SAMPLE PAPER-04 (solved)

CHEMISTRY (Theory)

Class – XII

Time allowed: 3 hours Maximum Marks: 70

General Instructions:

a) All the questions are compulsory.
b) There are **26** questions in total.
c) Questions **1** to **5** are very short answer type questions and carry **one** mark each.
d) Questions **6** to **10** carry **two** marks each.
e) Questions **11** to **22** carry **three** marks each.
f) Questions **23** is value based question carrying **four** marks.
g) Questions **24** to **26** carry **five** marks each.
h) There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all three questions in five marks each. You have to attempt only one of the choices in such questions.
i) Use of calculators is **not** permitted. However, you may use log tables if necessary.

1. Write the structure of 1-chloro-2,2-dimethylpropane.
2. What is the effect of presence of Schottky defects on the density of the crystal?
3. If a compound is formed by the elements X and Y crystallises in the cubic arrangement with X atoms at the corners of a cube and Y atoms at face centres, then give its formula of the compound?
4. Give any two main functions of hormone adrenaline.
5. Define co-enzyme.
6. Explain brown ring test.
7. Explain:

i. Electrophoresis
ii. Dialysis

8. A compound is formed by two elements X and Y. If the atoms of the element Y (as anions) make ccp and those of the element X (as cations) occupy all the octahedral voids, then what is the formula of the compound?

Or

An element has a body-centred cubic structure with a cell edge of 288 pm. The density of the element is 7.2 g/cm^3. How many atoms are present in 208 g of the element?

9. The initial concentration of N_2O_5 in the following first order reaction: $N_2O_5\,(g) \rightarrow 2\,NO_2\,(g) + 1/2\,O_2\,(g)$ was 1.24×10^{-2} mol/L at 318K. The concentration of N_2O_5 after 60 minutes was 0.20×10^{-2} mol/L. Calculate the rate constant of the reaction at 318 K.

10. What conclusions can be drawn from the equation: $P = p_1^0 + \left(p_2^0 - p_1^0\right)x_2$?
11. Give a short note on:
    a. Reimer – Tiemann Reaction.
    b. Friedel Crafts Reaction.
12. Show that in a first order reaction, time needed for completion of 99.9% is ten times of half-life of the reaction.
13. Complete the following reactions:

a. $KNO_2 + O_3 \rightarrow$

b. $KI + O_3 + H_2O \rightarrow$

c. $HCl + O_3 \rightarrow$

14. Differentiate between rate of reaction and reaction rate constant.
15. Explain the fact that in aryl alkyl ethers the alkoxy group activates the benzene ring towards electrophilic substitution reaction and it also directs the incoming substituents to o- and p-positions in benzene ring.
16.

i. Why bithional is added to soaps?

ii. Sulpha drugs work like antibiotics, but are not antibiotics. Comment.

iii. What type of drug is phenacetin?

17.

i. Define chelation.

ii. What is meant by chelating ligand?

iii. What is denticity?

Or

What are cationic complex, anionic complex and neutral complex? Give examples.

18.
    a) Give the sources of lead compounds.
    b) Define the term 'chemotherapy'.
    c) Name the macromolecules that are chosen as drug targets.
19. Write the possible sequences of the tripeptide which on complete hydrolysis gives glycine, alanine and phenylalanine.
20. What are the three ways to control the microbial diseases?
21. Explain pseudo first order reaction with an appropriate example.
22. Explain the term:
    a) Electro-osmosis
    b) Coagulation
23. The use of hydroelectricity is increasing day-by-day. Government is trying to reduce its dependency on thermal power plants

    Now answer the following question
    a. Why Government is trying to reduce its dependency on thermal power plant?
    b. What values are promoted by the use of hydroelectricity?
    c. Suggest two methods to promote above values.
24. Give the cause of lanthanoid contraction.

Or

Give five chemical characteristics of lanthanoids.

25. An organic compound (A) with molecular formula C_8H_8O forms an orange-red precipitate with 2,4-DNP reagent and gives yellow precipitate on heating with iodine in the presence of sodium hydroxide. It neither reduces Tollens' or Fehlings' reagent, nor does it decolourise bromine water or Baeyer's reagent. On drastic oxidation with chromic acid, it gives a carboxylic acid (B) having molecular formula $C_7H_6O_2$. Identify the compounds (A) and (B) and explain the reactions involved.

Or

Write chemical equations for the following conversions:

i. $CH_3–CH_2–Cl$ into $CH_3–CH_2–CH_2–NH_2$
ii. $C_6H_5–CH2–Cl$ into $C_6H_5–CH_2–CH_2–NH$
iii. Benzyl alcohol to phenylethanoic acid
iv. 4-Methylacetophenone to benzene-1,4-dicarboxylic acid

26. Calculate its resistivity, conductivity and molar conductivity, if the electrical resistance of a column of 0.05 mol L^{-1} NaOH solution of diameter 1 cm and length 50 cm is 5.55 × 10 ohm.

Or

a) A solution of $CuSO_4$ is electrolysed for 10 minutes with a current of 1.5 amperes. What is the mass of copper deposited at the cathode?
b) What are the observations made in a galvanic cell after the circuit is completed?

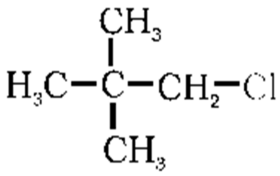
SAMPLE PAPER-04 (solved)

CHEMISTRY (Theory)

Class – XII

Answers

1.



2. The overall density of a crystalline substance decreases due to Schottky defects.
3. Here, X atoms are at 8 corners, each shared by 8 cubes. Therefore,
   The number of X atoms in the unit cell is 8/8 = 1.
   Y atoms are at the centres of 6 faces and each face is shared by two cubes. Therefore,
   The number of Y atoms = 6/2 = 3.
   The formula of the compound = XY_3.
4. The main functions include –
   a. It increases the pulse rate and blood pressure.
   b. It releases glucose from glycogen and fatty acids from fats.
5. The non-protein component of an enzyme which is loosely held by the enzymes and is essential for its biological activity is called a co-enzyme.
6. The familiar brown ring test for nitrates depends on the ability of Fe^{2+} to reduce nitrates to nitric oxide, which reacts with Fe^{2+} to form a brown coloured complex. The test is usually carried out by adding dilute ferrous sulphate solution to an aqueous solution containing nitrate ion, and then carefully adding concentrated sulphuric acid along the sides of the test tube. A brown ring at the interface between the solution and sulphuric acid layers indicates the presence of nitrate ion in solution.

$$NO_3 + 3Fe^{2+} + 4H^+ \rightarrow NO + 3Fe^{3+} + 2H_2O$$

$$[Fe(H_2O)_6]^{2+} + NO \rightarrow \underset{Brown}{[Fe(H_2O)_5(NO)]^{2+}} + H_2O$$

7.

i. The existence of charge on colloidal particles is confirmed by electrophoresis experiment. When electric potential is applied across two platinum electrodes dipping in a colloidal solution, the colloidal particles move towards one or the other electrode. The movement of colloidal particles under an applied electric potential is called electrophoresis.

ii. It is a process of removing a dissolved substance from a colloidal solution by means of diffusion through a suitable membrane. Since particles (ions or smaller molecules) in a true solution can pass through animal membrane (bladder) or parchment paper or cellophane sheet but not the colloidal particles, the membrane can be used for dialysis. The apparatus used for this purpose is called dialyser.

8. The ccp lattice is formed by the element Y. The number of octahedral voids generated would be equal to the number of atoms of Y present in it. Since all the octahedral voids are occupied by the atoms of X, their number would also be equal to that of the element Y. Thus, the atoms of elements X and Y are present in equal numbers or 1:1 ratio. Therefore, the formula of the compound is XY.

Or

Volume of the unit cell = $(288\ pm)^3$

= $(288\times10^{-12}\ m)^3 = (288\times10^{-10}\ cm)^3$

= $2.39\times10^{-23}\ cm^3$

Volume of 208 g of the element,

= mass/ density = $208/7.2 = 28.88\ cm^3$

Number of unit cells in this volume,

= $28.88/2.39 \times 10^{-23} = 12.08 \times 10^{23}$ unit cells

Since each bcccubic unit cell contains 2 atoms, therefore, the total number of atoms in 208 g

= 2 (atoms/unit cell) × 12.08×10^{23}unit cells = 24.16×10^{23} atoms.

9. For a first order reaction,

$$\log\frac{[R]_1}{[R]_2} = \frac{k(t_2 - t_1)}{2.303}$$

$$k = \frac{2.303}{(t_2 - t_1)}\log\frac{[R]_1}{[R]_2}$$

$$= \frac{2.303}{(60\,\text{min}\,0\ 0\,\text{min})}\log\frac{1.24\ x\ 10^{-2}\ mol\ L^{-1}}{0.20\ x10^{-2}\ mol\ L^{-1}}$$

$$= \frac{2.303}{60}\log 6.2\,\text{min}^{-1}$$

k =0.0304 min^{-1}

10.

i. Total vapour pressure over the solution can be related to the mole fraction of any one component.

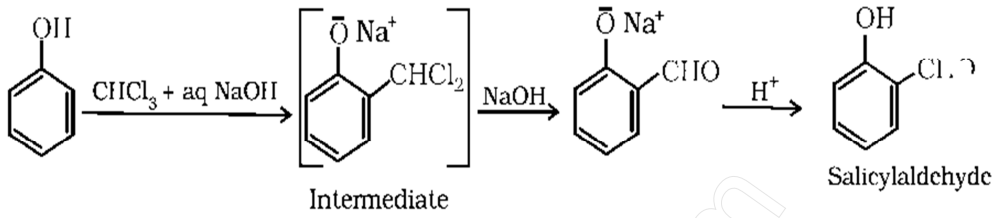
ii. Total vapour pressure over the solution varies linearly with the mole fraction of component 2.

iii. Depending on the vapour pressures of the pure components 1 and 2, total vapour pressure over the solution decreases or increases with the increase of the mole fraction of component 1.

11.

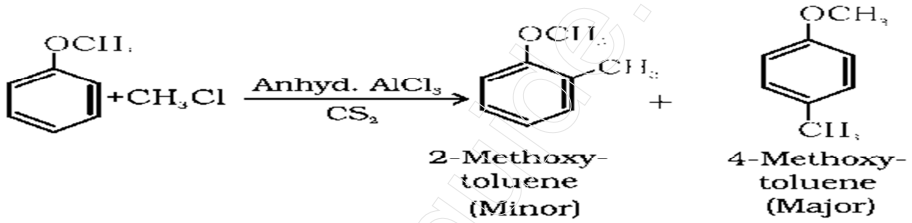
a. Reimer – Tiemann Reaction.

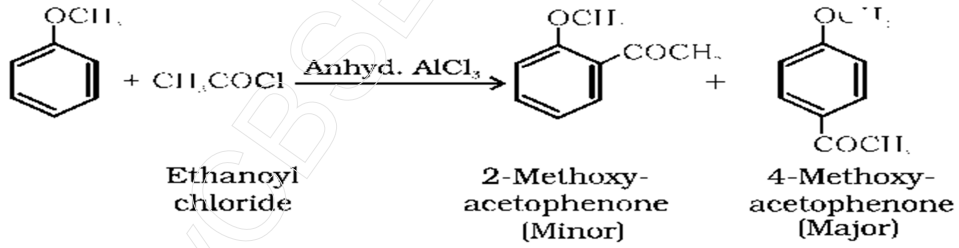
On treating phenol with chloroform in the presence of sodium hydroxide, a –CHO group is introduced at orthoposition of benzene ring. This reaction is known as Reimer - Tiemannreaction. The intermediate substituted benzal chloride is hydrolysed in the presence of alkali to produce salicylaldehyde.



b. Friedel –Crafts Reaction:

Anisole undergoes Friedel-Crafts reaction, *i.e.*, the alkyl and acyl groups are introduced at orthoand parapositions by reaction with alkyl halide and acyl halide in the presence of anhydrous aluminium chloride (a Lewis acid) as catalyst.





12. When reaction is completed 99.9% $[R]_n = [R]_0 - 0.999[R]_0$

$$k = \frac{2.303}{t}\log\frac{[R]_0}{[R]}$$

$$k = \frac{2.303}{t}\log\frac{[R]_0}{[R]_0 - 0.999[R]_0} = \frac{2.303}{t}\log 10^3$$

t = 6.909/k

For half-life of the reaction

$t_{1/2} = 0.6963/k$

$$\frac{t}{t_{1/2}} = \frac{6.909}{k}x\frac{k}{0.693} = 10$$

13.

a. $KNO_2 + O_3 \rightarrow KNO_3 + O_2$

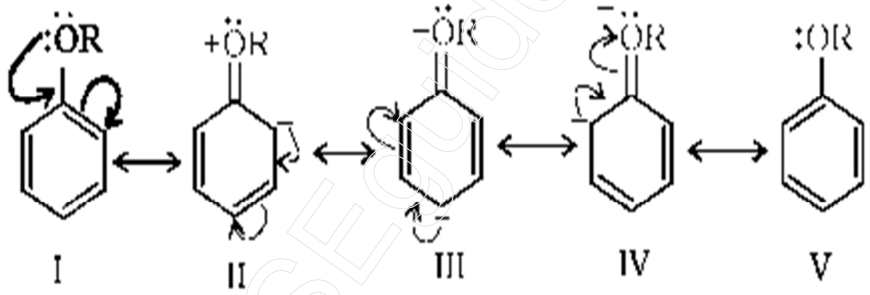
b. $2\,KI + O_3 + H_2O \rightarrow 2\,KOH + I_2 + O_2$

c. $2\,HCl + O_3 \rightarrow H_2O + Cl_2 + O_2$

14.

Rate of reaction	Reaction rate constant
It is the speed with which reactants are converted into products.	It is the proportionality constant in the rate law which is defined as the rate of reaction when the concentration of the reactants is unity.
It depends on the initial concentration of the reactants.	It does not depend on the initial concentration of the reactants.
Its units are mol/L/time.	Its unit depend on the order of the reaction.

15. The alkoxy group increases the electron density on the benzene ring and so activates the aromatic ring towards electrophilic substitution reaction as given below:



The structures, III – V show high electron density at o-and p-positions and so direct the incoming substituents to o- and p- positions in the benzene ring.

16.

i. Bithional acts as an antiseptic agent and reduces the odours produced by bacterial decomposition of organic matter on the skin.

ii. Sulpha drugs act against micro-organism like antibiotics. But these are not obtained from micro-organism like antibiotics.

iii. It is antipyretic.

17.

i. When a di- or polydendate ligand uses its two or more donor atoms to bind the same central metal atom or ion, it is called chelation.

ii. The resulting complex structure having ring structure and the ligand coordinating through two or more donor groups are called chelating ligand.

iii. The number of ligating groups indicates the denticity of the ligand.

Or

i. A complex ion or coordination entity which has a net positive charge is called cationic complex. Example – $[Co(NH_3)_6]^{3+}$

ii. A complex ion or coordination entity which has a net negative charge is called anionic complex. Example – $[Ag(CN)_2]^-$

iii. A complex or coordination entity which has no net charge is called neutral complex. Example – $[Ni(CO)_4]$

18.

a)

Lead compounds can be obtained from natural sources such as plants, trees, bushes, venoms and metabolites of micro-organisms. These compounds have also been isolated from fish, coral sponges and marine micro-organisms.

b)

The branch of chemistry which deals with the treatment of diseases using chemicals is called chemotherapy.

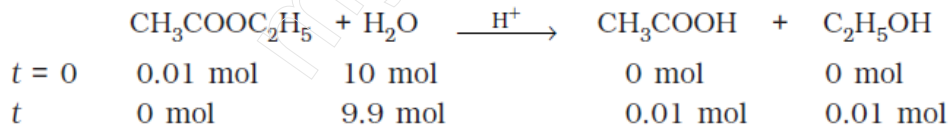
c)

It includes carbohydrates, proteins, lipids and nucleic acids.

19. The possible sequences are:
    a. Gly – Ala – Phe
    b. Gly – Phe – Ala
    c. Ala – Gly – Phe
    d. Ala – Phe – Gly
    e. Phe – Gly – Ala
    f. Phe – Ala – Gly

20.
    a. By drugs which kill the organism in the body – bactericidal.
    b. By drugs which inhibit the growth of the organism – bacteriostatic.
    c. By increasing immunity and resistance to infection of the body – immunity.

21. The order of a reaction is sometimes altered by conditions. Consider a chemical reaction between two substances when one reactant is present in large excess. During the hydrolysis of 0.01 mol of ethyl acetate with 10 mol of water, amounts of the various constituents at the beginning (t = 0) and completion (t) of the reaction are given as



	$CH_3COOC_2H_5$ + H_2O $\xrightarrow{H^+}$		CH_3COOH +	C_2H_5OH
t = 0	0.01 mol	10 mol	0 mol	0 mol
t	0 mol	9.9 mol	0.01 mol	0.01 mol

The concentration of water does not get altered much during the course of the reaction. So, in the rate equation,

Rate = $k'[CH_3COOC_2H_5]\,[H_2O]$ the term $[H_2O]$ can be taken as constant.

The equation, thus, becomes

Rate = $k\,[CH_3COOC_2H_5]$ where $k = k'[H_2O]$

This reaction behaves as first order reaction. Such reactions are called pseudo first order reactions.

22.

a) When electrophoresis, i.e., movement of particles is prevented by some suitable means, it is observed that the dispersion medium begins to move in an electric field. This phenomenon is termed electro-osmosis.

b) The stability of the lyophobic sols is due to the presence of charge on colloidal particles. If, somehow, the charge is removed, the particles will come nearer to each other to form aggregates (or coagulate) and settle down under the force of gravity. The process of settling of colloidal particles is called coagulation or precipitation of the sol.

23.

a. Thermal power plant causes air pollution. They use coal, which is non-renewable source of energy.
b. Promoted values – Reducing environmental pollution. Reducing dependency of fossil fuels,
c. Organizing mass campaigns for spreading awareness. Increase in the use of renewable sources energy such as solar energy etc.,

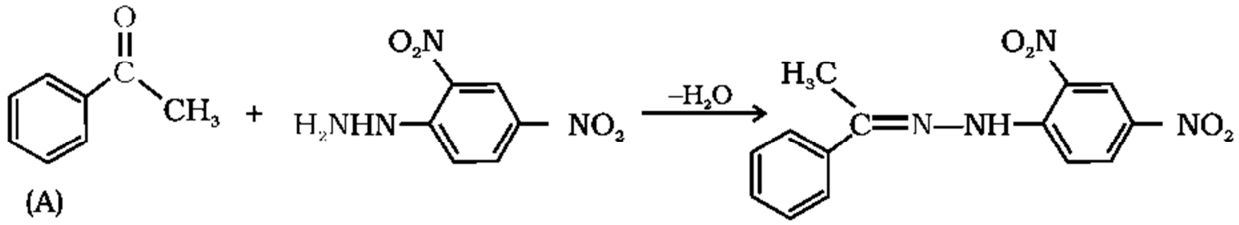
24. In the lanthanoid series, as we move from one element to another, the nuclear charge increases by one unit and one electron is added. The new electrons are added to the same inner 4f-subshells. However, the 4f-electrons shield each other from the nuclear charge quite poorly because of the very diffused shapes of f-orbitals. The nuclear charge increases by one step. Hence, with increasing atomic number and nuclear charge, the effective nuclear charge experienced by each 4f-electron also increases. As a result, there is a gradual decrease in size of lanthanoids with increase in atomic number.

Or

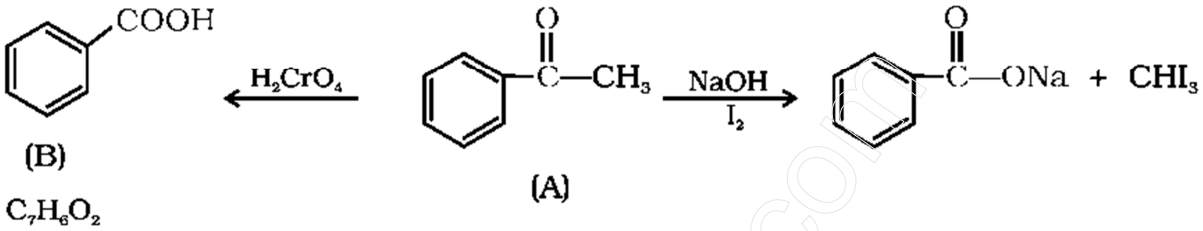
a) The hardness of lanthanoids increases with increasing atomic number.
b) In their chemical behaviour, the earlier members of the series are quite reactive but with increase in atomic number they behave like aluminium.
c) They combine with nitrogen to form nitrides.
d) They liberate hydrogen from dilute acids.
e) When the metals are heated with carbon, they form carbides of the formula Ln_3C, Ln_2C_3 and LnC_2.

25. (A) forms 2,4-DNP derivative. Therefore, it is an aldehyde or a ketone. Since it does not reduce Tollens' or Fehling reagent, (A) must be a ketone. (A) responds to iodoform test. Therefore, it should be a methyl ketone. The molecular formula of (A) indicates high degree of unsaturation, yet it does not decolourise bromine water or Baeyer's reagent. This indicates the presence of unsaturation due to an aromatic ring. Compound (B), being an oxidation product of a ketone should be a carboxylic acid. The molecular formula of (B) indicates that it should be benzoic acid and compound (A) should, therefore, be a monosubstituted aromatic methyl ketone. The molecular formula of (A) indicates that it should be phenyl methyl ketone (acetophenone).

Reactions:



(A) C_8H_8O 2, 4-Dinitrophenylhydrazine 2, 4-DNP derivative



(B) $C_7H_6O_2$ (A)

Or

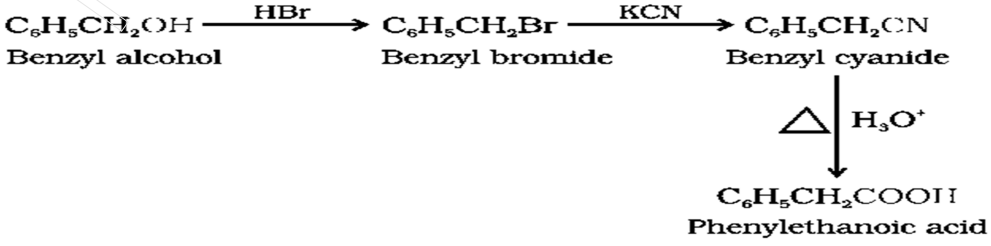
i.

$$\underset{\text{Chloroethane}}{CH_3-CH_2-Cl} \xrightarrow{\text{EthanolicNaCN}} \underset{\text{Propanenitrile}}{CH_3-CH_2-C\equiv N} \xrightarrow{\text{Reduction}} \underset{\text{Propan-1-amine}}{CH_3-CH_2-CH_2-NH_2}$$

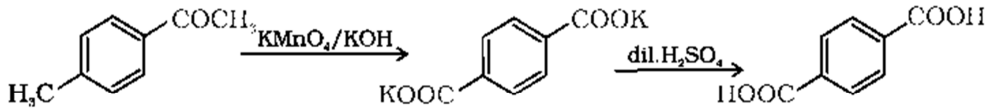
ii.

$$\underset{\text{Chlorophenylmethane}}{C_6H_5-CH_2-Cl} \xrightarrow{\text{EthanolicNaCN}} \underset{\text{Phenylethanehitrile}}{C_6H_5-CH_2-C\equiv N} \xrightarrow{H_2/Ni} \underset{\text{2-Phenylethanamine}}{C_6H_5-CH_2-CH_2-NH_2}$$

iii.



iv.



4-Methylacetophenone | Dipotassium benzene-1, 4-dicarboxylate | Benzene-1, 4-dicarboxylic acid (Terephthalic acid)

26.

$A = \pi r^2 = 3.14 \times 0.5^2\ cm^2 = 0.785\ cm^2 = 0.785 \times 10^{-4}\ m^2$

$l = 50\ cm = 0.5\ m$

$$R = \frac{\rho l}{A}\ or \rho = \frac{RA}{l} = \frac{5.55\ x\ 10^3 \Omega\ x\ 0.785\ cm^2}{50 cm} = 87.135\ \Omega\ cm$$

$$\text{Conductivity} = k = \frac{1}{\rho} = \left(\frac{1}{87.135}\right) S\ cm^{-1} = 0.01148\ S\ cm^{-1}$$

$$\text{Molar conductivity}\ \wedge_m = \frac{kx1000}{c}\ cm^3 L^{-1}$$

$$= \frac{0.01148\ S\ cm^{-1} x\ 1000\ cm^3 L^{-1}}{0.05\ mol L^{-1}}$$

$= 229.6\ S\ cm^2\ mol^{-1}$

Or

a) T = 600 sec, charge = current x time = 1.5 x 600 = 900 C
According to the reaction,
$Cu^{2+} + 2e^- = Cu$
We need, 2F = 2 x 96487 C to deposit 1 mol or 63 g of Cu.
For 900 C, the mass of Cu deposited = 63 x 900/ 2 x 96487 = 0.2938 g.

b) It is observed that the electric current flows through external circuit as indicated by the ammeter. The following observations are made:
   i. Zn rod gradually loses its weight.
   ii. The concentration of Zn ions in the zinc sulphate solution increases.
   iii. Cu gets deposited on the electrode.
   iv. The concentration of Cu ions in copper sulphate solution decreases.
   v. There is flow of electrons from Zn rod to Cu rod and so current flows from Cu to Zn rod.