CHEMISTRY GRADE-10

BREIF SHORT NOTE AND 84 PRACTICE QUESTIONS WITH ANSWERS @APRIL, 2020

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CHEMISTRY SHORT NOTE FOR GRADE-10@2020

CHAPTER-2

IMPORTANT INORGANIC COMPOUNDS

Inorganic compounds are the compounds consisting of mineral constituents of the earth or generally found in non-living things. The term inorganic compound refers to all compounds that do not contain carbon. Although, carbon dioxide, carbon monoxide, carbonates and hydrogen carbonates are carbon-containing compounds, which are classified as inorganic compounds.

- Inorganic compounds are mostly found in nature as silicates, oxides, carbonates, sulphides, sulphates, chlorides and nitrates, etc.

Inorganic compound are classified based on their composition:

i. Metal they contain such as copper compounds, aluminium compounds, etc

ii. Non-metal they contain such as sulphur compounds, nitrogen compounds, etc.

iii. Group they contain such as sulphates, nitrates, carbonates, etc.

There are four basic inorganic compounds: Oxides, Acids, Bases, and Salts

- Oxides are binary compounds containing oxygen and any other element (metal, non-metal or metalloid).
- Binary compounds are those consisting of only two elements.
- Examples of oxides are calcium oxide, CaO, aluminium oxide, Al_2O_3, sulphur dioxide, SO_2, and carbon monoxide, CO.

1. Acidic oxides

Acidic oxides are the oxides formed by the chemical combination of oxygen with non-metals. Thus, acidic oxides are non-metal oxides.

These oxides are also called acid anhydrides, since they form acidic solutions when reacted or dissolved in water. Acid anhydride means acid without water.

Generally speaking, acidic oxides are non-metal oxides. Examples of acidic oxides include carbon dioxide, CO_2, nitrogen dioxide, NO_2, and sulphur dioxide, SO_2 acidic oxide

2. Basic oxides

They are oxides obtained when metals are chemically combined with oxygen. All metallic oxides are not necessarily basic oxide but the vice-verssa is correct. e.g Al_2O_3, PbO , PbO_2 and ZnO are metallic oxides but they are not basic oxide rather they are amphoteric oxide.

3. Amphoteric oxides

   These are oxides those behave as acidic and basic oxides. When they react with acids they behave as bases and when they react with bases they behaves as acids.

4. Peroxides

   They are oxides in which there is –O-O- leankage. In this oxide the oxidation number of oxygen is -1. E.g H_2O_2, CaO_2, Na_2O_2, K_2O_2, MgO_2

5. **Neutral oxides**

   They are non-metallic oxides those exist rarely. E.g. H_2O,CO, NO

Q. **What are the common characteristics of acidic, basic and amphoteric oxides?**

- ✓ Acidic oxides form salts when reacted with basic oxides and bases.
- ✓ Basic oxides also produce salts in their reactions with acidic oxides and acids.
- ✓ Amphoteric oxides form salts when they react with acids and bases.
- ✓ Thus, acidic oxides, basic oxides and amphoteric oxides are salt-forming oxides.

Indicators

Indicators are organic substances used to identify whether a given solution is acidic or basic by showing/depicting colour changes.

- ✓ Universal indicator and litmus paper serve as indicators.
- ✓ They show different colour in acidic, basic and neutral oxide solutions.

ACIDS

- Acids are among the most familiar of all chemical compounds.
- Acetic acid in vinegar, citric acid in lemons and other citrus fruits, are among the acids that we encounter every day.
- Hydrochloric acid is the acid in gastric juice; it is essential to digestion. Phosphoric acid gives flavour to many carbonated beverages.
- Different scholars define acids differently.

1. **Arrhenuis definition of acid**

According to this definition, acids are substance those furnishes proton(H^+) in aqueos solution.

2. **Bronsted L.definition of acid**

According to him, acids are substance those donate proton to other speices.

3. **Lewis acid**

According to him, acids are substance those accept a pair of electron(s) from another speices.

E.g. $NH_3 + BF_3 \longrightarrow H_3N : BF_3$

Amminia is lewis base (it donates a pair of electrons) whereas boron triflouride is lewis acid (it accept a pair of electrons).

- **All Bronested L. acids can be Arrhenius acid but vice-verssa is not always correct.**

Classification of Acids

- Depending on the number of replaceable (ionizable) hydrogen atom(s) they contain per molecule: monoprotic or polyprotic acids.

A. Monoprotic acids are the acids containing only one ionizable (replaceable) hydrogen atom per molecule or those acids that can furnish only one hydrogen ion per molecule in aqueous solution.

Common examples of monoprotic acids are: HCl, HNO_3, HBr, HI, and CH_3COOH.

B. Diprotic acid : Furnishes two protons in aqueous solution. E.g. H_2SO_4, H_2S, H_2CO_3

C. Terprotic acid: It furnishes three moles of protons. They are said to be ternary acids/oxy-acids. E.g. $HClO_4$, $HClO_3$, H_3PO_4, $HClO_2$, HClO.

General Properties of Acids

1. Acids have a sour taste
2. Acids change the colour of indicators
3. Acids react with acive metals like Na, Mg, K, Ca etc. to form salt and hydrogen gas
4. Acids react with carbonate and bicarbonates/hydrogen carbonate to provide salt, water and carbon dioxide is evolved which is environmentally hazardous.
5. Concentrated acids react with sulphites(H_2SO_3) to provide sulphur dioxide ,salt and H_2O
6. Acids react with bases to form salt +water. This reaction is said to be neutralization reaction.

Concentrated and Diluted Acids

"Concentrated" and "dilute" are terms used to describe the relative amount of acid in a given acid solution.

A concentrated acid contains a relatively large amount (percentage) of acid and a small amount of water. For example, concentrated sulphuric acid is 98% H_2SO_4 and 2% water.

Concentrated acetic acid is 99% acetic acid and 1% water.

But, H_2SO_4 is a strong acid and CH_3COOH a weak acid.

A dilute acid contains a relatively small amount of acid dissolved in large amount of water.

For example, a diluted solution of sulphuric acid may contain 10% H_2SO_4 & 90% H_2O.

Bases

Bases are also inorganic substance those furnishes hydroxide ion(OH^-) in aqueous solution according to **Arrhenius**, they are are also substance those accept proton from other speices according to **Bronested** and they are also substance those donate a pair of electron(s) according to **Lewis** respectively.

p^H and p^{OH}

- ✓ ^{pH} –is the degree measure of acidity/alkalinity of solution. It measures the power of hydrogen. $p^H = -\log[H^+]$
- ✓ p^{OH} –measure the power of the concentration of hydroxide ion.

$$\text{i.e } p^{OH} = -\log[OH^-]$$

- ✓ **The sum of p^H + pOH = 14 at room temperature.**

SALTS

- ❖ Salts are important inorganic compounds derived from bases (cations of bases) and acids (anions of acids). They are ionic cpds formed when ionizable H^+ ion partly/completely replaced by metal ions or ammonium ion. Salts are classified as acidic, basic or normal salts based on the ionizable hydrogen ion they possess. They are also classified as hygroscopic (remain solid after it absorb water in the atmosphere), deliquescent (form solution) and efflorescent which release water of crystallization.

QUESTIONS

I. Write 'True' if the statement is correct and write 'False' if the statement is incorrect

1. Plant nutrients are minerals those are not required by plants for their growth and development.
2. Basic oxides are oxides containing a peroxide (-O-O) link and the oxidation state of oxygen is -1
3. Arrhenius bases are substances that release hydroxide (OH^-) ions in aqueous solution.
4. In the reaction between H_2O and H+ ion, H_2O is electron pair acceptor according to Lewis acid.
5. A salt is an ionic compound containing a cation derived from an acid and anion derived from a base
6. pH is the negative logarithm of hydrogen ion concentration or $pH = -\log [H^+]$.
7. All non-metallic oxides are necessarily acidic oxides but all acidic oxides are not necessarily non-metallic oxides.
8. Amphoteric oxides are oxides those behaves as acids when react with bases.
9. Given the reaction: NH_3 (ι) + H^+ (aq) ⟶ NH_4^+ (aq). Which of the following is true?
   A. H^+ is electron loving species/electrophile
   B. In NH_3 molecule, two lone pair es$^-$ exist on the 3Hs
   C. NH_3 is Lewis acid
   D. H^+ is Lewis base
10. Which of the following inorganic compound is not used as insecticides in agricultural practices?
    A. HCN B. PH_3 C.H2S D.SO_2
11. Given the sulphates of alkaline earth metals i.e $SrSO_4$, $MgSO_4$, $BaSO_4$ & $CaSO_4$. Which trend correctly represent increasing order of solubility these salts?
    A. $SrSO_4 < MgSO_4 < BaSO_4 < CaSO_4$
    B. $CaSO_4 < MgSO_4 < BaSO_4 < SrSO_4$
    C. $BaSO_4 < SrSO_4 < CaSO_4 < MgSO_4$
    D. $BaSO_4 < SrSO_4 < MgSO_4 < CaSO_4$
12. What is the pH of the solution having the concentration of hydroxide ion is $1.1x10^{-4}$M?
    A. 3.96 B. 9.36 C. 10.04 D. $9.0x10^{-19}$

13. The chemical used to kill pests that damage plants growth, development and crop yields is said to be:
    A. Fertilizers B. Herbicides C. Sedatives D. Pesticides
14. Which of the following solution would have a pH value much more graeter than 7?
    A. $[OH^-]= 4.4x10^{-9}M$ B.$1x10^{-3}M$ HCl(aq) C.$[OH^-]= 2.4x10^{-2}M$ D.$[H_3O^+]=1.1999x10^{-7}M$
15. Sodium hydroxide is strong base which is commonly named as:
    A. Epsom salt B. Caustic soda C. Slacked lime D. Caustic potash
16. What is the pH of a solution that has a $[OH^-]$ of 10,000 times greater than a solution with pOH of 5? A. 2 B. 13 C. 14 D.1
17. When 0.50g of sodium hydroxide is dissolved in 0.05L of water, what is the concentration of NaOH solution?
    A. 2.5M B. 5.2M C. 0.25M D. 0.52M
18. Given the phosphates of alkaline earth metals i.e $Be_3(PO_4)_2$, $Mg_3(PO_4)_2$, $Ba_3(PO_4)_2$ & $Ca_3(PO_4)_2$. Which trend correctly represent ascending order of solubility these salts?
    A. $Be_3(PO_4)_2 < Mg_3(PO_4)_2 < Ba_3(PO_4)_2 < Ca_3(PO_4)_2$
    B. $Ba_3(PO_4)_2 < Ca_3(PO_4)_2 < Mg_3(PO_4)_2 < Be_3(PO_4)_2$
    C. $Ca_3(PO_4)_2 < Mg_3(PO_4)_2 < Ba_3(PO_4)_2 < Be_3(PO_4)_2$
    D. $Ba_3(PO_4)_2 < Be_3(PO_4)_2 < Mg_3(PO_4)_2 < Ca_3(PO_4)_2$
19. Among the following salt one normal salt. Which one is it?
    A. Zn(OH)Cl B. $NaHSO_4$ C. KNO_3 D. Ni(OH)Br
20. Kamil and Rashad are grade 10 students. They carryout laboratory experiment on detection of metallic ions in different salts as per their laboratory assistance intended them to do so. Kamil achieved crimson color after he carry out the flames tests of different salts whereas Rashad obtained green color from the same tests on different salts.
    Which ions did Kamil and the second student detected respectively?
    A. Ca^{2+} & K^+ B. Li^+ & Ba^{2+} C. Ca^{2+} & Mg^{2+} D. Be^{2+} & Cl^-
21. Which of the following solution would have a pH value much more graeter than 7? $[OH^-]$
    A. $4.4x10^{-9}$ M C. $1x10^{-3}M$ HCl
    B. $[H_3O^+] = 1.1999x10^{-7}M$ D. $[OH^-] = 2.4x10^{-2}M$
22. Which reagent is used to test the presence of halide ions in laboratory?
    A. Acidified barium solution C. Ferrous sulphate and conc. H_2SO_4
    B. Lime water D. Nitrate solution
23. Which of the following statements is true about oxides?
    I. All types of oxides contain oxygen-oxygen bond in their formula except amphoteric oxide
    II. All metallic oxides are necessarily basic oxides as well all basic oxides are necessarily metallic oxides
    III. Acidic oxides, basic oxides and amphoteric oxides are known by their forming salts in common
    IV. All non-metallic oxides are necessarily acidic oxides whereas all acidic oxides are also necessarily non-metallic oxides.
    A. Only I B. II & III C. I, II & IV D. Only III

24. Among the following salts one is used in the treatment of waste water and etching printed circiuits. Which one is it? A. $CuSO_4$ B. $CaSO_4.2H_2O$ C. $FeCl_3$ D. $FeSO_4$
25. Potassium hydroxide is strong base which is commonly named as:
    A. Lye B. Caustic soda C. Slacked lime D. Caustic potash
26. Assume that sodium hydroxide is added to unknown solution and a reddish brown ppt was formed. The unknown solution would have:
    A. Fe (II) ions C. Cu (II) ions
    B. Fe (III) ions D. Au (III) ions
27. Mortar is a mixture of ---------- is used as binding materials for bricks and plastering walls.
    A. $CaO_2(s)$, SiO_2 & CO_2 C. $CaO(s)$, SiO_2, $H_2O(l)$
    B. $CaO_2(s)$, SiO_4, CO D. $Mg(OH)_2(aq)$, SiO_4, $H_2O(l)$
28. According to Brónsted-Lowery, Bases are:
    A. Electron pair donors C. Proton acceptors
    B. Electron pair acceptors D. Proton donors
29. Which of the following salt is used for covering the surface of metals or metal articles from corrosion?
    A. Copper(II) sulphate C. Lead nitrate
    B. Iron (II) sulphate D. Sodium perchlorate
30. Which one of the following is property of bases is not correct?
    A. They turn red litmus to blue C. They have pH value greater than 7
    B. They have sour taste D. They furnish $[OH^-]$ in aqueous solution
31. Which safety rule in the laboratory is expected from as when concentrated chemicals are splashed to our eyes?
    A. Washing acid entered our eyes with running water immediately and wash with 10% Na_2CO_3 solution
    B. If we encounter such hazardous problem no need of contacting physicians
    C. Drinking concentrated base and washing the affected area by concentrated bases
    D. Such problem is not expected in our laboratory because you knew how to handle and to use chemicals in general.
32. A salt that absorb water from the atmosphere and form a solution is known as:
    A. Efflorescent salts C. Deliquescent salts
    B. Hygroscopic salts D. Normal salts
33. What are negative logarithm of hydroxide ion concentration and that of hydronium ion concentration respectively?
    A. pKa & pOH B. pKb & pOH C. pKw & pH D. pOH & pH
34. The molar concentration of hydronium ion in pure water at 25^0C would be:
    A. 7.00 B. $1.0x10^{-7}$ C. 1.00 D. $1.0 x10^{-14}$
35. Which of the following salt is insoluble salt (under solubility < 0.1g salt/100g H_2O)?
    A. KCl B. Na_2SO_4 C. $LiNO_3$ D. $BaSO_4$

36. Which of the following pairs of elements are not considered as mineral nutrients?
    A. S & P B. Cl & B C. K & Ca D. C & O
37. Which of the following statement is correct?
    I. Salts are inorganic compounds containing positive ions derived from acids and negative ions derived from bases.
    II. All nitrate, formate, acetate and chlorate salts are soluble in water.
    III. Lead chloride is halide salt that soluble in cold water.
    IV. Sodium carbonate and potassium carbonate are salts those resist thermal decomposition.
    A. Only I B. II & IV C. I & III D. Only III
38. Which of the following statement regarding fertilizers is incorrect?
    A. Fertilizers are substance added to soil in order to enhance the growth and development of plants.
    B. Fertilizers are used for crop productions and they are used to enhance crop yield.
    C. Synthetic fertilizers are classified as calcium, aluminium and sulphur fertilizers.
    D. Ammonium sulphate is a synthetic fertilizer applied more in basic soil than acidic soil.
39. Sodium hydroxide is a strong base. This implies that:
    A. Aqueous solutions of NaOH contain equal $[H^+]$ (aq) & $[OH^-]$ (aq).
    B. NaOH does not dissociate at all when it is dissolved in water
    C. NaOH dissociates completely to Na^+ (aq) and OH^-(aq) when it dissolves in water
    D. NaOH cannot be neutralized by a weak acid.
40. Decomposition of sodium nitrate and potassium nitrate up on heating respectively would yield:
    A. Sodium nitrate, O_2(g) and potassium nitrate, O_2(g) C. Na_2O(s), O_2(g) & K_2O(s), O_2(g)
    B. Sodium nitrite, O_2(g) and potassium nitrite, O_2(g) D. Na_2O_2(s), O_2(g) & K_2O_2(s), O_2(g)
41. Which of the following is a hygroscopic salt?
    A. $CaCl_2$ B. $Na_2SO_4.10H_2O$ C. Anhydrous $CuSO_4$ D. $Na_2CO_3.10H_2O$
42. Which of the following acid in aqueous solution is a very strong electrolyte?
    A. H_2SO_4 B. H_2S C. HNO_2 D. H_2SO_3
43. When $Mg(NO_3)_2$(s) is decomposed by heat, which substance would not be formed?
    A. NO_2(g) B. O_3(g) C. MgO(s) D. O_2(g)
44. Which of the following statement is incorrect?
    I. A basic salts are those salts containing ionizable hydronium ions
    II. A normal salt is formed when ionizable hydronium ion of acids are completely replaced by non-metal ions and phosphate ion
    III. An acidic salt is formed when ionizable hydronium ion of acids are completely replaced by metal ions and ammonium ion
    IV. A basic salts are those salts containing ionizable hydroxide ions
    A. Only IV B. I & II C. I, II & III D. Only I
45. For a given solution if the concentration of hydroxide ion is less than $1x10^{-7}$M; which of the following is correct?
    A. $_pH > 7$ B. $[H_3O^+] < 1x10^{-7}$M C. $_pH <$

46. The magnitude of 'Kw' indicate that:
    A. Water autoinizes very slowly C. Water autoionizes very rapidly
    B. Water autoionizes completely D. Water autonizes only to some extent/very small extent
47. Which salt is commonly called 'Epsom salt'?
    A. $CaSO_4.2H_2O$ C. $MgSO_4.7H_2O$
    B. $FeSO_4$ D. $BaSO_4$
48. Which of the following method is not used to prepare an acid?
    A. Decomposition of carbonates and bicarbonates by heating
    B. Dissolving some non-metallic oxides in water
    C. Direct combinations of two different metals
    D. Direct combinations of two different non-metals
49. Which of the following base is strongest base?
    A. $NH_3(aq)$ B. $Mg(OH)_2(aq)$ C. $Ca(OH)_2(aq)$ D. NaOH(aq)
50. What is the mathematical relationship between $_pH$ & $_pOH$ fof a dilute water solution at 25^0C?
    A. $_pOH = {}_pKw + {}_pH$ C. $_pKw = {}_pH + {}_pOH = 14$
    B. $Kw = [H_3O^+][OH^-]$ D. $_pKw = {}_pH - {}_pOH = 14$

CHAPTER-3

ELECTROCHEMISTRY

- **Electrochemistry** is a field of chemistry that deals with the relationship between **electrical energy** and **chemical energy**.
- It is a field of chemistry concerned with processes that bring about **chemical reactions (*changes*)** using **electricity or generating electrical energy** from chemical reactions. Thus, electrical energy and chemical energy are inter-convertible.
- The devices that convert chemical energy to electrical energy or electrical energy to chemical energy are called **electrochemical cells.**
- These cells can be classified as electrolytic cells and galvanic or voltaic cells.

A. Electrolytic cells : It use electrical energy to bring about chemical changes that produce many desirable substances in our daily lives.

- In this cell anode is positive whereas cathode is negative. i. oxdn. –occur at anode and redn. – occur at cathode
- Non-Spontaneous redox reaction take place

B. Galvanic or voltaic cells:

- It converts **chemical energy** to **electrical energy**.
- Anode is negative where oxdn. Occur

- ❖ Cathode is positive where reduction occur
- ❖ spontaneous rexod reaction carry out
- ❖ Ultimate goal of using voltaic cell is **to generate electricity** from the chemical energy stored in the cell when reactions take place.
- ❖ The cells we use in flashlight batteries, wrist watches, cameras and car batteries are examples of Galvanic cells. The reactions between the chemicals in these cells are responsible for the generation of electricity.

Practical applications of electrochemistry

- Electrochemistry has practical applications in our modern world and in everyday life. Electrolysis is used to manufacture of:

- ➢ Metals like sodium, aluminium;
- ➢ Non-metals like chlorine, hydrogen and
- ➢ Compounds like sodium hydroxide and sodium hypochlorite.
- ➢ It plays a significant role in the production of dry cells and lead storage batteries used in the automotive industry.
- ➢ For purification of metals, for electroplating of metals

Classification of Voltaic cell

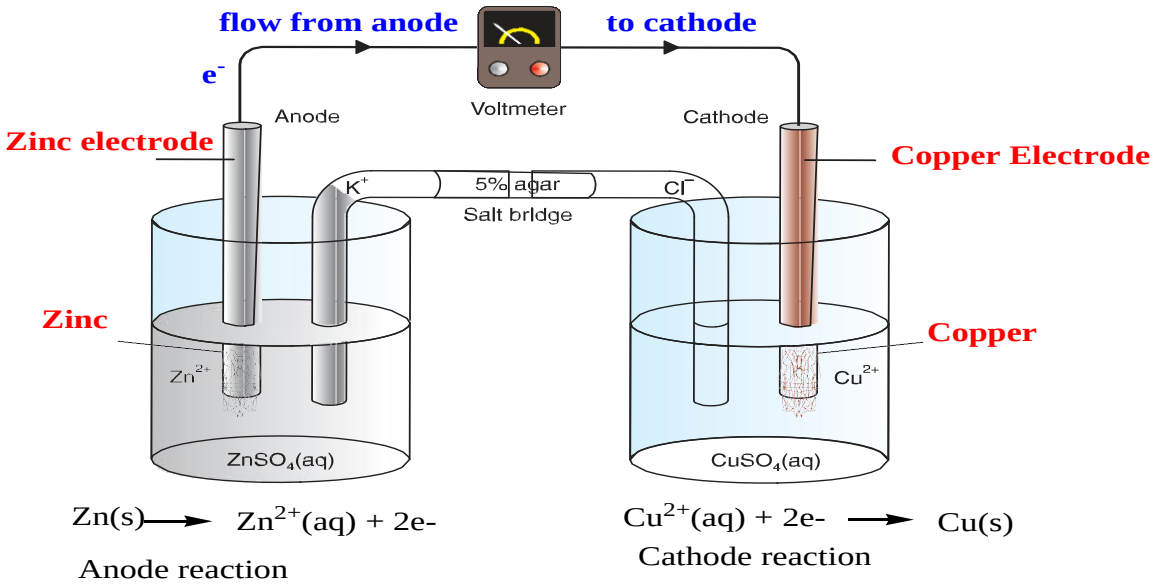
- Primary batteries are disposable because their electrochemical reaction cannot be reversed.
- Secondary batteries are rechargeable, because their electrochemical reaction can be reversed by applying a certain voltage to the battery in the opposite direction of the discharge.

E.g. Simple battery



Classification of primary voltaic cell

1. **Wet primary cell : Electrolyte exist in the form of solution. It has practical problems.**
   E.g. Daniel's cell



2. **Dry primary Voltaic cell : Elecrolyte exist in the form of pastes.**

e.g. Carbon-Zinc(Zn-carbon) Dry Cell

- This is one of the most popular primary cell.
- The negative electrode is made of zinc/ Zn-occur at anode and being oxidized by losing two electrons
- The positive electrode is made of carbon/Cu –occur at cathode thereby reduction taking place by gaining two electrons.
- The output voltage of a single cell is about 1.5 V.
- Performance of the cell is better with intermittent operation.



Secondary cell/Lead-storage battery/Lead-Acid Wet Cell

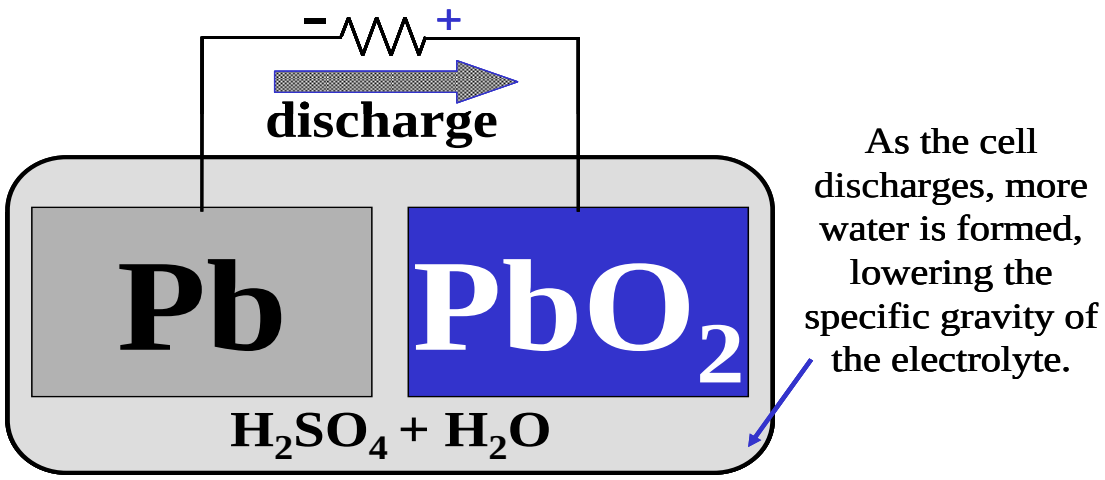
- This cell is a widely applied type of secondary cell, used extensively in vehicles and other applications requiring high values of load current.
- The positive electrode is made of lead peroxide/Pb(IV)oxide occur at cathode.
- The negative electrode is made of spongy lead metal/Lead occur at anode .
- The electrolyte is sulfuric acid/35% of H_2SO_4 (aq)
- The output is about 2.1 volts per cell.
- Cells are typically used in series combinations of 3 (6-V battery) or 6 (12-V battery).

In Secondary cell:

- Anode rxn: $Pb(s) + SO_4^{2-}(aq) \longrightarrow PbSO_4(s) + 2e^-$
- Cathode rxn: $PbO_2(s) + 4H^+(aq) + SO_4^{2-}(aq) + 2e^- \longrightarrow PbSO_4(s) + 2H_2O(l)$

Overall/cell reaction:

$$Pb(s) + PbO_{2(s)} + 4H^+(aq) + 2SO_4^{2-}(aq) \rightleftharpoons 2PbSO_{4(s)} + 2H_2O(l)$$



Nickel Cadmium (NiCd) Cells and Batteries

- This type of cell delivers high current.
- It can be recharged many times.
- It can be stored for long periods of time.

Applications include

- Portable power tools.
- Alarm systems.
- Portable radio and TV equipment.

ELECTROLYSIS

➔ Electrolysis is a process in which electrical energy is used to produce chemical changes.

➔ This process is carried out in an electrochemical cell known as an electrolytic or electrolysis cell.

➔ A typical electrolysis cell contains a source of direct electric current, an electrolyte and connecting wires that join the source to the electrodes.

➔ Electrodes are strips of metal or graphite that allow electrons to leave or enter the electrolytes. They can be chemically active or inert.

➔ Active electrodes directly take part in reactions. Examples include zinc and magnesium.

Inert electrodes do not directly take part in chemical reactions. They only serve to transfer electrons. Examples include platinum and graphite.

➔ The electrode connected to the positive terminal of the source is positively charged and is called the **anode.** It is the electrode through which electrons leave the cell.

➔ The electrode connected to the negative terminal of the source is negatively charged and is called the cathode. It is the electrode through which electrons enter the cell.

During electrolysis, the ions of the electrolyte migrate to the electrodes of the opposite charge.

➔ The positive ions are attracted to the cathode and are called **cations.** Since the cathode has excess electrons, the cations will discharge by gaining electrons.

➔ This process of gaining electrons is called reduction. The negative ions are attracted by the positive electrode (*anode*) and are called **anions.** These ions are discharged by losing electrons at the anode. This process of losing electrons is called **oxidation.**

➔ The reaction that takes place at each electrode is known as a half-cell reaction.

➔ **Oxidation half-reactions** occur at the anode and reduction half reaction at the cathode.

➔ The net reaction that takes place in the electrolytic cell is known as a **cell reaction.**

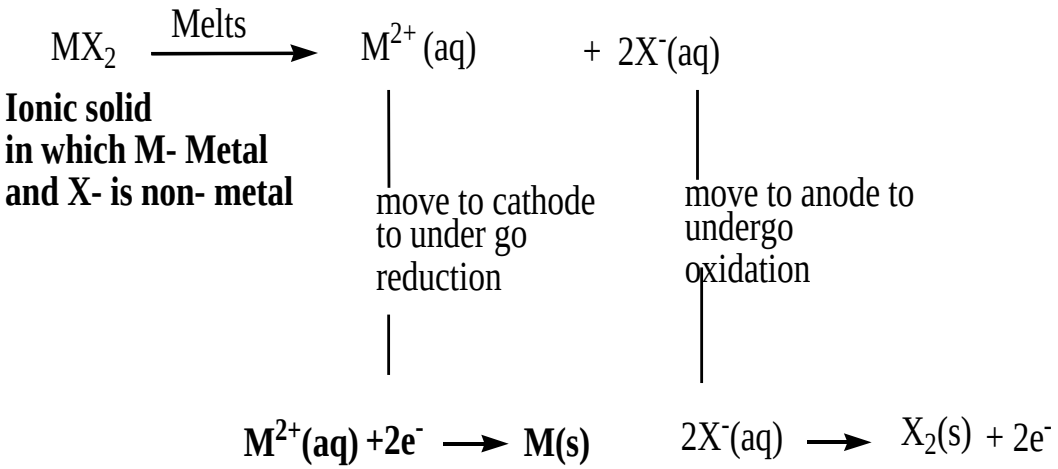
➔ This overall reaction is also referred to as an **oxidation-reduction** reaction or **redox reaction.**

So electrolysis is a process in which electric energy is used to bring about an oxidation-reduction reaction. It is also defined as the decomposition of an electrolyte, using electricity.

➔ The process of electrolysis includes electrolyzing aqueous solutions of electrolytes.

Electrolysis of Molten (Fused) Electrolytes

When ionic solids melt, they dissociates into positive and negative ions that are not held in fixed positions. To understand the chemical reactions that occur during electrolysis, consider a hypothetical electrolyte, MX, that dissociate into M^+ and X^-.



Class work

E.g. Electrolysis of molten NaCl

Anode : Chloride ion is oxidized by losing two electrons .

Cathode: sodium is reduced by gaining two electrons .

Cell rxn: two moles of aqueous sodium ion reacted with equal moles of chloride ion to provide 2moles of Na(s) +Cl_2(g)

➔ Determine the lectrolysis of the following molten ionic substances and write the anodic and cathodic reaction as well the over all reaction respectively

➔ A. Lead bromide, PbBr2

➔ Calcium flouride, CaF2

➔ Sodium chloride, NaCl

- In general, electrolysis is splitting (lysing) of a substance or decomposing by forcing a current through a cell to produce a chemical change for which the cell potential is negative.

➔ It is the process in which the external electrical circuit in electrical energy provide chemical reaction to be occur. This process is non-spontaneous

➔ Anode is **+ve electrode** where oxidation occur whereas cathode is **–ve electrode** at which reduction occur.

Industrial Applications of Electrolysis

1. Production of some laboratory reagents/chemicals like NaOH
2. The Downs Cell for the Electrolysis of Molten Sodium Chloride to produce Na/K metals
3. Making Aluminum by Electrolysis/extraction of Al from bauxite

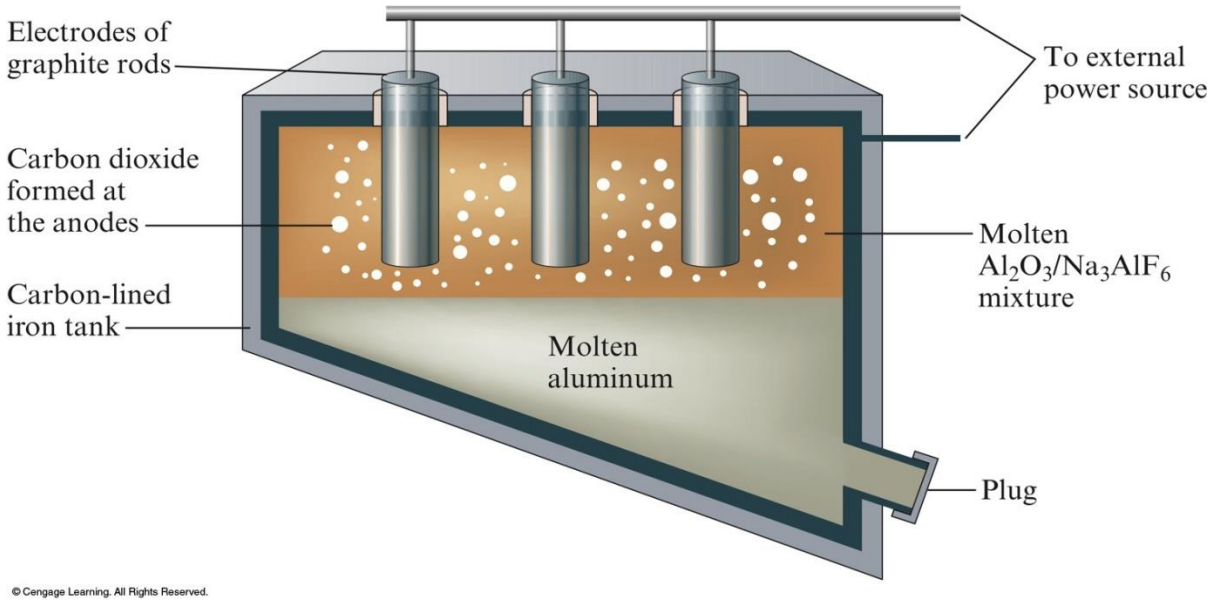


Fig. **A schematic diagram of an electrolytic cell for producing aluminum by the Hall-Heroult process.**

4. Electroplating

Electroplating is the process of reducing a metal on to the surface of another. It is covering the surface of metals by another thin layer of metals. It provides good appearance for metals.

Eg. Au plating a Cu penny

- ✓ Electrolyte-Must contain the ion of the metal that plates
- ✓ Cathode:-The metal to be covered with a new metal
- ✓ Anode-Metal to be plated on top the other metal

5. Electro-refining

The process in which metals are purified by electrolysis is said to be **electro-refining. Electro-refining** is the process of **purifying a metal** by electrolysis.

Example: electro-refining of lead.

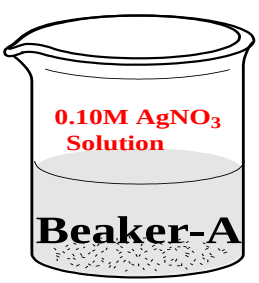
- ✓ Here, the electrolyte must contain Pb
- ✓ Impure metals deposited at anode
- ✓ Pure form of metals deposited at cathode
- ✓ Electrolyte solution must contain ions of metal metal to be purified
- ✓ **Impure** metal is **oxidized** at the **anode** and **pure** metal is **reduced** at the **cathode**.This is the **same** as **electroplating**.

QUESTIONS

II. Choose the most appropriate answer from the given alternatives

51. Which of the following statement is correct?
    A. Oxidation always take place at cathode electrode by gaining electron(s)
    B. Reduction always take place at anode electrode by losing of electron(s)
    C. The process in which chemical energy stored in the cell is used to generate electricity is said to be electrolysis
    D. A type of electrochemical cell in which the free energy change in the cell spontaneously generate electricity is known as voltaic cell
52. Given the hypothetical reaction: $\mathbf{AB_2(fused)} \xrightarrow{\text{Electrolyzed}} \mathbf{A^{2+}(aq) + 2B^-(aq)}$
    A. $\mathbf{A^{2+}}$ -occur at anode and it undergoes reduction by gaining 2electrons
    B. $\mathbf{2B^-}$-occur at anode electrode and it undergoes oxidation by losing 2electrons
    C. $\mathbf{2B^-}$-occur at cathode electrode and it undergoes reduction by gaining 2electrons
    D. Fused electrolysis of such compound is not occur in this material world
53. Which statement is correctly describing the wet primary cell?
    A. Electrolytes are substance used as source of mobile ions and they are made of pastes
    B. Wet primary voltaic cell has no practical problem at all
    C. In this cell Zn- occur at anode and it is being oxidized by losing 2electrons
    D. In this cell Cu- occur at anode and it is being oxidized by losing 2electrons

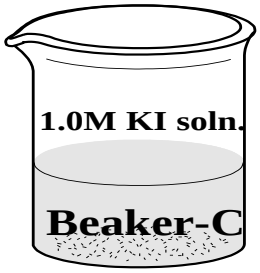
54. Consider the following experiments that are carried out under standard conditions:



A strip of Nikel/Ni is dipped in 0.1M $AgNO_3$ soln



A 1.0M $CuSO_4$ soln. is added to equal molar NaI soln.



Chlorine gas is bubbled through a 1.0M KIsoln.

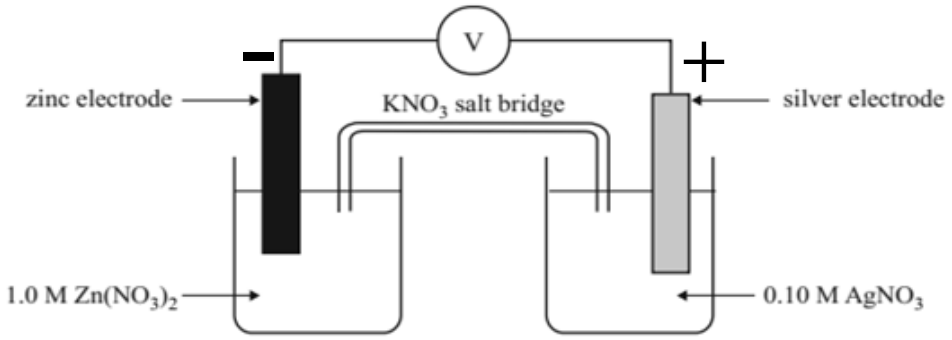
It would be predicted that a reaction will occur in:
A. Only beaker-A B. Only beaker-B C. Beaker-A and C D. Beaker-B and C

55. What makes voltaic/galvanic cell differ from electrolytic cell?
   A. Voltaic cell is a type of electrochemical cell in the electrical energy in the external electrical circuits bring about the chemical change
   B. In a voltaic cell anode is stripped on positive terminal and thereby reduction take place
   C. In a voltaic cell anode is stripped on negative terminal and thereby oxidation take place
   D. Electrolytic cell is a type of electrochemical cell in which the chemical energy stored in the cell is used to generate electrical energy

56. Which of the following conditions is not used to electroplate a tray made of iron with chromium?
   A. Using chromium as the anode C. Using an electrolyte containing chromium ions
   B. Using an electrolyte containing iron (III) D. Using the tray as the cathode

57. Secondary cell/battery is:
   A. Non-rechargeable battery and it is disposed when the battery run down
   B. It is sometimes said to be automotive battery and it can be reversed when battery decline by recharging
   C. Lead(IV) oxide occur at anode and it undergoes oxidation by losing 2electrons
   D. Lead occur at cathode and it undergoes reduction by gaining 2electrons

58. Consider the cell diagram illustrated below:



Which one of the following statements about the cell above is true?

A. Silver is deposited at anode whereas zinc electrode is deposited at cathode
B. The maximum voltage this cell can be deliver will be about 3.5V
C. Three electrons are leave anode cell reaction and the same electrons are enter cathode cell
D. Electrons in the external electrical circuit obtained from voltaic cell flow from zinc electrode to silver electrode

59. What are the charge-carriers in electrolytic conduction and metallic conduction respectively?

A. Only anions and localized electrons C. Ions and delocalized electrons
B. Only cations and localized electrons D. Cations and non-movable ions

60. Which of the following substance does not conduct electricity?

A. Dilute aqueous solution of H_3PO_4 C. Solid magnesium chloride
B. Moist strontium bromide D. Aqueous solution of potassium

61. Which of the following substance is not required to construct certain cell?

A. Electrodes (+ve & -ve)
B. Bolts, nails and clamps those are used to tide cell requirements together very well
C. Electric wire made up of copper in our case
D. Sources of direct current, switch and bulb

62. Among the three allotropes of carbon, graphite is the only substance that conducts electric current through it. Why it so?

A. Because in graphite electrons are arrayed in the tetrahedral structure and are localized very well
B. Because in graphite electrons are arrayed in the trigonal-pyramidal structure and they are delocalized very well
C. Because in graphite electrons are arrayed in the octahedral structure and are delocalized very well
D. Because in graphite electrons are arrayed in the T-shape structure and they are delocalized very well

63. Which of the following statement is incorrect?

A. A battery is portable, self-contained electrochemical power source that consists of one or more voltaic cell
B. The greater voltage can be achieved by using multiple cells connected in series in automotive battery

C. When batteries are connected in parallel, in most flashlight and digital cameras the total voltage is the sum of each voltage in each cell
D. Salt bridge is a porous disk used to maintain electrical neutrality between two solution

64. Which of the following statement is not correct regarding fuel cell?
A. In fuel cell reactants are continuously supplied
B. Fuel cell is essentially used in space exploring science programs
C. In fuel cell hydrogen diffuse to anode and it undergoes oxidation by losing 4 electrons
D. In fuel cell oxygen diffuse to anode and it undergoes oxidation by losing 4 electrons

65. Increasing the concentration of ions in electrolyte solution would:
A. Descends the extent of conduction of electricity through it
B. Ascends the extent of conduction of electricity through it
C. Change the direction of electron flows
D. Has no effect on the conduction of electricity at all

66. Which of the following substance is used as strong electrolyte?
A. HCOOH(aq) B. $CH_3COOH(aq)$ C. $H_2C_2O_4(aq)$ D. $HClO_4(aq)$

CHAPTETR-4
CHEMISTRY IN INDUSTRY AND ENVIRONMENTAL POLLUTION

- A chemical industry is a big institution involved in the production of chemical products.
- It involves the use of chemical processes such as chemical reactions and refining methods to produce a wide variety of materials with desirable properties and quality to satisfy social needs.
- Most of these products, in turn, can be used by other chemical industries to manufacture other items or can be used directly by consumers.
- In chemical industry, there are quality assurance, quality control and they check how the factory is being processed materials starting from raw materials to the desired products before distribution to the customers.

In general; chemical industries:

- ✓ Use naturally-available raw materials to produce the desired products,
- ✓ It involves chemical reactions to transform raw materials into finished and semi-finished products, consume relatively large quantities of energy during the manufacturing process, It also uses safe operation methods in their manufacturing processes, and there are quality control and quality assurances those test their products during and after manufacture in their quality control laboratories in order to ensure that the products meet the required specifications.

NATURAL RESOURCES AND INDUSTRY

Natural resources are those substances occur in nature in this material world.

- They include minerals, soil, water, plants and animals. Natural resources are classified as renewable and non-renewable.

Renewable natural resources- They are resources those can be replenished.

- They can be renewed at the same rate at which they are used. E,g. Plants, animals, soil and water

- **Non-renewable resources -**are resources that are found in a fixed amount in nature and cannot be replenished. E.g. Minerals, rocks, coals, natural gas etc. Non-renewable resources can be completely used up within some decades and cannot be replaced easily. Generally, any chemical industry utilizes either natural resource as starting materials, or other substances obtained from natural resources after processing, as a raw material, for its manufacturing activity.

PRODUCTION OF SOME IMPORTANT METALS AND NON-METALS

1. Production of some important metals (Al, Fe and Cu)

- Unlike those of non-reactive metals/inert metals like Au, Ag and Pt) most reactive metals are not occur in free state rather they occur in combined state in their ores.

A. **Aluminium**

Occurrence and extraction

- Aluminium is the most abundant metal and the third most plentiful element after oxygen and silicon in the earth's crust.

- About 7% of the earth's crust is aluminium. It is the second-most important metal, after iron, in terms of consumption. Aluminium does not occur as a free metal in nature.

- Its principal ore is bauxite ($Al_2O_3.2H_2O$).

- Other minerals containing aluminium are orthoclase ($KAlSi_3O_8$), cryolite (Na_3AlF_6), corundum (Al_2O_3), beryl ($Be_3Al_2Si_6O_8$) and china clay ($Al_2Si_2O_7.2H_2O$).

Aluminium is extracted industrially principally, from bauxite, $Al_2O_3 \cdot 2H_2O$, by the Hall–Héroult process or simply the Hall process.

- In this process, first the bauxite needs to be purified since it is frequently contaminated with silica (SiO_2), iron oxides and titanium (IV) oxide.

- To isolate pure Al_2O_3 from bauxite, the powdered ore is first heated with sodium hydroxide solution to convert silica into a soluble silicate.

Reading assignment

Read the occurrence, chief ores, the physical and chemical properties of iron (Fe) and copper (Cu) and some important non-metals i.e N_2, O_2, Cl_2, Sand P respectively.

SOME INDUSTRIES IN ETHIOPIA

In this chapter, we will look the glass, ceramics, cement, sugar, pulp and paper, leather, and food processing.

Glass Industry

- Glass is an amorphous or non-crystalline solid material. Almost all glass contains silica as the main component. Quartz glass is made by melting pure silica, SiO_2, at a temperature of about 2300°C and then pouring the molten viscous liquid into moulds. It is of high strength, low thermal expansion and highly transparent.

Summary of steps to be followed during manufacturing process of glass in glass factory

Batch preparation ⇨ Glass melting ⇨ Glass forming ⇨ Annealing ⇨ Inspection ⇨

Packing and dispatching ⇨ Distribution to the customers

Ceramics Industry

- ✓ Ceramic is an inorganic, non-metallic solid prepared by the action of heat and subsequent cooling.
- ✓ Traditional ceramics, such as porcelain, tiles and pottery are formed from minerals such as clay, talc and feldspar.

Most industrial ceramics, however, are formed from extremely pure powders of specialty chemicals, such as silicon carbide, alumina, barium titanate, and titanium carbide.

Manufacturing of ceramics

- The minerals used to make ceramics are dug out of the earth and are then crushed and ground into a fine powder.
- Manufacturers often purify this powder by mixing it in a solution and allowing a chemical precipitate (a uniform solid that forms within a solution) to form.
- The precipitate is then separated from the solution.
- The powder is heated to drive off impurities including water.

Raw Materials: Limestone and clay are the chief raw materials used in the manufacture of Portland cement.

Sugar manufacturing in sugar industry

- Sugar cane is the main raw material.
- Sugar cane harvested, crushed/grinded, dried first.
- Sugar cane process include:

  Entry-----Milling by milling machine------ Clarification (adding lime juice)---- Evaporation------ Crystallization-----Separation----Refining(remove impurities from sugar) by bleaching-------Drying-----Store in storage tank

Pulp and paper Industry

- Pulp and paper is made up of cellulose fiber,
- The main raw material are: wood and wool.

  Steps to be followed during manufacture of pulp and paper are:

STEPS: Wood preparation -----Cooking by adding solution of NaOH/Na_2S ----Pulp washing---------- Pulp screening-------Bleaching (1st adding NaOH to remove H ion from lignin and O_2 to break down polymer and 2nd adding ClO_2 to remove remains of lignin)--------Paper making

Leather Industry

- ✓ Tanning is conversion of animal's raw hides/skins in to suitable materials in which it is not putrefaction.

  The following steps are take in to considerations:
- ✓ Soacking & Scudding to remove dirty things ------Liming to remove hairs-----Deliming----- Bating --------Pickling------degreasing------dyeing-----finishing

Types of tanning

1. **Chrome tanning/Wet blue**

- It is faster
- It is easy to manipulate and provide leather
- It is environmentally not friendly and it is unpleasant to touch

2. Vegetable tanning: obtained from vegetables.

- It is expensive
- It has good lightness
- It has high softness
- It take time
- ✓ It is pleasant to touch

FOOD PROCESSING

Food processing industries manufacture different food items.

- ✓ Heating/blanching is used to reduce microbial load, improve enzymes attack i.e canning, & freezing
- ✓ Pasteurization reduce microorganisms i.e drying, refrigeration and sterilization.

Steps: Drying-----Irradiation -----Concentration -----Freezing------Chemical preservatives----------Chilling----Fermentation

ASSIGNMENT

1. Discuss pollutants and pollutions
2. State water pollution and its remedies in detail
3. What are the main agents those cause air pollution? Discuss them.
4. What are the main agents those cause land pollution? Discuss them.
5. Define green house effect and mention the green house gas?
6. What are the main issues of the green chemistry in the world? Discuss in detail
7. Compare and contrast between CFC, SO_X,NO_X and CO_X based on effect they exhibit on climate change.

I. Write 'True' if the statement is correct and write 'False' if the statement is incorrect

67. Pollution is the discharge of useful waste material into the environment.
68. The traditional and modern methods used in food processing and preservation are salting, pickling,
    sugaring, smoking, drying, canning etc
69. Paper and pulp are manufactured from animal's remains in a series of steps.
70. Sulphur is used for the manufacture of sulphuric acid by the Contact Process.
71. Steel is an alloy of iron containing definite amounts of carbon and other metals like chromium, nickel, tungsten, vanadium, manganese etc.
72. Land pollution results from the spillage of oil, leaching of harmful chemicals and heavy metal ions, and dumping of non-biodegradable wastes such as plastics.

I. Choose the most appropriate answer from the given alternatives

73. Which of the following process is not used in the conversion of pig iron to steel?
    A. Bessemer converter
    B. Open-Hearth Furnace
    C. Basic Oxygen Process
    D. Ostwald process
74. Sulphur is the main raw material for the production of H_2SO_4 by the Contact Process. In which stage catalyst V_2O_5 is used?
    A. When sulphur is oxidized to form sulphur dioxide
    B. When sulphur dioxide is converted to sulphur trioxide at high temperature
    C. When sulphur trioxide is absorbed into concentrated sulphuric acid to produce oleum
    D. When oleum is then diluted with water to produce the desired concentration of sulphuric acid.

75. Which trend is correctly state the steps in which glass is industrially manufactured?
    A. Batch-preparation ⟹ Glass-forming ⟹ Annealing ⟹ Glass-melting ⟹ Inspection ⟹ Packing and dispatching
    B. Batch-preparation ⟹ Glass-forming ⟹ Annealing ⟹ Inspection ⟹ Packing and dispatching ⟹ Glass-melting
    C. Packing & dispatching ⟹ Glass-melting ⟹ Glass-forming ⟹ Annealing ⟹ Inspection ⟹ Batch preparation
    D. Batch-preparation ⟹ Glass-melting ⟹ Glass-forming ⟹ Annealing ⟹ Inspection ⟹ Packing and dispatching
76. The process of removing coloring matter from wood pulp and increasing its brightness.
    A. Annealing B. Bleaching C. Soaking D. Scudding
77. Any discharge of a solid, liquid or gaseous substance or radiation (*energy*) in to an environment that causes unwanted changes is said to be:
    A. Pollution B. Corrosion C. Contaminets D. Slug
78. Which of the following methods are not remedies used to reduce water pollution?
    A. Avoid unnatural temperature changes in natural water systems; industries should not discharge heat-laddered water into them.
    B. Non-Recycling industrial and agricultural wastes.
    C. Using moderate amounts of agricultural chemicals and increasing the use of organic fertilizers and biological methods to control pests.
    D. Use water treatment in plant before discharge into rivers and lakes.
79. What is the function of adding gypsum salt to the cements' raw materials during industrial manufacture of cements?
    A. In order to solidify cement
    B. In order to make cement become fine powder
    C. To acidify cement
    D. To enhance impurities in cement
80. Which of the following statement is incorrect?
    A. Lithium ion battery (LIB) is the latest rechargeable battery that delivers 3.5-3.6V from a single cell.
    B. The purest form of iron is cast iron and it is directly obtained from blast furnace.
    C. Wet primary cell has practical problems because they are not easily handle/not portable.
    D. Electrolysis is used for extraction metals from their ores.
81. Which of the following statement is incorrect?
    A. In Chloro-Alkali industry brine solution is the chief raw material
    B. Mineral tanning is more slower but environmentally friendly than chrome-tanning
    C. Since red phosphorous poisonous and unstable, it must be stored under water
    D. In the stratosphere ozone resists ultra violet radiation not reach the surface of the earth
82. Which alloy is mismatched with the combined atoms it was formed from?
    A. Brass- Cu & Zn B. Solder-Al & Hg C. Duralumin- Al, Cu & Mg D. Bronze- Cu & Sn

83. Which of the following activities is used to reduce pollution?
    A. Releasing wastes in the atmosphere at very high altitude
    B. Burning wastes in an open air in the center of town
    C. Incinerating non-biodegradable waste materials in an open air in the town
    D. Recycling industrial and agricultural wastes

THANK YOU!!

CHEMISTRY GRADE-10

BREIF SHORT NOTE AND PRACTICE QUESTIONS

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April, 2020
Oromia, Ethiopia

ANSWER KEY

1	False	14	C	27	C	40	B	53	C	66	D	79	B
2	False	15	B	28	C	41	C	54	D	67	False	80	B
3	True	16	D	29	A	42	A	55	C	68	True	81	C
4	False	17	C	30	B	43	B	56	C	69	False	82	B
5	False	18	B	31	A	44	B	57	B	70	True	83	D
6	True	19	C	32	C	45	A	58	C	71	True		
7	False	20	B	33	D	46	D	59	C	72	True		
8	True	21	D	34	B	47	C	60	C	73	D		
9	A	22	D	35	D	48	C	61	B	74	B		
10	C	23	D	36	D	49	D	62	C	75	D		
11	C	24	C	37	B	50	C	63	C	76	B		
12	C	25	D	38	C	51	D	64	D	77	A		
13	D	26	B	39	C	52	B	65	B	78	B		