

Final 2018

Part (1)

Chapters 1, 4 & Hydrocarbons

Chapter One

Transition Elements

1- **Choose the correct answer for each of the following:**

- 1) The main transition elements consist of ten vertical columns, the electronic configuration of the first column is
- a) $[ns^1, (n-1)d^0]$ b) $[ns^1, (n-2)d^1]$ c) $[ns^2, (n-1)d^1]$ d) $[ns^2, (n-1)d^3]$
- 2) The electron configuration $[_{18}\text{Ar}] 3d^5$ is for $[_{26}\text{Fe} - _{25}\text{Mn} - _{24}\text{Cr} - _{27}\text{Co}]$
- a) Fe^{3+} b) Mn^{3+} c) Cr^{2+} d) Co^{3+}
- 3) The transition element that has not the maximum oxidation state corresponding to the removal of all electrons from (4s and 3d) is
- a) scandium. b) titanium. c) manganese. d) iron.
- 4) All of the following compounds are attracted to external magnetic field except:
- a) FeCl_3 b) MnO_2 c) ZnCl_2 d) CuSO_4 $[_{26}\text{Fe} - _{25}\text{Mn} - _{30}\text{Zn} - _{29}\text{Cu}]$
- 5) Bronze alloy consists of while brass alloy consists of
- a) $\text{Cu} + \text{Zn} / \text{Cu} + \text{Sn}$. b) $\text{Cu} + \text{Sn} / \text{Cu} + \text{Zn}$.
- c) $\text{Fe} + \text{Zn} / \text{Zn} + \text{Sn}$. d) $\text{C} + \text{Zn} / \text{Zn} + \text{Sn}$.
- 6) Carbon and iron form alloy.
- a) interstitial b) substitutional
- c) intermetallic d) a and c together
- 7) On passing hot steam over red hot iron it gives and hydrogen.
- a) Fe_3O_4 b) Fe_2O_3 c) FeO d) $\text{Fe}(\text{OH})_2$
- 8) Iron dissolves in diluted acids and produces
- a) Iron (III) salts. b) Iron (II) salts.
- c) Iron (II) oxide. d) Iron (III) oxide.
- 9) Heating iron II oxalate in the presence of air produces
- a) Iron II oxide. b) Magnetic iron oxide.
- c) Iron III oxide. d) Iron II carbonate.

The answer:

- 1- c) $[ns^2, (n-1)d^1]$ 2- a) Fe^{3+}
- 3- d) iron. 4- c) ZnCl_2
- 5- b) $\text{Cu} + \text{Sn} / \text{Cu} + \text{Zn}$. 6- d) a and c together
- 7- a) Fe_3O_4 8- b) Iron (II) salts. 9- c) Iron III oxide.

2- **Write the scientific term which illustrates each of the following statements:**

- 1) A transition element which is added to mercury vapour lamps to produce light with high quality.
- 2) An oxide of a transition metal used in the manufacture of dyes used in ceramics and glass industry.
- 3) The method of converting water gas (a mixture of carbon monoxide and hydrogen) into liquid fuel.
- 4) A group of elements, their 4d sublevel is successively filled with electrons and are located in the fifth period in the periodic table.
- 5) A transition element from the first transition series gives an oxidation number exceeds its vertical group number.

- 6) A property arises in ions, atoms or molecules due to the presence of single electrons in its orbitals.
- 7) The magnetic moment of a transition element in its atomic state and its oxidation state (+2) equal 5.
- 8) The process in which the fine particles of the iron ore are collected in larger size to be similar and homogeneous.
- 9) Increasing the percentage of iron in its ores by removing impurities and strange substances by means of surface tension and magnetism.
- 10) Heating iron ore strongly in air to expel humidity and increase the percentage of iron.
- 11) One of iron ores that is difficult to be oxidized.
- 12) The iron produced from the oxygen converter.
- 13) A mineral acid that can remove passivity of iron.

The answer:

- | | |
|--------------------------------|--|
| 1- Scandium. | 2- Vanadium pentoxide. |
| 3- Fischer Tropsch method. | 4- Elements of Second transition series. |
| 5- Copper. | 6- Paramagnetic property. |
| 7- Manganese. | 8- Sintering. |
| 9- Concentrating process. | 10- Roasting. |
| 11- Haematite. | 12- Steel. |
| 13- Diluted hydrochloric acid. | |

3- Write the scientific explanation for each of the following:

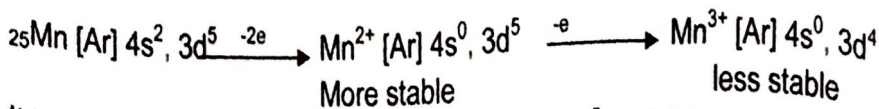
- 1) Titanium dioxide is used in the synthesis of sun protection cosmetics.
- 2) Titanium is used in dental implants and artificial joints.
- 3) Vanadium is used in the manufacture of car springs.
- 4) Chromium resists corrosion in spite of its chemical reactivity.
- 5) Nickel-chromium alloys are used in industry of heating coils and electric furnaces.
- 6) Oxidation of manganese (II) ion into manganese (III) ion is difficult ($_{25}\text{Mn}$).
- 7) It is difficult to obtain scandium ions, Sc^{2+} and Sc^{4+} .
- 8) Group 1B elements are transition elements.
- 9) Transition elements are characterized by variable oxidation numbers.
- 10) The decrease in atomic volume across the elements of the first transition series is not large.
- 11) The density of iron is higher than the density of titanium.
- 12) Iron is melted at a very high temperature (1538°C).
- 13) The elements of the first transition series are considered as ideal catalysts.
- 14) Chromium III compounds appear green.
- 15) The colour of siderite ore turns red during roasting process.
- 16) The element soft the first transition series are used in making alloys.
- 17) It is not preferable to use iron or manganese elements in their pure state.

The answer:

- 1- Because its minute nanoparticles prevent reaching the ultra violet rays (UV) to the skin.
- 2- Because it is inert substance so the body doesn't reject it and it doesn't cause any type of poisoning.
- 3- Because it forms with iron, ferrovanadium alloy which has a high strength and it is resistant to corrosion.
- 4- Due to the formation of a non porous oxide layer on its surface where the volume of oxide molecules are bigger than the volume of chromium atoms. This non porous oxide layer prevents further reaction with oxygen of air.

5- Because they resist corrosion, when they are heated strongly.

6- From the electronic configuration:



It is clear that Mn^{2+} ion has half filled d sublevel (d^5) which is more stable than Mn^{3+} ion, so it is difficult to oxidize Mn^{2+} to Mn^{3+} .

7- Since the electronic configuration of ${}_{21}\text{Sc}$ is $[\text{Ar}] 4s^2 3d^1$ so it is difficult to obtain Sc^{2+} because it is more stable by having empty (d) sublevel ($3d^0$) and it is difficult to obtain Sc^{3+} because it needs a great amount of energy to be obtained due to the breaking of completely filled energy level which represent the stable electron structure of argon.

8- Because in their oxidation states (+2) or (+3) the sublevel (d) will be partially filled (d^8) or (d^8).

9- Because the two sublevels 4s and 3d are of close energy and their electrons are lost in sequence.

10- Due to two opposite factors:

- By increasing atomic number the attraction force of the positive nuclear charge to the valence electrons increases causing a decrease in the atomic radius.
- By increasing atomic number the number of 3d electrons increases which increases the repulsion force between them causing an increase in the atomic radius.

As a result of these two opposite factors, atomic radii of these elements are relatively constant.

11- Because Density = atomic mass ÷ atomic volume

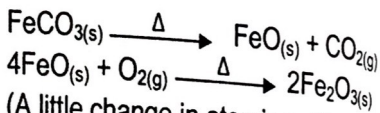
Since the atomic mass of ${}_{26}\text{Fe}$ is more than atomic mass of ${}_{22}\text{Ti}$ and the atomic volume is nearly constant therefore the density of iron is higher than the density of titanium.

12- Due to the strong binding (metallic bond) between atoms which includes sharing the electrons of 4s and 3d in this binding.

13- Due to the presence of 4s and 3d – electrons which can be used in the formation of bonds between the atoms of the surface of the catalyst and the reacting molecules leading to the increase of concentration of these molecules at the surface of the catalyst. Weakness of the bond between the reacting molecules leads to decrease in its activation energy which increases the rate of the chemical reaction.

14- Because it absorbs the red colour so appears by its complementary colour which is green.

15- Due to the formation of iron III oxide which is red:



16- because their atomic radii are nearly the same (A little change in atomic radii through the series).

17- Because iron is relatively soft with low hardness and manganese has high brittleness.

4- Mention one use for each of the following:

- Manganese dioxide
- Manganese II sulphate
- Cobalt.
- Divided nickel.
- Fehling solution** and what change would happen to it when it is used?
- Zinc sulphide.
- Haematite

The answer:

- 1- Oxidizing agent in dry cell.
- 2- Fungicide.
- 3- In the manufacture of:
 - a) Magnets.
 - b) Dry batteries in modern cars.
- 4- In hydrogenation of oils.
- 5- Fehling solution is used to detect glucose in which its blue colour changes into orange.
- 6- In the manufacture of luminous paints and X-ray screens.
- 7- Iron ore used in extraction of iron.

5- What is meant by:

- 1) Transition element.
- 2) Crushing process.
- 3) Passivity phenomenon.

The answer:

- 1- Transition element is the element whose (d) or (f) sublevel is partially filled (occupied by electrons but not completely filled) in either the atomic state or in one of its oxidation states.
- 2- It is the process of obtaining the ore in small sizes to be suitable for reduction.
- 3- It is the formation of a thin non porous layer of oxide on the metal surface which protects it from further reaction.

6- Compare between each of the following:-

- 1- Paramagnetic and diamagnetic substances.
- 2- The Blast furnace and Midrex furnace according to:
 - a- The reducing agent.
 - b- The source of obtaining the reducing agent.
 - c- The equation of the reaction to obtain iron.
- 3- Interstitial, substitution and inter-metallic alloys.

The answer:

1-

Paramagnetic substance	Diamagnetic substance
It is the substance which is attracted to the external magnetic field due to the presence of unpaired electrons in its orbitals.	It is the substance which is repelled with the external magnetic field due to the presence of all its electrons in a paired state in its orbitals.

2-

Point of comparison	Blast furnace	Medrix furnace
The reducing agent.	Carbon monoxide	Carbon monoxide and hydrogen
The source of obtaining the reducing agent.	Coke as follows: $C_{(s)} + O_{2(g)} \xrightarrow{\Delta} CO_{2(g)}$ $CO_{2(g)} + C_{(s)} \xrightarrow{\Delta} 2CO_{(g)}$	The natural gas as follows: $2CH_{4(g)} + CO_{2(g)} + H_2O_{(v)} \xrightarrow{\Delta} 3CO_{(g)} + 5H_{2(g)}$
The equation of the reaction to obtain iron.	$Fe_2O_{3(s)} + 3CO_{(g)} \longrightarrow 2Fe_{(s)} + 3CO_{2(g)}$	$2Fe_2O_{3(s)} + 3CO_{(g)} + 3H_{2(g)} \xrightarrow{\Delta} 4Fe_{(s)} + 3CO_{2(g)} + 3H_2O_{(v)}$

Interstitial alloys	Substitution alloys	Inter-metallic alloys
It is formed when an element of smaller atomic size is introduced in the intermolecular spaces of the crystal lattice of a pure metal.	It is formed when some atoms of the lattice of the pure metal are replaced by atoms of the metal added. All the atoms of the alloy have the same diameter, the same chemical properties and the same crystalline structure.	It is formed when the elements forming the alloy combine with each other to form chemical compounds with chemical formulas disobey the laws of valency. The compounds formed are solids and cannot be formed by metals of the same group of the periodic table.
e.g. Iron and carbon alloy (steel)	e.g. Copper - gold alloys and iron - nickel alloys.	e.g. Duralumin alloy, lead-gold alloy and cementite (Fe ₃ C) alloy

7- Show by a chemical equation:

1) The effect of heat on:

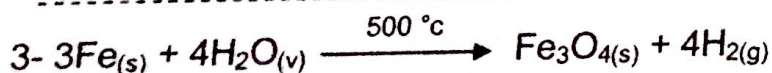
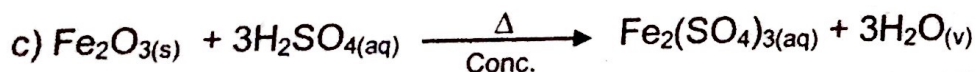
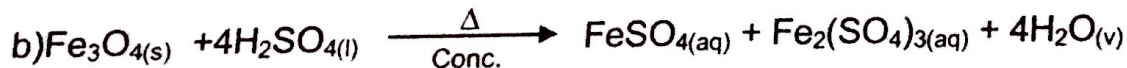
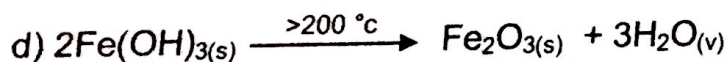
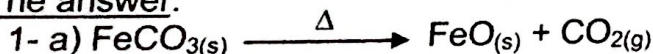
- Iron II carbonate.
- Iron II oxalate.
- Iron II sulphate.
- Iron III hydroxide.

2) Adding hot concentrated sulphuric acid to:

- Iron.
- Magnetic iron oxide.
- Iron III oxide.

3) The effect of passing water vapour (steam) on red hot iron.

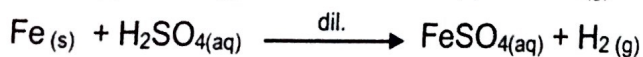
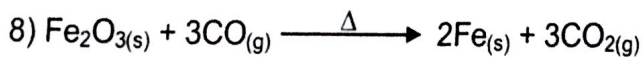
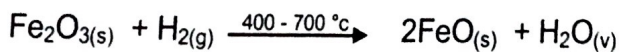
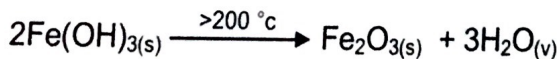
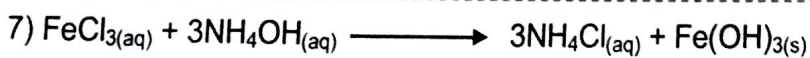
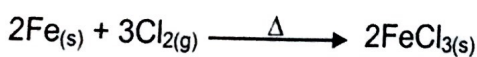
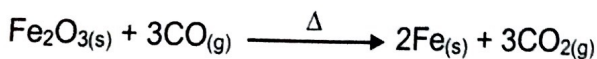
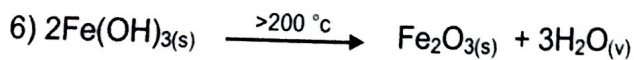
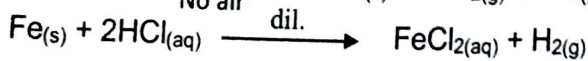
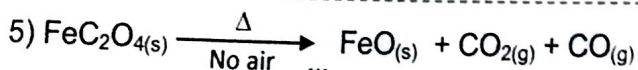
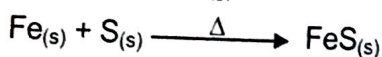
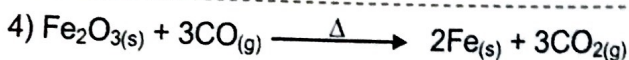
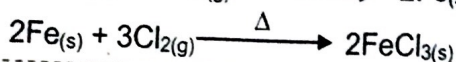
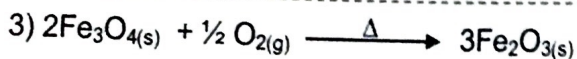
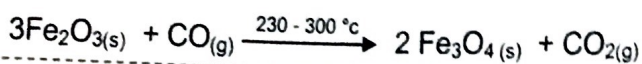
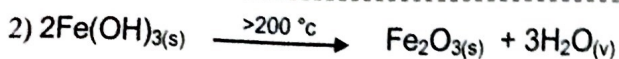
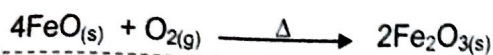
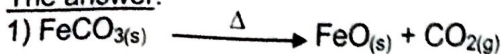
The answer:



8- Show by equations how to obtain:

- 1) Iron III oxide from siderite.
- 2) Magnetic iron oxide from iron III hydroxide.
- 3) Iron III chloride from magnetic iron oxide.
- 4) Iron II sulphide from iron III oxide.
- 5) Iron II chloride from iron II oxalate.
- 6) Iron III chloride from iron III hydroxide.
- 7) Iron (II) oxide from iron (III) chloride.
- 8) Iron II sulphate from Iron III oxide.

The answer:



9- How can you differentiate between each of the following:

- 1- Iron filings and Iron (II) oxide .
- 2- Conc. and dil. sulphuric acid by using iron filings.
- 3- Iron (II) oxide and Iron (III) oxide.

The answer:

1- By adding dilute hydrochloric acid on both of them separately.

If hydrogen gas, which burns with pop sound evolves, so it is iron metal.

If no gas evolves, so it is iron (II) oxide.

2- By adding iron filings on both of them separately.

If hydrogen gas which burns with pop sound evolves, so it is dilute sulphuric acid.

If sulphur dioxide gas which does not burn with pop sound evolves, so it is concentrated sulphuric acid.

3- By adding dilute sulphuric acid or dilute hydrochloric acid on both of them separately.

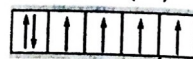
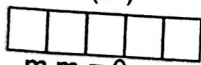
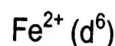
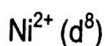
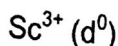
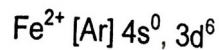
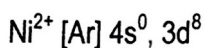
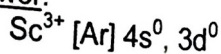
If the metal oxide reacts with the acid (dissolved), so it is iron (II) oxide.

If the metal oxide does not react with the acid (not dissolved), so it is iron (III) oxide.

10- Answer the following:

1- Arrange the following ions: (Iron (II) – Scandium (III) – Nickel(II) ions) in an ascending order according to their magnetic moment giving that:
(${}_{26}\text{Fe}$ - ${}_{21}\text{Sc}$ - ${}_{28}\text{Ni}$)

The answer:

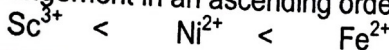


m.m = 0

m.m = 2

m.m = 4

∴ The arrangement in an ascending order according to its magnetic momentum is



2- Classify the following ions to coloured and colourless substances:

(Mn^{7+} / Co^{2+} / Cu^{1+}) given that

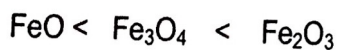
(${}_{25}\text{Mn}$ - ${}_{27}\text{Co}$ - ${}_{29}\text{Cu}$)

The answer:

$\text{Mn}^{7+}(d^0)$ is colourless, $\text{Co}^{2+}(d^7)$ is coloured, $\text{Cu}^{1+}(d^{10})$ is colourless.

3- Arrange the following oxides in ascending order according to the percentage of oxygen: FeO , Fe_2O_3 , Fe_3O_4 (Fe = 56 , O = 16)

The answer:



$$\text{The percentage of oxygen} = \frac{\text{mass of oxygen}}{\text{molar mass}} \times 100$$

$$\text{The percentage of oxygen in FeO} = \frac{16}{72} \times 100 = 22.22\%$$

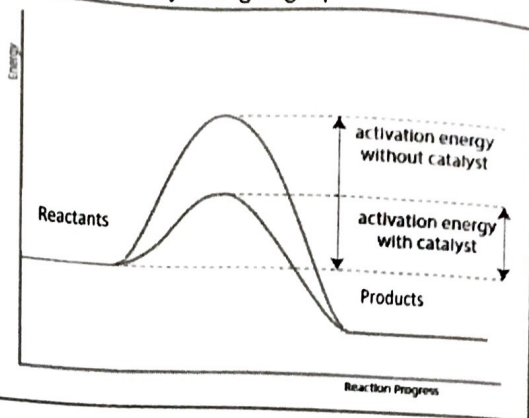
$$\text{The percentage of oxygen in Fe}_3\text{O}_4 = \frac{64}{232} \times 100 = 27.6\%$$

$$\text{The percentage of oxygen in Fe}_2\text{O}_3 = \frac{48}{160} \times 100 = 30\%$$

4- What is the role of: Catalyst in industry. illustrate your answer by using a graph

The answer:

Catalyst decreases the activation energy of the chemical reaction which increases the rate of the chemical reaction.



5- Write the chemical formula of:

a) Lead – gold alloy.

b) Limonite.

c) Black iron oxide.

d) Haematite.

e) Cementite.

f) An organic compound used to obtain iron II oxide.

The answers:

a) Au_2Pb

b) $2\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$

c) Fe_3O_4

d) Fe_2O_3

e) Fe_3C

f) FeC_2O_4

6- Classify the following alloys into interstitial alloy, substitution alloy and inter-metallic alloy:

1- Duralumin

2- Stainless steel (Fe,Cr)

3- Gold, copper

4- Cementite (Fe_3C)

5- Iron, nickel

6- Steel (Fe,C)

7- Lead, gold (Au_2Pb)

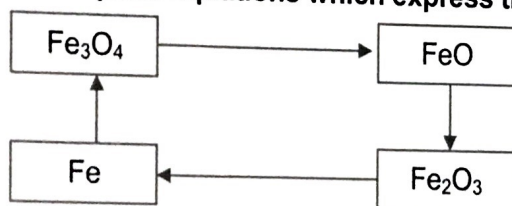
The answer:

Interstitial alloy: 6-Steel (Fe,C)

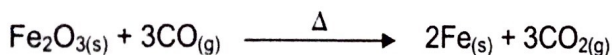
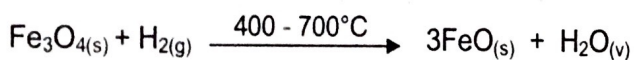
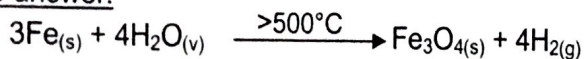
Substitution alloys: 2-Stainless steel (Fe,Cr) , 3- Gold, copper, 5- Iron, nickel

Inter-metallic alloys: 1- Duralumin, 4- Cementite, 7- Lead, gold (Au_2Pb)

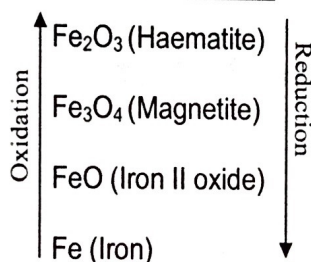
7- Write complete equations which express the reactions in the following diagrams.



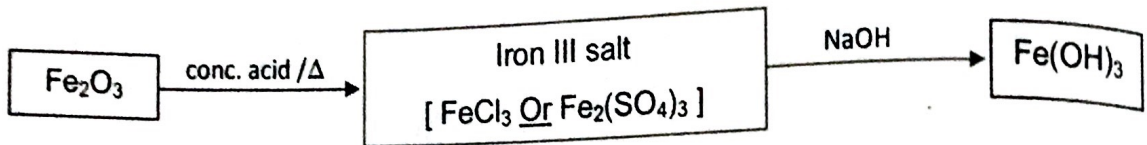
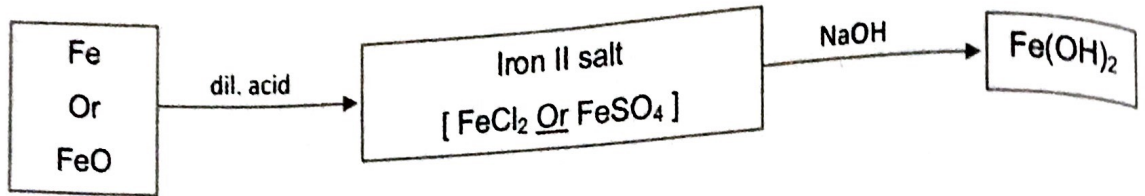
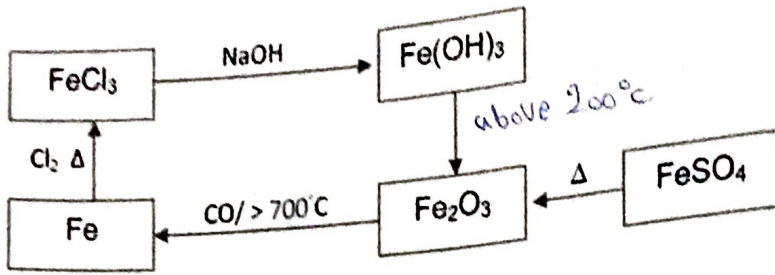
The answer:



Remember:



Important reactions:



N.B. Revise AL MOALEM. Questions: Q5 p.14, Q20 p.22 & 23

Chapter Four

Electrochemistry

Some important relations:

- The electromotive force can be calculated by one of the following rules:

e.m.f = the oxidation potential of the anode – the oxidation potential of the cathode

OR

= the reduction potential of the cathode – the reduction potential of the anode

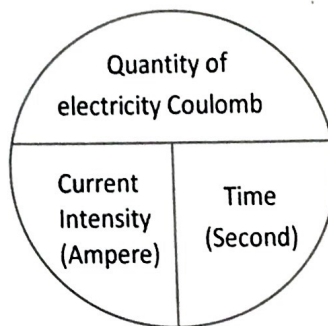
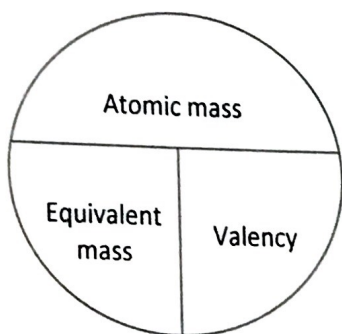
OR

= the oxidation potential of the anode + the reduction potential of the cathode

N.B:

If the value of e.m.f is positive, the cell is galvanic and produces electricity.

If the value of e.m.f is negative, the cell is electrolytic and does not produce electricity.



Passing one faraday (96500 coulomb) produce equivalent mass of any substance.
(General law of electrolysis)

$$\bullet \text{ Mass} = \frac{(Ixt) \times \text{Equivalent mass}}{96500}$$

Mass = Q in faraday x equivalent mass.

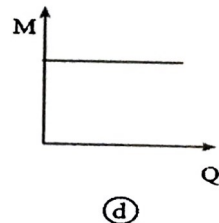
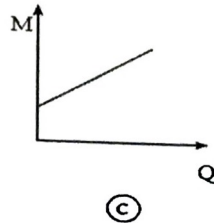
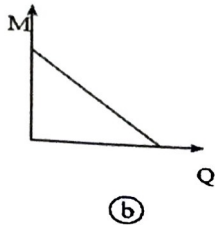
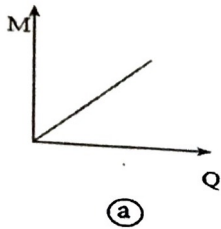
- The quantity of electricity needed to produce **one gram atom** (atomic mass) of an element = valency of element x

- According to Faraday's second law:

$$\frac{\text{Mass of X}}{\text{Mass of Y}} = \frac{\text{Equivalent mass of X}}{\text{Equivalent mass of Y}}$$

1- Choose the correct answer for each of the following:

- 1) replaces the hydrogen of acids.
 - a) Zn^{2+} / Zn (-0.76V)
 - b) Cu^{2+} / Cu (+0.34V)
 - c) Fe / Fe^{2+} (+0.409V)
 - d) more than one is correct
- 2) The elements which have the more positive reduction potential are agent.
 - a) strong reducing
 - b) weak oxidizing
 - c) strong oxidizing
 - d) all the pervious
- 3) The standard reduction potential of hydrogen in fuel cell is.....volt.
 - a) 0.83
 - b) -0.83
 - c) 0
 - d) 0.4
- 4) Concentration of sulphuric acid in the charged lead storage cell is the concentration of the acid in the discharged cell.
 - a) more than
 - b) equal to
 - c) less than
- 5) In lithium ion battery, the three thin layers are dipped in anhydrous electrolytic solution of
 - a) $LiCoO_2$
 - b) LiC_6
 - c) $LiPF_6$
 - d) LiP_2F_6
- 6) Which of the following graphs represents the relationship between the mass of the precipitated or evolved substance at the cathode (M) and the amount of electricity (Q) in an electrolytic solution?



- 7) The quantity of electricity required to precipitate 9 grams of aluminum (^{27}Al) from the electrolysis of molten $AlCl_3$ equals faraday.
 - a) 0.5
 - b) 1
 - c) 2
 - d) 3
- 8) The amount of electricity required to precipitate $\frac{1}{2}$ mole of silver from the solution of one of its salts is:
 - a) 96500 Coulomb.
 - b) 96500 Faraday.
 - c) 48250 Coulomb.
 - d) 48250 Faraday.
- 9) For electroplating of a copper spoon with a layer of silver, we use
 - a) silver cathode in copper sulphate solution.
 - b) silver anode in silver nitrate solution.
 - c) silver cathode in silver nitrate solution.

The answer:

- | | |
|--------------------------------|--|
| 1- d) more than one is correct | 2- c) strong oxidizing |
| 3- b) -0.83 | 4- a) more than |
| 5- c) $LiPF_6$ | 6- a) |
| 7- b) 1 | 8- b) 48250 Coulomb. |
| | 9- b) silver anode in silver nitrate solution. |

2- Write the scientific term which illustrates each of the following statements:

- 1) System in which chemical energy is converted into electrical energy through irreversible oxidation – reduction reaction.
- 2) System in which electrical energy changes into chemical energy through non spontaneous oxidation-reduction reactions.
- 3) Immersing iron in molten zinc to protect it against corrosion.
- 4) A process of covering the metal required to be protected by another less active metal.
- 5) The chemical decomposition of an electrolyte due to the effect of passing an electric current through it.
- 6) The mass of the substance that has the ability to lose or gain one mole of the electrons during the chemical reaction.

- 7) The mass of deposited or evolved substance on passing one Faraday through an electrolytic solution.
- 8) The quantity of material (gas or solid) formed or consumed at any electrode is directly proportional to the quantity of electricity that passes across the electrolytic solution.
- 9) Substance used in dissolving bauxite at extraction of aluminum.

The answer:

- 1- Primary galvanic cell.
- 3- Galvanization.
- 5- Electrolysis.
- 7- Equivalent mass.
- 9- Cryolite.

- 2- Electrolytic cell.
- 4- Cathodic protection.
- 6- Equivalent mass.
- 8- Faraday's first law.

3- Write the scientific explanation for each of the following:

- 1) The standard potential of the hydrogen electrode may shift from zero.
- 2) Mercury cell considered alkaline while lead battery is acidic.
- 3) Fuel cell doesn't store energy.
- 4) Lead- acid battery is considered from secondary galvanic cells.
- 5) It is necessary to recharge lead acid accumulator after using it for a long time.
- 6) Lithium is used in the structure of lithium ion battery.
- 7) The lithium ion battery is more preferable to lead acid cell in modern car.
- 8) Most of industrial metals that contain impurities corrode faster than pure metals.
- 9) Ship chassis are connected to a magnesium rod.

The answer:

- 1- Due to changing the concentration of the hydrogen ion in the solution or changing the partial pressure of the hydrogen gas or both.
- 2- Because the electrolyte used in mercury cell is potassium hydroxide which is an alkali while the electrolyte used in lead battery is sulphuric acid.
- 3- Because its work requires a continuous supply with the fuel and a continuous remove of the products.
- 4- It is a galvanic cell, because it produces an electric energy through a spontaneous oxidation – reduction reaction and it is a secondary cell because its chemical reactions are reversible and can be recharged.
- 5- Because using the battery for a long time leads to the dilution of sulphuric acid as a result of increasing the quantity of water produced from the discharge reaction and the conversion of cathode material (PbO_2) and anode (Pb) to lead (II) sulphate which leads to the decrease of the quantity of electric current produced from it. The charging of battery reversing the spontaneous reaction and lead to the conversion of lead sulphate to lead at the anode and lead dioxide at the cathode and the concentration of the acid returns as it was.
- 6- Because it is the lightest metal and it has the lowest reduction potential (-3.04V) Or highest oxidation potential.
- 7- Because lithium ion battery is lighter and stores a large amount of energy and is smaller in size than lead acid battery.
- 8- Because in case of the industrial metals (impure metal) a huge number of galvanic cells are formed in which the metal acts as anode while the impurities acts as cathode, so the metal corrodes faster than the pure metal.
- 9- To form a galvanic cell in which iron acts as a cathode and magnesium acts as an anode (sacrificial electrode) So, magnesium is corroded instead of iron.

4- **What is meant by:**

- 1) Salt bridge.
- 2) Electromotive series.
- 3) Discharging process in galvanic cell.
- 4) Sacrificial electrode.
- 5) General law of electrolysis.
- 6) Coulomb.

The answer:

- 1- It is a glass (U) shaped tube filled with electrolyte solution (e.g. Na_2SO_4) its ions do not react with the ions present in the two half cells as well as with the electrode materials of the galvanic cell.
- 2- It is the arrangement of elements in descending order relative to the negative reduction potentials and ascending relative to the positive reduction potentials, where the more negative values are in the top and the more positive values are in the bottom.
- 3- The process in which the stored chemical energy in the battery changes into electrical energy through spontaneous oxidation - reduction reaction.
- 4- Sacrificial electrode: It is a highly reactive metal (e.g. Mg) that is used to protect a less active metal (e.g. Fe) from corrosion. When Mg connected to iron pipe, a Galvanic cell is formed in which Mg acts as anode so it corrodes completely first protecting iron from corrosion.
- 5- Passing one Faraday (96500 coulomb) through an electrolyte, precipitates, dissolves or evolves one gram equivalent mass of any element at any electrode.
- 6- The unit of measuring quantity of electricity and it is defined as "The quantity of electricity required to precipitate 1.118 milligram of silver".

5- **Compare between each of the following:**

- 1) The Galvanic cell and electrolytic cell. (according to energy change and the value of E_{cell}).
- 2) Primary cells and secondary cells.
- 3) Mercury cell and lead acid battery related to:
 - a) Type of cell.
 - b) The used electrolyte.
- 4) Fuel cell and lithium ion battery according to:
 - a) Total reaction.
 - b) emf value.
- 5) Anodic cover and cathodic cover. (Giving example).

The answer:

1-

Galvanic cells	Electrolytic cells
- System in which chemical energy changes into electrical energy through spontaneous redox reaction.	- System in which electrical energy changes into chemical energy through non spontaneous redox reaction.
- Has positive e.m.f	- Has negative e.m.f

2-

Primary cells	Secondary cells
- Convert chemical energy into electrical energy through spontaneous irreversible redox reaction.	- Convert chemical energy into electrical energy through spontaneous reversible redox reaction.
- Cannot be recharged.	- Can berecharged.
- Ex: Fuel cell - mercury cell	- Ex: lithium ion battery - car battery

thickness

3-

Points of comparison	Mercury battery	Lead battery
a) Type	Primary galvanic cell.	Secondary galvanic cell.
b) The electrolyte	Potassium hydroxide.	Dil. sulphuric acid.

4-

Points of comparison	Fuel cell	Lithium ion battery
a) Total reaction	$2\text{H}_{2(g)} + \text{O}_{2(g)} \longrightarrow 2\text{H}_2\text{O}_{(v)}$	$\text{LiC}_6(s) + \text{CoO}_2(s) \rightleftharpoons \text{C}_6(s) + \text{LiCoO}_2(s)$
b) e.m.f value	$E_{\text{cell}} = 1.23 \text{ v}$	$E_{\text{cell}} = 3 \text{ v}$

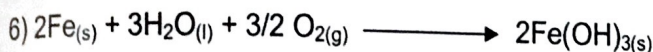
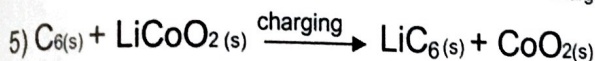
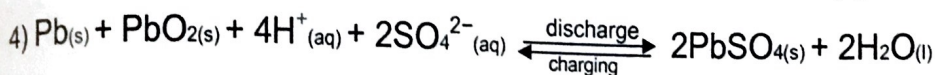
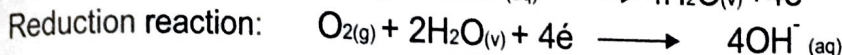
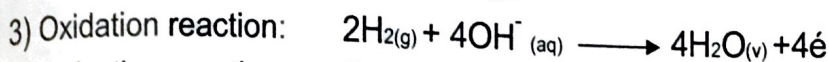
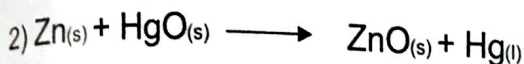
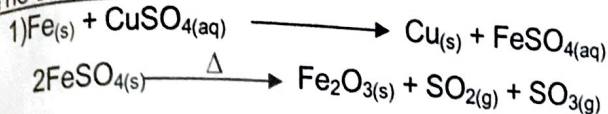
5-

Anodic cover	Cathodic cover
Covering the metal by another more active metal to protect it from corrosion. Ex: plating iron with zinc or magnesium.	Covering the metal by another less active metal to protect it from corrosion. Ex: plating iron with tin.

Show by a chemical equation:

- Adding iron filings to copper (II) sulphate solution, then heating the formed compound.
- Total reaction in the mercury cell.
- Oxidation reaction and reduction reaction in the fuel cell.
- The total reaction in the car battery (Lead-acid battery).
- Charging reaction of the lithium ion battery.
- The total equation for cell of iron corrosion.

The answer:



7. Write usage or function of each of the following:

- The salt bridge in the galvanic cell.
- Mercury cell.
- Electrolysis.
- Fluorspar.

The answer:

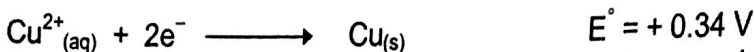
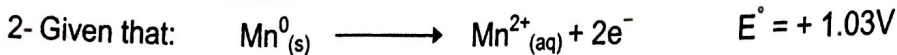
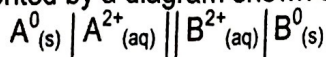
- Connects between the solutions of the two half cells without allowing a direct contact between them.
 - Neutralizes the excess of both the positive and negative ions which are formed in the solutions of the two half cells as a result of the oxidation and reduction reactions in the zinc and copper half cells respectively.
- Clocks, ear phone and camera.
 - Electroplating of metals, extraction of aluminum and purification of copper.
 - Decreases the melting point of the mixture from 2045 °C to 950 °C.

8- **Problems:**

1- A, B are two divalent elements, their oxidation potential are (0.7) volt, (-0.4) volt respectively. Calculate the (emf) of the formed cell, then mention does it produce an electric current or not and why? Write the symbolic expression for the formed cell.

The answer:

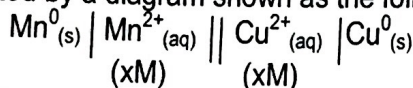
- e.m.f = oxidation potential of anode - oxidation potential of cathode.
= $0.7 - (-0.4) = 1.1$ volt
- Electric current is produced. Because the value of e.m.f is a positive value which means that the reaction is spontaneous.
- It represented by a diagram shown as the following:



Calculate e.m.f. for the formed cell, then mention does it produce an electric current or not and why? Write the symbolic expression for the formed cell.

The answer:

- e.m.f = oxidation potential of (Mn) + reduction potential of (Cu)
= $+ 1.03 + 0.34 = 1.37 V$
- Electric current is produced. Because the value of e.m.f is a positive value which means that the reaction is spontaneous.
- It represented by a diagram shown as the following:



3- Arrange the following electrodes ascending according to their reduction potentials.

- 1) Zn^{2+} / Zn (- 0.76 Volt).
- 2) Mg / Mg^{2+} (2.375 Volt).
- 3) $2Cl^- / Cl_2$ (- 1.36 Volt).
- 4) K^+ / K (- 2.924 Volt).
- 5) Pt^{2+} / Pt (1.2 Volt).

Then write the symbolic representation of the galvanic cell which formed of two electrodes from the above to give the maximum electromotive force, mention the value of E_{cell} and the direction of electric current flow.

The answer:

- The arrangement: $K^+ < Mg^{2+} < Zn^{2+} < Pt^{2+} < Cl_2^-$
- The cell diagram $2K / 2K^+ || Cl_2 / 2Cl^-$
(xM) (xM)
- The emf = $O.P_{(anode)} - O.P_{(cathode)} = (2.924) - (-1.36) = 4.284$ volt.
- The direction of current from K electrode (anode) to Cl electrode (cathode).

4- The electrolysis process of sodium chloride solution was carried out by passing an electric current its intensity is 2 amperes for half hour. Calculate the volume of chlorine gas evolved, given that the atomic mass of chlorine is (35.45).

The answer:

$$Q = I \times t = 2 \times 30 \times 60 = 3600 \text{ coulomb}$$

$$\text{Mass of chlorine} = \frac{Q \times eq. wt}{96500} = \frac{3600 \times 35.45}{96500} = 1.322g$$

$$\text{The number of moles of chlorine} = \text{mass} / \text{molar mass} = \frac{1.322}{35.45 \times 2} = 0.0186 \text{ mole}$$

$$\text{The volume of chlorine gas} = \text{number of moles} \times 22.4 = 0.0186 \times 22.4 = 0.416 \text{ L} = 416 \text{ ml}$$

5. On electroplating a copper watch by gold, 0.5 faraday is passed through an aqueous solution of gold (III) Chloride AuCl_3 . Calculate the volume of the deposited gold layer if the gold density is 13.2 gm/cm^3 .
 [Au=196.98]

The answer:

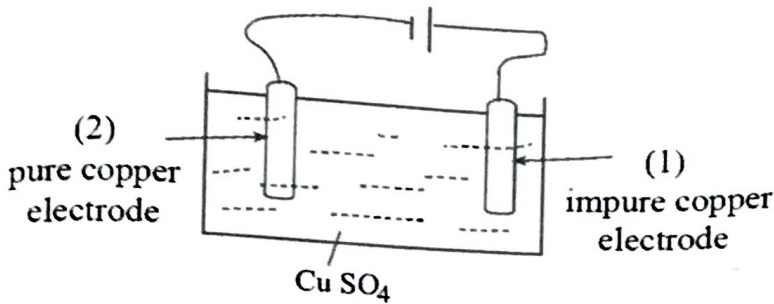
$$\text{Mass} = \text{Quantity of electricity} \times \text{equivalent weight}$$

$$= 0.5 \times \frac{196.98}{3} = 32.83 \text{ g}$$

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

$$\text{Volume} = \frac{\text{mass}}{\text{density}} = \frac{32.83}{13.2} = 2.49 \text{ cm}^3$$

6. The figure represents an electrolytic cell:



First: What are the mass changes taking place at both electrodes (1) and (2) in the cell?
 Second: Calculate the number of moles of the precipitated substance as a result of passing a quantity of electricity of 3 Faradays.
 (Cu = 63.5)

The answer:

First: The mass of electrode (1) decreases.

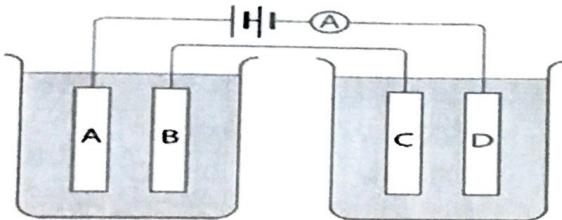
Second: The mass of electrode (2) increases.

$$1 \text{ Faraday} \longrightarrow \text{equivalent mass of Cu } (63.5/2) = (1/2 \text{ mole})$$

$$3 \text{ F} \longrightarrow X \text{ mole}$$

$$\text{No of moles} = 3 \times 0.5 = 1.5 \text{ mole}$$

7. In the circuit below, it is observed that 12.8 g of copper Cu^{+2} deposited on the electrode B and 14 g of cerium Ce deposited on the electrode D during a certain interval of time. Calculate the oxidation number of cerium given that: [Cu = 63.5, Ce = 140].



The answer:

$$\frac{\text{mass of Cu}}{\text{mass of Ce}} = \frac{\text{equivalent mass of Cu}}{\text{equivalent mass of Ce}}$$

$$\frac{12.8}{14} = \frac{31.75}{\text{equivalent mass of Ce}} \therefore \text{Equivalent mass of Ce} = \frac{14 \times 31.75}{12.8} = 34.7$$

$$\text{Equivalent mass} = \frac{\text{Atomic mass}}{\text{valency}}$$

$$\therefore \text{Valency} = \frac{\text{Atomic mass}}{\text{equivalent weight}} = \frac{140}{34.7} = 4$$

- 8- An electric current passes for 30 minutes in silver nitrate solution and copper (II) sulphate solution are connected in series 6.35g of Cu deposited at cathode in copper sulphate solution (Ag=108, Cu=63.5)

Calculate the following:

- 1) The gram equivalent mass of Cu and Ag.
- 2) Quantity of electricity.
- 3) Current Strength passing in both solutions.
- 4) The mass of silver deposited at cathode in silver nitrate solution.

The answer:

$$1) \text{ Gram equivalent mass of Cu} = \frac{63.5}{2} = 31.75 \text{ g}$$

$$\text{Gram equivalent mass of Ag} = \frac{108}{1} = 108 \text{ g}$$

$$2) \text{ Quantity of electricity} = \frac{\text{Mass of deposited Cu} \times 96500}{\text{Equivalent mass of Cu}} = \frac{6.35 \times 96500}{31.75} = 19300 \text{ Coulomb}$$

$$3) \text{ Current strength} = \frac{\text{Quantity of electricity}}{\text{Time (s)}} = \frac{19300}{30 \times 60} = 10.72 \text{ Ampere}$$

$$4) \frac{\text{mass of Ag}}{\text{mass of Cu}} = \frac{\text{Equivalent mass of Ag}}{\text{Equivalent mass of Cu}}$$

$$\frac{\text{mass of Ag}}{6.35} = \frac{108}{31.75}$$

$$\therefore \text{Mass of Ag} = 21.6 \text{ g}$$

9- **Answer the following:**

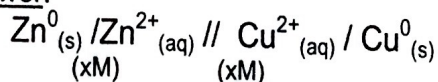
- 1- What happens after a short period of time of putting magnesium rod in blue copper sulphate solution?

The answer:

Copper precipitates on magnesium rod and the blue colour of copper sulphate disappears.

- 2- Write the cell diagram of Daniel cell then mention when it will stop producing electric current.

The answer:

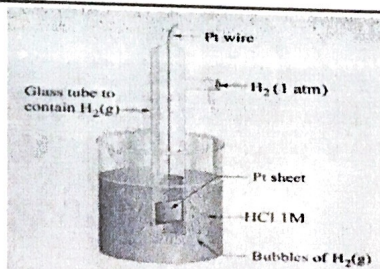
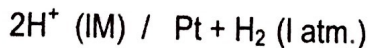


It will stop producing electric current when:

- a) Zinc metal is consumed (due to oxidation reaction).
- b) Copper ions are diminishing (due to reduction reaction).
- c) The absence of salt bridge.

- 3- Draw the standard hydrogen electrode – write its represented diagram when acts as cathode

The answer:



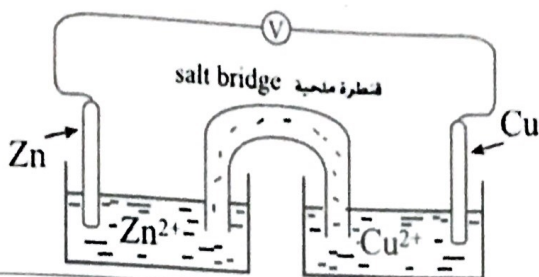
4- The figure below shows a galvanic cell:

First: What would happen to the value of the electromotive force if the zinc half-cell is replaced by a magnesium half-cell?

Explain your answer.

Second: What would happen when the salt bridge is taken out from the solutions of the cell?

Explain your answer.



The answer:

First: the electromotive force increases.

because the oxidation potential of magnesium is greater than that of zinc.
or (because magnesium is more active than zinc).

Second: the reaction stops.

because oxidation- reduction process has stopped.

or due to the increase in the concentration of positive ions and negative ions.

5- What are the methods to protect iron from corrosion?

The answer:

By covering iron using another substance to insulate iron from the surrounding medium.

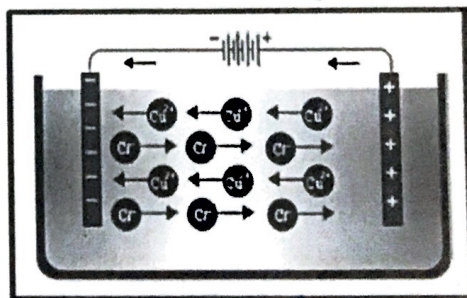
This is carried out by two methods:

- 1) Painting iron by an organic material like oil, varnish or primer, but this is not an effective method on the long run.
- 2) Covering iron by corrosion resistant metals like in steel galvanization process by dipping steel in molten zinc. Also magnesium is used to protect steel used in ships industry. Tin protects iron used in cans.
 - a- Cathodic protection (Cathodic cover): the protective metal is less active (like tin) than the original metal (like iron).
 - b- Anodic protection: (Anodic cover): the protective metal is more active (like zinc) than the original metal (like iron).

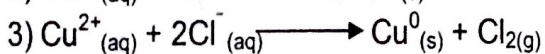
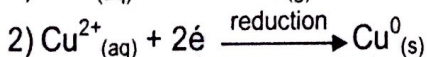
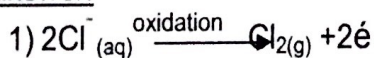
6- From the electrolytic cell for copper (II) chloride solution. As shown in the drawing.

Answer the following:

- 1) Write the anode reaction.
- 2) Write the cathode reaction.
- 3) Write the total cell reaction occurs in the cell.
- 4) **Calculate the emf, if you know that,** the standard oxidation potential for chlorine and copper are (-1.36 V) and (-0.34 V) respectively.



The answer:



$$4) \text{e.m.f} = \text{Oxidation potential of anode (Cl}_2) - \text{Oxidation potential of cathode (Cu)} \\ = -1.36 - (-0.34) = -1.02 \text{ V}$$

7- Mention the state of Faraday's second law, then write the mathematical expression of the law.

The answer:

- Faraday's second law: "The masses of the different materials formed or consumed by the same amount of electricity that passes in different electrolytes connected in series are proportional to their equivalent masses."
- Faraday's second law can be expressed mathematically as follows:

$$\frac{\text{Mass of the first element}}{\text{Mass of the second element}} = \frac{\text{Equivalent mass of the first element}}{\text{Equivalent mass of the second element}}$$

8- An electric current is passed in an electrolytic solution of silver nitrate between an anode of silver and cathode of iron.

Show: the change occurred to the mass of cathode, giving reason.

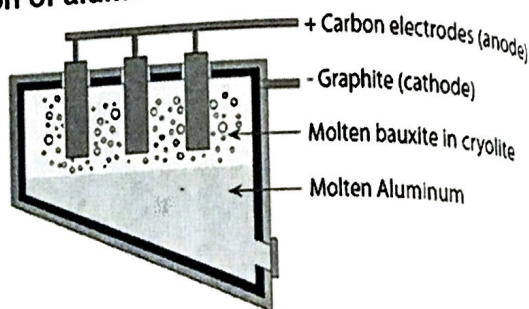
The answer:

Increasing the mass of cathode, due to the precipitation of silver on cathode.

9- The following apparatus is used in the extraction of aluminum from bauxite:

First: Mention a substitute for cryolite which is used in the cell of extracting aluminum from bauxite.

Second: Write both of oxidation and reduction reaction in this cell.



The answer:

First: A mixture of fluoride salts of aluminum, sodium and calcium.

Second: Oxidation reaction: $3\text{O}^{2-} \longrightarrow 3/2 \text{O}_{2(g)} + 6\text{e}^-$

Reduction reaction: $2\text{Al}^{3+} + 6\text{e}^- \longrightarrow 2\text{Al}_{(l)}$

10- **Explain by experiment:**

Explain how to obtain copper from an alloy of iron and copper.

The answer:

By adding diluted hydrochloric acid to the alloy, the acid will react with iron but does not react with copper. Copper precipitates and separated by filtration.

N.B. Revise Al Moalem. Questions:

Q5 page 154.

Q12 No. 38 page 167,

No. 43, 44, 45, 46, 50 & 53 page 168.

Explanation

↳ Both Zn, Fe are more active than hydrogen while Cu is less active than hydrogen

How to differentiate between two alloys

Zn. Cu alloy and Zn. Fe alloy

⇒ Add diluted HCl to both.

If the alloy dissolved (reacted) completely

∴ It's Zn. Fe alloy

If the alloy dissolved (reacted) partially and red substance is remained (Cu)

∴ It's Zn. Cu alloy

Chapter Five Hydrocarbons

1) Choose the correct answer for each of the following:

1- are isomers.

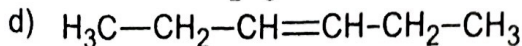
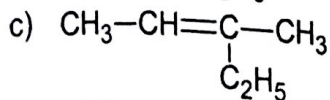
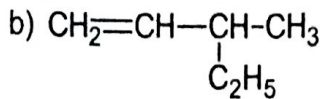
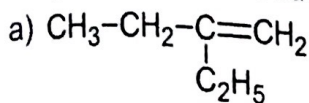
a) 2-methylpropane and butane

c) 2-chloropropane and 2-bromopropane

b) 2,3-dimethylbutane and 2-methylbutane

d) 1,3-dichloropentane and 1,3-dichlorobutane

2- Ethylbutene has the structural formula



3- On adding hydrogen chloride to 4-chloro-1-butene, the product is

a) 2,4-dichlorobutane.

b) 1,4-dichlorobutane.

c) 1,3-dichlorobutane.

d) 2,3-dichlorobutane.

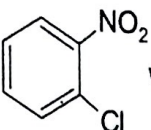
4- The chemical name of the compound DDT is:

a) dichlorodiphenyltrichloroethane.

b) trichlorotriphenyldichloromethane.

c) dichlorodiphenyltrichloromethane.

d) trichlorotriphenyldichloroethane.

5- To prepare  we carry out

a) alkylation of benzene then nitration of the product.

b) nitration of benzene then chlorination of the product.

c) chlorination of benzene then nitration of the product.

d) nitration of benzene then alkylation of the product.

6- The molecule of the detergent is composed of a tail which is and a head which is

a) hydrophobic – hydrophilic.

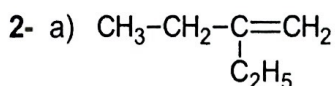
b) hydrophilic – hydrophobic.

c) hydrophilic – hydrophilic.

d) hydrophobic – hydrophobic.

The answers:

1-a) 2-methylpropane and butane,



3- c) 1,3-dichlorobutane.



4-a) dichlorodiphenyltrichloroethane.

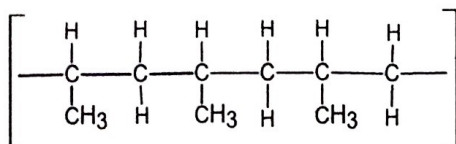
5- c) chlorination of benzene then nitration of the product.

6-a) hydrophobic – hydrophilic.

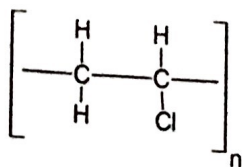
2) Write the structure formula of the polymer formed from monomer ($\text{CH}_3\text{-CH=CH}_2$). (showing three units).

The answer:

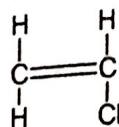
The structural formula of three repeated units of the polymer is:



3) Draw the structural formula of the monomer required to prepare the following polymer:



The answer:



4) Write the scientific term for each of the following statements:

- A saturated compound that consists of six carbon atoms and twelve hydrogen atoms.
- A radical produced by removing one hydrogen atom from benzene.
- Important organic compounds obtained by treatment of alkyl benzene sulphonic acid with caustic soda.
- A saturated aliphatic hydrocarbon used to prepare toluene by catalytic reforming method.

The answers:

- a) Cyclohexane. b) Phenyl radical. c) Detergents. d) Normal heptane.

5) Give reason for each of the following:

- Before the collection of acetylene gas, the evolved gas must be firstly passed over copper sulphate solution in diluted sulphuric acid.
- Thermal catalytic cracking of petroleum is carried out during its refining.
- Cyclobutane is more active molecule than normal butane.
- The poly nitro organic compounds are very explosive substances.
- It is hard to remove fatty spots from textiles by using water, except after adding a detergent.

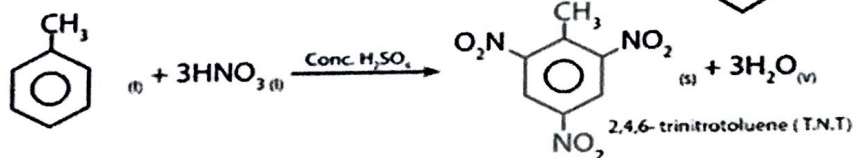
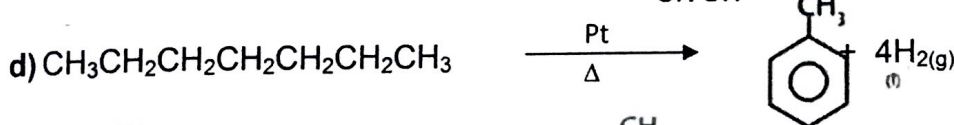
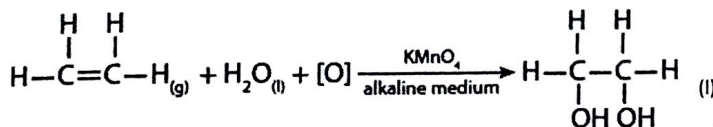
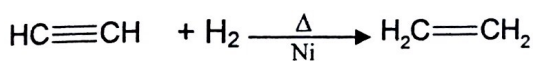
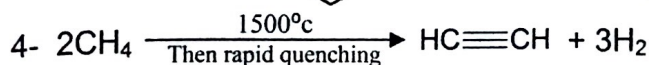
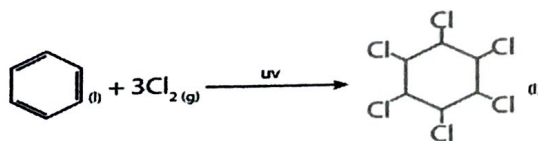
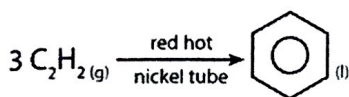
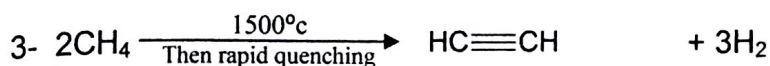
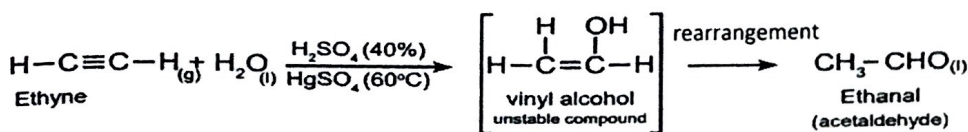
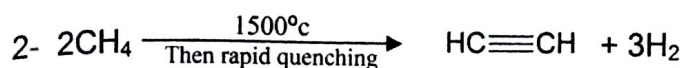
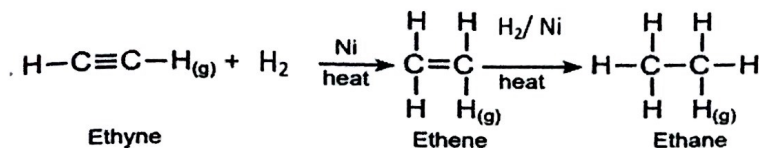
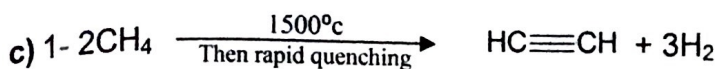
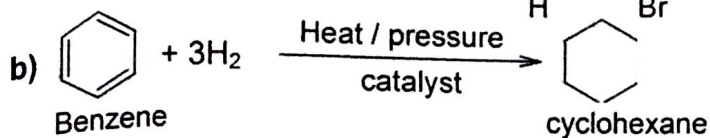
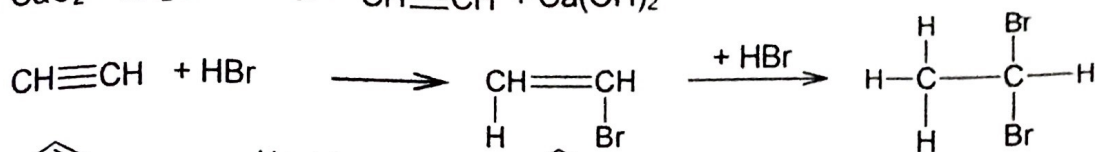
The answers:

- To remove phosphine gas (PH_3) and hydrogen sulphide (H_2S), which are produced from the impurities found in calcium carbide.
- To convert the undesired heavy petroleum products of long chains into the daily used lighter products of short chains.
- Because the angles between bonds in cyclobutane equal 90° which are less than those in normal butane (109°). These small angles lead to weak overlap between orbitals. Therefore, the combination between carbon atoms is weaker and easily broken in cyclobutane which makes it more reactive.
- Because:
 - They contain their own fuel which is carbon, beside oxidizing agent which is oxygen.
 - The bond ($\text{N}-\text{O}$) in nitro groups is weak and the bonds ($\text{C}-\text{O}$) in CO_2 and ($\text{N}-\text{N}$) in N_2 are strong, so they burn rapidly producing a great amount of heat and gases (CO_2 and N_2) accompanied by explosion.
- Because fat spots are nonpolar covalent compounds which do not dissolve in water but adding a detergent to water decreases the surface tension of water which increases the ability of water to wet textiles.

6) Show by balanced chemical equations, how you can obtain:

- 1,1-dibromoethane from calcium carbide.
- An aliphatic saturated hydrocarbon from an aromatic hydrocarbon
- (1- Ethane. 2- Ethanal. 3- An insecticide. 4- Ethylene glycol). From METHANE
- Trinitrotoluene from normal heptane.

The answers:

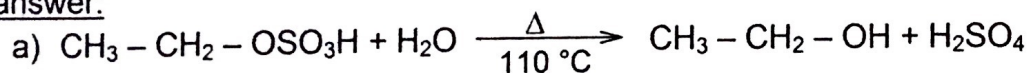


7) Show by balanced chemical equation:

a) The hydrolysis of ethyl hydrogen sulphate.

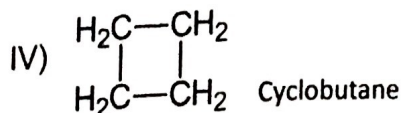
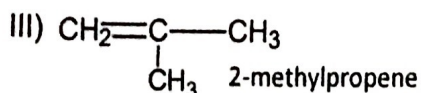
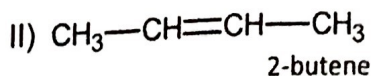
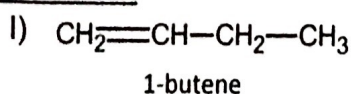
b) The role of sodium hydroxide solution in the manufacture of detergents

The answer:

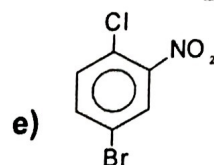
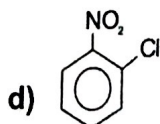
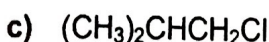
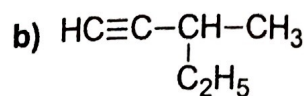
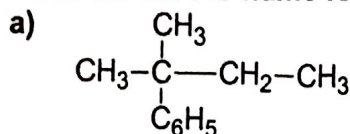


8) Write the structural formulas and IUPAC names of the possible isomers of the molecular formula C_4H_8 .

The answer:



9) Write the IUPAC name for each of the following:



The answers:

a) 2-methyl-2-phenyl butane.

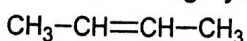
b) 3-methyl -1-pentyne.

c) 1-chloro -2-methyl propane.

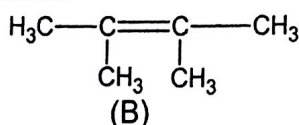
d) 1-chloro-2-nitrobenzene.

e) 4-bromo-1-chloro-2-nitrobenzene.

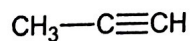
10) Given the following hydrocarbons:



(A)



(B)



(C)

a) Calculate the number of sigma and pi bonds in (A) and (C) molecules.

b) How many hydrogen moles are required to convert (B) and (C) to a saturated compound?

The answers:

a) The number of sigma bonds in (A) molecule is 11, while in (C) molecule is 6,
The number of pi bonds in (A) molecule is 1, while in (C) molecule is 2.

b) Compound (B) needs 1 hydrogen mole to be saturated, while compound (C) needs 2 hydrogen moles to be saturated.

11) "Saturated open chain hydrocarbon having 17 atoms in its structure." ($C=12, H=1$)

a) What are the number of carbon and hydrogen atoms in this compound.

b) Write the molecular formula of this hydrocarbon.

c) Write the expected structural formulas, then name each one according to IUPAC system.

The answers:

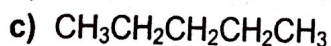
a) The number of carbon atoms = 5, the number of hydrogen atoms = 12

Explanation:

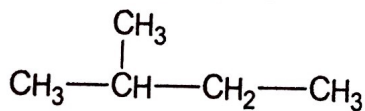
The general molecular formula of alkanes (saturated open chain hydrocarbon) = C_nH_{2n+2}

$$C_nH_{2n+2} = 17 \quad n + 2n + 2 = 17 \quad 3n = 15 \quad \text{therefore } n = 5$$

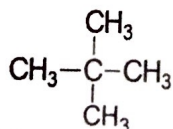
b) The molecular formula is C_5H_{12}



The IUPAC name is pentane.



The IUPAC name is 2-methylbutane.



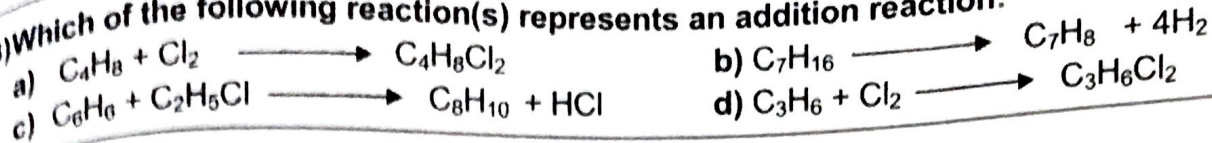
The IUPAC name is 2,2-dimethylpropane.

12) What is the role of:
Hot zinc powder in the preparation of benzene from phenol.

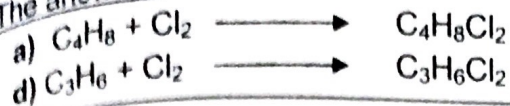
The answer:

The hot zinc powder acts as reducing agent in this reaction.

13) Which of the following reaction(s) represents an addition reaction:



The answers:



14) Write the scientific contribution of:

a) Berzelius.
 d) Bayer.

b) Wohler.
 e) Kekule.

c) Markownikoff.
 f) Friedel – Craft.

The answers:

a) Berzelius:

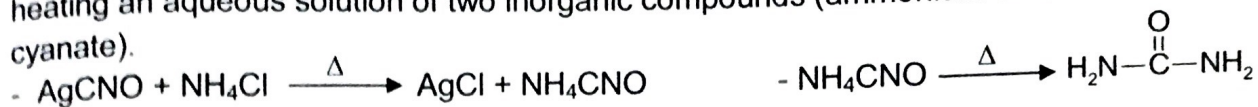
i) Berzelius divided all compounds into two categories:

a- Organic compounds which are extracted from animal or plant origin.

b- Inorganic compounds which are originated from mineral sources in earth.

ii) He introduced the vital force theory which states that "the organic compounds are formed by vital force which is found in living cells of the body and it is impossible to synthesize them in laboratories".

b) Wohler destroyed the vital force theory when he prepared an organic compound (urea) by heating an aqueous solution of two inorganic compounds (ammonium chloride and silver cyanate).



c) Markownikoff:

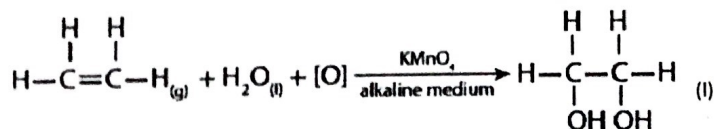
He discovered a rule named "Markownikoff's" which states that:

"On adding an asymmetric reagent (HX or H-OSO₃H) to an asymmetric alkene, the positive part of the reagent is added to the unsaturated carbon atom which carries a large number of hydrogen atoms and the negative part is added to the unsaturated carbon atom which carries less number of hydrogen atoms."

d) Bayer:

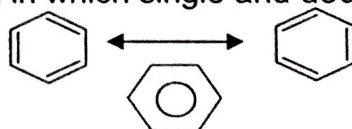
He discovered a reaction named Bayer's reaction:

In which ethylene reacts with alkaline solution of potassium permanganate to form ethylene glycol. The violet colour of KMnO₄ disappears so, this reaction is used to detect the pi bond.

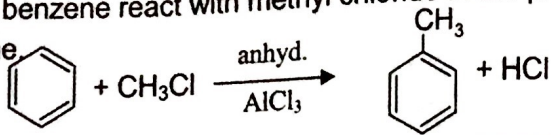


e) Kekule:

He discovered the hexagonal cyclic shape of benzene ring in which single and double bonds are exchanged.



f) They discovered a reaction named Friedel – craft's alkylation:
 In which an alkyl group substitutes a hydrogen atom from the benzene ring.
 For example: benzene react with methyl chloride in the presence of anhydrous AlCl_3 catalyst to form toluene

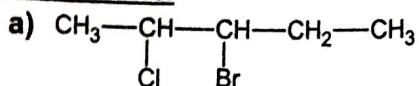


15) Write the structural formula for the following compounds, then write their correct IUPAC names:

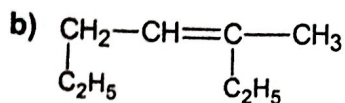
- a) 3-bromo-4-chloropentane.
 c) 1-Chloro-6-bromobenzene.

b) 1,3-diethyl-2-butene.

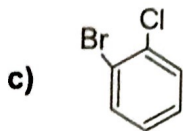
The answers:



The IUPAC name is: 3-bromo-2-chloropentane.



The IUPAC name is: 3-methyl -3- heptene.

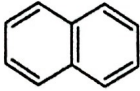
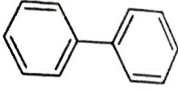


The IUPAC name is: 1-bromo-2 -chlorobenzene.

16) Compare between naphthalene and diphenyl according to:

- a) Structural formula.
 b) Number of hydrogen atoms in each.
 c) Number of pi bonds in each.
 d) Number of hydrogen moles needed to saturate one mole of each.

The answer:

Points of comparison	Naphthalene	Diphenyl
a) Structural formula		
b) Number of hydrogen atoms	8	10
c) Number of pi bonds	5	6
d) Number of hydrogen moles needed to saturate one mole	5	6

17) Write the molecular and structural formulas for each of the following:

- a) An alkane having six carbon atoms and does not contain methylene group in its structure.
 b) An alkane obtained on dry distillation of sodium propanoate ($\text{CH}_3\text{CH}_2\text{COONa}$) with soda lime.
 c) An aromatic hydrocarbon having seven carbon atoms and eight hydrogen atoms.

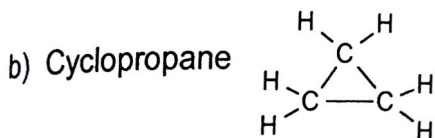
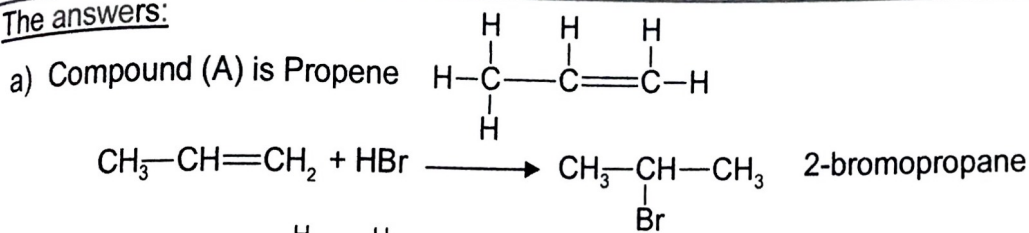
The answers:

The molecular formula	The structural formula
a) C ₆ H ₁₄	$\begin{array}{c} \text{CH}_3 \quad \text{CH}_3 \\ \quad \\ \text{a) CH}_3\text{—CH—CH—CH}_3 \end{array}$
b) C ₂ H ₆	$\text{b) } \begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H—C—C—H} \\ \quad \\ \text{H} \quad \text{H} \end{array}$
Explanation: $\text{CH}_3\text{CH}_2\text{COONa} + \text{NaOH} \xrightarrow[\Delta]{\text{CaO}} \text{CH}_3\text{CH}_3 + \text{Na}_2\text{CO}_3$	
c) C ₇ H ₈	$\text{c) } \begin{array}{c} \text{CH}_3 \\ \\ \text{C}_6\text{H}_6 \end{array}$

18) Two organic compounds (A) and (B), each of them contains three carbon atoms and their general formula (C_nH_{2n}). The compound (A) is an aliphatic unsaturated compound, the compound (B) is an aliphatic cyclic compound.

- Write the structural formula of the compound (A) and what is the product of adding HBr to it?
- Write the structural formula of the compound (B). How could you explain the high chemical reactivity of this compound compared to the normal alkane having the same number of carbon atoms.

The answers:



Due to the small angles between bonds in cyclopropane (60°) that leads to weak overlap between the atomic orbitals. Therefore, the combination between carbon atoms is very weak so it is very active compared to normal propane (109.5°).

19) An aliphatic organic compound (A) doesn't dissolve in concentrated H₂SO₄, but reacts with Cl₂ gas in direct sunlight forming a compound (B) that reacts with caustic soda forming compound (C) which in turn can be converted to acetaldehyde by adding acidified K₂Cr₂O₇. What are the chemical formulae for the compounds (A&B)?

The answers:

Compound A: Ethane. CH₃CH₃
 Compound B: Ethyl chloride. CH₃CH₂Cl

20) Complete the following table:

Monomer	Commercial name of the polymer	Type of polymerization	Polymer property	One use
Chloroethene	<i>Polyvinylchlorid e</i>	<i>Addition polymerization</i>	<i>Strongsoft</i>	<i>Drainage tubes, plastic tubes</i>

21) Write the structural formula for each of the following:

a) Methylene chloride.

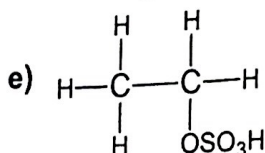
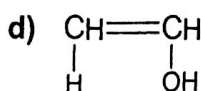
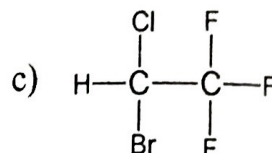
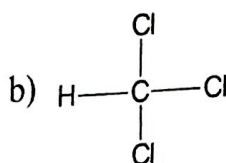
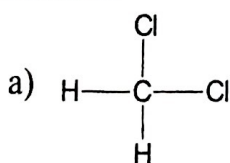
b) Chloroform.

c) Halothane.

d) Vinyl alcohol.

e) Ethyl hydrogen sulphate.

The answers:



22) Mention one use for each of the following:

a) Black carbon.

b) 1,1,1-trichloroethane.

c) Freon.

d) Polypropylene.

e) Polytetrafluoroethene.

f) Polyvinylchloride.

The answers:

- a) Car tires, black painting, polishes, and printing ink.
 b) Dry cleaning.
 c) Air conditioners and fridges, rushed substance to liquids, perfumes and cleaners of electronic sets.
 d) Carpets, cases, cans.
 e) Cooking utensils, surgical threads.
 f) Drainage tubes, plastic tubes, shoes, hoses, electrical wires Insulators, floors, oils bottles.

N.B. Revise AL MOALEM. Questions

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