid are required. (ii) For copper sulphate copper oxide and dilute sulphuric acid are required.

(iii) For sodium sulphate sodium carbonate and dilute sulphuric acid are required. (iv) For zinc sulphate zinc and dilute sulphuric acid are required.

(v) $PbCO_3 + 2HNO_3 \longrightarrow Pb(NO_3)_2 + H_2O + CO_2$

$Pb(NO_3)_2 + HCl \longrightarrow PbCl_2 + HNO_3$

(vi) Lead nitrate, $2Pb(NO_3)_2 \xrightarrow{\Delta} 2PbO + 4NO_2 + O_2\uparrow$

Question11:

Name the method used for preparation of the following salts from the list given below

(i) sodium nitrate

(ii) Iron (III) chloride

(iii) Lead chloride

(iv) Zinc sulphate

(v) Sodium hydrogen sulphate

List:

(a) Simple displacement

(b) Neutralization

(c) Decomposition by acid

(d) Double decomposition

(e) Direct synthesis.

Answer:

(i) (B) Neutralisation

(ii) (E) Direct synthesis

(iii) (D) Double decomposition

(iv) (A) Simple displacement

(v) (C) Decomposition by acid.

Question12:

Name three classes of substances, which react with an acid to form salts. Write equations to describe their reactions with suitable acids.

Answer:

Three different classes of substances are a metal, a base and a metallic carbonate, which react with an acid to form salts.

(i) Zinc, a metal reacts with dilute sulphuric acid to form zinc sulphate and hydrogen gas is liberated.

$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$

(ii) Sodium hydroxide, a base reacts with dilute nitric acid to form sodium nitrate and water. $NaOH + HNO_3 \rightarrow NaNO_3 + H_2O$

(iii) Magnesium carbonate a metallic carbonate reacts with dilute hydrochloric acid to form magnesium chloride, water and carbon dioxide gas is liberated.

Question13:

Making use only of substances chosen from those given below: Give the equations for the reactions by which you could obtain:

(i) Hydrogen
(ii) Sulphur dioxide
(iii) Carbon dioxide
(iv) Zinc carbonate

Answer:

(i) $Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$

(ii) $Na_2SO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + SO_2$

(iii) $Na_2CO_3 + H_2SO_4 \xrightarrow{\Delta} Na_2SO_4 + H_2O + CO_2$ Or

$CaCO_3 \xrightarrow{\Delta} CaO + CO_2$

(iv) $Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$

$ZnSO_4 + Na_2CO_3 \longrightarrow ZnCO_3 + Na_2SO_4$

Question14:

Which of the following salts give acidic solutions, alkaline solutions, and neutral solutions in water:

Potassium nitrate,KNO_3; ammonium sulphate,$(NH_4)_2SO_4$; potassium carbonate, K_2CO_3;

sodium chloride, NaCl; sodium acetate, CH_3COONa; and copper sulphate, $CuSO_4$.

(i) Acidic solutions ……..

(ii) Alkaline solutions
…….

(iii) Neutral solutions
…….

Answer:

(i) Acidic solutions: ammonium sulphate; $(NH_4)_2SO_4$,copper sulphate ($CuSO_4$).

(ii) Alkaline solutions: potassium carbonate; (K_2CO_3),sodium acetate (CH_3COONa).

(iii) Neutral solutions: potassium nitrate; (KNO_3),sodium chloride (NaCl).

Question15:

(i) Name four soluble salts.

(ii) Name four insoluble salts.

Answer:

(i) (a) Zinc sulphate

(b) Iron (II) sulphate.

(c) Copper (II) sulphate.

(d) Sodium sulphate.

(ii) (a) Calcium carbonate.

(b) Lead sulphate

(c) Silver chloride

(d) Barium sulphate.

Question16:

(i) What happens to the crystals of washing soda when exposed to air ? Name the phenomenon exhibited.

(ii) Classify the following compounds into: Deliquescent, Efflorescent, None of these

(a) Magnesium chloride crystals

(b) Zinc chloride crystals,

(c) Lead nitrate crystals

(d) Ferrous sulphate crystals

(e) Lead chloride

(f) Copper sulphate crystals,

(g) Zinc hydroxide, (h) Magnesium chloride.

Answer:

(i) When exposed to air washing soda crystals lose their water of crystallisation and become amorphous.

∴ The phenomenon is called efflorescence.

(ii) (a) Deliquescent

(b) Deliquescent

(c) None of these

(d) None of these

(e) None of these

(f) Efflorescent

(g) None of these

(h) Highly deliquescent.

Question17:

Answer the questions given below, relating your answers only to salts given in the following list: Sodium chloride, calcium chloride, copper sulphate.5-water.

(i) What name is given to the water in compound copper sulphate. 5-water ?

(ii) If copper sulphate. 5-water is heated, the water is driven off leaving anhydrous copper sulphate.(a) What is the colour of anhydrous copper sulphate ?

(b) By what means, other than heating, could you dehydrate copper sulphate. 5-water and obtain anhydrous copper sulphate ?

(iii) What is deliquescence.

(iv) Which one of the salts in the given list is deliquescent ?

Answer:

(i) Water of crystallization.

(ii) (a) White

(b) By adding cone. H_2SO_4.

(iii) Compounds that take up enough water from the air to dissolve in the water, are called deliquescent, e.g. Calcium chloride ($CaCl_2$)and sodium hydroxide are deliquescent.

(iv) Calcium chloride.

Question18:

$CuSO_4.5H_20$,$Na_2CO_3.10H_2O$,CaO and anhydrous calcium chloride are chemicals commonly available in laboratory. Answer the following questions relating your answer to the

list of chemicals given above.

(i) Which salt is blue in colour ?
(ii) Which salt is efflorescent in nature ?
(iii) Which salt is hydroscopic in nature ?
(iv) Which salt is deliquescent in nature.

(v) State your observations when solution of calcium chloride is mixed with solution of sodium carbonate.

Answer:

(i) $CuSO_4.5H_2O$is blue in colour
(ii) $Na_2CO_3.10H_2O$is efflorescent in nature.
(iii) CaO is hydroscopic in nature.
(iv) Anhydrous calcium chloride is deliquescent in nature.

(v) A white ppt. of calcium carbonate appears when the solutions of $CaCl_2$and $Na_2CO_3$are mixed. The white ppt. gradually settles at the base of test tube.

Question19:

(i) State the colour of the following salts:
(a) Copper chloride

(b) Ferric chloride

(c) Copper nitrate

(d) Lead nitrate

(e) Magnesium carbonate

(f) Zinc hydroxide

(ii) State the colours of the aqueous solution of the following salts:
(a) Calcium sulphate crystals

(b) Ferrous chloride crystals

(c) Ferric chloride crystals

(d) Ferrous sulphate crystals

(e) Ferric sulphate crystals

(f) Copper sulphate crystals.

Answer:

(i) (a) Brown (anhydrous)

(b) Black (anhydrous)

(c) Blue

(d) White

(e) White

(f) White

(ii)(a) Colourless

(b) Blue green

(c) Yellow

(d) Green

(e) Yellowish white

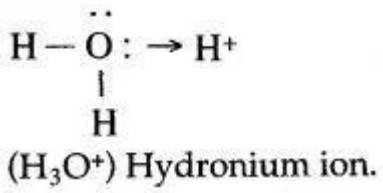
(f) Blue.

Figure/Table Based Questions:

Question1:

Draw the structure of the stable positive ion formed when an acid dissolves in water.

Answer:



(H_3O^+) Hydronium ion.

Question2:

Some methods used for the laboratory preparation of salts are : A : metal + acid

B : carbonate + acid

C : precipitation (double decomposition)
D : direct combination

E: titration

Copy and complete the following table:

Salt	Method of Preparation
Ammbnium sulphate	
Calcium carbonate	
Iron (III) chloride	
Lead nitrate	
Zinc sulphate	

Answer:

Salt	Method of Preparation
Ammonium sulphate	E: Titration
Calcium carbonate	C: Precipitation
Iron (III) chloride	D: Direct Combination
Lead nitrate	B : Carbonate + acid
Zinc sulphate	A : Metal + acid

Reasoning Based Questions:

Question1:

Hydrochloric acid is considered as a strong acid whereas acetic acid is a weak acid. Why ?

Answer:

Hydrochloric acid is consMered as a strong acid because it dissociates completely in water.

$HCl\,(aq.) \rightleftharpoons H^+\,(aq.) + Cl^-\,(aq.)$ Acetic acid is a weak acid as it-dissociates partially when dissolved in water. Most of its molecules remain in molecular form in the solution.

$CH_3COOH\,(aq) \rightleftharpoons CH_3COO^-\,(aq) + H^+\,(aq)$

Question2:

Why dilute sulphuric acid is stronger acid than concentrated sulphuric acid ?

Answer:

The presence of water in dilute sulphuric acid increases the hydrogen ion concentration. Hence it is a stronger acid than concentrated sulphuric acid which contains comparatively less water.

Question3:

Acetic acid is monobasic. Why ?

Answer:

Acetic acid is monobasic because it has one dissociable hydrogen ion and combines with one hydroxyl ion of the base to give a single salt and water.

$$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$$

$$NaOH + CH_3COOH \longrightarrow CH_3COONa + H_2O$$

Question4:

Carbonic acid is a dibasic acid. Why ?

Answer: Carbonic acid (H_2CO_3)is a dibasic acid because it has two replaceable hydrogen atoms and hence it combines with two hydroxyl groups of the bases to form two kinds of salt and water.The displacement of two hydrogen atoms takes place in two steps

$$H_2CO_3 \rightleftharpoons HCO^-_3 + H^+$$

$$HCO^-_3 \rightleftharpoons CO_3^{2-} + H^+$$

Question5:

An aqueous solution of the salt ammonium chloride is acidic in nature while an aqueous solution of sodium chloride is neutral. Why ?

Answer:

Ammonium chloride is a salt of weak base and strong acid, it undergoes salt hydrolysis to produce an acidic solution whereas sodium chloride is a salt of strong acid and strong base, it does not undergo salt hydrolysis hence its solution remains neutral.

Question6:

An aqueous solution of the zinc sulphate acidic in nature. Why?

Answer:

When zinc sulphate is dissolved in water, it is hydrolysed to form sulphuric acid and zinc hydroxide. Sulphuric acid is a strong acid, while zinc hydroxide is a weak base, hence, the solution is acidic in nature.

$$ZnSO_4 + 2H_2O \longrightarrow \underset{\text{Weak base}}{Zn(OH)_2} + \underset{\text{Strong acid}}{H_2SO_4}$$

Question7:

An aqueous solution of ammonium acetate, neutral in nature. Why?

Answer:

Ammonium acetate, when dissolved in water is hydrolysed to form ammonium hydroxide and acetic acid. Ammonium hydroxide and acetic acid both are weak alkali and acid respectively, hence the solution is neutral in nature.

Question8:

An aqueous solution of sodium carbonate is alkaline and that of ammonium chloride is acidic in behaviour. Why?

Answer:

Both of these salts react with water. Sodium carbonate reacts with water, producing a strong alkali, sodium hydroxide and a weak acid, carbonic acid. Hence, the solution is alkaline:

$$Na_2CO_3 + H_2 \rightleftharpoons 2NaOH + H_2CO_3$$

Ammonium chloride reacts with water to produce ammonium hydroxide, a weak alkali and hydrochloric acid, a strong acid. Hence the solution is acidic:

$$NH_4Cl + H_2 \rightleftharpoons NH_4OH + HCl$$

Question9:

The heat of neutralization of a strong acid with strong base is always the same. Why?

Answer:

Strong acids, strong bases and their salts ionize completely in the solution. Consider the neutralization of hydrochloric acid by sodium hydroxide, which is as follows:

$$NaOH + HCl \longrightarrow NaCl + H_2O + Q \text{ cals.}$$

On ionization, we have

$$Na^+ + OH^- + H^+ + Cl^- \longrightarrow Na^+ + Cl^- + H_2O + Q \text{ cals.}$$

$$H^+ + OH^- \longrightarrow H_2O + Q \text{ cals.}$$

This shows that heat of neutralization of a strong acid by a strong base is nothing, but heat of formation of water molecule from hydrogen and hydroxyl ions, hence it is in the same and fixed quantity.

Question10:

While mixing strong sulphuric acid and water, why is the acid always poured slowly into water instead of water into the acid?

Answer:

When concentrated sulphuric acid is mixed with water, it evolves a considerable amount of heat. This heat is liberated due to the hydration of hydrogen ions derived from the acid.

$H^+ + H_20 \rightarrow H_3O^+ +$ Heat.

Due to the production of heat, the water may be vaporised into steam and spill out corrosive drops of acid. To avoid this, the acid is always slowly added to water.

Question11:

It is necessary to find out the ratio of reactants required in the preparation of sodium sulphate. Why?

Answer:

In the preparation of sodium sulphate, sodium hydroxide and sulphuric acid are both soluble and excess of any of them can not be removed by filtration. Thus it is necessary to find out the ratio of the solutons of the two reactants required for complete neutralisations.

Question12:

Lead chloride can not be prepared by the action of hydrochloric acid on lead sulphate directly. Why?

Answer:

An insoluble salt can not be prepared from another insoluble salt and since both lead chloride and lead sulphate are insoluble salt, we can not prepare lead chloride by the action of hydrochloric acid on lead sulphate directly.

Question13:

Sodium sulphite (Na_2SO_3)and sodium hydrogen sulphite ($NaHSO_3$)are salts of sodium but sodium sulphite is called a normal salt and sodium hydrogen sulphite is called an acid salt. Why?

Answer:

Sodium hydrogen sulphite has replaceable hydrogen in its molecule so it is called an acid salt but sodium sulphite does not have, so it is called a normal salt.

$$NaHSO_3 \rightleftharpoons Na^+ + HSO_3^-$$

$$HSO_3 \rightleftharpoons H^+ + SO_3^{2-}$$

Question14:

Fused calcium chloride used in a desiccator. Why ?

Answer:

Calcium chloride is a deliquescent substance, it absorbs water up to such an extent that it finally dissolves in it and more over, it does not react with water. When calcium chloride

is put in a desiccator, it absorbs all water vapours present in it and thus dry atmosphere is created inside.

Question15:

Why zinc chloride is stored in air-tight bottles.

Answer:

Zinc chloride absorbs moisture from the atmosphere and turns into solution because it is a deliquescent substance. In order to prevent this, it si stored in air tight bottles.

Chemical Tests:

Question:

How will you distinguish between the following pairs of compounds:

1. Iron (II) chloride and Iron (III) chloride.
2. Lead nitrate and copper nitrate.
3. Zinc oxide and calcium oxide.
4. Sodium carbonate and sodium nitrate.
5. Sodium sulphate and sodium sulphite.

Answer:

1.Iron (II) chloride is dissolved in water and then sodium hydroxide is added. A dirty green precipitate is obtained which confirms the presence of iron (II) chloride.

$$FeCl_2 + 2NaOH \longrightarrow Fe(OH)_2 + 2NaCl$$

Iron (IK) chloride is also dissolved in water and then sodium hydroxide solution is added. A reddish brown precipitate is obtained, which confirms the presence of iron (HI) chloride.

$$FeCl_3 + 3NaOH \longrightarrow Fe(OH)_3 + 3NaCl.$$

2.Lead nitrate is dissolved in water and then sodium hydroxide solution is added, a white precipitate is obtained, which is soluble in excess of sodium hydroxide.

$$Pb(NO_3)_2 + 2NaOH \longrightarrow Pb(OH)_2 + 2NaNO_3$$

Copper nitrate is dissolved in water and sodium hydroxide solution is added, a light blue precipitate of copper hydroxide is obtained.

$$Cu(NO_3)_2 + 2NaOH \longrightarrow Cu(OH)_2 + 2NaNO_3.$$

3.Zinc oxide is dissolved in dilute hydrochloric acid to form zinc chloride and then sodium hydroxide solution is added, a white precipitate is obtained, which is soluble in excess of

$$ZnO + 2HCl \longrightarrow ZnCl_2 + H_2O$$

$$ZnCl_2 + 2NaOH \longrightarrow Zn(OH)_2 + 2NaCl$$

$$Zn(OH)_2 + 2NaOH \longrightarrow \underset{\text{Sodium zincate (A clear solution)}}{Na_2ZnO_2} + 2H_2O$$

Calcium chloride is obtained by dissolving calcium oxide in dilute hydrochloric acid. To the solution of calcium chloride, sodium hydroxide solution is added, a white precipitate of calcium hydroxide is obtained, which is insoluble even in the excess of sodium hydroxide.

$$CaO + 2HCl \longrightarrow CaCl_2 + H_2O$$

$$CaCl_2 + 2NaOH \longrightarrow \underset{\text{Calcium hydroxide}}{Ca(OH)_2} + 2NaCl.$$

4.Sodium carbonate when treated with dilute hydrochloric acid, a vigorous reaction takes place and a colourless, odourless gas carbon dioxide is evolved which turns lime water milky.

$$Na_2CO_3 + 2HCl \longrightarrow 2NaCl + H_2O + CO_2$$

Sodium nitrate when mixed with copper filings and heated with concentrated sulphuric acid, reddish brown fumes of nitrogen dioxide are evolved.

$$2NaNO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + 2HNO_3$$

$$Cu + 4HNO_3 \longrightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O.$$

5.Sodium sulphate is dissolved in water and barium chloride solution is added, an insoluble white precipitate of barium sulphate is obtained.

$$Na_2SO_4 + BaCl_2 \longrightarrow \underset{\text{White ppt.}}{BaSO_4} + 2NaCl.$$

Sodium sulphite is warmed with dilute sulphuric acid, a colourless gas with a pungent and suffocating smell is evolved. When this gas is bubbled through acidified solution of potassium dichromate, it turns its colour from orange to green.

$$Na_2SO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + SO_2$$

$$K_2Cr_2O_7 + H_2SO_4 + 3SO_2 \longrightarrow K_2SO_4 + Cr_2(SO_4)_3 + H_2O$$

Balancing/Writing the Chemical Equations:

Question1:

Write correctly balanced equations for the following reactions :

1. Molten sodium and chlorine.
2. Nitrogen and oxygen, when lightning strikes.
3. Iron and dilute sulphuric acid.
4. Decomposition of hypochlorous acid in sunlight.
5. Decomposition of potassium nitrate.
6. Sodiumlfubsulphate is reacted with dilute hydrochloric acid.
7. Calcium bicarbonate reacts with dilute hydrochloric acid.

8. Dilute sulphuric acid is poured over sodium sulphate

9. Lead nitrate solution is added to sodium chloride solution

10. Zinc is heated with sodium hydroxide solution.

11. Lead sulphate from lead nitrate solution and dilute sulphuric acid.

12. Copper sulphate from copper and concentrated sulphuric acid.

13. Lead chloride from lead nitrate solution and sodium chloride solution.

14. Ammonium sulphate from ammonia and dilute sulphuric acid.

15. Sodium chloride from sodium carbonate solution and dilute hydrochloric acid.

16. Magnesium anft dilute sulphuric acid.

17. Zinc carbonate and dilute sulphuric acid.

18. Copper oxide and dilate sulphuric acid.

19. Ferric hydroxide reacts with nitric acid.

20. Zinc oxide dissolves in sodium hydroxide.

Answer:

1. $2Na + Cl_2 \longrightarrow 2NaCl$

2. $N_2 + O_2 \longrightarrow 2NO$

3. $Fe + H_2SO_4 \longrightarrow FeSO_4 + H_2$

4. $2HClO \xrightarrow{\text{Sun light}} 2HCl + O_2$

5. $2KNO_3 \longrightarrow 2KNO_2 + O_2$

6. $Na_2S_2O_3 + 2HCl \longrightarrow 2NaCl + SO_2 + \ + S \downarrow + H_2O$

7. $Ca(HCO_3)_2 + 2HCl \longrightarrow CaCl_2 + 2H_2O + 2CO_2 \uparrow$

8. $Na_2SO_3 + H_2SO_4\ (dilute) \longrightarrow Na_2SO_4 + H_2O + SO_2 \uparrow$

9. $Pb(NO_3)_2 + 2NaCl \longrightarrow PbCl_2 + 2NaNO_3$

10. $Zn + 2NaOH \longrightarrow Na_2ZnO_2 + H_2 \uparrow$

11. $Pb(NO_3)_2 + H_2SO_4 \longrightarrow PbSO_4 \downarrow + 2HNO_3$
    Lead nitrate — Sulphuric acid — Lead sulphate — Nitric acid

12. $Cu + 2H_2SO_4 \longrightarrow CuSO_4 + 2H_2O + SO_2$
    Copper — Sulphuric acid — Copper sulphate — Water — Sulphur dioxide

13. $Pb(NO_3)_2 + 2NaCl \longrightarrow PbCl_2 + 2NaNO_3$
    Lead nitrate — Sulphuric chloride — Lead chloride — Sodium nitrate

14. $2NH_3 + H_2SO_4 \longrightarrow (NH_4)_2SO_4$
Ammonia — Sulphuric acid — Ammonium sulphate

15. $Na_2CO_3 + 2HCl \longrightarrow NaCl + H_2O + CO_2$
Sodium carbonate — Hydrochloric acid — Sodium chloride — Water — Carbon dioxide

16. $MgO + H_2SO_4$ (dil). $\longrightarrow MgSO_4 + H_2\uparrow$

17. $ZnCO_3 + H_2SO_4 \longrightarrow ZnSO_4 + H_2O + CO_2\uparrow$

18. $CuO + H_2SO_4$ (dil.) $\longrightarrow CuSO_4 + H_2O$

19. $Fe(OH)_3 + 3HNO_3 \longrightarrow Fe(NO_3)_3 + 3H_2O$

20. $ZnO + 2NaOH \longrightarrow Na_2ZnO_2 + H_2O$

Question2:

Write the equation for the laboratory preparation of the following salts

1. Iron (II) sulphate from iron.
2. Copper sulphate from copper.
3. Lead sulphate from lead nitrate.
4. Sodium sulphate from sodium carbonate.
5. Copper sulphate from copper (II) oxide.
6. Iron (in) chloride from iron.
7. Potassium sulphate from potassium hydroxide solution.
8. Lead chloride from lead carbonate (two equations).
9. Zinc sulphate from zinc.
10. Sodium sulphate from sodium hydroxide.
11. Lead (n) chloride from lead nitrate.
12. Copper (II) sulphate from copper carbonate.
13. Calcium carbonqfe from calcium chloride.
14. Sodium sulphate from sodium carbonate
15. Zinc carbonate from zinc nitrate.

Answer:

1. $Fe + H_2SO_4 \xrightarrow{dil} FeSO_4 + H_2 \uparrow$

2. $Cu + 2H_2SO_4 \xrightarrow{conc.} CuSO_4 + 2H_2O + SO_2$

3. $Pb(NO_3)_2 + H_2SO_4 \xrightarrow{dil} PbSO_4 + 2HNO_3$

4. $Na_2CO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + CO_2$

5. $CuO + H_2SO_4 \longrightarrow CuSO_4 + H_2O$
   copper (II) oxide — copper sulphate

6. $2Fe + 3Cl_2 \longrightarrow 2FeCl_3$
   iron chlorine — ferric chloride

7. $2KOH + H_2SO_4 \xrightarrow[200°C]{\text{Temp. above}} K_2SO_4 + 2H_2O$
   potassium hydroxide — potassium sulphate

8. $PbCO_3 + 2HNO_3 \longrightarrow Pb(NO_3)_2 + H_2O + CO_2 \uparrow$
   lead carbonate (insoluble salt) — lead nitrate (soluble salt)

   $Pb(NO_3)_2 + 2HCl \longrightarrow PbCl_2 + 2HNO_3$
   lead nitrate — lead chloride

9. $Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2 \uparrow$
   (dil.)

10. $2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$
    (dil.)

11. $Pb(NO_3)_2 + 2HCl \longrightarrow PbCl_2 + 2HNO_3$

12. $CuCO_3 + H_2SO_4 \longrightarrow CuSO_4 + H_2O + CO_2$
    copper carbonate — (dil.) — copper (II) sulphate

13. $CaCl_2 + Na_2CO_3 \longrightarrow CaCO_3 + 2NaCl$

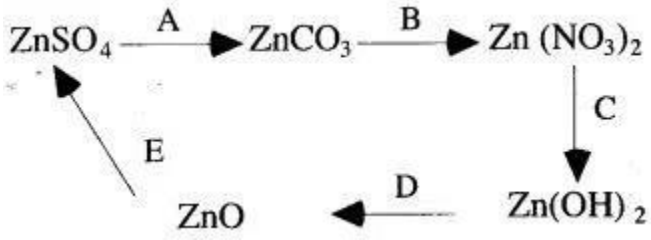
14. $Na_2CO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + CO_2$
    Sodium carbonate — dil. sulphuric acid — Sodium sulphate

15. $Zn(NO_3)_2 + Na_2CO_3 \longrightarrow ZnCO_3 + 2NaNO_3$
    Zinc nitrate — Sodium carbonate — Zinc carbonate — Sodium nitrate

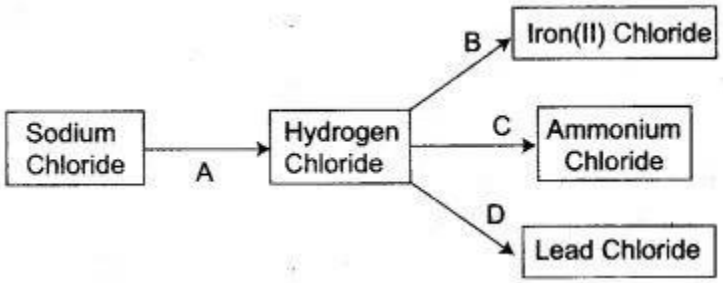
Question3:

Study the following conversion schemes:

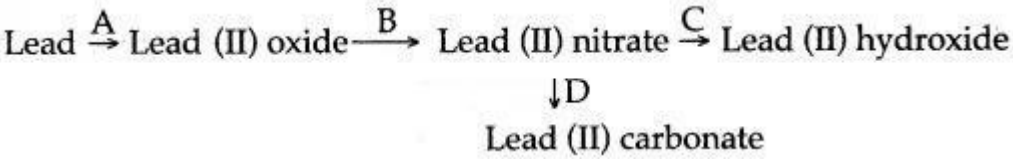
1.Write the following equations according to the given arrow marks.



2.Refer to the flow chart diagram below and give balanced equations with conditions, if any, for the following conversions A to D.



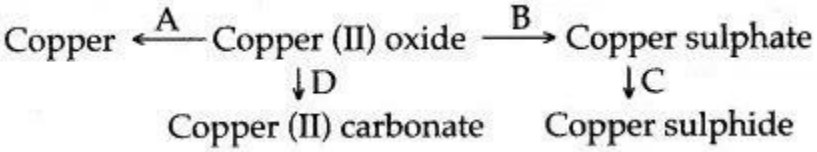
3.



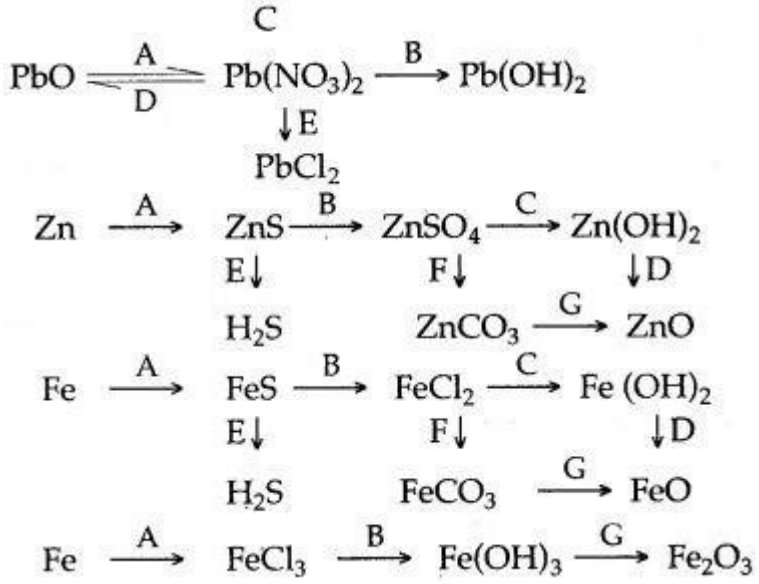
(i) For each of the conversions A to D in the above state briefly how the conversions can be carried out.

(ii) Write equations for the conversions.

4.For each of the conversion in the scheme given below, state briefly in words or by means of chemical equation, how the conversion is carried out ?



5.How are the following conversions



Answer:

1. $A: ZnSO_4 + Na_2CO_3 \longrightarrow ZnCO_3 + Na_2SO_4$
   Zinc sulphate; sodium carbonate; zinc carbonate; sodium sulphate

   $B: ZnCO_3 + 2HNO_3 \longrightarrow Zn(NO_3)_2 + H_2O + CO_2$
   Zinc carbonate; nitric acid; zinc nitrate; water

   $C: Zn(NO_3)_2 + 2NaOH \longrightarrow Zn(OH)_2 + 2NaNO_3$
   Zinc nitrate; sodium hydoxide; zinc hydroxide; sodium nitrate

   $D: Zn(OH)_2 \xrightarrow{\text{Heated}} ZnO + H_2O$
   Zinc hydroxide; zinc oxide; water

   $E: ZnO + H_2SO_4 \longrightarrow ZnSO_4 + H_2O$
   Zinc oxide; sulphuric acid; zinc sulphate; water

2. [A] $NaCl + H_2SO_4 \xrightarrow{\Delta < 200^\circ C} NaHSO_4 + HCl\uparrow$
   conc.; Hydrogen chloride

   [B] $2HCl + Fe \longrightarrow FeCl_2 + H_2$
   Iron (II) chloride

   [C] $HCl_{(g)} + NH_{3(g)} \longrightarrow NH_4Cl$
   Ammonium chloride

   [D] $2HCl + Pb(NO_3)_{2(aqu)} \longrightarrow PbCl_2\downarrow + 2HNO_3$
   (dil); Lead chloride

3.[A] Lead (II) oxide, when heated with powdered coke, reduced to metallic lead and carbon monoxide is formed.

$PbO + C \longrightarrow Pb + CO$

$$PbO + 2HNO_3 \longrightarrow \underset{\text{Lead nitrate}}{Pb(NO_3)_2} + H_2O$$

[C] Lead (U) nitrate is dissolved in water and then sodium hydroxide solution is added, a white precipitate of lead hydroxide is obtained.

$$Pb(NO_3)_2 + 2NaOH \longrightarrow Pb(OH)_2 + 2NaNO_3$$

[D] Lead (II) nitrate is dissolved in water and then concentrated soLution of sodium carbonate is added, a white precipitate of lead (Il) carbonate is obtained.

$$Pb(NO_3)_2 + Na_2CO_3 \longrightarrow PbCO_3 + 2NaNO_3$$

4.

[A] Copper (II) oxide, when heated with coke powder is reduced to metallic copper.

$$CuO + C \longrightarrow \underset{\text{Metallic copper}}{Cu} + CO$$

[B] Copper (II) oxide is dissolved in dilute sulphuric acid to form copper sulphate.

$$CuO + H_2SO_4 \longrightarrow \underset{\text{Copper sulphate}}{CuSO_4} + H_2O$$

[C] Copper sulphate is dissolved in water and hydrogen suiphide gas is passed, a black precipitate of copper suiphide is formed.

$$CuSO_4 + H_2S \longrightarrow \underset{\text{Black ppt.}}{CuS} + H_2SO_4$$

[D] Copper (II) oxide is dissolved in dilute hydrochloric acid to form copper chloride. To the solution of copper chloride, when a saturated solution of sodium carbonate is added, a light blue precipitate of copper (II) carbonate is formed.

$$CuCl_2 + Na_2CO_3 \longrightarrow CuCO_3 + 2NaCl$$

5. (i) [A]

$$PbO + \underset{\text{(dil)}}{2HNO_3} \longrightarrow Pb(NO_3)_2 + H_2O$$

[B] $Pb(NO_3)_2 + 2NaOH \longrightarrow Pb(OH)_2 + 2NaNO_3$

[C] $Pb(OH)_2 \xrightarrow{\Delta} PbO + H_2O$

[D] $2Pb(NO_3)_2 \xrightarrow{\Delta} 2PbO + 4NO_2 + O_2$

[E] $Pb(NO_3)_2 + 2NaCl \longrightarrow PbCl_2 + 2NaNO_3$

(ii) [A] $Zn + S \xrightarrow{\Delta} ZnS$

[B] $ZnS + \underset{\text{(dil.)}}{H_2SO_4} \longrightarrow ZnSO_4 + H_2S$

[C] $ZnSO_4 + 2NaOH \longrightarrow Zn(OH)_2 + Na_2SO_4$

[D] $Zn(OH)_2 \xrightarrow{\Delta} ZnO + H_2O$

[E] $ZnS + \underset{\text{(dil)}}{2HCl} \longrightarrow ZnCl_2 + H_2S$

[F] $ZnSO_4 + Na_2CO_3 \longrightarrow ZnCO_3 + Na_2SO_4$

[G] $ZnCO_3 \xrightarrow{\Delta} ZnO + CO_2$

(iii) [A] $Fe + S \xrightarrow{\Delta} FeS$

[B] $FeS + \underset{\text{(dil)}}{2HCl} \longrightarrow FeCl_2 + H_2S$

[C] $FeCl_2 + 2NaOH \longrightarrow Fe(OH)_2 + 2NaCl$

[D] $Fe(OH)_2 \xrightarrow{\Delta} FeO + H_2O$

[E] $FeS + 2HCl \longrightarrow FeCl_2 + H_2S$

[F] $FeCl_2 + Na_2CO_3 \longrightarrow FeCO_3 + 2NaCl$

[G] $FeCO_3 \xrightarrow{\Delta} FeO + CO_2$

(iv) [A] $2Fe + \underset{\text{dry}}{3Cl_2} \longrightarrow 2FeCl_3$

[B] $FeCl_3 + 3NaOH \longrightarrow Fe(OH)_3 + 3NaCl$

[C] $2Fe(OH)_3 \xrightarrow{\Delta} Fe_2O_3 + 3H_2O$

Question4:

How can the following be converted to the respective chloride, sulphate and nitrate salts ? Give equations.

1. Magnesium
2. Zinc
3. Iron
4. Lead carbonate
5. Copper oxide
6. Potassium hydroxide
7. Copper hydroxide

8. Ammonium hydroxide

Answer:

1. $Mg_{(S)} + 2HCl_{(aq.)} \longrightarrow MgCl_{2\,(aq)} + H_{2\,(g)}$
   Magnesium; Hydrochloric acid; Magnesium chloride; Hydrogen
2. $Zn\,(S) + H_2SO_{4\,(aq.)} \longrightarrow ZnSO_{4\,(aq.)} + H_{2\,(g)}$
   Zinc; Sulphuric acid; Zinc sulphate; Hyrogen
3. $Fe\,(S) + S\,(s) \longrightarrow FeS\,(s)$
   Iron; Sulphur; Iron (II) Sulphide
4. $PbCO_{3(s)} + 2HNO_{3(aq.)} \longrightarrow Pb(NO_3)_{2(aq.)} + H_2O_{(l)} + CO_{2(g)}$
   Lead carbonate; Nitric acid; Lead nitrate
5. $CuO(s) + H_2SO_{4(aq)} \longrightarrow CuSO_{4(aq)} + H_2O_{(l)}$
   Copper oxide; Sulphuric acid; Copper sulphate
6. $2KOH + CO_{2(g)} \longrightarrow K_2CO_{3(aq)} + H_2O_{(l)}$
   Potassium hydroxide; Carbon dioxide; Potassium carbonate
7. $Cu(OH)_2(s) + H_2SO_{4(aq.)} \longrightarrow CuSO_{4(aq.)} + 2H_2O$
   Copper hydroxide; Sulphuric acid; Copper sulphate
8. $3NH_4OH(aq.) + H_3PO_{4(aq.)} \longrightarrow (NH_4)_3PO_{4(aq.)} + 3H_2O_{(l)}$
   Ammonium hydroxide; Phosphoric acid; Ammonium phosphate

Chapter 4. Analytical Chemistry

Short Questions

Question 1: What are the use of sodium and ammonium hydroxide in analytical chemistry ?

Answer: Sodium hydroxide and ammonium hydroxide are used in analytical chemistry to precipitate insoluble metal hydroxide.

Question 2: Out of the following metallic ions : Al^{3+}, Ca^{2+}, Cu^{2+}, Pb^{2+} and Zn^{2+}; which one forms a white hydroxide which dissolves in an excess of either aqueous sodium hydroxide or ammonium hydroxide ?

Answer: Zn^{2+}.

Question 3: Which reagent can be used to distinguish a solution containing a lead salt from a solution containing a zinc salt ?

Answer: Ammonium hydroxide.

Question 4: A metal, whose alloy is used in the construction of aircrafts, in the powdered form was added to sodium hydroxide solution, a colourless gas was evolved and after the reaction was over, the solution was colourless.

(i) Name the powdered metal added to sodium hydroxide solution.
(ii) Name the gas evolved.

Answer: (i) Aluminium (ii) Hydrogen (iii) Sodium aluminate, ($NaAlO_2$).

Question 5: State the colour of the precipitate observed when caustic soda solution is added to the following solutions (prepared in water):

(i) Copper sulphate crystals (ii) Ferrous sulphate crystals

(iii) Ferric chloride crystals (iv) Lead nitrate crystals

(v) Zinc chloride crystals (vi) Calcium chloride

(vii) Zinc sulphate.

Answer: (i) Blue (ii) Dull green (iii) Reddish brown

(iv) White (v) White (vi) White curdy

(vii) White gelatinous.

Question 6: The questions (i) to (v) refer to the following salt solutions listed A to F :
A. Copper nitrate B. Iron (II) sulphate.

C. Iron (III) chloride D. Lead nitrate

E. Magnesium sulphate F. Zinc chloride.

(i) Which two solutions will give a white precipitate when treated with dilute Hydrochloric acid followed by Barium chloride solution ?

(ii) Which two solutions will give a white precipitate when treated with dilute Nitric acid followed by Silver nitrate solution ?

(iii) Which solution will give a white precipitate when either dilute Hydrochloric acid or dilute

Sulphuric acid is added to it ?

(iv) Which solution becomes a deep /inky blue colour when excess of Ammonium hydroxide is added to it ?

(v) Which solution gives a white precipitate with excess Ammonium hydroxide solution ?

Answer: (i) B and E (Iron III sulphate and magnesium sulphate).

(ii) C and F (Iron III chloride and zinc chloride) (iii) D (lead nitrate)

(ii) A (copper nitrate) (v) F (Zinc chloride)

Question 7: What do you observe when caustic soda solution is added to the following solutions first a little and then in excess :

(i) $FeCl_3$ (ii) $Al_2(SO_4)_3$, (iii) $ZnSO_4$ (iv) $Pb(NO_3)_2$ (v) $CuSO_4$.
Also give balanced chemical equations.

Answer: (i) A reddish brown ppt. of ferric hydroxide is obtained which is insoluble in excess of caustic soda solution.

$$FeCl_3 + 3NaOH \longrightarrow \underset{\text{Ferric hydroxide (Reddish brown ppt.)}}{Fe(OH)_3 \uparrow} + 3NaCl$$

(ii) A gelatinous white ppt. of aluminium hydroxide is obtained which is soluble in excess of caustic soda solution.

$$Al_2(SO_4)_3 + 6NaOH \longrightarrow \underset{\text{Aluminium hydroxide (White, gelatinous ppt.)}}{2Al(OH)_3 \downarrow} + 3Na_2SO_4$$

$$Al(OH)_3 + \underset{\text{(Excess)}}{NaOH} \longrightarrow \underset{\text{Sodium meta-aluminate (Soluble)}}{NaAlO_2} + 3Na_2SO_4$$

(iii) A gelatinous white ppt. of zinc hydroxide is obtained which is soluble in excess of caustic soda solution.

$$ZnSO_4 + 2NaOH \longrightarrow \underset{\text{Zinc hydroxide (White gelatinous ppt.)}}{Zn(OH)_2 \downarrow} + Na_2SO_4$$

$$Zn(OH)_2 + \underset{\text{(Excess)}}{2NaOH} \longrightarrow \underset{\text{Soluble (Colourless)}}{NaZnO_2} + 22H_2O$$

(iv) A white ppt. of lead (II) hydroxide is obtained which is soluble in excess of caustic soda solution.

$$Pb(NO_3)_2 + 2NaOH \longrightarrow \underset{\text{Lead hydroxide (White ppt.)}}{Pb(OH)_2\downarrow} + 2NaNO_3$$

$$Pb(OH)_2 + \underset{\text{(Excess)}}{2NaOH} \longrightarrow \underset{\text{Sodium plumbite (Colourless) (Soluble)}}{Na_2PbO_2} + 2H_2O$$

(v) A pie blue ppt. of copper (II) hydroxide is obtained which is insoluble in excess of caustic soda solution.

$$CuSO_4 + 2NaOH \longrightarrow \underset{\text{Copper (II) (hydroxide) (Pale blue ppt.)}}{Cu(OH)_2\downarrow} + Na_2SO_4$$

Question 8: (i) What are amphoteric metals ?. Describe their reactions with hot caustic alkali. (ii) What are amphoteric oxides ? Why these oxides react with NaOH ?

Answer: (i) Those metals which react with both alkalies as well as acids are called amphoteric metals e.g., Zn, Sn, Al etc. They react with caustic alkalies like NaOH, KOH on heating and liberates H_2 gas. e.g.,

$$\underset{\text{Zinc}}{Zn} + \underset{\text{(Conc.)}}{2NaOH\,(aq.)} \longrightarrow \underset{\text{Sodium zincate}}{Na_2ZnO_2} + H_2\uparrow$$

$$\underset{\text{Zinc}}{Zn} + \underset{\text{(Conc.)}}{2KOH\,(aq.)} \longrightarrow \underset{\text{Potassium zincate}}{K_2ZnO_2} + H_2\uparrow$$

$$\underset{\text{Tin}}{Sn} + \underset{\text{(Conc.)}}{2NaOH\,(aq.)} + H_2O \longrightarrow \underset{\text{Sodium stannate}}{Na_2SnO_3} + 2H_2\uparrow$$

$$\underset{\text{Tin}}{Sn} + \underset{\text{(Conc.)}}{2KOH\,(aq.)} + H_2O \longrightarrow \underset{\text{Potassium stannate}}{K_2SnO_3} + 2H_2\uparrow$$

$$\underset{\text{Aluminium}}{2Al} + 2NaOH + 2H_2O \longrightarrow \underset{\text{Sodium aluminate}}{2NaAlO_2} + 3H_2\uparrow$$

$$\underset{\text{Aluminium}}{2Al} + 2KOH + 2H_2O \longrightarrow \underset{\text{Potassium aluminate}}{2KAlO_2} + 3H_2\uparrow$$

(ii) Those oxides which react with both acids as well as bases are called amphoteric oxides. Oxides of amphoteric metals like Zn, Sn, Al, etc. react With strong alkalies like NaOH to form complex salt and water, e.g.,

$$\underset{\text{Zinc oxide}}{ZnO} + \underset{\text{(Conc.)}}{2NaOH\,(aq.)} \longrightarrow \underset{\text{Sodium zincate}}{Na_2ZnO_2} + H_2O$$

$$\underset{\text{Tin oxide}}{SnO_2} + \underset{\text{(Conc.)}}{2NaOH\,(aq.)} \longrightarrow \underset{\text{Sodium stannate}}{Na_2SnO_3} + H_2O$$

$$\underset{\text{Aluminium oxide}}{Al_2O_3} + \underset{\text{(Conc.)}}{2NaOH\,(aq.)} \longrightarrow \underset{\text{Sodium aluminate}}{2NaAlO_2} + H_2O$$

Figure/Table Based Questions

Question 1: Sodium hydroxide solution is added first in a small quantity, then in excess to the aqueous salt solution of copper (II) sulphate, zinc nitrate, lead nitrate, calcium chloride and iron (III) sulphate. Copy the following table and write the colour of the precipitate in (i) to (v) and the nature of the precipitate (soluble/insoluble) in (vi) to (x).

Aqueous salt solution	Colour of ppt. when NaOH is added in a small quantity	Nature of ppt. (soluble/ insoluble) when NaOH is added in excess
Copper (II) sulphate	(i)	(vi)
Zinc nitrate	(ii)	(vii)
Lead nitrate	(iii)	(viii)
Calcium chloride	(iv)	(ix)
Iron (III) sulphate	(v)	(x)

Answer:

Aqueous salt solution	Colour of ppt. when NaOH is added in a small quantity	Nature of ppt. (soluble/ insoluble) when NaOH is added in excess
Copper (II) sulphate	Blue	Insoluble
Zinc nitrate	White	Soluble
Lead nitrate	White	Soluble
Calcium chloride	White	Insoluble
Iron (III) sulphate	Reddish Brown	Insoluble

Question 2: Three test tubes contain calcium nitrate solution, zinc nitrate solution and lead nitrate solution respectively. Each solution is divided into two portions. Describe the effect of:
(i) Adding sodium hydroxide solution to each portion in turn till it is in excess.

(ii) Adding ammonium hydroxide to each portion till it is in excess.

Answer:

Solution	Effect of adding sodium hydroxide solution		Effect of adding ammonium hydroxide solution	
	Small amount	In excess	Small amount	In excess
Calcium nitrate	A white precipitate.	No change.	No precipitate.	No change.
Zinc nitrate	A white ppt.	White ppt. dissolves, gives a colourless solution.	A white ppt.	A white ppt. dissolves to give a colourless solution.
Lead nitrate	A white ppt.	White ppt. dissolves to give a colourless solution.	A white ppt.	No change.

Question 3: The following table shows the tests a student performed on four aqueous solutions A, B, C and D. Write down on your answer sheet the observations (i) to (iv) that were made.

Test	Observations	Conclusions
(i) To solution A, calcium nitrate solution and sodium hydroxide solution were added.	(i)	A contains Ca^{2+} ions
(ii) To solution B sodium hydroxide solution was added	(i i)	B contains Fe^{3+} ions
(iii) To solution C ammonium hydroxide was added slowly till in excess	(ii i)	C contains Cu^{2+} ions
(iv) To solution D Lead nitrate solution and sodium hydroxide solution were added	(i v)	D contains Pb^{2+} ions

Answer: Observations:

(i) White ppt. of Calcium hydroxide is formed.

(ii) Reddish brown ppt. of $Fe(OH)_3$ is formed.

(iii) Pale blue ppt. is formed which gives deep blue solution with excess of ammonium hydroxide.

(iv) A white ppt. of Lead hydroxide AgCl is formed.

Question 4: Sodium hydroxide solution is added to the solutions containing the ions mentioned in list X. Y gives the details of the precipitate. Match the ions with their coloured precipitates.

List X	List Y
(i) Pb^{2+}	A. Reddish brown
(ii) Fe^{2+}	B. White insoluble in excess

(iii) Zn^{2+}	C. Dirty green
(iv) Fe^{3+}	D. White soluble in excess
(v) Cu^{2+}	E. White soluble in excess
(iv) Ca^{2+}	F. Blue

Answer: (i) $Pb^{2+} \rightarrow$ White soluble in excess (ii) $Fe^{2+} \rightarrow$ Dirty green

(iii) $Zn^{2+} \rightarrow$ White soluble in excess (iv) $Fe^{2+} \rightarrow$ Reddish brown

(v) $Cu^{2+} \rightarrow$ Blue (vi) $Ca^{2+} \rightarrow$ White insoluble in excess.

Chemical Tests

Question: How will you distinguish between the following pairs of compounds:

1.Zinc nitrate solution and Calcium nitrate solution.

2. Sodium nitrate solution and sodium chloride solution.

3. Iron (III) chloride solution and Copper Chloride solution.

4. Iron (II) sulphate solution and copper (II) sulphate solution.

5. Zinc nitrate solution and calcium nitrate solution.

6. Iron (II) chloride and Iron (III) chloride solution.

Answer:

1. Add NaOH solution in excess to the two solutions. The one in which white ppt. initially formed dissolves in excess of NaOH solution is $Zn(NO_3)_2$ solution and the other is $Ca(NO_3)_2$ solution.

2. Add freshly prepared ferrous sulphate solution to the two solutions. Then by the side of the test tube, pour cone, sulphuric acid to each slowly. The one in which brown ring appears is sodium nitrate solution while the other is sodium chloride solution.

3. Add NaOH solution to both the solutions. The one which gives a reddish brown ppt. is iron(III) chloride solution and the one which gives blue ppt. is copper chloride solution.

4. When sodium hydroxide solution is added to iron (II) sulphate solution, a dirty green precipitate is formed.

When sodium hydroxide solution is added to copper (II) sulphate solution, light blue precipitate is formed.

5. When ammonium hydroxide is added to zinc nitrate solution, a white precipitate is formed. The white precipitate dissolves when excess of ammonium hydroxide is added.

When ammonium hydroxide is added to calcium nitrate solution, no visible reaction occurs even with the addition of excess of NH_4OH.

6. When sodium hydroxide is added to Iron (II) chloride, dirty green precipitate of $Fe(OH)_2$ is formed.

$FeCl_2 + 2\ NaOH \longrightarrow Fe(OH)_2 \downarrow + 2NaCl$

When sodium hydroxide is added to iron (III) chloride, reddish brown precipitate is formed

$FeCl_3 + 2NaOH \longrightarrow Fe(OH)_3 + 3NaCl$

Balancing/Writing the Chemical Equations

Question: Write balanced chemical equations to show the reactions of the following :

1. Aluminium and caustic potash solution.

2. Aluminium oxide and sodium hydroxide.

3. Aluminium oxide and potassium hydroxide.
4. Zinc oxide and potassium hydroxide.
5. Zinc is heated with sodium hydroxide solution.
6. Zinc oxide dissolves in sodium hydroxide.
7. Caustic soda solution and Zinc oxide
8. Caustic soda solution and Aluminium oxide
9. Caustic soda solution and Lead monoxide
10. Action of KOH on $CuSO_4$
11. Action of KOH on $CaSO_4$
12. Action of KOH on $ZnSO_4$
13. Action of KOH on $Fe2(SO_4)_3$.
14. Action of sodium hydroxide on freshly precipitated aluminium hydroxide.
15. Zinc oxide is treated with sodium hydroxide solution.

Answer:

1. $2Al + 2KOH + 2H_2O \longrightarrow 2KAlO_2 + 3H_2\uparrow$
   Aluminium; Caustic potash; Potassium aluminate

2. $Al_2O_3 + 2NaOH \longrightarrow 2NaAlO_2 + H_2O$
   Aluminium oxide; Sodium hydroxide; Sodium aluminate

3. $Al_2O_3 + 2KOH \longrightarrow 2KAlO_2 + H_2O$
   Aluminium oxide; Potassium hydroxide; Potassium aluminate

4. $ZnO + 2KOH \longrightarrow K_2ZnO_2 + H_2O$
   Zinc oxide; Potassium hydroxide; Potassium zincate

5. $Zn + 2NaOH \longrightarrow Na_2ZnO_2 + H_2\uparrow$
   Sodium zincate

6. $ZnO + 2NaOH \longrightarrow Na_2ZnO_2 + H_2O$
   Sodium zincate

7. $ZnO + 2NaOH \longrightarrow Na_2ZnO_2 + H_2O$
   Zinc oxide; Caustic soda; Sodium zincate; Water

8. $Al_2O_3 + 2NaOH \longrightarrow 2NaAlO_2 + H_2O$
   Aluminium oxide; Caustic soda; Sodium meta aluminate; Water

9. $PbO + 2NaOH \longrightarrow Na_2PbO_2 + H_2O$
   Lead oxide; Caustic soda; Sodium plumbite; water

10. $CuSO_4 + 2KOH \longrightarrow Cu(OH)_2\downarrow + K_2SO_4$
    Copper sulphate Blue solution; Potassium hydroxide; Copper hydroxide (Blue ppt.); Potassium sulphate

    $Cu(OH)_2 + KOH \longrightarrow$ No reaction
    (Excess)

11. $MgSO_4 + 2KOH \longrightarrow Mg(OH)_2\downarrow + K_2SO_4$
    Magnesium sulphate; Potassium hydroxide; Magnesium hydroxide (A white ppt.); Potassium sulphate

    $Mg(OH)_2 + KOH \longrightarrow$ No reaction
    (Excess)

12. $ZnSO_4 + 2KOH \longrightarrow Zn(OH)_2 + K_2SO_4$
    Zinc sulphate (Colourless); Potassium hydroxide; Zinc hydroxide (white ppt.); Potassium sulphate

    $Zn(OH)_2 + 2KOH \longrightarrow K_2ZnO_2 + 2H_2O$
    (Excess); Potassium zincate (Water soluble)

13. $Fe_2(SO_4)_3 + 6KOH \longrightarrow 2Fe(OH)_3 + 3K_2SO_4$
    Ferric sulphate (Brown); Potassium hydroxide; Ferric hydroxide (Reddish brown ppt.); Potassium Sulphate

    $Fe(OH)_3 + KOH \longrightarrow$ No reaction
    (Excess)

14. $Al(OH)_3 + NaOH \xrightarrow{\Delta} NaAlO_2 + 2H_2O$
    Aluminium hydroxide; Sodium meta-aluminate

15. $ZnO + 2NaOH \longrightarrow Na_2ZnO_2 + H_2O$
    Zinc oxide; Sodium zincate

Chapter 5
Mole Concept and Stoichiometry

Short Questions:

Question1:

State Gay-Lussac's Law of combining volumes.

Answer:

The law states that—Under same conditions of temperature and pressure, the volume of gases taking art in a chemical reaction show simple whole number ratio to one another and to those of products if gaseous.

Question2:

(i)When gases react together, their reaction volume bears a simple ratio to each other, under the same conditions of temperature and pressure. Who proposed this gas law?

(ii)What is the volume (measured in dm^3 or litres occupied by one mole of gas at S.T.P.?

Answer:

(i)This law was proposed by "Gay Lussac".

(ii)One mole of gas occupies 22.4 litres at S.T.P.

Question3:

Under the same conditions of temperature and pressure, one collects 2.2 litres of CO_2, 3.3 litres of Cl_2, 5.5 litres of hydrogen, 4.4 litres of nitrogen and 1.1 litres of SO_2. In which gas sample their will be:

(i) Greatest number of molecules.
(ii) The least number of molecules.

Answer:

We know that 22.4 litres of any gas at S.T.P. has 6.023×10^{23} molecules. If the volume of gas at

S.T.P. is more than 22.4 litres, then the number of molecules will be greater and vice-versa.

(i) 5.5 litres of hydrogen will contain greatest number of molecules.

(ii) 11 litres of sulphur dioxide will contain least number of molecules.

Question4:

Under the same conditions of temperature and pressure, you collect 2 litres of carbon dioxide,

3 litres of chlorine, 5 litres of hydrogen, 4 litres of nitrogen and 1 litre of sulphur dioxide. In which gas will there be sample?

(i)The greatest number of molecules

(ii)The least number of molecules . Justify your answer.

Answer:

The greatest number of molecules will be in 5 litres of hydrogen and the least number of molecules in 1 litre of sulphur dioxide. The justification is based on Avogadro's law, which states that equal volumes of all gases, under conditions of same temperature and pressure, contain same number of molecules. So greater the volume, greater will be the number of molecules.

Question5:

What is the relationship between gram molecular weight and gram molecular volume at S.T.P.?

Answer:

1 gram molecular weight of hydrogen occupies 22.4 dm^3 at S.T.P.

Question6:

What is the relation between atomic mass and equivalent mass?

Answer:

Atomic mass = Equivalent mass × Valency.

Question7:

Explain One mole of hydrogen contains $2\times6.023\times10^{23}$ atoms of hydrogen whereas one mole of helium contains 6.023×10^{23} atoms of helium.

Answer:

Hydrogen is a diatomic gas.

So one molecule of hydrogen = 2atoms

$\therefore$1 mole or 6.023×10^{23} molecules of H_2 = $2\times6.023\times10^{23}$atoms

On the other hand, helium is mono atomic gas,

$\therefore$One molecule of helium 1 atom of He

or 6.023×10^{23} molecules of He = 6.023×10^{23} atoms of He.

Question8:

What do you understand by the statement "The vapour density of CO_2 is 22"? The molecular weight of the gas is twice its vapour density.

Answer:

Molecular weight =2×molecular weight of carbon dioxide

CO_2=12+2(16)=12+32=44 gram.

The vapour density of carbon dioxide

$$\text{V.D.}(CO_2) = \frac{\text{Molecular weight of } CO_2}{2}$$

$$\text{V.D.}(CO_2) = \frac{44}{2}$$

$$\text{V.D.}(CO_2) = 22$$

The vapour density of CO_2 is 22 indicates that the mass of x litres of hydrogen gas or the molecular mass of

CO_2 is 44 gm.

Thus, the vapour density of carbon dioxide (CO_2) is 22.

Question9:

A compound is formed by 24 grams of X and 64 grams of oxygen, if X =12 and O=16. Find the simplest formula of the compound."

Answer:

Relative number of atoms	Simplest ratio
$X = \frac{24}{12} = 2$	$X = \frac{2}{2} = 1$
$O = \frac{64}{16} = 4$	$O = \frac{4}{2} = 2$

Therefore, simple ratio between X and O is X:O=1:2

Thus, empirical formula of the compound is XO_2.

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Reasoning Based Questions:

Question:

"The number of atoms in one mole of hydrogen is twice the number of atoms in 1 mole of helium at the same temperature and pressure."Why?

Answer:

It is because, hydrogen is a diatomic gas, whereas helium is mono atomic gas. As number of atoms in one molecule of hydrogen are double, as compared to one molecule of helium, therefore one mole of hydrogen has double the atoms, as compared to helium at the same temperature and pressure.

NUMERICALS

1. 0.48 g of a gas forms 100 cm3 of vapours at s.t.p. Calculate the gram molecular mass of the gas:
Sol. 100 cm3 of the gas weighs 0.48 g at s. t. p

22.4×1000cm3 of the gas weighs $\frac{22400\times0.48}{100}$

= 107.52 g

2. Calculate the gram molecules present in 45 g of water:
Sol. Gram molecules $=\frac{\text{Mass in grams}}{\text{R M M}}=\frac{45}{18}$ =2.5 gram molecules

3. Calculate the volume of oxygen required to burn completely a mixture of 22.4 L of CH_4 and 11.2 l Of H_2 :

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
$2H_2 + O_2 \rightarrow 2H_2O$

Sol. 1 vol of CH_4 =22.4 L

2 vol OF O_2 =22.4 × 2= 44.8L

2 vol of hydrogen =11.2 L

1 vol of oxygen = 11.2÷ 2= 5.6L

Total vol of oxygen = 44.8+ 5.6 L= 50.4 L

4. Calculate the number of molecules in 1 kg of sodium chloride.
Sol. GMM of NaCl= 58.5 g

58.5 g of NaCl contains 6×10^{23} molecules

1000 g of NaCl contains $\frac{6\times10^{23}\times 1000}{58.5}$

= 102.56×10^{23} molecules.

Chapter6

Electrolysis

Short Questions

Question1: How will you distinguish between metallic conductions and electrical conductions?

Metallic conduction	Electrical conduction
1. By the movement of electrons	1. By the movement of ions
2. Does not involve the transfer of matter	2. It involves the transfer of matter as ions
3. No change in chemical properties of the conductor	3. it involves the decomposition of electrolytes as a result of chemical reactions
4. Increase in resistance with the rise of temperature	4.Decrease in resistance with the rise of temperature

Answer:

Question2: Differentiate between an electrolytic cell and Electrochemical cell.

Answer:

Electrolytic cell	Electrochemical cell
It is a device (vessel) in which chemical changes are brought about with the help of electric energy.	It is a device in which electric energy is generated as a result of chemical change.

Question3: Differentiate between electrical conductivity of copper sulphate solution and copper metal.

Answer: Differences between electrical conductivity of copper sulphate solution and copper metal:

Copper sulphate solution	Copper metal
Electric current flows by flow of ions	Electric current is by flow of electrons
It is aqueous solution of ionic compound	It is a metal in solid state
Copper sulphate undergoes chemical change	Copper metal remains unchanged chemically

Question4: ChooseA, B, C or D to match the descriptions (i) to (v) below. Some alphabets maybe repeated.

A. non-electrolyte

B. strong electrolyte

C. Weak electrolyte

D. metallic conductor

(i) Molten ionic compound
(ii) Carbon tetrachloride
(iii) An aluminum wire

(iv)A solution containing solvent molcules, solute molecules and ions formed by the dissociation of solute molecules.

(v)A sugar solution with sugar molecules and water molecules.

Answer:(i)B,(ii)A,(iii)D,(iv)C,(v)A.

Question5: Give three differences between sodium atom and sodium ion.

Answer :(i) Sodium atom is neutral in nature, while sodium ion is a positively charged particle.

(ii)Sodium atom vigorously reacts with water to liberate hydrogen gas, while sodium ion does not react with water.

(iii)Sodium atom tends to lose an electron to form sodium ion with a complete octet in the outermost shell.

Question6: Explain how electrolysis is an example of redox reaction.

Answer: Redox reactions are called simultaneous oxidation-reduction reactions. In electrode reactions, the positively charged ions (cations) accept electrons from cathode to form neutral atoms, i.e., at cathode reduction take place. At anode, the negatively charged ions (anions) lose electrons to form neutral atoms,i.e.,at anode oxidation takes place. So, electrode react ions also signify oxidation- reduction reactions. Hence, they are also called Redox reactions.

Question7 :(i)Write equations to show the electrolytic dissociation of:
(a)Two acids(b)Two bases.

(ii)When fused sodium chloride is electrolysed, explain exactly what happens at the electrodes and explain how the electricity is conducted?

Answer:(i)

(a)Acids:

$H_2SO_4 \rightleftharpoons 2H^+ + SO_4$

$HNO_3 \rightleftharpoons H^+ + NO^-_3$

(b)Bases:

$NaOH \rightleftharpoons Na^+ + OH^-$

$KOH \rightleftharpoons K^+ + OH^-$

(ii)When electricity is passed through fused sodium chloride, the electrolysis starts as follows:

$NaCl \rightleftharpoons Na^+ + Cl^-$

$Na^+ + e^- \longrightarrow Na$(At cathode)

$Cl^- - e^- \longrightarrow Cl$

$Cl + Cl \longrightarrow Cl_2$(At anode)

Sodium metal is deposited at cathode, while chlorine gas is liberated at anode. Electricity is conducted with the help of sodium and chloride ions, which are present in fused sodium chloride.

Question 8:How is it possible to discharge Na^+ions in preference to H^+ions in electrolysis of NaCl solution?

Answer:By using cathode made of moving mercury, Na^+ions are discharged in preference to H^+ions because of the nature of electrode. Mercury has strong tendency to form an amalgam with: sodium

$Na^+ + e^- \rightarrow Na$

$Na + Hg \rightarrow Na/Hg$

When the sodium amalgam dissolves in water, the reaction is

$2Na/Hg + 2H_20 \rightarrow 2NaOH + H_2 + Hg$

Question9:A certain metal, say M, does not liberate hydrogen from dilute sulphuric acid, but displaces copper from aqueous copper(II)sulphate. State the most likely place for the metal in electrochemical series.

Answer: The activity series is obtained, when we examine replacement of one metal ion from its solution by another metal .The metal(M)which displaces copper from aqueous copper(II)sulphate is placed at higher position as compared to copper in activity series.

Question10: A metal above hydrogen in the activity series and its oxide has the formula M_2O. This oxide when dissolved in water forms the corresponding hydroxide which is a good conductor of electricity. In the above context answer the following:

(i)What kind of combination exists between M and O?

(ii)How many electrons are there in the outermost shell of M?

(iii)Name the group to which M belongs.

(iv)State the reaction taking place at the cathode.
(v)Name the product at the anode.

Answer :(i)Electrovalent bond exists between M and O.
(ii)One electron is there in the outermost shell.

(iii)M belongs to First group.

(iv)$M^+ + e^- \rightarrow M$ (at cathode). $M + M \rightarrow M_2$

(v)Oxygen gas is liberated at a node.

Question11 :(i)What are the particles present in a non-electrolyte?
(ii)What is conductivity of metals due to?

(iii)What should be the physical state of lead bromide, if it is to conduct electricity?

(iv)What particles are present in pure lead bromide?

Answer:(i)Molecules are present in a non-electrolyte.

(ii)The conductivity of metals is due to movement of electrons.

(iii)Lead bromide should be in molten state, if it is to conduct electricity.

(iv)Lead ions and bromide ions are present in pure lead bromide in molten state.

Question12:(i)When the electrolysis of acidified water is carried out:

(a)What is the ratio of the volume of hydrogen produced to the volume of oxygen?

(b)Give the equation for the discharge of ions at the cathode.

(ii)To carry out the so-called "electrolysis of water", sulphuric acid is added to water. How does the addition of sulphuric acid produce a conducting solution?

Answer :(i) (a) the ratio is 2:1

(b)$H^+ + e^- \rightarrow H$; $2H + 2H \rightarrow 2H_2$

(ii)Addition of sulphuric acid causes dissociation of water molecules into $[H^+]$ and $[OH^-]$ ions.

Question13: What would happen if in the electrolysis of acidified water, copper electrodes were used instead of platinum ones?

Answer: At anode: OH^- $_3$ Would migrate to anode but neither would be discharged, and$S0^{2-}$ instead

Copper atoms would get oxidized to $Cu^{2+}$and enter solution

$Cu \rightarrow Cu^{2+} + 2e^-$

The electrolytic solution would become blue in color. Anode would dissolve.

At cathode: H+ions would migrate to the cathode and get reduced. Thus, H_2 gas would be discharged at cathode

$2H^+ + 2e^- \rightarrow 2H \rightarrow H_2$

Later, as the solution turns blue due to formation of Cu^{++}ions, the Cu^{++}ions will get discharged to

$2H^+$ions as they are less electropositive

$Cu^{2+} + 2e^- \rightarrow Cu\downarrow$

Question14: During the electrolysis of aqueous copper sulphate, between copper electrodes, the sulphate and hydroxyl ions remain as spectator ions.

Answer: During electrolysis of aqueous copper sulphate using copper electrodes, the two anions

OH^- .andSO_4 Migrate to the anode, but none of them get discharged because the copper of the anode

Dissolves in the solution producing copper ions and electrons. Hence, OH^-andSO_4^{2-} ions remain as spectator ions

Question15:The following questions refer to the electrolysis of copper sulphate solution with copper electrodes.

(i)Compare the change in mass of the cathode with the change in mass of the anode.

(ii)What happens, when electrolysis of aqueous copper sulphate between platinum electrode, occurs. (iii)What is the practical application of the electrolysis of copper sulphate solution? Briefly describe one such application.

Answer:(i)Mass of Cathode increases whereas that of anode decreases due to deposition of pure copper on cathode.

(ii)The blue color of copper sulphate is due to the presence of cupric ions (Cu^{++}).Cu^{++}ions are discharged at the cathode and deposited as Pinkish copper metal, but OH^- ions are discharged at anode. The electrolyte consists of hydrogen and sulphate ions which associate to form colorless sulphuric acid.

(iii)The electrolysis of copper sulphate solution is used in the purification of copper using pure copper plate as cathode and impure copper plate as anode.

Question16: During the electrolysis of copper (II)sulphate solution using platinum as cathode and carbon as anode:

(i)What do you observe at the cathode and at the anode?

(ii)What change is noticed in the electrolyte?

(iii)Write the reactions at the cathode and at the anode.

Answer :(i) at cathode red shiny metal deposits.

At anode bubbles of a colorless odorless gas are seen coming out. (ii)Color of electrolyte gradually fades from blue to colorless.

(iii)Reaction at cathode: $Cu^{2+}+2e^{-} \rightarrow$ Cu Reaction at anode:

$OH^{-}-1e^{-} \rightarrow OH$

$4OH \rightarrow 2H_2O+O_2\downarrow$

Question17:Explain, how the blue color of electrolyte fades during electrolysis of $CuSO_4$ solution?

Answer:The blue color of electrolyte is due to the presence of copper ions in it. As the electrolysis is.carried out, the copper ions discharge at the cathode.

$Cu^{2+}+2e^- \longrightarrow Cu$

However, no copper ions enters in the electrolyte from anode. Thus concentration of copper ions goes on decreasing. This result in fading of blue color. When copper ions completely finish the electrolyte becomes colorless.

Reaction of cathode: $H^+ + e^- \longrightarrow H$

$H+H \longrightarrow H_2$

Reaction of anode : $OH^- - 1e^- \longrightarrow OH$

$4OH \longrightarrow 2H_2O+O_2(g)$

Question18: Mention the type of ions present, the products obtained and the electrode reactions that occur, when the following are electrolysed:

(i)Molten lead bromide between steel

Cathode and graphite anode.

(ii)Water acidified with sulphuric acid between platinum electrodes.

(iii)Aqueous copper sulphate between copper electrodes.

(iv)Aqueous copper sulphate between copper cathode and platinum anode.

Answer:

		Cathode	Anode
(i)	Electrode used	Steel	Graphite
	Ions present	Pb^{2+}	Br^-
	Products	Lead	Bromine
	Reaction	$Pb^{2+} + 2e^- \longrightarrow Pb$	$2 \times [Br^- - 1\ e^- \longrightarrow Br]$
(ii)	Electrode used	Platinum	Platinum
	Ions present	H^+	OH^- and SO_4^{2-}
	Products	Hydrogen	Oxygen
	Reaction	$4H^+ + 4\ e^- \longrightarrow 2H_2$	$4OH^- - 4\ e^- \longrightarrow 2H_2O + O_2$
(iii)	Electrode used	Copper	Copper
	Ions present	Cu^{2+} and H^+	OH^- and SO_4^{2-}
	Products	Copper atom	Copper ions
	Reaction	$Cu^{2+}(aq) + 2e^- \longrightarrow Cu(s)$	$Cu(s) - 2e^- \longrightarrow Cu^{2+}(aq)$
(iv)	Electrode used	Copper	Platinum
	Ions present	Cu^{2+} and H^+	OH^- and SO_4^{2-}
	Products	Copper atom	Oxygen
	Reaction	$Cu^{2+} + 2e^- \longrightarrow Cu(s)$	$4OH^- - 4\ e^- \longrightarrow 2H_2O + O_2$

Question22:WiQuestion19; with reference to electroplating answer the following:

(i)Why are articles electroplated?

(ii)Why a small current passed for a longer period is preferred over high current for a shorter period?

(iii)Why the article to be electroplated is made a cathode?

(iv)Why a direct current is used?

Answer:(i)Articles are electroplated for the following reasons:

(a)To prevent it from corrosion.

(b)To improve the appearance of the metal articles.

(ii)To get a uniform and smooth coating of superior metal, a small current should be used-for a longer time.

(iii)The article to be electroplated is always placed at cathode because the metal is always deposited at cathode.

(iv)Direct current is used to get smooth coating and the phase of the current is same at all instance of time.

Question20: Element X is a metal with a valency2. Element Y is a non-metal with a valency 3.

(i)Write equations to show how X and Y form ions.

(ii)If Y is a diatomic gas, write the equation for the direct combination of X and Y to form a compound.

(iii)Write two applications of electrolysis in which the anode diminishes in mass.

(iv)If the compound formed between X and Y is melted and an electric current passed through the molten compound, the element X will be obtained at the…and Y at the…of the electrolytic cell. (Provide the missing words.)

Answer :(i)$X-2e^{-} \rightarrow X^{2+}$

$Y+3e^{-} \rightarrow Y^{3-}$

(ii)$3X^{+2}+2Y^{-3} \rightarrow X_3Y_2$

(iii)(1)Electroplating of Metals. (2)Electro-refining of Metals.

(iv)If the compound formed between X and Y and an electric current passed through the molten compound, the element X will be obtained at the cathode and Y at the anode of the electrolytic cell.

Question21:Mr.Ramu wants to electroplate with nickel to prevent rusting. For this electroplating:

(i)Name the
electrolyte (ii) Name
the cathode (iii)
Name the anode

(iv) Give the reaction at the cathode

(v)Give the reaction at the anode.

Answer:(i)Nickel sulphate

(ii)Keychain

(iii)Pure nickel plate

(iv)$Ni^{2+}+2e^{-} \rightarrow Ni$

(v)$Ni-2e^{-} \rightarrow Ni^{2+}$.

Question22:Three different electrolytic cells A,B and C are connected in separate circuits. Electrolytic

Cell A contains sodium chloride solution. When the circuit is completed a bulb in the circuit glows brightly. Electrolytic cell B contains acetic acid solution and in this case the bulb in the circuit glows dimly. The electrolytic cell C contains sugar solution and the bulb does not glow. Give a reason for each of these observations.

Answer:In Cell A: Sodium chloride being strong electrolyte dissociates completely and therefore current flows better.

In Cell B: Acetic acid being weak electrolyte ionises only partially and therefore, only a weak

current flows.

In Cell C:Sugar being a covalent compound does not ionise at all and therefore, no current flows.

Figure/TableBasedQuestion

Question1:

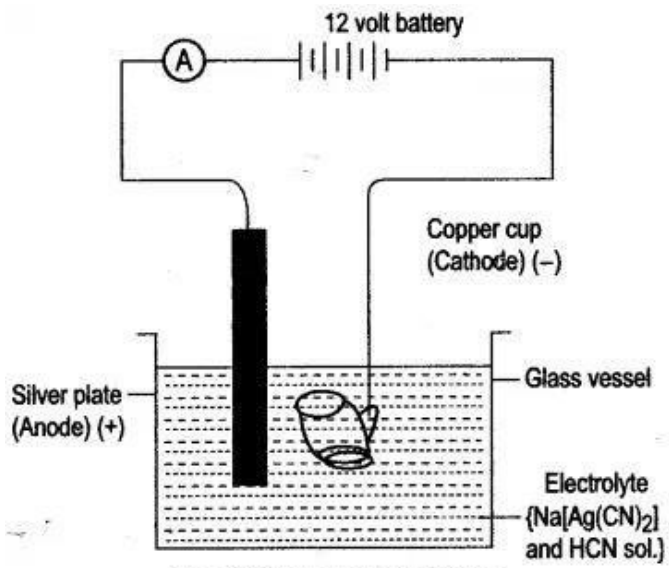


Fig. Silver electroplating

(i)Name the cathode and anode used during electroplating of silver.

(ii)Name the electrolyte used in this processes.

(iii)Give the dissociation reactions taking place.

(iv)Give the reactions occuring at cathode and anode.

(v)The overall strength of silver ions remain constant in the reaction.Why?

Answer:(i)Cathode: Highly cleaned article such as coppercup. Anode:A plate or rod of silver.

(ii)Sodium argentocyanide($Na[Ag(CN)_2]$)

(iii) $Na[Ag(CN)_2] \rightleftharpoons Na^+ + Ag^+ + 2CN^-$

$HCN \rightleftharpoons H^+ + CN^-$

$H_2O \rightleftharpoons H^+ + OH^-$

(iv) At cathode :

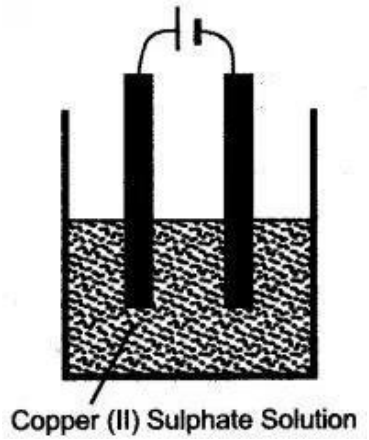
$Ag^+ + 1e^- \longrightarrow Ag$

At anode :

$Ag - e^- \longrightarrow Ag^+$

(v)Overall strength of silver ions does not change in the electrolyte as the number of Ag^+ions entering the electrolyte is equal to the number of Ag^+ions discharged at cathode.

Question2:Copper sulphate solution is electrolysed using copper electrodes. Study the diagram given below and answer the question that follows:



(i)Which electrode to your left or right Is known as the oxidising electrode and why?

(ii)Write the equation representing the reaction that occurs.

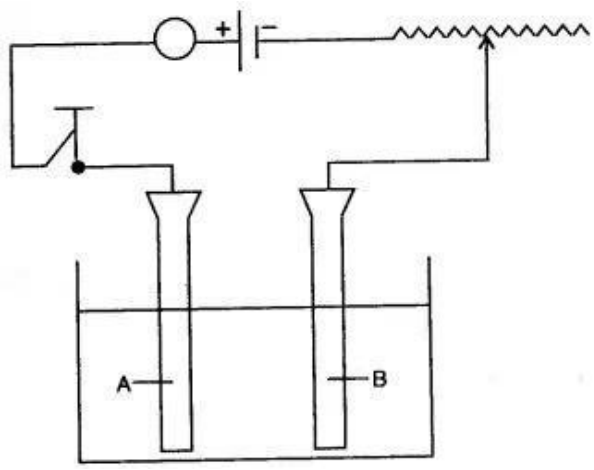
(iii)State two appropriate observations for the above electrolysis reaction.

Answer:(i)Electrode on the left side is the oxidising electrode because copper atoms lose electrons at this electrode.

(ii)$Cu - 2e^- \rightarrow Cu^{2+}$

(iii)Reddish brown copper metal is deposited at cathode and blue color of aqueous copper(II) Sulphate solution remains unchanged.

Question3:(i)Studythediagramgivenbelowandanswerthequestionsthatfollows:



(a)Give the names of the electrode s A a
nd B. (b)Which electrode is the oxidizing
electrode?

(ii)A strip of copper is placed in four different colorless salt solutions. They are KNO_3, $AgNO_3$, $Zn(NO_3)_2$,$Ca(NO_3)_2$.Which one of the solutions will finally turn blue?

(iii)Write the equations of the reactions which take place at the cathode and anode when acidified water is electrolysed.

Answer:(i)(a)A—Anode

B—Cathode

(b)A

(ii)$AgNO_3$solution

(iii) Cathode reaction

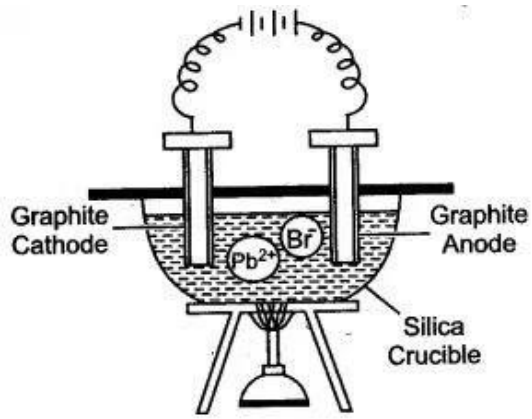
$$2H^+ + 2e^- \longrightarrow 2H \longrightarrow H_2$$

Anode reaction

$$2OH^- - 2e^- \longrightarrow 2OH \longrightarrow H_2O + O$$

$$O + O \longrightarrow O_2$$

Question4:Study the given figure and answer the question that follow:



(i)Why silica crucible is used in this type of electrolysis?

(ii)Which anode is preferred and why?

(iii)Why crucible is heated from outside?

(iv)Write the equations of the reaction which take place at the cathode and anode.

Answer:(i)Silica is non-reactive. It can withstand at high temperature and is almost a non-conductor of electricity.

(ii)The graphite anode is preferred because it is unaffected by the active bromine vapours.

(iii)The crucible is heated from outside to keep lead bromide in the molten state. So that the ions become free.

(iv) At the cathode : $Pb^{2+} + 2e^- \longrightarrow Pb$

At the cathode : $Br^- - e^- \longrightarrow Br$

$Br + Br \longrightarrow Br_2$

Question5:An electrolytic cell is an setup using two platinum electrodes and an aqueous solution of copper(II)sulphate.

(i)Draw a labeled diagram of the electrolytic cell.

(ii)Name the ions present in the cell.

(iii)Name the ions migrating towards the anode.

(iv)Name the ions migrating towards the cathode.

(v)Name the ions which will not be discharged at electrodes during electrolysis.

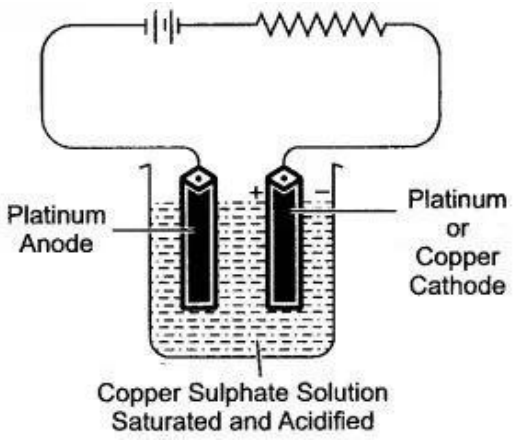
(vi)Write the reaction at the cathode.

(vii)Write the reaction at theanode.

(viii)Name the spectator ions in the solution.

(ix)Why the electrolytic solution acidified.

Answer:(i)



(ii)The ions present in the cell are And OH.
$Cu^{2+}+H^{+},SO_4$

(iii)The ions migrating towards the anode And OH.
areSO_4

(iv)The ions migrating towards the cathode is Cu^{2+}.

(v)The ions will not be discharged at electrode during electrolysis are $H^{+}$and OH^{-}.

(vi) Reaction at cathode :

$$Cu^{2+} - 2e^{-} \longrightarrow Cu$$

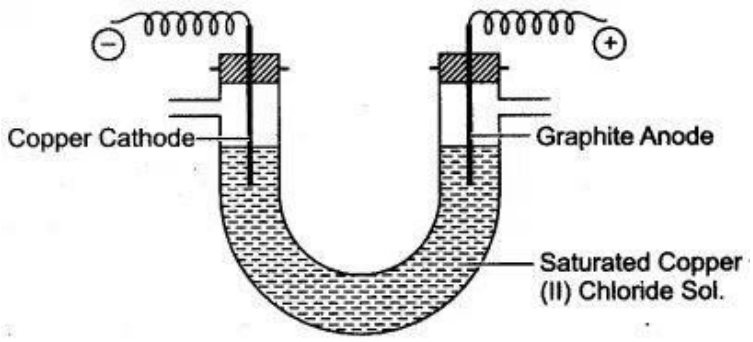
(vii) Reaction at anode :

$$4OH^{-} - 4e^{-} \longrightarrow 4OH$$
$$2OH + 2OH \longrightarrow 2H_2O + O_2$$

(viii) Thespectator ions present in the solution are – SO_4^{2-} and OH^{-}

(ix)To increase the electrical conductivity of electrolyte.

Question6:A saturated aqueous copper(II)chloride is electrolysed using graphite anode andc opper cathode as illustrated in diagram given below:



(i)Name the ions which will migrate to cathode.

(ii)Name the ions which will migrate to anode.

(iii)Which ionis likely to discharge at cathode and why?

(iv)Write ionic equation fòr reaction taking place at cathode.

(v)Which ion is likely to discharge at anode and why?

(vi)Write ionic equation for reaction taking place at anode.

(vii)If electric current is passed for a very long time, state color change taking place in electrolyte. State one reason for the change.

(viii)Give one reason for using graphite anode, rather than copper anode.

(ix)Name the gas liberated at cathode after the color changes in electrolyte.

Answer:

(i)Copper ions (Cu^{2+})and hydrogen ionsH^{+}migrate to cathode. (ii)Chloride ions(Cl^{-})and hydroxyl ions OH^{-} migrate to anode.

(iii)Copper ions (Cu^{2+})are likely to discharge at cathode, because their position is lower than hydrogen ions H^{+}in electrochemical series.

(iv)$Cu^{2+}+2e^{-} \rightarrow Cu$

(v)Hydroxyl ions(OH^{-})are likely to discharge at anode, because their position is lower than chloride ion(Cl^{-})in electrochemical series.

(vi)$4OH^{-}-4e^{-} \longrightarrow 2H_2O+O_2(g)$

(vii)The electrolyte gets decolorised. It is because, the blue color of electrolyte is due to the presence of Cu^{2+}ions. As Cu^{2+}ions discharge at cathode, therefore their concentration in electrolyte decreases. Thus, gradually blue color fades away.

(viii)In such a situation the copper atoms on copper anode ionise and enter into electrolyte. Thus ,size of copper anode gradually decreases. This is not possible in case of graphite anode.

(ix)Hydrogen gas is liberated at cathode.

ReasoningBasedQuestions

Question1:Why are acids, bases and salts classified as electrolytes?

Answer:Acids, bases and salts are classified as electrolytes because these compounds dissociate into ions, conduct electricity and undergo chemical decomposition at the same time.

Question2:Metals like potassium, calcium, sodium, etc. ,can be extracted only by electrolysis.

Answer: Metals like K, Ca, Na, etc., can be extracted only by electrolysis because conventional

Reducing agents such as coke , carbon monoxide, hydrogen do not supply sufficient energy to break ionic bonds between the active metals and their chlorides or oxides.

Question3:Dilute acids are strong electrolytes. Why?

Answer: Dilute acids produce a large number of hydronium ions, so they behave like strong electrolytes.

Question4:Sea water is a strong electrolyte. Why?

Answer: Sea water is a strong electrolyte because sodium chloride dissolved in it dissociates completely into free mobile ions.

$Na^{+}Cl\text{-} \rightleftharpoons Na^{+}+Cl^{-}$

Question5: Copper is a good conductor of electricity, but it is a non-electrolyte. Why?

Answer: During metallic conduction , the chemical properties of copper are intact as it does not undergo chemical decomposition. Since, the flow of electricity only produces heat and energy and no new products are formed copper metal is thus a good conductor of electricity but is an electrolyte.

Question6: A solution of ionic compound is an electrolyte, while that of covalent compound is non electrolyte?

Answer: The solution of ionic compound has free ions, which can migrate to cathode and anode and discharge. Thus, solution of ionic compound is good conductor of electricity and hence is electrolyte. However, a solution of covalent compound, consists of only molecules and does not have any free ions, which could migrate to cathode or anode. Hence, it is non-electrolyte.

Question7:Explain, why hydrochloric acid is a conductor of electricity?

Answer: Hydrochloric acid dissociates into ions in aqueous solution as follows: $HCl \rightleftharpoons H^+ + Cl^-$

When a current is passed through in aqueous solution of HCl, the ions move towards their respective

electrodes. Thus, the hydrochloric acid is a conductor of electricity.

Question8:Does wax conduct electricity? Give reason to justify your answer.

Answer: No, wax does not conduct electricity because wax, being a covalent compound, does not have positively or negatively charged ions which could not be weakened by heating or in aqueous solution. Therefore due to absence of free ions, wax does not conduct electricity.

Question11:During electrolysis high voltage is not favoured. Why?

Answer: During electrolysis high voltage is not favoured because the electrolytic conduction increases with rise in temperature, i.e., decrease in resistance. Increase in resistance can only be obtained by applying low voltage during electrolysis.

Thus, only electricity is suitable as reducing agent which provides unlimited amount of energy to break ionic bonds easily.

Question12:Why electrolysis of acidulated water is considered example of electrolysis?

Answer: It is because the amount of sulphuric acid does not change when water is electrolysed.The sulphuric acid just helps in increasing the conductivity of water.

Question13:Why should water be acidified before proceeding with the electrolysis of water?

Answer: It is done because water is a non-electrolyte, so it can be electrolytically decomposed by removing the $H^+$and OH^-ions continuously because the negligible ionization of water yields $H^+$and

OH^-ions which recombine to form a water molecule, then another molecule will ionize. Sulphuric acid is used to remove these ions.

$$H_2O\,(l) \rightleftharpoons H^+\,(aq) + OH^-\,(aq)$$
$$H_2SO_4\,(aq) \rightleftharpoons 2H^+\,(aq) + SO_4^{2-}\,(aq)$$

Question14: Hydroxyl (OH^-) ion is lower in the activity series, than chloride ion. Yet when a concentrated solution of hydrochloric acid is subjected to electrolysis, the hydroxyl ion does not get discharged.

Answer: If an electrolyte has a much higher concentration of ions that are higher in the electrochemical series than those that are lower, then the higher gets discharged in preference to the lower one. Concentrated hydrochloric acid being strong electrolyte gets fully dissociated furnishing H^+ and Cl^-ion. Water is less dissociated into $H^+$and OH^-ion. Thus, concentration of chloride ion is more as compared to OH^-ion and hence, chloride ion is discharged in preference to the OH^-ion.

Balancing/Writing the Chemical Equations

Question1: Write equations for the reactions taking place at cathode and at anode during the electrolysis of:

1. Acidified nickel sulphate solution with nickel electrode.
2. Acidified copper sulphate solution with copper electrode.
3. Acidified copper sulphate solution with platinum electrode.
4. Acidulated water with inert electrode.
5. Molten lead bromide with inert electrodes.
6. Electroplating a spoon with silver.

Answer:

1. Cathode : $Ni^{2+} + 2e^- \longrightarrow Ni$
   Anode : $Ni - 2e^- \longrightarrow Ni^{2+}$
2. Cathode : $Cu^{2+} + 2e^- \longrightarrow Cu$
   Anode : $Cu - 2e^- \longrightarrow Cu^{2+}$
3. Cathode : $Cu^{2+} + 2e^- \longrightarrow Cu$
   Anode : $OH^- - e^- \longrightarrow OH$
   $4OH^- \longrightarrow 2H_2O + H_2$
4. Cathode : $H^+ + e^- \longrightarrow [H]$
   $2[H] \longrightarrow H_2$
   Anode : $OH^- - e^- \longrightarrow OH$
   $4OH \longrightarrow 2H_2O + O_2$
5. Cathode : $Pb^{2+} + 2e^- \longrightarrow Pb$
   Anode : $2Br^- - 2e^- \longrightarrow 2[Br]$
   $2[Br] \longrightarrow Br_2$
6. Cathode : $AgNO_3 \longrightarrow Ag^+ + NO_3^-$
   $Ag^+ + e^- \longrightarrow Ag$
   Anode : $NO_3^- - e^- \longrightarrow NO_3$
   $Ag + NO_3 \longrightarrow AgNO_3$

Chapter7
Metallurgy

Short Questions

Question1:(i) Arrange Cu, Ca, Al, Fe, Mg, Pb, Na and Zn in the decreasing order, in which they appear in the activity series; putting down the most reactive metal first and least reactive in the last.

(ii) (a) Among the above metals, write the names of metals which will displace hydrogen from water or steam.

(b) Give two evidences to show that magnesium is more reactive than iron.

Answer:(i) The given metals are arranged in the activity series of metals as follows: Na, Ca, Mg, Al, Zn, Fe, Pb (most reactive) and Cu (least reactive)

(ii) (a) (1) Sodium and calcium displace hydrogen from cold water.

$2Na + 2H_2O \rightarrow 2NaOH + H_2\uparrow$

$Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2\uparrow$

(2) Magnesium and zinc metals are less reactive as they react with boiling water to liberate hydrogen gas.

$Mg + 2H_20 \rightarrow Mg(OH)_2 + H_2\uparrow$

$Zn + 2H_20 \rightarrow Zn(OH)_2 + H_2\uparrow$

(3) Iron which is less reactive, reacts in red hot conditions with steam to liberate hydrogen gas.

$3Fe + 4H_20 \rightarrow Fe_3O_4 + 4H_2\uparrow$

(4) Lead and copper almost fail to liberate hydrogen gas in any conditions, because they are not so reactive. They lie just above and below hydrogen in activity series of metals.

(b) (1) Magnesium reacts with boiling water to liberate hydrogen gas, while iron can do so with steam in red hot condition only.

(2) Magnesium can displace hydrogen from acids vigorously in cold but iron displaces hydrogen slowly.

Question2:(i) Na, Ca, Mg, Al, Zn, Fe, Pb and Cu, are well known metals.

(a) X, Y and Z are coded letters for three of the metals in the activity series of metals as given above,

Metal X, reacts violently with cold water and its hydroxide is not decomposed by heat.

Metal Y, has no reaction with water but its hydroxide decomposes, with slight warming, giving a black powder.

Metal Z, reacts vigorously with dilute hydrochloric acid but hardly at all with cold water. If it is heated in steam, a white solid A is formed and a colourless gas B is set free

(1) which of the metals in the list is X ?
(2) which of the metals in the list is Y ?
(3) which of the metals in the list is Z ?

(4) Write the name of the solid A and gas B.

(b) State whether the following are soluble or insoluble in water.
(1) The carbonate of X.

(2) The carbonate of Y.
(3) The hydroxide of Z.

(ii) A certain metal does not liberate hydrogen from dilute sulphuric acid but it displaces silver from aqueous silver nitrate solution. State the most likely place for the metal in the activity series.

(iii) What would you expect to happen, if aluminium metal is heated with iron (III) oxide ? Also write the equation.

Answer:(i) (a) (1) The metal X is sodium.

(2) The metal Y is copper.

(3) The metal Z is magnesium.

(4) The name of the solid A is magnesium hydroxide, while the gas B is hydrogen.

(b) (1) Soluble as sodium carbonate is soluble in water.

(2) Insoluble, as copper carbonate is insoluble in water.

(3) Soluble, as magnesium hydroxide is soluble in water.

(ii) The metafiles below hydrogen and above silver in the activity series of metals.

(iii) When aluminium metal is heated with iron (III) oxide with metallic iron, an enormous amount of heat is produced due to the exothermic nature of the reaction. Molten iron is thus produced, which can be used in welding.

$Fe_2O_3 + 2Al \rightarrow Al_2O_3 + 2Fe + Q$.

Question3:(i) Arrange Ca, Pb, Fe, Na, Zn, Cu, and Al in the decreasing order of their reactivity.

(ii) Answer the following question related to above (i) sequence :

(a) Which of these is most likely to tarnish readily when exposed to the air ?
(b) Which of these is most likely to be found in free state in nature ?

(c) Which of these is most likely to react with cold water ?

Answer:(i) The decreasing order of the given metals is as follows :

[Most reactive] Na, Ca, Al, Zn, Fe, Pb, and Cu [Least reactive]

(ii) (a) Sodium [Na].

(b) Copper [Cu].

(c) Sodium [Na] and calcium [Ca].

Question4:(i) From the metals copper, zinc, magnesium, sodium and iron, select the metal in each case which:

(a) Does not react with dil. hydrochloric acid.

(b) Has a hydroxide that reacts with both acids and alkalies.

(c) Does not react with cold water but reacts with steam when heated.

(d) Can form +2 and +3 ions.

(ii) Arrange the metals in decreasing order of reactivity.

Answer:(i) (a) Copper (b) Zinc

(c) Magnesium (d) Iron

(ii) Sodium > Magnesium > Iron > Zinc > Copper.

Question5:(i) Differentiate between:

(a) Slag and Flux. (b) Calcination and Roasting.

(ii) Compare the properties of a typical metal and a non-metal on the basis of the following :
(a) Electronic configuration (b) Nature of the oxides

(c) Oxidising or reducing action (d) Conductivity of heat and electricity.
(iii) What are the differences between a mineral and an ore ?

Answer:(i) (a)

~~SlagFlux~~	
It is the product obtained by the combination of the flux with gangue in metallurgy.	It is a substance which is added along with charge to separate the gangue in metallurgy.

(b)

Calcination	Roasting
It is the process of heating concentrated ore in a limited supply of air to a temperature insufficient to melt the ore.	It is the process of heating concentrated ore in a free supply of air to a temperature insufficient to melt the ore.
During calcination, no other chemical change occurs except decomposition.	During roasting, chemical changes like oxidation or reduction take place.

(ii) (a) Metals complete their octet by the loss of electrons whereas non-metals complete their octet by the gain of electrons.

Metals generally contain 1 to 3 valence electrons in their outermost shell whereas non-metals contain 4 to 7 valence electrons in their outermost shell.

(b) Metals form basic oxides whereas non-metals form acidic oxides.

(c) Metals are reducing agents whereas non-metals act as oxidising agents.

(d) Metals He generally good conductors of heat and electricity whereas non-metals are bad conductors of heat and electricity.

(iii) (a) The minerals contain a low percentage of metal, while the ores contain a large percentage of the metal.

(b) The metal cannot be extracted from mineral, on the other hand ores can be used for the extraction of metal.

(c) All minerals are not ores, but all ores are minerals.

Question6:(i) The ore zinc blende, is an important source of the metal zinc. What is the name of the zinc compound in zinc blende ?

(ii) What is the zinc compound obtained by roasting zinc blende ?

(iii) What is the type of chemical reaction carried out in order to obtain zinc ?

(iv) Are liquid zinc and liquid lead miscible or immiscible ?

(v) What is the name of the alloy formed between zinc and copper ?

Answer:(i) Zinc sulphide (ZnS).

(ii) Zinc blende is oxidized to zinc oxide by roasting in presence of excess air,

(iii) Reduction of zinc oxide.

(iv) Immiscible.

(v) Brass [7% of Cu, 30% of Zn].

Question8:(i) What is bauxite ? Which metal is extracted from it ?

(ii) In the electrolysis of molten alumina, the carbon anode is gradually burnt away. Why ?
(iii) Describe modem method of aluminium extraction.

Answer:(i) Bauxite is hydrated aluminium oxide [$Al_2O_3.2H_20$]and aluminium metal is extracted from bauxite.

(ii) In the electrolysis of molten aluminium oxide, oxygen gas is liberated which gradually bums away carbon anode at a higher temperature to form carbon dioxide.

$C + O_2 \rightarrow CO_2$

(iii) In the modern method, pure alumina is dissolved in cryolite [$Na_3.AlF_6$],which makes it good conductor of electricity.

When an electric current is passed through electrolyte, the heat is also produced which keeps

the mass in molten state and alumina gets reduced to free aluminium metal according to the following reactions:

$$Na_3AlF_6 \longrightarrow 3NaF + AlF_3$$

$$2AlF_3 \rightleftharpoons 2Al^{3+} + 6F^-$$

$$6F^- + Al_2O_3 \longrightarrow 2AlF_3 + 3O^{2-}$$

At cathode : $2Al^{3+} + 6e^- \longrightarrow 2Al$

At anode : $3O^{2-} - 6e^- \longrightarrow 3O$

$$3O + 3O \longrightarrow 3O_2$$

Question9:The following questions are relevant to the extraction of Aluminium :

(i) State the reason for addition of caustic alkali to bauxite ore during purification of bauxite.
(ii) Give a balanced chemical equation for the above reaction.

(iii) Along with cryolite and alumina, another substance is added to the electrolyte mixture. Name the substance and give one reason for the addition.

Answer:(i) Caustic alkali dissolves aluminium oxide forming soluble sodium aluminate while impurities remains insoluble and ppt. as red mud.

(ii) $Al_2O_3.2H_20 + NaOH \rightarrow 2NaAlO_2 + 3H_2O$

(iii) The name of substance is Fluorspar (CaF_2)and it increases conductivity of the electrolyte.

Question10:'Alumina (aluminium oxide) has a very high melting point of over 2,000°C so that it cannot readily be liquefied. However, conversion of alumina to aluminium and oxygen, by electrolysis, can occur when it is dissolved in some other substance.'

(i) Which solution is used to react with bauxite as a first step in obtaining pure aluminium oxide ?

(ii) The aluminium oxide for the electrolytic extraction of aluminium is obtained by heating aluminium hydroxide. Write the equation for this reaction.

(iii) Name the element which serves both as the anode and the cathode in the extraction of aluminium.

(iv) Write the equation for the reaction that occurs at the cathode during the extraction of aluminium by electrolysis.

(v) Give the equation for the reaction which occurs at the anode when aluminium is purified by electrolysis.

Answer:(i) Sodium hydroxide

(ii) $2Al(OH)_3 \xrightarrow{\Delta} Al_2O_3 + 3H_2O$

(iii) Carbon

(iv) $[Al^{3+} + 3e^- \longrightarrow Al] \times 2$

(v) $[O^{2-} - 2e^- \longrightarrow O] \times 3$

$$3O \longrightarrow 1\frac{1}{2}O_2$$

Question16:(i) What is froath floatation process and for, what purpose it is used ?

(ii) How is the metal sodium extracted ? Write the equations for the reactions involved.
(iii) Name two other metals, which can be extracted by electrolytic reduction method.

Answer:(i) In this process, the heavy material containing metal, is floated upward with froath to separate it from,waste material present in ore or mineral. Hence it is called froath floatation process.

(ii) Sodium metal is Extracted by the electrolysis of fused sodium chloride. Sodium is collected at cathode, while chlorine gas is liberated at anode; as an important by product.

$$NaCl \rightleftharpoons Na^+ + Cl^-$$

At Cathode : $Na^+ + e^- \longrightarrow Na$

At anode : $Cl^- - e^- \longrightarrow Cl$

$Cl + Cl \longrightarrow Cl_2$

(iii) Calcium, and magnesium are other two metals, which can be extracted by electrolytic reduction method.

Answer:(i) The gas Y, carbon dioxide and the gas Z, is carbon monoxide. The gas Z is a reducing agent because it removes oxygen from iron oxide and converts it into metallic iron and itself gets oxidized to carbon dioxide.

(ii) (a) Iron, Chromium, (b) Zinc.

Question21:A to F below relate to the source and extraction of either Zinc or Aluminium.
A. Bauxite: B. Coke

C. Cryolite D. Froth floatation

E. Sodium hydroxide solution. F. Zinc blende.

(i) Write down the three letters each from the above list which are relevant to :
(1) Zinc (2) Aluminium.

(ii) (1) Metals are generally solid at room temperature. Name the metal which is liquid at room temperature [say 25°C].

(2) Which allotrope of the non-metal conducts electricity ?

(iii) How many valence electrons are present in (a) Metals, (b) Non-metals,

Answer:(i) (1) B, D, F (2) A, C, E

(ii) (1) Mercury metal exists in liquid state at room temperature.

(2) Graphite, an allotrope of carbon is a good conductor of electric current.

(iii) Atom of metals contain 1, 2 and 3 valence electrons, while the atom of non-metals contain

4,5, 6 and 7 valence electrons.

Question23:(i) Name an alloy used in aircraft construction and give a reason for its use.

(ii) What is rusting of iron ?

(iii) (a) How are the following protected from rust ?
(1) A car bumper and (2) A food can.

(b) How can iron or steel be prevented from rusting, when used for ?
(c) What is galvanized iron and for what purposes it is used ?

(d) To protect iron from rusting it is coated with a thin layer of zinc. Name this process.

Answer:(i) Duralumin, an alloy of aluminium, is used in the construction of aircraft; because it is light, resistant to corrosion and has great tensile strength.

(ii) The rusting of iron is a process of atmospheric corrosion, i.e., slow destruction of iron by moisture and atmospheric oxygen. Rust is a reddish-brown powdery deposit and consists of a mixture of ferric hydroxide and hydrated ferric oxide.

(iii) (a) (1) Nickel Plating and (2) Galvanizing.

(b) By painting and by coating with nickel.

(c) Iron coated with zinc is called galvanized iron. Galvanization is a process of depositing a thin layer of zinc, over the surface of iron to protect iron from rusting. Zinc is more electropositive

and would be attacked first and thus iron is protected from any corrosion. Galvanized iron is used in making different varieties of tools for industries, scientific apparatus and household fittings.

(d) Galvanisation.

Question25:(i) (a) With reference to the reduction of copper oxide, iron (II) oxide, lead (II) oxide and magnesium oxide by hydrogen; place the oxides in increasing order of reduction, i.e., first the oxide that is most difficult to reduce; and at last, the oxide that is most easy to reduced.

(b) (1) What is the type of bonding expected in metallic chloride ?

(2) If fused metallic chloride is electrolysed, at which electrode the metal will be obtained.
(3) 'What metallic property is shown by the non-metal graphite ?

(c) (1) Cast iron contains about 4% of carbon. By which chemical process is the amount of carbon decreased to make steel ?

(2) Which metal is added to steel to make stainless steel ?

(ii) (a) For each substance listed below, explain its significance in the extraction of Aluminium:
(1) Bauxite. (2) Cryolite.

(3) Graphite. (4) Sodium hydroxide.

(b) The following questions relate to the extraction of aluminium by electrolysis :
(1) Give the equation for the reaction that takes place at the cathode.

(2) Explain why it is necessary to renew the anode from time to time.

Answer:(i) (a) The increasing order of oxides is :

Magnesium oxide > iron (II) oxide > lead (II) oxide > copper oxide.

The magnesium oxide is highly stable. It cannot be reduced by hydrogen, while the last three members are reduced by hydrogen to their metals according to reactivity series.

(b) (1) Electrovalent or ionic bond.

(2) Cathode.

(3) Non-metal graphite is good conductor of heat and electricity.

(c) (1) In the Bessemer process it takes only a few minutes to convert cast iron into steel.

(2) Stainless steel is an alloy which contains about 18% of Cr, 8% Ni and 1% C.

(ii) (a) (1) Bauxite : It is the main ore of aluminium from which aluminium metal can easily be extracted.

(2) Cryolite : It is added to lower the fusion temperature of the electrolytic bath. The mixture melts at 950°C instead of 2050°C thereby saving electrical energy. It also increases conductivity alongwith fluorspar.

(3) Graphite acts as an anode. Here the anode gets oxidised to carbon dioxide, i.e.
$C + O_2 \rightarrow CO_2$

Or $2O^{2-} - 4e^- \rightarrow O_2$

Thus, electrodes are made of graphite.

(4) Sodium hydroxide when added to powdered bauxite and the mixture when heated under pressure for 2-3 hours, bauxite is converted to soluble sodium aluminate ($NaAlO_2$).

$$Al_2O_3.2H_2O + 2NaOH \xrightarrow{150 \text{ to } 200^\circ C} 2NaAlO_2 + 3H_2O$$

This solution is used, to obtain pure aluminium.

(b) (1) The following reaction (reduction) takes place at the cathode during the extraction of aluminium.

$Al^{+3} + 3e^- \rightarrow Al$.

(2) Oxygen gas is produced at the graphite anode, which combines with carbon to form carbon dioxide gas at high temperature and thus anode destroys away. Thus, it is necessary to renew the anode to continue the process of extraction of aluminium.

Question26:(i) How are the alloys classified ?
(ii) What are ferrous alloys ? Give one example.

(iii) What are non-ferrous alloys ? Give one example.

(iv) An alloy usually has some property which makes it particularly useful. What is the special property of: (a) Type metal, (b) Duralumin ?

Answer:(i) Alloys are classified on the basis of their constituents. They are classified as follows:

(a) Ferrous alloys. (b) Amalgams. (c) Non-ferrous alloys.

(ii) Ferrous alloys: It is an alloy having iron as one of the constituent, e.g., nickel, steel.

(iii) Non-ferrous alloys: An alloy that does not contain iron as one of its constituents, is called a non-ferrous alloy, e.g., brass.

(iv) (a) Type metal is hard and expands on cooling and is therefore used for making

types. (b) Duralumin, is light and strong therefore it is used in the construction of air-

craft.

Question30:(i) (a) How will you show that sodium is a metal ?
(b) How will you show that sulphur is a non-metal ?

(ii) (a) Which gas is liberated when aluminium metal reacts with a solution of sodium hydr¬oxide ?

(b) Which gas is generally liberated when metals react with dilute acid?

Answer:(i) (a) Sodium metal can form positive ions by the loss of one electron, this metal is electropositive.

$Na - e^- \rightarrow Na^+$

Sodium has high density and is less dense then water.

(b) Sulphur is non metal because, it gives negative sulphur ions by gaining of two electrons. It dissolves in many liquid solvents, but it is non-conductor of electricity and heat.

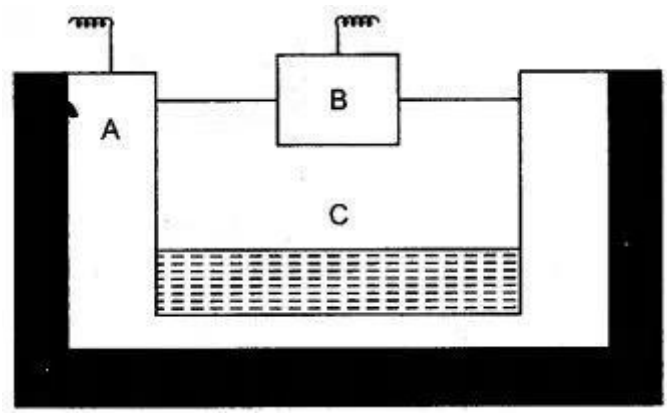
$S + 2e^- \rightarrow S_2$

(ii) (a) When aluminium metal reacts with sodium hydroxide solution, hydrogen gas is liberated.

(b) Hydrogen gas is generally liberated when metals react with dilute acid.

Figure/TableBasedQuestions

Question1:The given sketch of an electrolytic cell used in the extraction of aluminium:



(i) What is the substance of which the electrode A and B are made ? (ii) At which electrode (A ro B) is the aluminium formed ?

(iii) What are the two aluminium compound in the electrolyte C ?

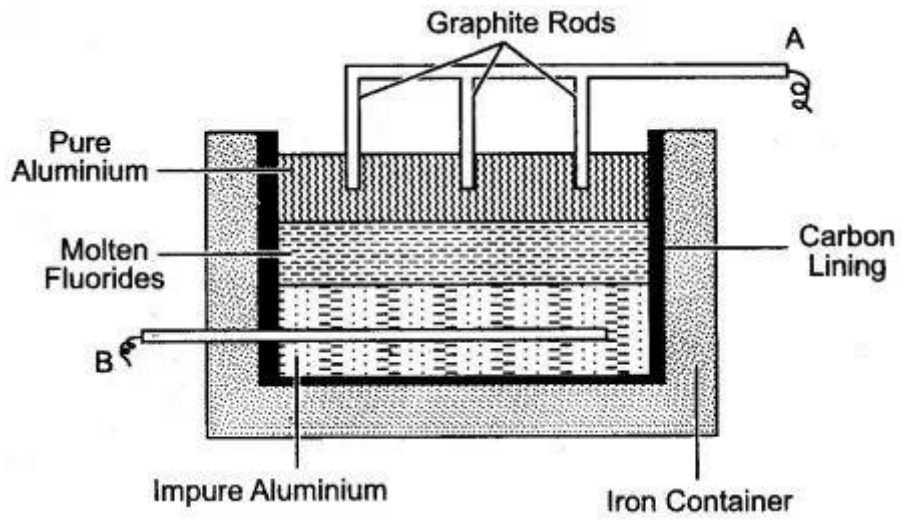
(iv) Why is it necessary for electrode B to be continuously replaced ?

Answer:(i) Carbon (Graphite) (ii) A

(iii) Aluminium oxide / Alumina / cryolite (sodium aluminium fluoride). (iv)

Burns away in the presence of oxygen produced or consumed.

Question2:The given figure illustrates the refining of aluminium by Hoope's process.



(i) Which of A and B is the cathode and which one is the anode ? (ii) What is the electrolyte in the tank ?

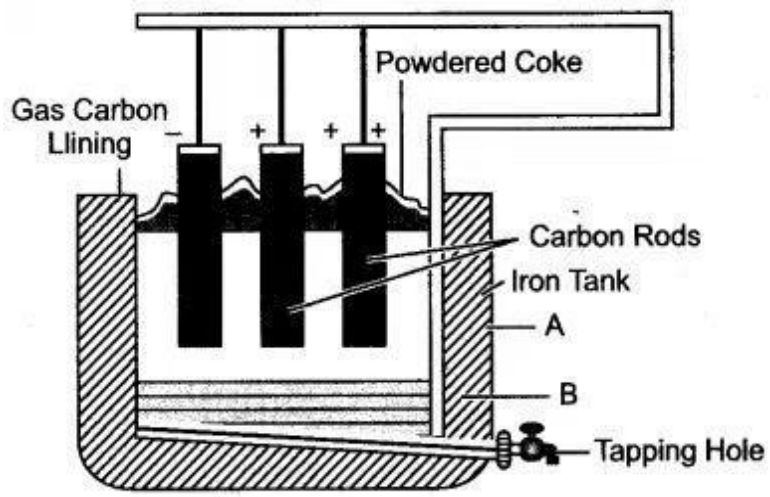
(iii) What material is used for the cathode ?

Answer:(i) A—Cathode, B—Anode. (ii)

Mixture of fluorides.

(iii) Graphite

Question4:(i) Name the process and the element extracted by the above process as shown in the figure.



(ii) Give the function of three components of electrolyte.
(iii) Why is electrolyte covered with coke?

(iv) Write the electrolytic reaction taking place at cathode?

Answer:(i) Aluminium, Hall and Herault's process.

(ii) Alumina (Al_2O_3)is the main aluminium yielding compound.

Cryolite [Na_3AlF_6]acts as a solvent and lowers the fusion temperature from 2050°C to 950°C.

Fluorspar (CaF_2)acts as a solvent and increases the conductivity of electrolytic mixture.

(iii) A layer of powdered cpke is sprinkled over the surface of the electrolyte mixture because it reduces the heat loss by radiation and prevents carbon anode from brning in air.

(iv) Aluminium formed sinks to the bottom of the tank and is periodically tapped off.

At Cathode $\quad Al^{3+} + 3e^- \longrightarrow \underset{\text{Aluminium}}{Al}$

Question5:List 1 contains the metals/alloys, (i), (ii), (iii), (iv), (v) and list 2 contains their uses A, B, C, D, E.

List 1	List 2
(i) aluminium	A. steel making
(ii) lead	B. aeroplane wings
(iii) brass	C. galvanizing
(iv) iron	D. radiation shield
(v) zinc	E. electrical fittings

Copy and complete the following table writing down the letter for the correct use of each metal. An answer may be used only once. The first has been done for you.

Metal	(i)	(ii)	(iii)	(iv)	(v)
Use	B				

Answer:

Metal	(i)	(ii)	(iii)	(iv)	(v)
Use	B	D	E	A	C

Question6:The table below compare some properties of metals and non-metals. Write down the missing statements (i) to (iv).

Metal	Non-Metal
(i)	Poor conductor of heat
(ii) Malleable	.....
(iii) Forms positive ions	.....
(iv)	Form acidic oxide.

Answer:(i) Metals are good conductor of heat.

(ii) Non-metals are non-malleable [Brittle].

(iii) Non-metals form negative ions [Anions].

(iv) Metals form basic oxides.

ReasoningBasedQuestions

Question1:Why are metals called reducing agents ?

Answer:They tend to lose electrons and act as reducing agents.

Question2:Why are non-metals called oxidizing agents ?

Answer:They tend to gain electrons and act as oxidising agents

Question4:Iron liberates hydrogen from dilute sulphuric acid,

while silver cannot. Why ?

Answer:In activity series of metal, iron occupies a higher position than hydrogen; while silver is placed below hydrogen; hence iron is more reactive than silver and is able to displace hydrogen from dilute sulphuric acid.

$Fe + H_2SO_4 \rightarrow FeSO_4 + H_2\uparrow$

Question5:Zinc displaces lead from lead nitrate solution, while gold is unable to do so. Why ?

Answer:Zinc is above lead in the metal activity series. It is more reactive than lead while gold, a noble metal, lies far below lead in the activity series and it is less reactive or highly unreactive. Zinc reacts with lead nitrate solution to precipitate lead and zinc nitrate is formed. There is no reaction between gold and lead nitrate.

$$Pb(NO_3)_2 + Zn \longrightarrow Zn(NO_3)_2 + Pb \downarrow$$
$$Pb(NO_3)_2 + Au \longrightarrow \text{No reaction.}$$

Question6:Why is sodium metal always stored under kerosene oil ?

Answer:Sodium is a very reactive metal and on exposure to moist air, the surface of sodium metal is tarnished due to formation of sodium carbonate.

$$4Na + O_2 \longrightarrow 2Na_2O.$$
$$Na_2O + H_2O \longrightarrow 2NaOH$$
$$2NaOH + CO_2 \longrightarrow \underset{\text{Sodium Carbonate}}{Na_2CO_3} + H_2O$$

To avoid this sodium is always kept under kerosene oil.

Question7:Why carbon can reduce copper (II) oxide to copper but not calcium oxide to calcium ?

Answer:Because carbon has greater affinity for oxygen than copper and less affinity for oxygen than calcium.

Question8:Aluminium is highly electropositive metal, in spite of it aluminium does not oxidise rapidly in air. Why ?

Answer:In moist air, a thin layer of aluminium oxide is formed on it quickly which protects aluminium to oxidise. This is the reason why aluminium does not oxidise rapidly in air.

Question9:Why extraction of aluminium is difficult ?

Answer:Extraction of aluminium is difficult because :

(i) Pure aluminium oxide melts at 2050°C only. So, a large amount of energy is needed to maintain this high temperature.

(ii) A good amount «f the aluminium vaporises at this temperature.

(iii) Fused alumina does not conduct electricity well.

Question10:During the extraction of aluminium, cryolite and fluorspar are added to alumina. Why ?

Answer:Cryolite and fluorspar are added to alumina :

(i) To lower the melting point of aluminium.

(ii) To make alumina a good conductor of electricity.

(iii) Cryolite acts as a solvent for alumina.

Question11:Aluminium transmission wires are preferred to copper transmission wires. Why ?

Answer:(i) Aluminium is lighter than copper.

(ii) It is a good conductor of electricity.

(iii) Aluminium is cheaper than copper.

Question12:Why in construction work alloy duralumin is used rather than aluminium ?

Answer:Because duralumin is harder, stronger and more resistant to corrosion.

BalancingWritingtheChemicalEquations

Question1:Write balanced chemical equation:

1. The reduction of metallic oxide inside the blast furnace.

2. Formation of Hag inside the blast furnace.

3. Heating of aluminium hydroxide.

4. Reaction of zinc with hot concentrated sodium hydroxide.

5. Reduction of zinc oxide.

6. Burning of aluminium in air.

7. Reduction of ferric oxide by aluminium powder.

8. Calamine is heated.

9. Zinc placed in ferrous sulphate solution.

10. Reduction of copper oxide by hydrogen.

11. Reduction of iron (III) oxide by carbon monoxide.

12. Reduction of lead (II) oxide by carbon.

13. Action of heat on aliuninium hydroxide.

14. Zinc is treated with dilute sulphuric acid.
15. Action of Copper sulphate solution on zinc.

16. Action of Steam on Zinc.

Answer:

1. $Fe_2O_3 + 3CO \longrightarrow 2Fe + 3O_2$
2. $CaO + SiO_2 \longrightarrow CaSiO_3$
3. $2Al(OH)_3 \xrightarrow{\Delta} Al_2O_3 + 3H_2O$
4. $Zn + 2NaOH \longrightarrow Na_2ZnO_2 + H_2$
5. $ZnO + C \longrightarrow Zn + CO$
6. $4Al + 3O_2 \xrightarrow{\Delta} 2Al_2O_3$

   $2Al + N_2 \xrightarrow{\Delta} 2AlN$
7. $Fe_2O_3 + 2Al \longrightarrow Al_2O_3 + 2Fe$
8. $ZnCO_3 \xrightarrow{\Delta} ZnO + CO_2$
9. $Zn + FeSO_4 \longrightarrow ZnSO_4 + Fe$
10. $CuO + H_2 \longrightarrow Cu + H_2O$
11. $Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$
12. $PbO + C \longrightarrow Pb + CO$
13. $2Al(OH)_3 \xrightarrow{\Delta} Al_2O_3 + 3H_2$
14. $Zn + \underset{\text{(Dil.)}}{H_2SO_4} \longrightarrow ZnSO_4 + H_2\uparrow$
15. $Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu.$
16. $\underset{\text{Steam}}{Zn + H_2O} \longrightarrow \underset{\text{Zinc oxide}}{ZnO} + H_2\uparrow$

Chapter 8

Study of Compounds: Hydrogen Chloride

Short Questions:

Question 1:

(i) State one condition under which chlorine and hydrogen react to form hydrogen chloride gas.

(ii) Give balanced chemical equation for the above reaction.

(iii) Name the gas which is a covalent compound but becomes electrovalent when dissolved in water.

(iv) For which gas, ammonia fountain experiment can be used ?

Answer:

(i) Presence of diffused sunlight.

(ii) $H_2 + Cl_2 \longrightarrow 2HCl$

(iii) Hydrogen chloride (HCl) gas.

(iv) Hydrogen chloride gas.

Question 2:

A colourless gas G fumes strongly in the air. The gas gives dense white fumes when a glass rod dipped in ammonia solution is held near the gas.

Answer the following questions:

(i) Name the gas G.

(ii) Name two chemicals used in the preparation of the gas G.

(iii) Write the chemical equations for the reaction of the chemicals named in (ii) when : (a) The reaction mixture is not heated. (b) The reaction mixture is heated above 200°C.

(iv) Why does the gas G fume strongly in air ?

(v) Why does the gas G form dense white fumes with ammonium hydroxide ?

Answer:

(i) The gas G is hydrogen chlorine gas.

(ii) The chemicals are:

(i) sodium chloride,

(ii) concentrate sulphuric acid.

(iii) (a) $NaCl + H_2SO_4$ (conc.) $\longrightarrow$ $NaHSO_4 + HCl$ (g)

(b) $Nacl + NaHSO_4 \longrightarrow Na_2SO_4 + HCl$ (g)

(iv) It is because the HCl gas is extremely soluble in water. Thus when HCl gas comes in contact with the atmosphere , the gas dissolves in water vapour present in the air to form tiny and misty droplets of hydrochloric acid, which appear in the form of fumes.

(v) The HCl gas reacts with vapours of ammonium hydroxide to form very fine solid particles of ammonium hydroxide which are white in colour. These white particles of solid ammonium hydroxide appear in the form of white fumes.

Question 3:

(i) How will you dry HCl gas.

(ii) Give three tests of hydrogen chloride.

(iii) Which two colourless gases combine to form a white solid.

Answer:

(i) HCl gas can be dried by passing it over conc. H_2SO_4, which acts as a powerful dehydrating agent.

(ii) Tests for Hydrogen Chloride are:

(1) It gives dense white fumes with a rod dipped in NH_4OH solution.

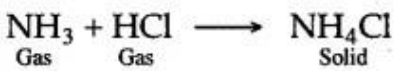
(2) It gives white ppt. with $AgNO_3$ solution.

$$AgNO_3 + HCl \longrightarrow \underset{\text{White ppt.}}{AgCl\downarrow} + HNO_3$$

(3) It produces a greenish yellow gas (chlorine) that turns moist starch iodide paper blue black when treated with an oxidising agent like manganese dioxide.

MnO2 + 4HCl ----> MnCl2 + 2H2O + Cl2

(iii) NH_3 and HCl gases combine to form a white solid NH_4Cl.



Question 4:

(i) (a) What must be added to sodium chloride to obtain hydrogen chloride ?

(b) Write the equation for the reaction which takes place in (a) (i) above.

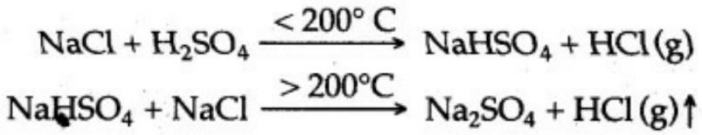
(c) What would you see when hydrogen chloride is mixed with ammonia ? (ii) Hydrogen chloride dissolve in water forming an acidic solution:

(a) Name the experiment which demonstrates that hydrogen chloride is very soluble in water.

(b) Give three distinct tests (apart from using an indicator) you would carry out with this solution to illustrate the typical properties of an acid.

Answer: (i) (a) Concentrated Sulphuric acid.

(b)



(c) When aqueous solution of ammonia is taken in the jar of hydrogen chloride, it forms dense white fumes of ammonium chloride.

$NH_3 + HCl \longrightarrow NH_3Cl$

(ii) (a) Fountain

experiment.

(b) An acid reacts

with:

(I) Metal carbonates and bicarbonates with effervescence to liberate a colourless and odourless gas that turns lime water milky and has no effect on pink potassium permanganate solution (CO_2).

(II) Acids react with metal sulphides to liberate a gas which has smell of rotten eggs and turns moist lead acetate paper black (H2S).

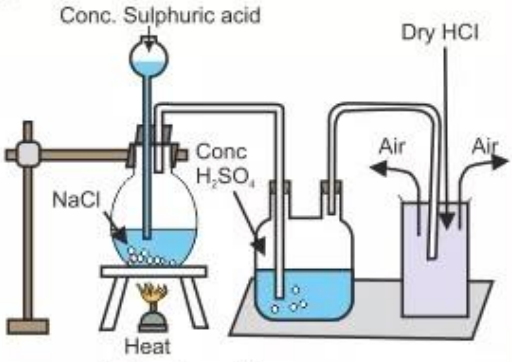
(III) Acids react with metal sulphites to liberate a colourless and odourless gas that turns lime water milky and decolourizes pink potassium permanganate solution (SO_2).

Laboratory Preparation of HCl Gas

I. Reactants: Sodium chloride (NaCl) and conc. sulphuric acid (H_2SO_4)
II. Procedure:
1. Conc. sulphuric acid is poured through the thistle funnel into a flask with NaCl.
2. Reaction proceeds and gas is liberated on heating.
3. HCl gas is evolved with effervescence.
4. HCl is dried by passing through conc. sulphuric acid.
III. Reaction:

$$NaCl + H_2SO_4\ (conc.) \xrightarrow{\text{Below } 200^\circ C} NaHSO_4 + HCl$$

$$2NaCl + H_2SO_4\ (conc.) \xrightarrow{\text{Above } 200^\circ C} Na_2SO_4 + 2HCl$$



IV. Purification of HCl gas: It is dried by passing through conc. sulphuric acid.
V. Collection: HCl is collected by the upward displacement of air (1.28 times heavy than air).
VI. Precautions:
a) Temperature should be maintained at nearly 200 °C.
b) Delivery tube should be dipped in drying agent.
c) The lower end of the thistle funnel must be dipped in conc. sulphuric acid.

Question 5:

(i) (a) Name the oxidising agent in the reaction between Manganese dioxide and hydro-chloric acid.

(b) State your observation when a rod dipped in ammonium hydroxide solution is brought near a gas jar containing hydrogen chloride gas.

(ii) (a) What is the common property being shown by these metal oxides ?

(b) Write the equation for the reaction of concentrated hydrochloric add with Pb_3O_4. (c) What kind of compound can be added to bleaching powder to obtain chlorine ?

Answer:

(i) (a) Manganese dioxide acts as an oxidising agent.

(b) Dense white fumes appear in the jar on account of formation of fine particles of ammonium chloride which get suspended in the gas.

(ii) (a) Oxidizing property

(b) $Pb_3O_4 + 8HCl \longrightarrow 3PbCl_2 + 4H_2O + Cl_2$

(c) Dilute acid (Hydrochloric acid)

Question 6:

Answer the following questions, stating your answer only to compounds in the following list: Silver nitrate, hydrochloric acid, chlorine, ammonia, bleaching powder.

(i) Which is water sterilizer ?

(ii) Which compound forms curdy white precipitate with hydrogen chloride ?

(iii) Name the gas which produces dense white fumes with ammonia, write the balanced chemical equation.

Answer:

(i) Chlorine is water sterilizer.

(ii) Silver nitrate and hydrochloric acid forms

curdy white ppt. $AgNO_3 + HCl \longrightarrow AgCl$ (White ppt.)

$+ HNO_3$

(iii) Hydrogen chloride (HCl)

$NH_3 + HCl \longrightarrow NH_4Cl$ (Dense white fumes)

Question 7: (i) When moist chlorine reacts with hydrogen sulphide, two products are formed : (a) A gas which fumes in moist air; and

(b) A yellow solid.
Name these
products.

(ii) What type of reaction is taking place when chlorine acts as a bleaching agent ?

Answer: (i) (a) Hydrogen chloride gas (b) Sulphur

(ii) Oxidation reaction.

Question 8: From the gases-ammonia, hydrogen chloride, hydrogen sulphide, sulphur dioxide- Select the following:

(i) The gas which gives a white percipitate when reacted with silver nitrate solution acidified with dilute nitric acid.

(ii) A solution of hydrogen chloride in water is prepared. The following substances are added to separate portions of the solution.

Substances Added	Gas evolved	Odour
Calcium carbonate	—	—
Magnesium ribbon	—	—
Manganese (IV) oxide with heating	—	—
Sodium sulphide	—	—

Complete the table by writing the gas evolved in each case and its odour, (i) Hydrogen chloride

Answer: (i) hydrogen chloride

(ii)

Substances Added	Gas evolved	Odour
Calcium carbonate	Carbon dioxide	Odourless
Magnesium ribbon	Hydrogen	Odourless
Manganese (IV) oxide with heating	Chlorine	Pungent irritating
Sodium sulphide	Hydrogen sulphide	Rotten eggs

Question 9: What is aqua regia ? How does it help in dissolving Gold or Platinum.

Answer: A mixture of 1 part of cone, nitric acid and 3 parts of cone, hydro chloric acid by weight is called aqua regia.

The cone. HCl and conc. HNO_3 reacts to form hascent chlorine which reacts with Gold or Platinum to form their respective soluble chlorides.

$$HNO_3 + \underset{\text{(Conc.)}}{3HCl} \longrightarrow 2H_2O + NOCl + 2\,(Cl)$$

$$Au + 3[Cl] \longrightarrow \underset{\text{Gold (II) Chloride}}{AuCl_3}$$

$$Pt + 4\,[Cl] \longrightarrow \underset{\text{Platinium (IV) Chloride}}{PtCl_4}$$

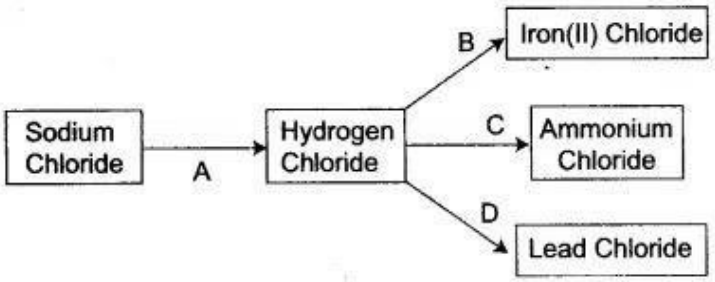
Question 10: State three uses of hydrochloric acid.

Answer: (i) It is used in the manufacture of silver chloride, which is used widely in photography. (ii) It is used in the manufacture of dyes, drugs and paints.

(iii) It is used for cleaning metal surface before painting, electroplating, galvanising, soldering etc.

Figure/Table Based Questions:

Question 1: Refer to the flow chart diagram below and give balanced equations with conditions, if any, for the following conversions A to D.



Answer:

A. $NaCl + H_2SO_4 \xrightarrow{\Delta < 200^\circ C} NaHSO_4 + HCl\uparrow$
conc. Hydrogen chloride

B. $2HCl + Fe \longrightarrow FeCl_2 + H_2$
Iron (II) chloride

C. $HCl_{(g)} + NH_{3(g)} \longrightarrow NH_4Cl$
Ammonium chloride

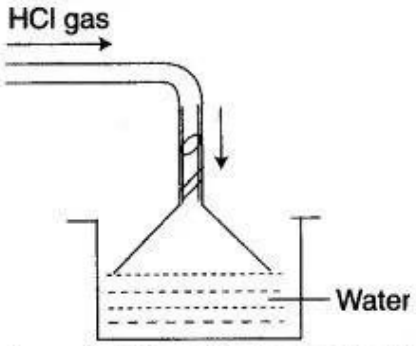
D. $2HCl + Pb(NO_3)_{2(aq)} \longrightarrow PbCl_2\downarrow + 2HNO_3$
(dil) Lead chloride

Question 2: In the laboratory preparation of hydrochloric acid, HCl gas is dissolved in water. (i) Draw a diagram to show the arrangement used for the absorption of HCl in water.

(ii) Why is such an arrangement necessary ? Give two reasons.

(iii) Write the chemical equations for the laboratory preparation of HCl gas when the reactants are : (A) below 200°C (B) above 200°C

Answer:

(i) 

Inverted funnel arrangement.

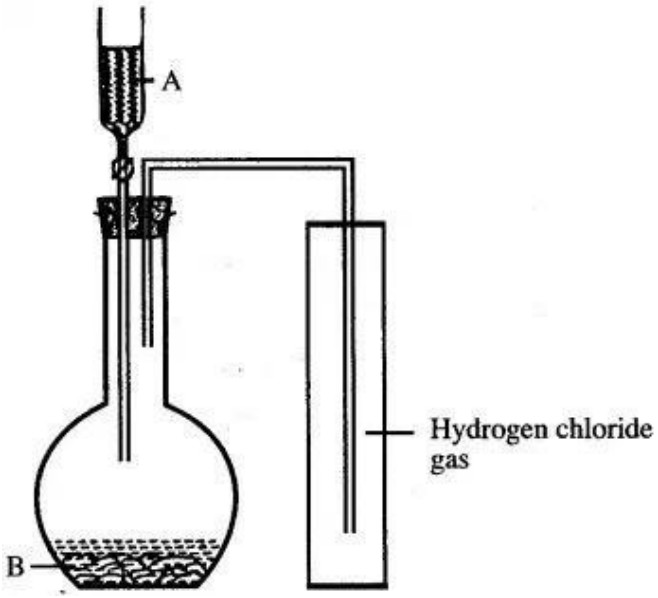
(ii) (A) To check back suction.

(B) To check its escape in the air.

(iii) (A) $NaCl + \underset{\text{conc.}}{H_2SO_4} \xrightarrow[\text{below } 200^\circ C]{\text{heated}} NaHSO_4 + HCl\uparrow$

(B) $2NaCl + \underset{\text{conc.}}{H_2SO_4} \xrightarrow[\text{above } 200^\circ C]{\text{heated}} Na_2SO_4 + 2HCl\uparrow$

Question 3: The diagram shows an apparatus for the laboratory preparation of hydrogen chloride.



(i) Identify A and B.

(ii) Write the equation for the reaction.

(iii) How would you check whether or not the gas jar is filled with hydrogen chloride ? (iv) What does the method of collection tell you about the density of hydrogen chloride ?

Answer:

(i) $A \rightarrow$ Conc H_2SO_4, $B \rightarrow NaCl$

(ii) $NaCl + H_2SO_4 \rightarrow \underset{\text{sodium hydrogen sulphate}}{NaHSO_4} + HCl$

(iii) If a moist blue litmus brought near the mouth of gas jar turns red, the gas jar is filled with HCI. (iv) Hydrogen chloride is denser than air.

Reasoning based questions :

Question 1: Mixture of sodium chloride and concentrated sulphuric acid does not heated above the temperature of 170°C while preparing hydrogen chloride. Why ?

Answer: The mixture of sodium chloride and concentrated sulphuric acid is not heated above 170°C in preparing hydrogen chloride gas because at a higher temperature sodium sulphate is formed which is a hard substance and difficult to remove from the reaction flask.

$2NaCl + H_2S0_4 \rightarrow Na_2S0_4 + 2HCl$

Question 2: Hydrogen chloride gas cannot be dried over quick time. Why ?

Answer: Because quick lime is basic in nature and combines with moist hydrogen chloride gas forming calcium chloride.

Question 6: Dilute hydrochloric acid cannot be concentrated by distilling (boiling) the dilute acid. Why ?

Answer: When dilute hydrochloric acid is distilled, a constant boiling mixture containing 20 – 24% of hydrochloric acid distills over unchanged at 760 mm Hg pressure. This constant boiling mixture cannot be separated into its constituents by simply distilling.

.

Chemical Tests:

Question1:

1. Manganese dioxide and copper (II) oxide.

2. Hydrogen chloride gas and carbon dioxide gas.

3. Give three tests for HCl gas.

Answer: When cone, hydrogen chloride is added to manganese dioxide, greenish yellow gas (Cl2)

is liberated.

$$MnO_2 + \underset{(Conc.)}{4HCl} \longrightarrow MnCl_2 + 2H_2O + \underset{\text{Greenish yellow gas}}{Cl_2 \uparrow}$$

When cone, hydrogen chloride is added to copper (II) oxide, no. gas is liberated but the solution turns bluish because of the formation of copper chloride.

$$CuO + \underset{(Conc.)}{HCl} \xrightarrow{\Delta} \underset{\text{Greenish blue solution}}{CuCl_2} + H_2O$$

2. When passed into silver nitrate solution, forms a curdy white precipitate of silver chloride.

$$HCl + AgNO_3 \longrightarrow \underset{\text{Curdy white ppt.}}{AgCl \downarrow} + HNO_3$$

When passed into lime water, forms a milky white precipitate of calcium carbonate.

$$CO_2 + Ca(OH)_2 \longrightarrow \underset{\text{Milky white ppt.}}{CaCO_3} + H_2O$$

3.(i) When a glass rod dipped in ammonia, solution is held near the vapours of the acid, it form a dense white fumes of ammonium chloride.

(ii) When hydrochloric acid is treated with silver nitrate solution, it forms curdy white precipitate which is soluble in excess of ammonium hydroxide solution.

(iii) When hydrochloric acid is boiled with manganese dioxide, greenish yellow chlorine gas is evolved.

Balancing/Writing the Chemical Equations:

Question 1: Write balanced equations for the reaction of dilute hydrochloric acid with each of the following :

1.	Iron	2.	Sodium hydrogen carbonate
3.	Iron (II) sulphide	4.	Sodium sulphite
5.	Sodium thiosulphate solution	6.	Calcium bicarbonate
7.	Calcium carbonate	8.	Sodium hydroxide
9.	Zinc metal	10.	Potassium permanganate
11.	Red lead heated	12.	Magnesium metal
13.	Ammonium hydroxide.	14.	Magnesium sulphite.
15.	Sodium hydrogen sulphide.	16.	Manganese dioxide.

Answer:

1. $Fe + \underset{(Dil.)}{2HCl} \longrightarrow FeCl_2 + H_2$

2. $NaHCO_3 + \underset{(Dil.)}{HCl} \longrightarrow NaCl + H_2O + CO_2$

3. $FeS + \underset{(Dil.)}{2HCl} \longrightarrow FeCl_2 + H_2S$

4. $Na_2SO_3 + \underset{(Dil.)}{2HCl} \longrightarrow 2NaCl + SO_2 + H_2O$

5. $Na_2S_2O_3 + \underset{(Dil.)}{2HCl} \longrightarrow 2NaCl + H_2O + SO_2 + S\downarrow$

6. $Ca(HCO_3)_2 + \underset{(Dil.)}{2HCl} \rightarrow \underset{\text{Calcium chloride}}{CaCl_2} + 2H_2O + 2CO_2\uparrow$

7. $CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2$

8. $NaOH + HCl \longrightarrow NaCl + H_2O$

9. $Zn + 2HCl \longrightarrow ZnCl_2 + H_2$

10. $2KMnO_4 + \underset{(Conc.)}{16\,HCl} \longrightarrow 2KCl + 2NaCl_2 + 8H_2O + 5Cl_2\,(g)$

11. $Pb_3O_4 + \underset{(Conc.)}{8HCl} \longrightarrow 3PbCl_2 + 4H_2O + Cl_2\,(g)$

12. $Mg + 2HCl\,(g) \longrightarrow MgCl_2 + H_2\,(g)$

13. $\underset{\text{Ammonium hydroxide}}{NH_4OH} + HCl \longrightarrow NH_4Cl + H_2O$

14. $\underset{\text{Magnesium sulphite}}{MgSO_3} + 2HCl \longrightarrow MgCl_2 + SO_2 + H_2O$

15. $\underset{\text{Sod. hydrogen sulphide}}{NaHS} + HCl \longrightarrow NaCl + H_2S\,(g)$

16. $MnO_2 + \underset{(Conc.)}{4HCl} \xrightarrow{\text{Boiling}} MnCl_2 + 2H_2O + \underset{\text{Chlorine gas}}{Cl_2\uparrow}$

Question 2: Write balanced equation for the reaction of hydrochloric acid with each of the following

:

1. Marble chips

2. Calcium sulphite

3. Lead nitrate solution.

4. Mangnese oxide.

Answer:

1. $CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2\uparrow$
2. $CaSO_3 + 2HCl \longrightarrow CaCl_2\downarrow + H_2O + SO_2\uparrow$
3. $Pb(NO_3)_2 + 2HCl \longrightarrow PbCl_2\downarrow + 2HNO_3$
4. $MnO_2 + 4HCl \longrightarrow MnCl_2 + 2H_2O + Cl_2$

CHAPTER-9

STUDY OF COMPOUNDS: AMMONIA

Short Questions

Question1:The questions below are related to the manufacture of ammonia.

(i) Name the process.

(ii) In what ratio must the reactants be taken ?

(iii) Name the catalyst used.

(iv) Give the equation for the manufacture of ammonia.

(v) Ammonia can act as a reducing agent — write a relevant equation for such a reaction.

Answer:(i) Haber's process.

(ii) Nitrogen one part, hydrogen three parts.

(iii) Iron powder.

(iv) $N_2 + 3H_2 \longrightarrow 2NH_3$

(v) $2NH_3 + 3CuO \longrightarrow 3Cu + 3H_2O + N_2$

copper oxide — copper

Question2:The following questions are based on the preparation of ammonia gas in the laboratory:

(i) Explain why ammonium nitrate is not used in the preparation of ammonia.

(ii) Name the compound normally used as a drying agent during the process.

(iii) How is ammonia gas collected ?

(iv) Explain why it is not collected over water.

(v) Give the name of a hydride of nitrogen.

(vi) Which reactants are used in laboratory preparation of ammonia ?

(vii) What is the vapour density and nature of ammonia ?

(viii) Which feature of the Ammonia molecules leads to the formation of the Ammonium ion when Ammonia dissolves in water. Name the other ion formed when Ammonia dissolves in water.

Answer:(i) Because ammonium nitrate is explosive in nature and dissociate into nitrous oxide and water on heating.

(ii) Quick lime.

(iii) By downward displacement of air.

(iv) It is highly soluble in water.

(v) Ammonia.

(vi) Ammonium chloride and slaked lime [$Ca(OH)_2$].

(vii) Vapour density of ammonia is 8.5, and it is alkaline in nature.

(viii) In ammonia molecule there is one lone pair of electrons available on nitrogen atom. This lone pair of electron leads to the formation of ammonium ion. Hydroxide ion (OH^-).

Question3:What are the necessary conditions for getting maximum yield of ammonia ?

Answer:The necessary conditions for getting maximum yield of ammonia are as follows :

(i) Low Temperature : As the reaction is exothermic in nature, so the temperature should be low. When temperature is lowered, the rate of the reaction slows down and the yield is maximum. It is found for maximum yield, temperature should be between 450° to 500°C (optimum temperature).

(ii) Catalyst: A catalyst is used to accelerate the reaction at optimum temperature. Following are the catalysts used:

(a) Finely divided iron, mixed with molybdenum as promoter.

(b) A better catalyst is ferric oxide (Fe2O3)containing 1% of potassium oxide (K2O)and 3% of aluminium oxide (Al2O3)which acts as promoters.

(iii) High Pressure : When 4 volumes of a mixture of nitrogen and hydrogen are reduced to 2 volumes of ammonia, the pressure drops. In order to have maximum yield the pressure should be very high. The optimum pressure should be between 200 atmospheres to 900 atmospheres.

Pressure (in atm.)	Temperature (in °C)	Yield (in %)
200	400°C	36.3%
1000 atms.	400°C	79.8%

(iv) Purity of Gases : Any kind of impurity tends to slow down the reaction or poisons catalyst. So, the gases that are to be used should be pure and dry.

Question4:(i) What are the products formed when ammonia is oxidised with copper oxide ?

(ii) What is the difference between chemical nature of an aqueous solution of hydrogen chloride and an aqueous solution of ammonia. .

Answer:(i) Nitrogen, copper and water.

(ii) Aqueous solution of HCl is acidic while aqueous solution of ammonia is basic.

Question5:Name one element in each case, to which the following description would apply.

(i)The burning metal which combines directly with nitrogen.

(ii)Give two reasons to show that the solution of ammonia in water contains hydroxide ions.

Answer: (i)Magnesium, calcium and aluminium.

(ii)(a)It turns red litmus solution to blue.

(b) It reacts with adds to form salt and water.

Question6:(i) Of the two gases, ammonia and hydrogen chloride, which is more dense ? Name the method of collection of this gas.

(ii) Give one example of a reaction between the above two gases which produces a solid compound.

Answer:(i) HCl collected by upward displacement of air.

(ii) $NH_3 + HCl \rightarrow NH_4Cl$

Question7:The action of heat on the blue crystalline solid L gives a reddish brown gas M, a gas which relights a glowing splint and leaves a black residue. When as N, which has a rotten egg smell, is passed through a solution of L a black precipitate is formed.

(i) Identify L, M and N (Name or formula).

(ii) Write the equation for the action of heat on L.

(iii) Write the equation for the reaction between the solution of L and the gas N.

Answer:(i) L is copper

nitrate. M is nitrogen dioxide

gas.

N is hydrogen sulphide gas.

(ii) $2\,Cu\,(NO_3)_2 \longrightarrow 2CuO + 4NO_2 + O_2$

(iii) $Cu\,(NO_3)_2 + H_2S \longrightarrow CuS + 2HNO_3$.

Question8:Gas B turns moist red litmus paper

blue.

(i) What is the name of gas B ?

(ii) Write the equation for the reaction that takes place when gas B is passed over- heated copper oxide.

Answer:(i) Gas B is ammonia.

(ii) $3CuO + 2NH_3 \rightarrow 3Cu + 3H_2O + N_2\uparrow$

Question9:(i) Sodium hydroxide solution is added to solution A, a white precipitate is formed which is soluble in excess of sodium hydroxide. What metal ion is present in A ?

(ii) Ammonium hydroxide solution is added to solution B, when a pale blue precipitate is formed. This pale blue precipitate dissolves in excess of ammonium hydroxide to give inky blue colouration. Name the cation present in B. Name the probable colour of solution B.

(iii) When an ammonium salt is warmed with sodium hydroxide solution, ammonia gas is evolved. State three ways in which you can identify the gas.

Answer:(i) Ammonium ion is present in A.

(ii) The cation present in B is copper. Solution B is blue in colour.

(iii) The three ways in which the gas can be identified are as

follows : (a) It gives dense white fumes when a rod dipped in

HCl is held in it.

(b) It turns moist red litmus paper

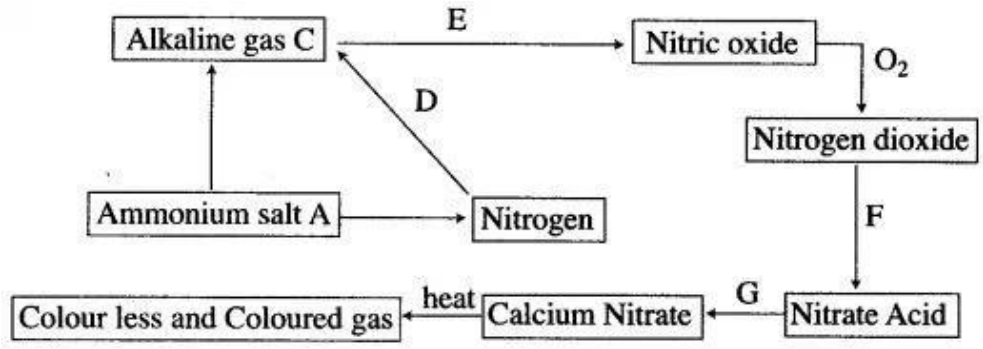
blue. (c) It turns phenolphthalein

solution pink.

Figure/Table Based

Questions

Question1:



(i) Name (a) the ammonium salt A (b) alkaline gas C.

(ii) How the conversion D is carried out ? State all the conditions like temperature, pressure and catalyst.

(iii) (a) How is C converted to nitric oxide ? Write the equation.

(b) What is the name of the process ?

(c) How is temperature maintained in above process ?

(d) Write the equation for conversion of F and G.

(iv) Name the coloured gas and the colourless gas.

Answer:(i) (a) Ammonium nitrate, NH_4NO_3.

(b) Ammonia.

(ii) D is mixed with hydrogen in the ratio of 1 : 3, compressed to a pressure of 200 to 500 atmosphere and passes over a catalyst (iron) heated to 450 to 500°C.

(iii) (a) By passing the gas with excess of air over platinum gauze heated to 800°C.

$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$

(b) Ostwald process.

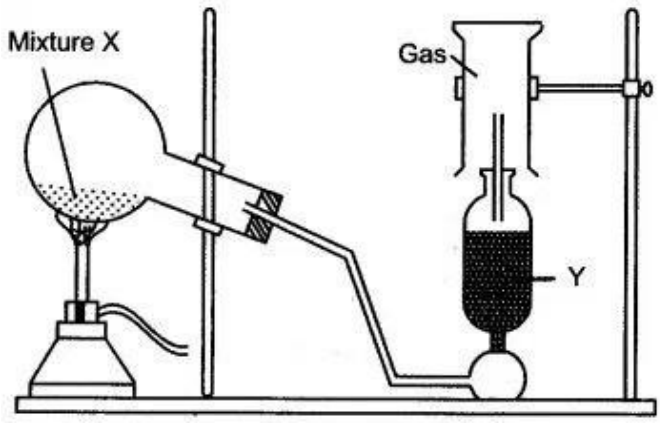
(c) The oxidation of ammonia to nitric oxide is exothermic reaction and once the reaction is started it maintains the temperature of the platinum gauze.

(d) $2N_2O + 2H_2O + O_2 \longrightarrow 4HNO_3$

$Ca(OH)_2 + 2HNO_3 \longrightarrow Ca(NO_3)_2 + 2H_2O$

(iv) Nitrogen dioxide and oxygen.

Question2:The diagram shows an experimental set up for the laboratory preparation of a pungent smelling gas. The gas is alkaline in nature.



(i) Name the gas collected in the jar.

(ii) Write the balanced equation for the above preparation.

(iii) How is the gas being collected ?

(iv) Name the drying agent used.

(v) How will you find that the jar is full of gas ?

Answer:(i) Ammonia.

(ii) $Ca(OH)_2 + 2NH_4Cl \xrightarrow{\Delta} CaCl_2 + 2H_2O + 2NH_3\uparrow$

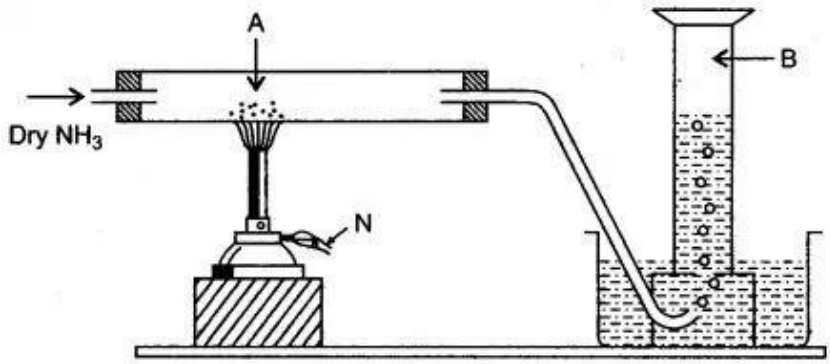
Calcium oxide — ammonium chloride — Calcium chloride

(iii) By downward displacement of

air. (iv) Quick lime (CaO).

(v) By bringing a wet red litmus paper near the brim (mouth) of the gas jar. When jar is full of gas litmus will turn blue.

Question3:Dry ammonia gas is passed over black substance as shown in figure below :



(i)Name the black substance A.

(ii) Name the gas evolved B.

(iii) Write a balanced equation for the reaction of ammonia with A.

(iv) What do you observe when ammonia is passed over copper oxide ?

(v) State the property illustrated in the above reaction (iii).

Answer:(i) Copper II oxide.

(ii) Nitrogen gas.

(iii) $$3CuO + 2NH_3 \xrightarrow{\Delta} 3Cu + 3H_2O + N_2$$

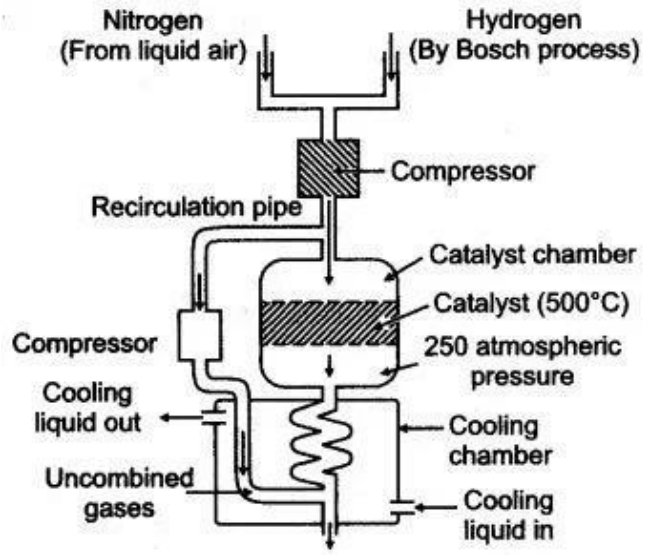
(iv) The black mass changes t0 reddish powdery

mass.

(v) Ammonia is a reducing agent.

Question4:(i) Draw a neat sketch for the manufacture of ammonia by Haber's process. (ii) Discuss the principles involved in Haber's process.

Answer:(i)



(ii) The principles involved in Haber's Process are :

In this process, a mixture of pure, dry nitrogen and hydrogen in the ratio of 1 : 3 is compressed to a pressure of 200 to 900 atmospheres. The compressed gases are passed over heated catalyst (finally divided molybdenum, i.e. Fe/Mo) at 450° to 500°C.

$$\underset{\text{1 vol.}}{N_2} + \underset{\text{3 vols.}}{3H_2} \rightleftharpoons \underset{\text{2 vols.}}{2NH_3};\ \Delta H = -92{\cdot}38\ \text{kJ}$$

The above reaction is exothermic and reversible. It is accompanied by decrease in volume. Ammonia formed is immediately removed from the catalytic chamber and allowed to condense to form liquid ammonia.

Question8:Copy and complete the following table relating to important industrial process:

Name of the process	Temperature	Catalyst	Equation for the catalyzed reaction
Haber's process			

Answer:

Name of process	Temperature	Catalyst	Equation for the catalysed reaction
Haber's	450° – 500 °C	Finely divided iron	$N_2 + 3H_2 \rightarrow 2NH_3 + \text{heat}$

Reasoning based Questions

Question1:Ammonia cannot be obtained in laboratory from ammonium nitrate and sodium hydroxide. Why?

Answer:This is because ammonium nitrate on heating decomposes explosively with the formation of nitrous oxide and water.

Question2:Why ammonia gas is not collected over water ?

Answer:Ammonia gas Is not collected over water because it is highly soluble in water.

Question3:Ammonia cannot be dried by bubbling through concentrated sulphuric acid. Why ?

Answer:Ammonia gas cannot be dried by bubbling through concentrated sulphuric acids as it
reacts with sulphuric acid to form ammonium sulphate.

$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$

Question4:Quick lime is the only drying agent used for drying ammonia gas. Why ?

Answer:Quick lime is basic in nature and hence does not react with ammonia, which is also basic in nature, whereas all other drying agents are acidic in nature and hence react with ammonia.

$$\underset{\text{(conc.)}}{2NH_3} + H_2SO_4 \longrightarrow (NH_4)_2SO_4$$

$$\underset{\text{(anhydrous)}}{CaCl_2} + 8NH_3 \longrightarrow CaCl_2.8NH_3$$

$$6NH_3 + \underset{\text{Phosphorous pentaoxide}}{P_2O_5} + 3H_2O \longrightarrow 2(NH_4)_3.PO_4$$

Question5: Aqueous solution of ammonia gives a pungent smell. Why ?

Answer: Aqueous solution of ammonia gives a pungent smell because it is produced due to bacterial decomposition of urea (NH_2CONH_2),present in urine.

Question6: Ammonia solution is used as laboratory reagent to identify metal ions. Why ?

Answer:Ammonium hydroxide can precipitate insoluble hydroxide of metals from their salt solutions.

Thus, it is used in analytical analysis of salts in laboratory.

Question7:Aqueous solution of ammonia turns red litmus blue. Give reason.

Answer:This is because ammonia on dissolving in water furnishes ammonium (NH^+)ions and hydroxyl (OH^-)ions. The presence of OH^-ions in the solution turns red litmus blue.

$NH_3 + H_2O \rightleftharpoons NH^+_4 + OH^-$

Question8:Ammonia solution is used to remove oil and grease stains from clothes. Give reason.

Answer:When ammonium chloride is heated and rubbed with the metal, the ammonia formed removes grease, oil, etc. It emulsifies fats, grease, etc.

$$\underset{\text{Ammonium chloride}}{NH_4Cl\ (s)} \longrightarrow \underset{\text{Ammonia}}{NH_3\ (g)} + \underset{\text{Hydrogen chloride}}{HCl\ (g)}$$

The hydrogen chloride formed removes the oxides of metals and thus cleans the metal surfaces before soldering, tinning, etc.

Question9:Liquid ammonia is used as refrigerant in ice plants. Give reason.

Answer:Liquid ammonia is a refrigerant as it has high latent heat of vaporisation equal to 5700 cals/mole and a low boiling point. When liquid ammonia evaporates, it takes large amount of heat from surroundings, resulting in the fall in temperature.

$$NH_3 \xrightarrow{\text{Vapourises}} NH_3\ (gas) - 5700\ cals.$$

Question10:In Haber's process before the gases are allowed to enter the oxidation chamber, the gases are sufficiently cooled. Why ?

Answer:The gases are cooled so that the complete oxidation of nitric oxide takes place or the rate of forward reaction increases or to minimize the decomposition of nitrogen dioxide.

Question11:The mixture of nitrogen and hydrogen gases entering the catalyst chamber must be pure. Why?

Answer:The mixture of nitrogen and hydrogen gases entering the catalyst chamber must be pure, because the presence of carbon dioxide, carbon monoxide and traces of sulphur compound poison the catalyst. Therefore, the removal of these catalyst poison from nitrogen and hydrogen is very essential.

Chemical Tests

Questions:

1. Dilute hydrochloric acid and dilute nitric acid.

2. Ammonium ion and hydroxide ion.

3. Nitric oxide gas and nitrous oxide gas.

4. Dilute hydrochloric acid and dilute sulphuric acid.

5. Oxygen gas and nitrous oxide gas.

Answer:

1. Silver nitrate solution when added to dil. hydrochloric acid will give a white ppt. and when added to dil. nitric acid no change will be observed.

2. When iron (II) sulphate solution is added to ammonium ion, dirty green precipitate is obtained. No change will be observed with hydroxide ion.

3.If reddish brown fumes are produced in the atmosphere of oxygen then the given sample of gas is nitric oxide and if no brown fumes are produced and the mixture remains colourless, then the gas is nitrous oxide.

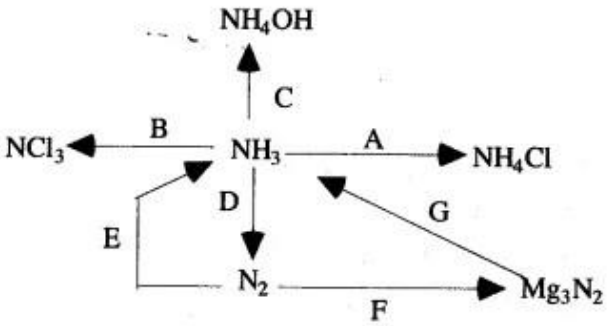
4. Dilute sulphuric acid will give a white precipitate of barium sulphate with barium chloride solution whereas no visible reaction occurs with dilute hydrochloric acid.

5. Carbon (red hot) burns in oxygen to form carbon dioxide gas only, but in nitrous oxide it forms carbon dioxide gas and nitrogen.

Balancing/Writing the Chemical Equations

Question1:How are the following conversions carried out ? Give equations only.

1. $NH_3 \xrightarrow{A} NO \xrightarrow{B} NO_2 \xrightarrow{C} HNO_3 \xrightarrow{D} Cu(NO_3)_2$

2. 

3. $Na_2CO_3 \xrightarrow{A} NaNO_3 \xrightarrow{B} O_2$

4. $NH_4Cl \underset{B}{\overset{A}{\rightleftharpoons}} NH_3 \xrightarrow{C} NH_4OH \xrightarrow{D} Cu(OH)_2 \xrightarrow{E} CuO \underset{F}{\overset{G}{\rightleftharpoons}} Cu(NO_3)_2$

Answer:

1. A. $4NH_3 + 5O_2 \xrightarrow[800°C]{Pt} 4NO + 6H_2O$

   B. $2NO + O_2 \longrightarrow 2NO_2$

   C. $4NO_2 + 2H_2O + O_2 \longrightarrow 4HNO_3$

   D. $CuO + 2HNO_3 \xrightarrow[dil.]{} Cu(NO_3)_2 + H_2O$

2. A. $8NH_3 + 3Cl_2 \xrightarrow[excess]{} 6NH_4Cl$

   Or

   $NH_3 + HCl \longrightarrow NH_4Cl$

   B. $NH_3 + 3Cl_2 \xrightarrow[excess]{} NCl_3 + 3HCl$

C. $NH_3 + H_2O \longrightarrow NH_4OH$

D. $4NH_3 + 3O_2 \longrightarrow 2N_2 + 6H_2O$

E. $N_2 + 3H_2 \underset{400\text{–}500^\circ C,\ 200\text{–}1000\ Atm.}{\overset{Fe/MO}{\rightleftharpoons}} 2NH_3 + \Delta$

F. $3Mg + N_2 \xrightarrow[\text{Burning}]{} Mg_3N_2$

G. $Mg_3N_2 + 6H_2O \xrightarrow{Warm} 3Mg(OH)_2 + 2NH_3$

3. A. $Na_2CO_3 + 2HNO_3 \longrightarrow 2NaNO_3 + CO_2 + H_2O$

B. $2NaNO_3 \xrightarrow{\Delta} 2NaNO_2 + O_2$

4. A. $NH_4Cl + NaOH \xrightarrow{\Delta} NaCl + H_2O + NH_3$

Or

$2NH_4Cl + Ca(OH)_2 \xrightarrow{\Delta} CaCl_2 + 2H_2O + 2NH_3$

B. $8NH_3 + 3Cl_2 \longrightarrow 6NH_4Cl + N_2$

Or

$NH_3 + HCl \longrightarrow NH_4Cl$

C. $NH_3 + H_2O \longrightarrow NH_4OH$

D. $CuSO_4 + 2NH_4OH \longrightarrow Cu(OH)_2 + (NH_4)_2SO_4$

E. $Cu(OH)_2 \xrightarrow{\Delta} CuO + H_2O$

F. $CuO + 2HNO_3 \xrightarrow[\text{dil.}]{} Cu(NO_3)_2 + H_2O$

G. $2Cu(NO_3)_2 \xrightarrow{\Delta} 2CuO + 4NO_2 + O_2$

CHAPTER-10

STUDY OF COMPOUNDS: NITRIC ACID

SHORT ANSWER QUESTIONS

Question1: (a) What compounds are required for the laboratory preparation of nitric acid ?

(b) The first step in the manufacture of nitric acid is the catalytic oxidation of ammonia. What is the name of the catalyst ?

Answer: (a) Nitre (Potassium Nitrate) and cone, sulphuric

acid. (b) Platinum.

Question2:(i) Among the elements chlorine, nitrogen and sulphur select: (a) The least reactive. (b) Obtained from the atmosphere.

(ii) Why commercial nitric acid is brown ?

(iii) How can you get 'liquid air' ?

Answer:(i) (a) Nitrogen. (b) Nitrogen.

(ii) Commercial nitric acid is brown in colour because it contains dissolved nitrogen dioxide.

(iii) $CO_2$and moisture-free air is passed through a condenser. Finally, this air is compressed, cooled and suddenly allowed to expand. By repeating this process, the air can be liquified.

Question3:Give two reactions to show that nitric acid is : (i) An acid.

(ii) An oxidizing agent.

Answer:(i) (a) Dilute nitric acid reacts with magnesium metal to liberate hydrogen gas and magnesium nitrate is formed.

$Mg + 2NHO_3 \rightarrow Mg(NO_3)_2 + H_2\uparrow$

(b) Dilute nitric acid reacts with marble pieces to liberate carbon dioxide gas and calcium nitrate is formed.

$CaCO_3 + 2HNO_3 \rightarrow Ca(NO_3)_2 + H_2O + CO_2\uparrow$

(ii) (a) When carbon is heated with concentrated nitric acid, it is oxidized to carbonic add and the acid is reduced to nitrogen dioxide and water.

$C + 4HNO_3 \rightarrow H_2CO_3 + 4NO_2 + H_2O$

(b) When sulphur is heated with concentrated nitric acid, it is oxidized to sulphuric acid and the nitric acid is reduced to nitrogen dioxide and water. Carbonic add further decomposes to carbon dioxide.

$S + 6HNO_3(Conc) \rightarrow H_2SO_4 + 6NO_2 + 2H_2O$

Question4:The reaction of nitric acid with metals depends upon the concentration of the acid. Give examples, along with equations to illustrate the reaction of the add.

Answer:Copper reads differently with nitric add at different concentrations and temperature.

(i) Copper reacts with cold and dilute nitric add to form copper nitrate, water and nitric oxide gas is liberated.

$$3Cu + 8HNO_3 \longrightarrow Cu(NO_3)_2 + 4H_2O + \underset{\text{Nitric Oxide}}{2NO}$$

(ii) Copper reacts with hot and concentrated nitric acid to form copper nitrate, water and nitrogen dioxide.gas, which has reddish brown fumes and a pungent smell is liberated.

$$Cu + 4HNO_3 \longrightarrow \underset{\text{Copper nitrate}}{Cu(NO_3)_2} + 2H_2O + \underset{\text{Nitrogen dioxide}}{2NO_2}$$

Question5:The action of heat on the blue crystalline solid L gives a reddish brown gas M, a gas which relights a glowing splint and leaves a black residue. When as N, which has a rotten egg smell, is passed through a solution of L a black precipitate is formed.

(i) Identify L, M and N (Name or formula).

(ii) Write the equation for the action of heat on L.

(iii) Write the equation for the reaction between the solution of L and the gas N.

Answer:(i) L is copper nitrate. M is nitrogen dioxide gas. N is hydrogen sulphide gas.

Question6:(i) Does ammonia bum in oxygen ? If yes, give equation.

(ii) What is catalytic oxidation of ammonia ?

(iii) What is the special feature of the apparatus that is used in the laboratory preparation of nitric acid ?

(iv) Why should the temperature of the reaction mixture of nitric acid not be allowed to rise above 200°C?

Answer:(i) Yes. Ammonia bums in oxygen with a greenish yellow flame producing water vapour and nitrogen.

$4NH_3 + 3O_2 \rightarrow 2N_2 + 6H_2O$

(ii) Ammonia, when reacts with oxygen in presence of platinum (as catalyst) at 800°C, ammonia is oxidised to nitric oxide (NO). This is called catalytic oxidation of ammonia.

(iii) It is an all glass retort.

(iv)Because above 200°C nitric acid will decompose.

Question7:Oxidation of ammonia under certain conditions is represented by the following equation.

$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$

(i) Give the conditions required for this reaction.

(ii) Briefly describe the importance of this reaction in industry.

Answer:(i) Pure and dry ammonia gas mixed with air in the ratio of 1 : 8 by volume is first compressed and then passed over heated platinum gauze at 800°C.

(ii) Nitric oxide is obtained by the oxidation of ammonia, which is further oxidised to form nitrogen dioxide. Nitrogen dioxide is dissolved in water, in the presence of oxygen, to form nitric acid. Thus, nitric acid can be prepared by the catalytic oxidation of ammonia.

$$4NH_3 + 5O_2 \xrightarrow[800°C]{\text{Platinum}} \underset{\text{Nitric Oxide}}{4NO} + 6H_2O$$

$$2NO + O_2 \longrightarrow \underset{\text{Nitrogen dioxide}}{2NO_2}$$

$$4NO_2 + 2H_2O + O_2 \longrightarrow \underset{\text{Nitric Acid}}{4HNO_3}$$

Question8:(i) What would you see during burning of ammonia in oxygen.

(ii) Name the catalyst used in the catalytic oxidation of ammonia.

(iii) In the reaction of the catalytic oxidation of ammonia the catalyst glows red hot, Why ?

(iv) What is the name of the industrial process, which starts with the reaction of catalytic oxidation of ammonia.

(v) How is the temperature maintained in the Ostwald's process ?

Answer:(i) The bunting of ammonia in oxygen produces a bluish green flame. The reaction is irreversible and highly exothermic.

(ii) Platinum.

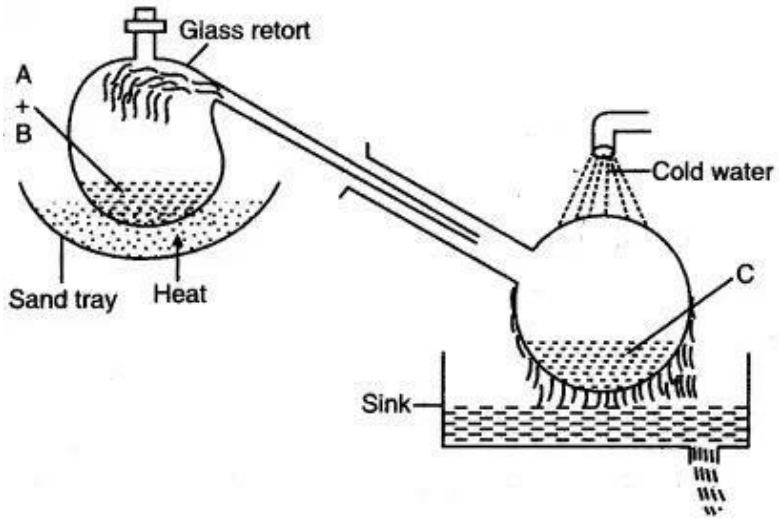
(iii) The catalyst glows red hot without external heating because much heat is liberated during the reaction.

(iv) Ostwald's process.

(v) In the Ostwald's process, the catalytic oxidation of ammonia to nitric oxide is an exothermic reaction. Once the reaction starts, the heat released maintains the temperature of the catalyst.

FIGURE /TABLE BASEDQUESTIONS

Question1:The figure given below illustrates the apparatus used in the laboratory preparation of nitric acid.



(i) Name A (a liquid), B (a solid) and C (a liquid). (Do not give the formulae) (ii) Write an equation to show how nitric acid undergoes decomposition.

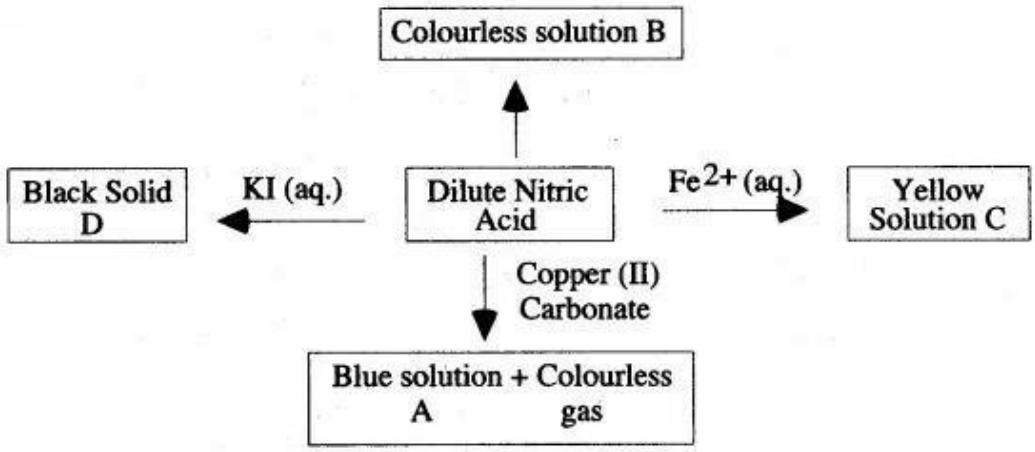
(iii) Write the equation for the reaction in which copper is oxidized by concentrated nitric acid.

Answer:(i) A-Conc. Sulphuric acid, B-Potassium nitrate or Sodium nitrate, C-Nitric acid

(ii) $4HNO_3 \longrightarrow 2H_2O + 2NO_2 + O_2$

(iii) $Cu + 4HNO_3 \longrightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2$

Question2:Study the scheme for dilute nitric acid.



(i) Give the name or formula of

(a) Solution A

(b) Solution B

(c) A cation in solution C

(d) Solid D

(ii) What property of nitric acid is shown by its reaction with iron (II) ions and aqueous potassium iodide solution ?

(iii) Describe one other reaction of dilute nitric acid not shown in the reaction scheme, that is typical of a strong acid.

Answer:(i) (a) Copper (II) nitrate $Cu(NO_3)_2$

(b) Ammonium nitrate

(c) Fe^{3+}

(d) Iodine

(ii) Oxidising property of nitric acid.

(iii) It is a characteristic of strong acids that when dilute, they react with the more electropositive metals, liberating hydrogen gas.

$Zn + 2H^+ \longrightarrow Zn^{2+} + H_2$

This reaction can not occur with nitric acid as it is a powerful oxidising agent. Any hydrogen initially produced is at once oxidised by more of the acid to water. If however

very dilute nitric acid is used (about 1%) with magnesium or manganese, some hydrogen will be produced, escaping oxidation because of the very dilute condition of the acid.

$Mg + 2HNO_3$(very dil.) $\longrightarrow Mg(NO_3)_2 + H_2$

Question3:Copy and complete the following table relating to the important industrial process. Output refers to the product of the process and not the intermediate steps.

Name of	Inputs	Catalyst	Equation for catalyst	Output
	Ammonia + air			Nitric add

Answer:

Name of process	Inputs	Catalyst	Equation for catalyst reaction	Output
Ostwald's process	Ammonia + air	Platinum	$4NH_3 + 5O_2 \xrightarrow[800°C]{Pt.} 4NO + 6H_2O + heat$	Nitric acid

REASONING BASED QUESTIONS

Question1:During the manufacture of nitric acid by Ostwald's process excess of oxygen is taken. Give reason.

Answer:Excess of oxygen is taken because each and every step requires oxygen.

Question2:In the laboratory preparation of nitric acid, it can be obtained below 200°C or above

200°C, but the lower temperature is preferred. Why ?

Answer:The lower temperature is favoured due to the following

reasons : (i) The glass apparatus may break at higher temperature.

(ii) A significant amount of nitric acid gets decomposed at higher temperature.

(iii) At higher temperature, potassium or sodium sulphate are formed, which cannot be easily removed from the apparatus.

Question3:Cone. HCl is not used in place of cone. $H_2SO_4$to prepare nitric acid from KNO_3.Why?

Answer:Cone. HCl is not used in place of cone. $H_2SO_4$for the preparation of cone. $HNO_3$from KNO_3because cone. HCl is volatile and, hence, nitric acid vapours will carry HClvapours. The property of cone. H_2SO_4used in the preparation of cone. $HNO_3$is its lower volatility.

Question4:Only all-glass apparatus should be used for the preparation of nitric acid. Why ?

Answer:Nitric acid is highly corrosive and hence destroys rubber and cork of the apparatus.

Question5:Pure nitric acid take on a yellowish-brown colour when exposed to light. Why ?

Answer:When pure $HNO_3$is exposed to light it decomposes to give a reddish brown NO_2gas which dissolves in undecomposed nitric acid to give yellowish brown colour.

Question6:Concentrated nitric acid fumes when kept open. Why ?

Answer:Concentrated nitric acid fumes when kept open because it contains considerable amount of nitrogen dioxide which escapes when exposed.

Question7:Nitric acid stains the skin yellow. Give reason.

Answer:Dilute nitric acid reacts with the proteins of the skin and forms a yellow compound called xanthoproteic acid. Hence, the skin becomes yellow. Cone, nitric acid causes blisters on the skin and is highly corrosive.

Question8:Iron is rendered passive with fuming nitric acid. Why ?

Answer:This is because of the formation of reddish brown layer of iron oxide which prevents its further reaction with the acid.

Question9: Aluminium does not react with nitric acid of any concentration. Why ?

Answer:Aluminum metal is not attacked by nitric acid of any concentration because of the thin and unreactive protective layer of aluminum oxide formed on the metallic surface due to the reaction of aluminium metal with oxygen of air.

Question10:Nitrogen obtained from air is more dense as compared to nitrogen obtained from chemicals. Why ?

Answer:Nitrogen obtained from air contains traces of inert gases and therefore, it is more dense as compared to chemical nitrogen.

Question11:Colourless nitric oxide forms brown fumes in air. Give reason.

Answer: Nitric oxide is oxidized by the oxygen of air to form brown coloured nitrogen dioxide :

OBSERVATIONS QUESTION

Question:

1-Sodium nitrate and conc. Sulphuric acid is heated above 200C.

2- Dilute nitric acid is added to a piece of iron.

3- 98% of nitric acid is exposed to air.

4- Hot concentrated nitric acid is poured on sawdust.

5- To acidified ferrous sulphate solution dilute nitric acid is added carefully.

6- A few drops of conc. nitric acid dropped on the skin.

7- Copper turnings, sodium nitrate, and concentrated sulphuric acid are heated together.

Answer:

1- A white hard crust of sodium sulphate sticks to the glass.

2- A light green coloured iron(II) nitrate solution is formed.

3- White fumes re seen.

4- Saw dust bursts into flames.

5- A brown ring appears at the junction of the two liquids.

6- The skin stains yellow due to xanthroprotic acid.

7- A blue coloured solution of copper nitrate is formed and reddish brown fumes of nitrogen dioxide is evolved.

NAME /IDENTIFY THE FOLLOWING

Question:

1- The chemical name of brown ring.

2- The nitrate which on thermal decomposition leaves no residue.

3- The nitrate which on thermal decomposition gives only oxygen.

4- The nitrate which on thermal decomposition gives a reddish brown gas.

5- The nitrate which on thermal decomposition leaves a black metal oxide as residue.

6- The nitrate which on thermal decomposition leaves a buff yellow metal oxide as residue.
7- The nitrate which on thermal decomposition leaves a metal as residue.

8- The nitrate which on thermal decomposition leaves a residue which is yellow when hot and white when cold.

9- The colour of the nitric acid prepared in the laboratory.

10-The metal which displaced hydrogen gas from very dilute nitric acid.

Answer:

1- Nitroso ferrous sulphate.

2- Ammonium nitrate.

3- Sodium nitrate/potassium nitrate.

4- Calcium nitrate.

5- Copper nitrate.

6- Lead nitrate.

7- Silver nitrate.

8- Zinc nitrate.

9- Yellowish brown.

10-Manganese/ Magnesium.

Chapter 11.

Sulphuric Acid

Short Questions:

Question 1:

Sulphuric acid is said to be dibasic acid. What is meant by the term "dibasic" ?

Answer:

Basicity of an acid is the number of H^+ ions that one formula unit of an acid liberates, e.g.,

Monobasic = HCl, HNO_3, etc.
Dibasic = H_2SO_4, H_2SO_3 etc.

Each acid can form as many kinds of salts, as it has hydrogen ions. Sulphuric acid can form two kinds of salts, i.e., SO_4^{2-} and HSO_4^-. It ionizes in water to form two hydrogen ions. Hence, it is said to be dibasic

$$H_2SO_4 \rightleftharpoons H^+ + HSO_4^-$$
$$HSO_4^- \rightleftharpoons H^+ + SO_4^{2-}$$

These acids can yield two kinds of salts, i.e., the normal salt and the acid salt.

Question 2:

(i) Write balanced equations for the three chemical reactions that take place during the conversion of sulphur dioxide to sulphuric acid in the contact process.

(ii) Name the catalyst used in the contact process.

(iii) Name another ore which on roasting gives sulphur dioxide.

Answer:

(i) The chemical reactions are summarised as below:

$$S + O_2 \longrightarrow SO_2$$

$$2SO_2 + O_2 \longrightarrow 2SO_3$$

$$SO_3 + H_2SO_4 \longrightarrow \underset{\text{(Oleum)}}{H_2S_2O_7}$$

$$H_2S_2O_7 + H_2O \longrightarrow 2H_2SO_4$$

(ii) Platinized asbestos or V_2O_5

(iii) Zinc blende or ZnS

$2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2 \uparrow$

Question 3:

(i) With the help of equations, give an outline for the manufacture of sulphuric acid by the contact process.

(ii) What property of sulphuric acid is shown by the reaction of concentrated sulphuric acid when heated with (a) potassium nitrate (b) carbon ?

Answer: (i)

Contact Tower :

$$\underset{\text{Sulphur dioxide}}{2SO_2} + O_2 \xrightarrow[450°C]{V_2O_5} \underset{\text{Sulphur trioxide}}{2SO_3}$$

Absorption Tower :

$$SO_3 + \underset{\text{conc.}}{H_2SO_4} \longrightarrow \underset{\text{oleum}}{H_2S_2O_7}$$

Dilution Tower :

$$H_2S_2O_7 + H_2O \longrightarrow \underset{\text{Sulphuric acid}}{2H_2SO_4}$$

(ii) (a) Non-volatile nature. (b) Oxidising property.

Question 4:

(i) Which two gases are combined during contact process ?

(ii) Write the equation for the reaction between zinc and the final product of the contact process ?

(iii) What happens when sulphur trioxide gas is passed into concentrated sulphuric acid.

Answer:

(i) SO_2 and O_2 (sulphur dioxide and oxygen) (ii) Zn +

$2H_2SO_4$ (Conc.) $\rightarrow$ $ZnSO_4 + 2H_2O + SO_2$

(iii) Sulphur trioxide gas dissolves in concentrated sulphuric acid to form fuming sulphuric acid, commonly known as oleum.

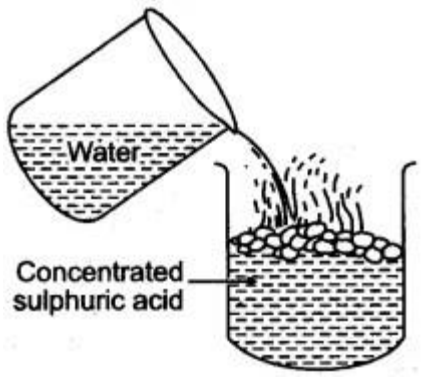
$SO_3 + H_2SO_4 \rightarrow H_2S_2O_7$ (Oleum)

Question 5:

While diluting concentrated sulphuric acid, the acid should be added to water and not water to the acid. Explain ?

Answer:

When equal volumes of the acid and water are mixed at room temperature, the temperature may reach up to 120°C. Therefore, dilution of the acid should be done by adding small quantity of acid into water.



If water is added to concentrated sulphuric acid, the molecules of the acid try to grasp the molecules of water resulting in molecular tension, liberating heat and due to sudden rise in temperature, the acid starts splashing.

If a drop of concentrated acid is added to water, the molecules of acid go in different directions to pick up water which is available in plenty. Although the same amount of heat is formed but since the molecules are spread out, no splashing occurs.

Question 6:

(i) Which property of sulphuric acid is used to prepare the hydrochloric and nitric acid respectively.

(ii) What is the catalyst used in catalytic chamber and what is the temperature used ?

Answer:

(i) Non-volatile nature of sulphuric acid is responsible to prepare HCl and HNO_3 by using H_2SO_4.

(ii) The catalyst used is platinized asbestos or vanadium pentaoxide and the temperature used is about 450°C.

Question 7:

(i) (a) Name the acid formed when sulphur dioxide dissolves in water.

(b) What are the two necessary conditions for the direct combination of sulphur dioxide and chlorine forming sulphuryl chloride ?

(c) State the property of sulphur dioxide which causes potassium permanganate to change its colour from purple to colourless.

(ii) Answer the following questions related to dilute and concentrated sulphuric acid.

(a) Which acid does not react with metals that are placed below hydrogen in activity series ?
(b) Which acid will give white precipitates with barium sulphate.

Answer:

(i) (a) Sulphurous acid

(b) Sunlight and absence of moisture

(c) Reducing.

(ii) (a) Dilute sulphuric acid.

(b) Dilutesiilphuric acid.

Question 8:

Give one reaction in each case to illustrate the following properties of sulphuric acid:

(i) As an acid. (ii) As an oxidising agent.

(iii) As a dehydrating agent. (iv) As a less volatile acid.

Answer:

(i) Dilute sulphuric acid reacts with metals above hydrogen in the activity series, for example, magnesium to liberate hydrogen gas and magnesium sulphate.

$Mg + H_2SO_4 \rightarrow MgSO_4 + H_2 \uparrow$

(ii) When sulphur is heated with concentrated sulphuric acid, it is oxidised to sulphur dioxide.

$S + 2H_2SO_4 \rightarrow 3SO_2$ (Sulphur dioxide) $+ 2H_2O$

(iii) Add few drops of concentrated sulphuric acid to blue coloured crystals of copper (II) sulphate. After sometime, white anhydrous copper (II) sulphate is left, due to loss of water of crystallization.

$$\underset{\text{Hydrated Copper Sulphate (Blue)}}{CuSO_4.5H_2O} + [H_2SO_4] \longrightarrow \underset{\text{Anhydrous Copper Sulphate (White)}}{CuSO_4} + [H_2SO_4.5H_2O]$$

(iv) Concentrated sulphuric acid, when heated with sodium chloride, produces volatile hydrochloric acid.

$$NaCl + \underset{\text{(Conc.)}}{H_2SO_4} \xrightarrow{\text{Heat}} NaHSO_4 + HCl$$

Question 9:

Which property of sulphuric acid is used in the following:

(i) As a source of hydrogen when treated in dilute form with metals like Zn, Mg, Fe, etc.
(ii) Production of hydrogen chloride on treating concentrated add with sodium chloride.

(iii) Production of sulphur dioxide on heating in concentrated form with copper turnings.

(iv) Liberation of sulphur from H_2S with concentrated form.

(v) Charring of sugar with hot concentrated add.

(vi) Liberation of ethylene gas with hot concentrated add.

(vii) Liberation of carbon monoxide with hot concentrated add.

Answer:

(i) Addic property.

(ii) Non volatile nature.

(iii) Oxidising nature.

(iv) Oxidising property.

(v) Dehydrating nature.

(vi) Dehydrating nature.

(vii) Dehydrating nature.

Question 10:

Some properties of Sulphuric add are listed below. Choose the property A, B, C

or D which is responsible for the reactions (i) to (v). Some properties may be repeated:

A. Acid

B. Dehydrating agent
C. Non-volatile acid D.
Oxidizing agent

(i) $C_{12}H_{22}O_{11} + nH_2SO_4 \longrightarrow 12C + 11H_2O + nH_2SO_4$

(ii) $S + 2H_2SO_4 \longrightarrow 3SO_2 + 2H_2O$

(iii) $NaCl + H_2SO_4 \longrightarrow NaHSO_4 + HCl$

(iv) $CuO + H_2SO_4 \longrightarrow CuSO_4 + H_2O$

(v) $Na_2CO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + CO_2$

(vi) $CuSO_4 \cdot 5H_2O \xrightarrow{\text{conc. } H_2SO_4} CuSO_4 + 5H_2O$

(vii) $NaNO_3 + H_2SO_4\ (\text{conc.}) \xrightarrow{< 200^\circ C} NaHSO_4 + HCl$

(viii) $MgO + H_2SO_4 \longrightarrow MgSO_4 + H_2O$

(ix) $Zn + 2H_2SO_4\ (\text{conc.}) \longrightarrow ZnSO_4 + SO_2 + 2H_2O$

Answer:

(i)B (ii)D (iii)C (iv)A (v)A (vi)B (vii)C (viii)A (ix)D

Question 11:

Name from the list of substances given below, the substances which you would use to prepare each of the following salts, named in parts (i) to (iv):

The substances are:

Copper, Lead, Sodium, Zinc, Copper oxide, Lead carbonate, Sodium Carbonate solution, Dilute hydrochloric acid, Dilute nitric acid and Dilute sulphuric acid:

(i) Zinc sulphate; (ii) Copper sulphate; (iii) Sodium sulphate; (iv) Lead sulphate.

Answer:

(a) For zinc sulphate — Zinc and dilute sulphuric acid.

(b) For copper sulphate — Copper oxide and dilute sulphuric acid.

(c) For sodium sulphate — Sodium carbonate and dilute sulphuric acid.

(d) For lead sulphate — Lead carbonate + dil. nitric and then dil. sulphuric acid.

Question 12:

Some of the properties of six pure substances represented by A, B, C, D, E and

F are given below:

A-when heated with concentrated sulphuric acid, it gives off a choking gas which dissolves in water giving an acid.

B- is a greenish-yellow gas which dissolves in water and when this aqueous : solution is exposed to sunlight, bubbles of a gas are evolved, which rekindles a glowing splinter.

C- is a metal which when treated with concentrated nitric acid, gives off a brown gas and a blue solution is obtained.

D- is a white solid, which when heated, gives off a sweet smelling gas which rekindles a glowing splinter.

E- is a heavy oily liquid which when added to moist sugar, chars it into a black porous mass.
F- is a gas which turns moist red litmus to blue. When the gas is passed over heated copper oxide, an inactive gas is obtained.

(i) Name the substances A, B, C, D, E and F.

(ii) Write equations for the following reactions involving A, B, C, D, E and F.

(a) A is heated with concentrated sulphuric acid.

(b) An aqueous solution of B is exposed to bright sunlight.

(c) Concentrated nitric acid and the metal C are heated.

(d) The action of heat on D.

(e) Oily liquid E is added to sugar.

(f) The action of F on heated copper (II) oxide.

Answer:

(i) A is sodium chloride, B is chlorine gas, C is copper, D is ammonium nitrate, E is concentrated sulphuric acid and F is ammonia gas respectively.

(ii) When sodium chloride is heated with concentrated sulphuric acid, hydrogen chloride gas is liberated and sodium sulphate is also formed.

$$2NaCl + \underset{(Conc.)}{H_2SO_4} \xrightarrow{Heat} Na_2SO_4 + 2HCl.$$

(a) Chlorine gas reacts with water in the presence of sunlight to liberate oxygen gas and hydrochloric acid is formed.

$$2Cl_2 + 2H_2O \xrightarrow{Sunlight} 4HCl + \underset{Oxygen}{O_2\uparrow}$$

(b) Copper and concentrated nitric acid when heated, a brown gas, nitrogen dioxide is evolved and-a blue coloured copper nitrate is formed.

$$Cu + \underset{(Conc.)}{2HNO_3} \xrightarrow{Heat} \underset{\substack{Copper\ nitrate\\ Blue}}{Cu(NO_3)_2} + 2H_2O + \underset{\substack{Nigrogen\ dioxide\\ Brown\ gas}}{2NO_2\uparrow}$$

(c) Ammonium nitrate on heating gives off a sweet smelling gas nitrous oxide, commonly known as laughing gas and water is formed.

$$NH_4NO_3 \xrightarrow{Heat} \underset{\substack{Nitrous\ oxide\\ (laughing\ gas)}}{N_2O\uparrow} + 2H_2O$$

(d) Sulphuric acid acts as dehydrating agent and chars the sugar to black porous mass, i.e., carbon.

$$\underset{Sugar}{C_{12}H_{22}O_{11}} + H_2SO_4 \longrightarrow 12C + [\underset{Hydrate}{H_2SO_4 + 11H_2O}]$$

(e) When ammonia is passed over heated copper (II) oxide, it is oxidized to form nitrogen and water. Copper (II) oxide itself reduces to metallic copper.

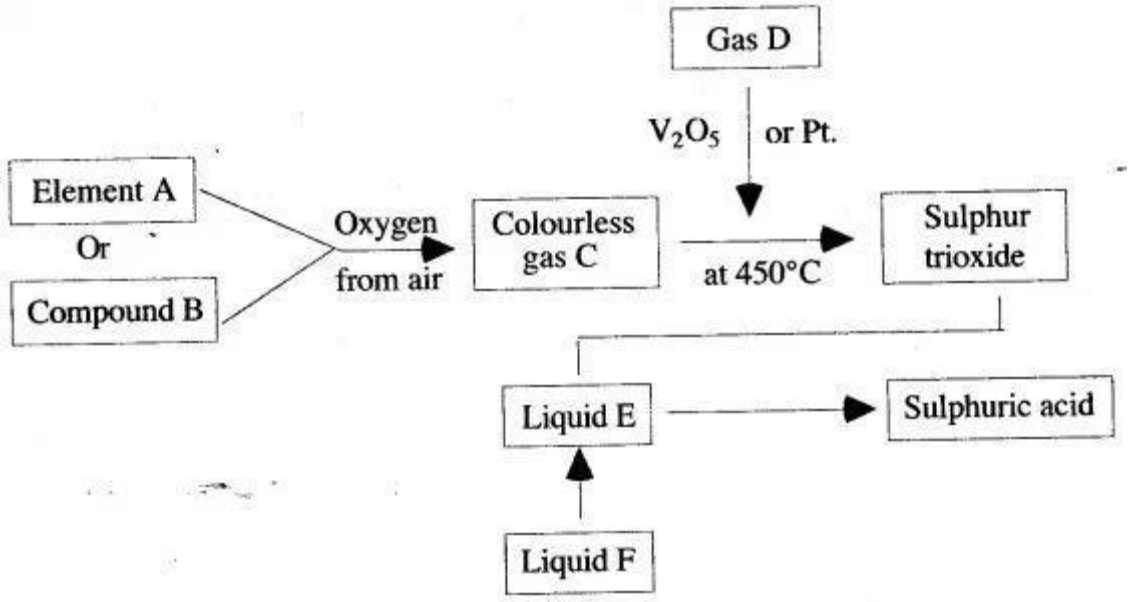
$$2NH_3 + 3CuO \longrightarrow 3Cu + 3H_2O + N_2\uparrow$$
Nitrogen gas

(ii) (a) $2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$

(b) $Pb(OH)_2 + H_2SO_4 \longrightarrow PbSO_4 + 2H_2O$

Question 13:

Study the diagram given below, which illustrates the manufacture of sulphuric acid.



(i) Write the names of the substances A to F.
(ii) Describe how gas C could be identified. (iii)
Explain the purpose of V_2O_5 or Pt.

(i) A—Sulphur

B—Iron pyrites

C—Sulphur

D—Oxygen

E—Concentrated sulphuric acid

F—Water

(ii) The gas C will turn acidified potassium dichromate paper green.

(iii) V_2O_5 or Pt acts as a catalyst and increases the rate of formation of sulphur trioxide from sulphur dioxide and oxygen.

Question 14:

(i) Name the catalyst which helps in the conversion of sulphur dioxide to sulphur trioxide in step C.

Reasoning based Questions:

Question 1:

Why concentrated sulphuric acid is called the "oil of vitriol" ?

Answer:

Concentrated sulphuric acid is called "Oil of vitriol" because of its oily appearance and the fact that it is present in vitreous or glassy substances like ferrous sulphate, alum, etc.

Question 2:

For the production of concentrated sulphuric acid, sulphur trioxide is not directly dissolved in water. Why ?

Answer:

Because with water, sulphur trioxide forms a mist of fine drops of sulphuric acid.

Question 3:

The impurity of arsenic oxide must be removed before passing the mixture of sulphur dioxide and air through the catalytic chamber in contact process. Why ?

Answer:

Because the impunty of arsenic oxide makes the catalyst poisonous.

Question 4:

Why concentrated sulphuric acid is kept in air tight bottles ?

Answer:

Concentrated sulphuric acid readily absorbs moisture from atmosphere and gets diluted. Hence, it is kept in air tight bottles.

Question 5:

Why the level of concentrated sulphuric acid gets higher if it is left in an open vessel for a week ?

Answer:

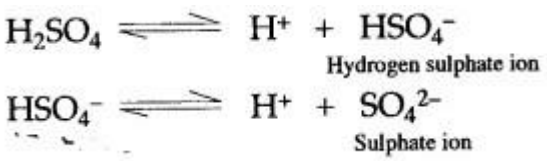
This is due to the hygroscopic nature of sulphuric acid. It absorbs water vapour from the atmosphere.

Question 6:

Why sulphuric acid behaves as an acid when diluted with water ?

Answer:

When sulphuric acid is diluted with water, it ionizes almost completely into hydrogen ions (H^+) and sulphate ions (SO_4^{2-})



Since presence of H^+ ions imparts acidic character, therefore solution of sulphuric acid in water behaves as an acid.

Question 7:

Why the wooden shelves on which cone, sulphuric acid bottles are kept, stained black?

Answer:

Concentrated sulphuric acid is a very powerful dehydrating agent. It removes atoms of hydrogen and oxygen in the form of water from the cellulose $[(C_6H_{12}O_5)_n]$, leaving behind carbon. It is black carbon which appears in the form of black stains.

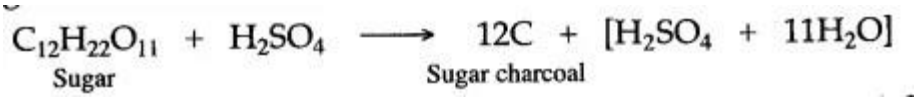
Question 8:

A black spongy mass is formed, when concentrated sulphuric acid is added to sugar. Why ?

Answer:

Sulphuric acid has great affinity for water, hence when concentrated sulphuric acid is added to sugar, it absorbs water from sugar by removing hydrogen and oxygen atoms in the ratio of 2:1

from sugar molecules. The sugar is charred producing black spongy mass of carbon, which is known as sugar charcoal.

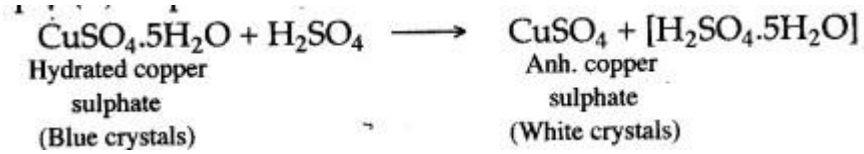


Question 9:

When blue crystals of copper (II) sulphate are added to concentrated sulphuric acid crystals turn white. Why ?

Answer:

Hydrated copper (II) sulphate, when added to concentrated sulphuric acid, loses water of crystallization and thus white anhydrous copper (II) sulphate is formed. The blue coloured hydrated copper (II) sulphate turns white due to the loss of water of crystallization.



Question 10:

Why brisk effervesence is seen when H_2SO_4 is added to sodium carbonate ?

Answer:

This brisk effervescence is seen due to the evolution iof carbon dioxide gas.

Chemical Tests:

Question:

1. Dilute sulphuric acid and dilute hydrochloric acid.

2. Chlorine gas and sulphur dioxide gas

Answer:

When barium chloride solution is added to the dilute sulphuric acid, thick white precipitate of barium sulphate is formed which is insoluble in any mineral acid such as nitric acid or hydrochloric acid

$$BaCl_2 + \underset{(dil)}{H_2SO_4} \longrightarrow BaSO_4 \downarrow + 2HCl$$

With dilute hydrochloric acid, no effect is observe.

Chlorine gas turns starch iodide paper blue and sulphur dioxide gas turns moist acidified potassium dichromate paper green.

Balancing/Writing the Chemical Equations:

Question 1:

Write balanced chemical equation for the following :

1. Action of concentrated sulphuric acid on carbon.

2. Dilute sulphuric add produdng hydrogen.

3. Dilute sulphuric add is poured over sodium sulphite

4. Zinc reacts with cone. Sulphuric add.

5. Sodium bicarbonate and dilute sulphuric acid.

6. Sodium nitrate and cone. Sulphuric add.

7. Iron reads with dil sulphuric acid.

8. Sulphur is heated with concentrated sulphuric add.

9. Concentrated sulphuric acid is poured over sugar.

10. Dilute sulphuric add with Copper carbonate.

11. Dilute sulphuric acid with Lead nitrate solution.

12. Dilute sulphuric acid with Zinc hydroxide.

13. Concentrated sulphuric acid with barium chloride.

14. Concentrated sulphuric add with sulphur trioxide.

15. Sodium sulphite with dilute sulphuric acid.

16. Concentrated sulphuric acid with potassium chloride.

17. Concentrated sulphuric add with zinc nitrate.

18. Concentrated sulphuric add with potassium nitrate.

19. Potassium hydrogen carbonate and sulphuric add.

20. Sodium nitrate and concentrated sulphuric acid.

Answer:

1. $C + 2H_2SO_4 \xrightarrow{\text{Conc.}} \underset{\text{Carbon dioxide}}{CO_2} + 2H_2O + \underset{\text{Sulphur dioxide}}{2SO_2}$

2. $H_2SO_4 + Zn \longrightarrow ZnSO_4 + H_2$

3. $Na_2SO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + SO_2\uparrow$
Sodium sulphate

4. $Zn + 2H_2SO_4 \longrightarrow ZnSO_4 + 2H_2O + SO_2$

5. $NaHCO_3 + H_2SO_4 \longrightarrow NaHSO_4 + H_2O + CO_2$

6. $NaNO_3 + H_2SO_4 \longrightarrow NaHSO_4 + HNO_3$

6.

7. $Fe + H_2SO_4 \longrightarrow FeSO_4 + H_2\uparrow$
(Dil.)

8. $S + 2H_2SO_4 \longrightarrow 2H_2O + 3SO_2$
Sulphur dioxide

9. $C_{12}H_{22}O_{11} + H_2SO_4 \longrightarrow 12C + 11H_2O + H_2SO_4$

10. $CuCO_3 + H_2SO_4 \longrightarrow CuSO_4 + H_2O + CO_2\uparrow$
(Dil.)

11. $Pb(NO_3)_2 + H_2SO_4 \longrightarrow PbSO_4\downarrow + 2HNO_3$
(Dil.)

12. $Zn(OH)_2 + H_2SO_4 \longrightarrow ZnSO_4 + 2H_2O$
(Dil.)

13. $BaCl_2 + H_2SO_4 \longrightarrow BaSO_4\downarrow + 2HCl$
(conc.) white ppt.

14. $SO_3 + H_2SO_4 \longrightarrow H_2SO_3O_7$
(conc.) oleum

15. $Na_2SO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + SO_2\uparrow$
(Dil.)

16. $KCl + H_2SO_4 \longrightarrow KHSO_4 + HCl$
(conc.)

17. $Zn(NO_3)_2 + H_2SO_4 \longrightarrow ZnSO_4 + 2HNO_3$

18. $KNO_3 + H_2SO_4 \xrightarrow{< 200^\circ C} KHSO_4 + HNO_3$

19. $2KHCO_3 + H_2SO_4 \longrightarrow K_2SO_4 + 2H_2O + CO_2\uparrow$

20. $NaNO_3 + H_2SO_4 \longrightarrow NaHSO_4 + HNO_3$
(Conc.)

Chapter 12

Organic Chemistry

Short Questions

Question1: The list of some organic compound is given below:

Ethanol, ethane, methanol, methane, ethyne, and ethene.

From the list above ,name a compound:

(i) Formed by the dehydration of ethanol by concentrated sulphuric acid.
(ii) Which will give red precipitate with ammoniacal cuprous chloride solution.
(iii) Which forms methanoic acid on oxidation in the presence of copper at 200°C.
(iv) Which has vapour density 14 and turns alkaline potassium permanganate green.
(v) Which forms chloroform on halogenations in the presence of sunlight.
(vi) Which decolourises bromine solution in carbon tetrachloride.

Answer:

(i)Ethene .

(ii)Ethyne.

(iii)Methane.

(iv)Ethene.

(v)Methane.

(vi)Ethene.

Question2: Name the functional group of each of CH_3OH,CH_3COOH,CH_3CHO.

Answer: Alcoholic–OH group present in CH_3OH.

Carboxylic–COOH group present in CH_3COOH.

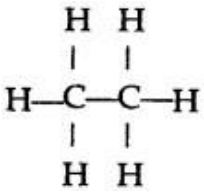
Aldehydic–CHO group present in CH_3CHO.

Question3: (i) Alkanes are called saturated hydrocarbons. Give a brief explanation, by taking the example of C_2H_6.

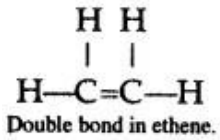
(ii) Alkenes are unsaturated hydrocarbons. Illustrate it, by taking the example of ethene(C_2H_4).

(iii) A compound has number of H atoms just double that of C atoms. What types of hydrocarbon is it?

Answer: (i) Alkanes are called saturated hydrocarbons because tetra-valency of each carbon atom is satisfied by single covalent bond.



(ii) Ethene (C_2H_4) is an unsaturated hydrocarbon, commonly known as alkene. Ethene molecule contains two carbon atoms bonded by double bond.



Double bond in ethene.

(iii) The compound is an unsaturated hydrocarbon having general formula C_nH_{2n}. So, this compound is an alkene.

Question4: (i) In the general formula C_nH_{2n+2} write the meaning of 2n+2.

(ii) Write the formulae and names of the first four members of the alkane family.

(iii) Write the molecular formula of an alkane, which is composed of 16 H atoms.

(iv) In a molecule of saturated hydrocarbon the number of C-atoms is 5, what is the number of H-atoms ?

Answer: (i) The number of alkane family represents the general formula C_nH_{2n+2}.

In this formula: n=number of carbon atoms in the same molecule of alkane.

2n+2=number of H-atoms in a molecule of alkane.

(ii) CH_4(methane),C_2H_6(ethane),C_3H_8(propane),C_4H_{10}(butane).

(iii) C_7H_{16}(Heptane).[∵2n+2=16,2n=16–2,2n=14, n=14/2=7].

(iv) According to general formula C_4H_{2n+2} when n=5,$C_5H_{2x\ 5+2}$ or C_5H_{10+2} or C_5H_{12}.Thus, the number of hydrogen atom is 12.

Question5: The molecules of alkene family are represented by a general formula C_nH_{2n}. Now answer the following:

(i) What do n and 2n signify?
(ii) What is the lowest value which can be assigned ton?
(iii) What is the molecular formula of alkene, when n=4?

(iv) What is the structural formula of the first member of the alkene family?

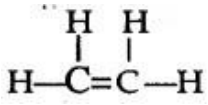
Answer: (i) n=Number of C-atoms in a molecule of alkene.

2n= Number of H-atoms in a molecule of alkene.

(ii) The lowest value of n is 2.

(iii) Butene (C_4H_6).

(iv)The first member of alkene family is C_2H_4.It is called ethene, the structural formula is:



Question6: (i) Which compound should be heated with soda lime to obtain ethane gas in the laboratory ?

(ii) Write the equation for the reaction in (i) above.

(iii) Write a balanced equation for the complete combustion of ethane.

(iv) Name a solid which can be used instead of concentrated sulphuric acid to prepare ethylene by the dehydration of ethanol.

(v)Ethylene forms an addition product with chlorine. Name this addition product and write its structural formula.

Answer:(i) Sodium propionate.

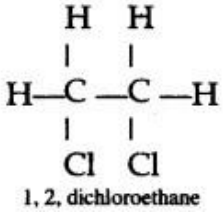
(ii) $\underset{\text{Sodium propionate}}{C_2H_5COONa} + \underset{\text{Sodium hydroxide}}{NaOH} \xrightarrow[CaO]{\Delta} \underset{\text{Ethane}}{C_2H_6} + Na_2CO_3$

(iii) $\underset{\text{Ethane}}{2C_2H_6} + 7O_2 \longrightarrow 4CO_2 + 6H_2O$

(iv) Alumina (Al_2O_3).

$$C_2H_5OH \xrightarrow[\Delta]{Al_2O_3} C_2H_4 + H_2O$$

(v) $\underset{\text{Ethylene}}{\begin{matrix}CH_2\\ \|\\ CH_2\end{matrix}} + Cl_2 \longrightarrow \underset{\text{Ethene dichloride}}{\begin{matrix}CH_2Cl\\ |\\ CH_2Cl\end{matrix}}$



1, 2, dichloroethane

Question7: (i) Write the equation, for the preparation of ethylene from ethyl alcohol.

(ii) Write the general formula of a saturated hydrocarbon and give one example of a saturated hydrocarbon with its structural formula.

(iii) Name a compound, which will give acetylene gas, when treated with water.

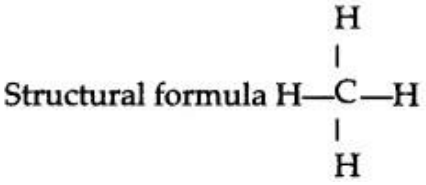
Answer:

(i) $C_2H_5OH\ (l) \xrightarrow[160–170°C]{\text{conc. } H_2SO_4} C_2H_4(g) + H_2O(l)$

(ii) General formula C_nH_{2n+2}.

Example–Methane—CH_4

Structural formula



(iii) Calcium carbide.

Question8:(i)Ethane and chlorine react together to form monochloro ethane [ethyl chloride].
(a) Write down the structural formula of ethane.

(b) What type of reaction has taken place between ethane and chlorine?

(ii) The type of reaction between ethane and chlorine is different from that between ethane and chlorine.
(a) What is the type of reaction between ethane and chlorine.

(b) What feature of the ethane structure makes such reaction possible?
(c) Name the product of the reaction between ethane and chlorine.

(iii) Ethane bums completely in air or oxygen to give carbon dioxide and water vapours. With a limited supply of air or oxygen, carbon monoxide is formed. The same gases are found in automobile exhaust gases. Both gases can be considered as atmospheric pollutants.

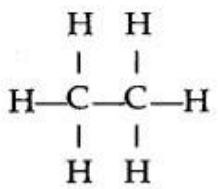
(a) Write the equation for the complete combustion of ethane.

(b)What danger is associated with carbon monoxide?.

(c) What effect is associated with too much carbon dioxide in the atmosphere?

(d) Burning of acetylene [Ethyne] in oxygen, under appropriate conditions, produces a very hot flame. What is this hot flame used for?

Answer: (i) (a) The structural formula of ethane is given by



(b) Substitution reaction takes place in between ethane and chlorine.

$$\underset{\text{Ethane}}{C_2H_6} + Cl_2 \longrightarrow \underset{\text{Ethyl chloride}}{C_2H_5Cl} + HCl$$

(ii)(a) Addition reaction takes place in between ethane and chlorine.

$$\begin{matrix} CH_2 \\ \| \\ CH_2 \\ \text{Ethene} \end{matrix} + Cl_2 \longrightarrow \begin{matrix} CH_2Cl \\ | \\ CH_2Cl \\ \text{Dichloroethene} \end{matrix}$$

(b) Ethene is an unsaturated hydrocarbon [Alkene], containing double covalent bonds, which respond to the addition reaction.

(c) Ethene combines with chlorine to form 1:2 dichloro ethane [Ethylene dichloride]

(iii)(a) Ethane bums in atmospheric oxygen to form carbon dioxide and steam [water].

$$2C_2H_6 + 7O_2 \longrightarrow 4CO_2\uparrow + 6H_2O$$

(b) Carbon monoxide is a highly poisonous gas. It readily combines with haemoglobin of blood to form carboxy haemoglobin. Carboxy haemoglobin is a stable compound and is incapable of taking up the oxygen from the inhaled air and as a result, people die due to suffocation.

(c) Green house effect or global warming is associated with too much carbon dioxide in the atmosphere.

(d) This hot flame is used for welding and cutting of steel.

Question9: Indicate the type of reaction that occurs when: (i)
Ethane reacts with chlorine.

(ii) Ethene reacts with chlorine.

(iii) What type of reaction is common in C_2H_4 and C_2H_2?

(iv) What is formed when ethane reacts with steam at 300°C in the presence of phosphoric acid as catalyst?

(v)Name a solid which on reaction with water forms: (a)
methane (b) ethyne (acetylene)

(vi) Give the names of each of the following compounds:

(a) $CH_3CH_2CH_2CH_3$

(b) $CH_2 = CH_2$

(c) $CH \equiv CH$

Answer: (i) Substitution reaction. (ii)Addition reaction.

(iii)Addition reaction. (iv)Ethanol.

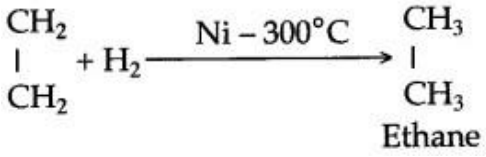
(v)(a)Aluminium carbide(b)Calcium carbide.

(vi)(a)Butane (b)Ethylene(Ethene) (c)Acetylene(Ethyne).

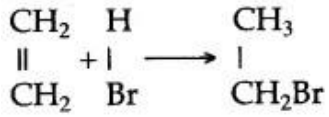
Question10:How does ethane gas react with the following:

(i)Hydrogen,(ii)Halogen acid,(iii)Sulphuric acid,(iv)Bromine,(v)Alkaline potassium permanganate, (v)HCl gas.

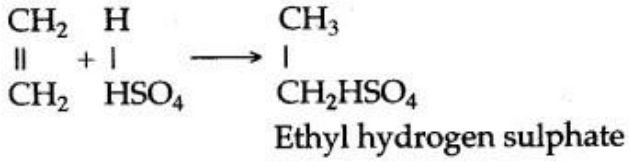
Answer: (i)When a mixture of ethane and hydrogen are passed over heated catalyst (Ni,Pd or Pt), an addition reaction takes place with the formation of ethane, a saturated hydrocarbon.



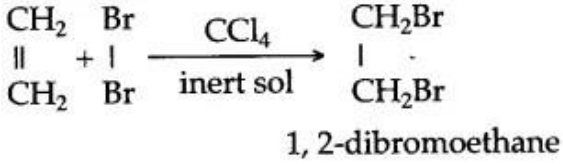
(ii) When vapours of ethane and hydrobromic acid are mixed at room temperature, they react to form addition product, bromo ethane.



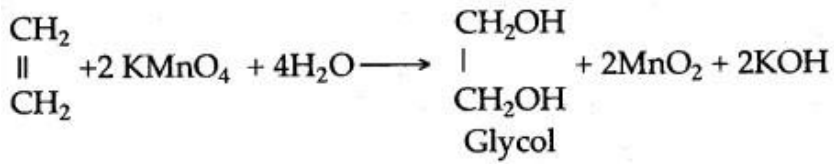
(iii)When ethane is passed through conc. Sulphuric acid, an addition reaction takes place at room temperature with the formation of ethyl hydrogen sulphate.



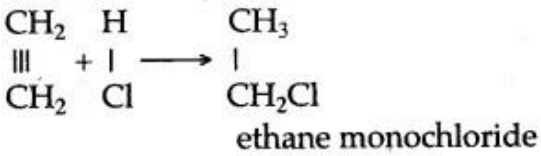
(iv)When bromine is passed through the inert solution of ethene, an addition reaction takes place with the formation of 1,2, dibromo ethane.



(v)Ethene reacts with alkaline potassium permanganate solution to form glycol.



(vi)Ethene reacts with HCl to for methane glycol mono chloride.



Question11: (i) What is the type of reaction taking place between ethane and chlorine to form mono-chloro-ethane?

(ii)The reaction between ethane and chlorine forms only one product. Name the type of this reaction.
(iii)(1) Draw the structural formula of ethene.

(2) What is the feature of the ethane structure, which allows ethene to react with chlorine in the way it does?

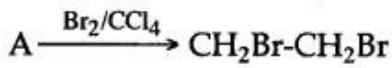
Answer:(i) Substitution Reaction.

(ii)Addition Reaction.

(iii)(1)

(2)Unsaturated hydrocarbon with double bond.

Question12:Compound A is bubbled through bromine dissolved in carbon tetrachloride and the product is CH_2Br-CH_2Br.



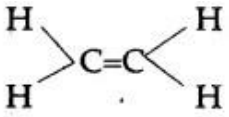
(i) Draw the structural formula of A.

(ii)What type of reaction has A Undergone?
(iii)What is your observation?

(iv)Name (not formula) the compound formed when steam reacts with A in the presence of phosphoric acid.

(v)What is the procedure for converting the product of (b) (iv)back to A?

Answer:

(i) 

(ii)Addition reaction.

(iii)Bromine solution gets decolourised.

(iv)Ethanol

(v)By heating it (ethanol)with concentrated sulphuric acid at 170°C.

Question 13:(i) Give the names and structural formulae of:

(a) An alkane with a carbon to carbon single bond.

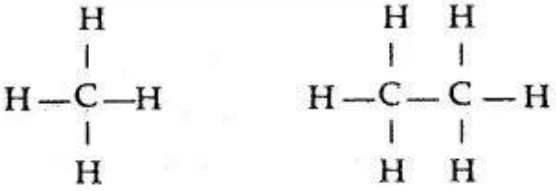
(b)An unsaturated hydrocarbon with a double bond.

(ii)(a)Write the equation, for the laboratory preparation of ethane (acetylene) from calcium carbide.
(b)What is the special feature of the structure of ethyne?

(iiii) Name the addition product formed between ethane and water.

Answer:

(i) (a) Saturated hydrocarbon—methane and ethane.



(b) Unsaturated hydrocarbon—ethene, ethyne.

(ii) (a) $CaC_2 + 2H_2O \longrightarrow Ca(OH)_2 + C_2H_2 \uparrow$ (Acetylene)

(b)Ethyne is highly reactive because of presence of one triple bond between two carbon atoms.

(iii)Ethylene glycol.

Question14:(i)A compound 'X' reacts with compound 'Y' in presence of lime to form a 'Z'. It is insoluble in water.

(a) Name the compound X and Y.(b) Name the gas Z.
(c)Write only balanced chemical equation.
(ii)(a)Name the product of the reaction between ethane and chlorine.

(b)Burning acetylene in oxygen, under appropriate conditions, produces a very hot flame. For what purpose, this hot flame is used?

Answer:(i)(a)X—Sodium ethanoate . Y—

Sodium hydroxide.

(b)Z—Methane(CH_4).

(c) $CH_3COONa + NaOH \xrightarrow{CaO} CH_4 + Na_2CO_3$.

(ii)(a)Ethene dichloride.

(b)For welding.

Question15:(i)What word is used to describe these three compounds taken together?
(ii)What is the special feature of the structure of:

(a)C_2H_4(b)C_2H_2

(iii) What type of reaction is common in both of these compounds?
(iv)Flow is acetylene filled in commercial gas cylinders?

Answer:(i)Organic compounds.

(ii)(a)C_2H_4 contains a double bond between two carbon atoms.

(b)C_2H_2 contains a triple bond between two carbon atoms.

(iii)Addition reaction.

(iv) The commercial gas cylinders of acetylene contain a solution of acetylene in acetone. The cylinder contains a porous material in to which the acetone and acetylene are absorbed. The pressure in a freshly filled cylinder of acetylene is about 15 atmosphere.

Question16:(i)(a)A compound has triple bond in its molecule and has only two carbon atoms with two hydrogen atoms. Name the compound.

(b)What is hydrogenation?
(c)What is halogenation?

(d)What 'substitution reaction' and 'substitution product'.

(e)What is 'pyrolysis'? What is the other term signifying the same?

(ii) State the conditions required for the following reactions to take place:
(a)Catalytic hydrogenation of ethyne.

(b)Preparation of ethyne from ethylene di-bromide.

Answer:(i)(a)Acetylene H-C≡C-H Or Acetylene.

(b)Addition of hydrogen to some unsaturated hydrocarbons is called hydrogenation.

(c)Addition of halogens (Cl,Br,I) to some unsaturated hydrocarbons is called halogenation.

(d)A substitution reaction is one in which one atom in a molecule is replaced by another atom (or group of atoms).The product of a substitution reaction is known as a substitution product.

(e)Decomposition of alkanes by heat is called pyrolysis. Another term signifying the same is cracking.

(ii)(a)In presence of catalyst like finely divided nickel, platinum, heating upto 473K.

(b)Hot and concentrated alcoholic solution of potassium hydroxide.

Question17:A hydrocarbon decolourises $KMnO_4$ solution but does not for many precipitate with ammoniacal $AgNO_3$. Now answer the following questions:

(i)Is the hydrocarbon saturated or unsaturated?

(ii)What is the type of bonds between two carbon atoms?

(iii)Does the hydrocarbon belong to alkane, alkene or alkyne family?

(iv)What will be the change on adding a few drops of bromine solution in a test tube filled with this hydrocarbon?

Answer:(i)Unsaturated.

(ii)Double bond between two carbon atoms.

(iii)Alkene family.

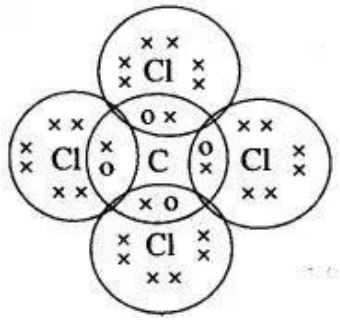
(iv) Ethene decolourises the solution of bromine in carbon tetrachloride and dibromo –ethane is formed

$$\underset{\text{Brownish red}}{C_2H_4 + Br_2} \longrightarrow \underset{\substack{\text{Dibromo ethane}\\ \text{(Colourless)}}}{CH_2Br.\,CH_2Br}$$

Figure/Table Based Questions

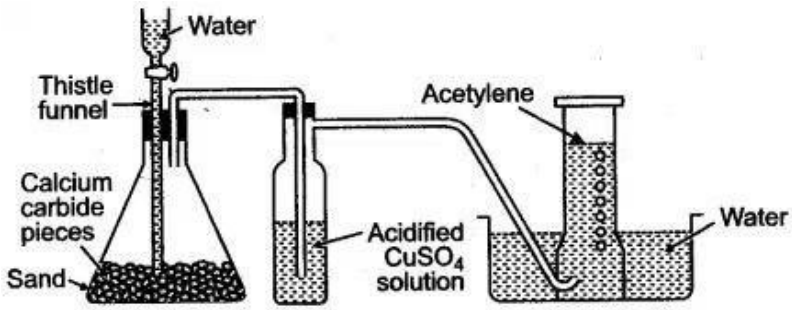
Question1: Methane is the first member of alkane, when it is treated with excess of chlorine in the presence of diffused sunlight forms carbon tetrachloride. Draw the appropriate structural formula of carbon tetrachloride and state the type of bond present in it.

Answer:



Structural formula of CCl_4. The type of bond present in CCl_4 is covalent bond.

Question2: The figure given below is showing the laboratory preparation of acetylene gas.



(i) How it is prepared in the laboratory?
(ii) What is the function of acidified copper sulphate solution?
(iii) Give a reaction in which acetylene gas is prepared by synthesis reaction.
(iv) What happens when acetylene is heated in a copper tube at 600°C?

Answer: (i) Laboratory preparation of acetylene gas (ethyne gas): When calcium carbide is treated with water, it forms calcium hydroxide, with the liberation of acetylene.

$$\underset{\text{Calcium carbide}}{CaC_2} + 2H_2O \longrightarrow \underset{\text{Calcium hydroxide}}{Ca(OH)_2} + \underset{\text{Acetylene}}{C_2H_2}\uparrow$$

(ii)Acidified $CuSO_4$ solution is used to absorb impurities of phosphene hydrogen sulphide, ammonia etc.

(iii) $$2C + H_2 \xrightarrow{\Delta} \underset{\text{Acetylene}}{CH \equiv CH}$$

(iv) Acetylene will polymerise in the copper tube to form benzene.

$$\underset{\text{Acetylene}}{3C_2H_2} \xrightarrow[600°C]{\text{Cu tube}} \underset{\text{Benzene}}{C_6H_6}$$

Question3: Copy and complete the following table which relates to three homologous series of Hydro-carbons:

General Formula	C_nH_{2n}	C_nH_{2n-2}	C_nH_{2n+2}
IUPAC name of the homolo-gous series			
Characteristic bond type			Single bonds
IUPAC name of the first member of the series			
Type of reaction with chlorine.		Addition	

Answer:

General Formula	C_nH_{2n}	C_nH_{2n-2}	C_nH_{2n+2}
IUPAC name of the homolo-gous series	Alkynes	Alkenes	Alkanes
Characteristic bond type	Triple bond	Double bond	Single bonds
IUPAC name of the first member of the series	Ethyne	Ethene	Methane
Type of reaction with chlorine.	Addition	Addition	Substitution

Reasoning based Questions

Question1: Hydrocarbons are excellent fuels. Give reason.

Answer: Hydrocarbons are excellent fuels because they ignite easily at low temperature and liberate large amount of heat without producing harmful products.

Question2: Why alkanes are so inert?

Answer: It is because in a molecule, it has one or more unshared pairs of electrons and a polar bond or an electron deficient atom. Alkanes have none of these.

Question3: Methane is called as marsh gas. Why?

Answer: Because methane is formed by the decomposition of plant and animal matter lying under water in marshy areas.

Question4: Methane does not undergo addition reactions, but ethane does. Why?

Answer: Because methane is saturated hydrocarbon while ethane is an unsaturated hydrocarbon. Addition reactions are characteristic properties of unsaturated hydrocarbons.

Question5: Why it is dangerous to bum methane in an insufficient supply of air?

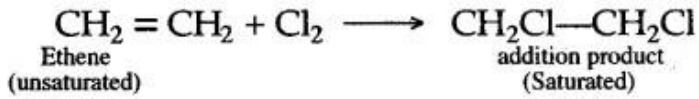
Answer: Because it will form carbon monoxide which is poisonous for human beings as it cuts off the oxygen supply by forming carboxy –haemoglobin in the blood.

Question6: Why light or heat is necessary for chlorination of alkanes?

Answer: The Cl-Cl bond must be broken to form Cl radicals, before the chlorination of alkanes can commence. The breaking of bond requires energy which is supplied either by heat or light.

Question7: Ethene undergoes addition reactions with halogens where as ethane undergoes substitution reactions .Why?

Answer: Ethene is an unsaturated hydrocarbon so, it adds up a molecule of halogen to give a saturated compound, where as, ethane is a saturated hydrocarbon compound and hence, can only undergo substitution reaction with halogen.



Question8: Alkynes are unsaturated hydrocarbons. Give reason.

Answer: Alkynes have triple bonds, so they are unsaturated hydrocarbon.

Question9: Why ethyne is more reactive than ethane?

Answer: Ethyne is an unsaturated hydrocarbon with a triple covalent bond. Ethane is a saturated hydrocarbon and hence is less reactive than ethyne.

Question10: Acetylene bums with sooty flame. Why?

Answer: Acetylene has higher proportion of carbon and all carbon in it does not burn completely. Hence, unburnt carbon particles make the flame sooty.

Question11: Why pure acetic acid known as glacial acetic acid?

Answer: Because on cooling below its melting point (17°C) it solidifies and forms little ice –like crystals.

Chemical Tests

Question:

1. Ethene and ethane.

2. Ethyne and ethane.

3. Alkanes, alkenes and alkynes.

Answer:

1. Ethene gas decolourises bromine solution and potassium permanganate solution. But, ethane gas does not change the colour of these solutions.

2. Ethyne gas forms a white precipitate with ammonical solution of silver nitrate and red ppt. with ammonical solution of copper(I) chloride. But, ethane does not respond to such tests.

3.

S. No.	Test	Alkanes	Alkenes	Alkynes
(i)	Bromine Test Add a few drops of sol. Of bromine in carbon tetra-chloride to the hydrocarbon	No change takes place.	The red colour of bromine is	The red colour of bromine is
(ii)	Alkaline Potassium Permanganate Test: Add a few drops of alkaline pot. Permanganate sol. To the hydrocarbon	No change takes place.	The purple colour of Potassium permanganate is	The purple colour of potassium permanganate is
(iii)	Ammoniacal Cuprous Chloride Test: Add a few drops of ammoniacal cuprous chloride sol. To the hydrocarbon.	No change takes place.	No change takes place.	A red ppt. of copper acetylide is formed

Balancing/Writing the Chemical Equations

Question1:

2. A mixture of soda lime and sodium acetate is heated.

5. Ethanol reacts with sodium at room temperature.

7. Preparation of ethane from sodium propionate.

9. A saturated hydrocarbon from iodo-methane.

10. An unsaturated hydrocarbon from an alcohol.

11. An unsaturated hydrocarbon from calcium carbide.

13. Reaction between ethyl alcohol and acetic acid.

14. Reaction of chlorine with excess of methane.

15. Addition of chlorine to ethane at ordinary temperature.

16. Burning of ethanol in air.

23. Excess chlorine reacts with methane.

24. Excess chlorine reacts with ethane.

Answer:

1. $C_2H_5Cl + KOH \xrightarrow{\text{aqu.}} C_2H_5OH + KCl$

2. $CH_3COONa + NaOH \xrightarrow[\text{(soda lime)}]{\text{Cao}} \underset{\text{methane}}{CH_4} + Na_2CO_3$

3. $CH_3CH_2OH + 2O \xrightarrow[K_2Cr_2O_7]{\text{acidified}} \underset{\text{acetic acid}}{CH_3COOH} + H_2O\uparrow$

4. $CaC_2 + 2H_2O \longrightarrow \underset{\text{Calcium hydroxide}}{Ca(OH)_2} + C_2H_2\uparrow$

5. $2C_2H_5OH + 2Na \longrightarrow \underset{\text{Sodium ethoxide}}{2C_2H_5ONa} + H_2\uparrow$

6. $CH_2Br\text{-}CH_2Br + 2KOH \xrightarrow{\text{alc.}} \underset{\text{ethyne}}{CH \equiv CH} + 2KBr + 2H_2O$

7. $\underset{\text{Sodium proprionate}}{C_2H_5COONa} + NaOH \xrightarrow{CaO} \underset{\text{Ethane}}{C_2H_6} + \underset{\text{Sodium Carbonate}}{Na_2CO_3}$

8. $\underset{\text{Mono-chloro-ethane}}{C_2H_5Cl} + \underset{\text{(aq.)}}{NaOH} \longrightarrow \underset{\text{Ethanol}}{C_2H_5OH} + \underset{\text{Sodium chloride}}{NaCl.}$

9. $\underset{\text{Iodomethane}}{CH_3I} + 2[H] \longrightarrow \underset{\text{methane}}{CH_4} + HI$

10. $\underset{\text{Ethanol}}{C_2H_5OH} + \underset{\text{conc}}{H_2SO_4} \xrightarrow{170^\circ C} \underset{\text{Ethene}}{C_2H_4} + H_2SO_4 + H_2O$

11. $\underset{\text{Calcium carbide}}{CaC_2} + 2H_2O \longrightarrow Ca(OH)_2 + \underset{\text{Ethyne}}{C_2H_2}$

12. $\underset{\text{Ethyl bromide}}{C_2H_5Br} + KOH_{aqu} \longrightarrow \underset{\text{Ethanol}}{C_2H_5OH} + KBr$

13. $\underset{\text{Acetic acid}}{CH_3COOH} + \underset{\text{Ethyl alcohol}}{C_2H_5OH} \longrightarrow \underset{\text{Ethyl acetate}}{CH_3COOC_2H_5} + H_2O$

14. $CH_4 + Cl_2 \xrightarrow{CH_2} CH_3Cl + HCl$

15. $\underset{\text{Ethene}}{CH_2 = CH_2} + Cl_2 \xrightarrow[\text{(solvent)}]{CCl_4} \underset{\text{Ethylene chloride}}{CH_2Cl—CH_2Cl}$

16. $\underset{\text{Ethanol}}{C_2H_5OH} + \underset{\text{(Air)}}{O_2} \longrightarrow \underset{\text{Carbon dioxide}}{2CO_2} + \underset{\text{Water}}{2H_2O}$

17. $CH_3CH_2COONa + NaOH \xrightarrow{CaO} C_2H_6 + Na_2CO_3$

18. $CH_3CH_2I + KOH \xrightarrow[\text{(alc.)}]{\Delta} C_2H_4 + KI + H_2O$

19. $CaC_2 + 2H_2O \longrightarrow Ca(OH)_2 + C_2H_2$

20. $CH_3I + KOH \xrightarrow[\text{(aq.)}]{} CH_3OH + KI$

21. $CH_4 + O_2 \xrightarrow{\text{Molybdenum}} \underset{\text{Formaldehyde}}{HCHO} + H_2O$

22. $CH_4 \xrightarrow{400^\circ C} \underset{\text{Formic acid}}{HCOOH}$

23. $\underset{\text{Methane}}{CH_4} + 4Cl_2 \longrightarrow \underset{\text{Carbon tetrachloride}}{CCl_4} + 4HCl$

24. $\underset{\text{Ethane}}{CH_3\text{–}CH_3} \xrightarrow{Cl_2} \underset{\text{Ethyl chloride}}{CH_3CH_2Cl} + HCl$

$CH_3CH_3Cl \xrightarrow{Cl_2} \underset{\text{Dichloroethane}}{C_2H_4Cl_2}$

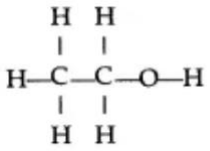
IUPAC Naming / Writing the Structural Formula

Question1:

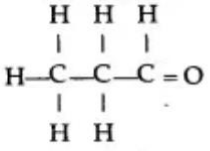
Give the structural formula of the following:

1.	Ethanol.	2.	1-propanal
3.	Ethanoic acid	4.	1,2,dichloroethane
5.	An isomer of n-butane	6.	2-propanol
7.	Di-ethyl ether	8.	Methanoic acid
9.	Ethanal	10.	Ethyne
11.	Acetone	12.	2-methylpropane
13.	Ethanoic acid	14.	But-2-yne
15.	Two isomers of Butane		

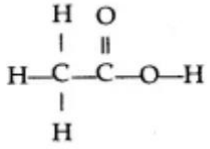
Answer:

1. 

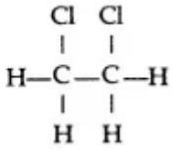
Ethanol

2. 

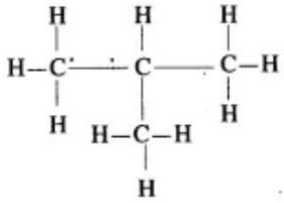
1-Propanal

3. 

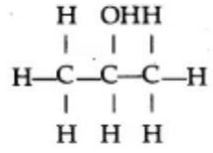
Ethanoic acid

4. 

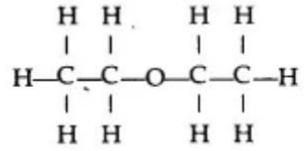
1, 2-Dichloro ethane

5. 

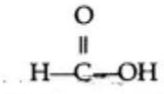
2-methyl propane (an isomer of n-butane)

6. 

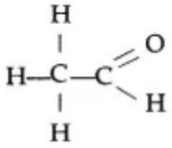
2-propanol

7. 

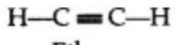
Diethyl ether

8. 

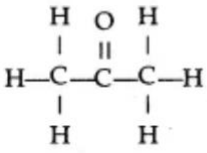
Methanoic acid

9. 

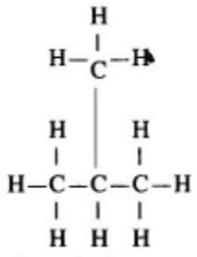
Ethanal

10. 

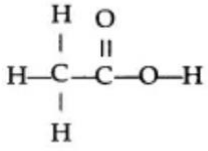
Ethyne

11. 

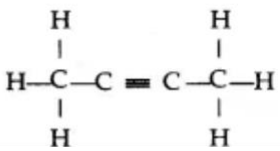
Acetone

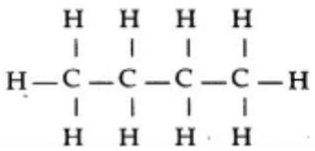
12. 

2-methyl propane

13. 

Ethanoic acid

14. 

15. 

Question2: Give the formula of the next highest homologue of:

1. Methanol 2. Ethane

3. Ethene 4.Ethyne

5. Propyl 6.Methanoic acid

Answer:

1.	Ethanol	—	C_2H_5OH	2.	Propane	—	C_3H_8
3.	Propene	—	C_3H_6	4.	Propyne	—	C_3H_4
5.	Butyl	—	C_4H_9	6.	Ethanoic acid	—	CH_3COOH
7.	Butane	—	C_4H_{10}	8.	Pentene	—	C_5H_{10}
9.	Hexane	—	C_6H_{14}	10.	Ethanal	—	CH_3CHO