ST. LAWRENCE HIGH SCHOOL
A JESUIT CHRISTIAN MINORITY INSTITUTION

FOR GOD AND COUNTRY

SELECTION EXAMINATION– 2019
CLASS – XII

SUBJECT – CHEMISTRY
DURATION – 3 hrs. 15 mins

F.M. - 70
DATE-22.11.2019

ANSWER KEY

SECTION-I

MARKS – 1X14=14

MULTIPLE CHOICE TYPE QUESTIONS

1. The edge length of FCC cells is 508 pm. If the radius of the cation is 110 pm, the radius of the anion is-   **(a) 144 pm** (b) 398 pm (c) 288 pm (d) 618 pm

2. A 5 ampere current is passed through a solution of Zinc sulphate for 40 minutes. The amount of zinc deposited at the cathode is-
    (a) 0.4065 g (b) 65.04 g (c) 40.65 g **(d) 4.065 g**

3. Which one of the following method is commonly used method for destruction of colloid?**(all the options are correct)**
    (a) Dialysis (b) Condensation (c) Filteration by animal membrane (d) By adding electrolyte

4. The number of P-O-P bonds in cyclic metaphosphoric acid is-
    (a) Zero (b) Two **(c) Three** (d) Four

5. When I^- ion is oxidized by MnO_4^- in alkaline medium, I- is converted into-
    (a) IO_3^- (b) I_2 (c) IO_4^- (d) IO^-

6. The oxidation state of Chromium in $[Cr\ (en)\ (NH_3)_4]^{+2}$ is-
    (a) +3 **(b) +2** (c) +1 (d) 0

7. Which of the following is the least reactive in a nucleophilic substitution reaction?
    (a) $(CH_3)_3CCl$ **(b) $CH_2=CHCl$** (c) CH_3CH_2Cl (d) $CH_2=CHCH_2Cl$

8. Chlorobenzene reacts with Mg in dry ether to give a compound (A) which further reacts with ethanol to yield-
    (a) Phenol **(b)Benzene** (c) Ethyl benzene (d) Phenyl ether

9. Which one of the following compounds is resistant towards nucleophilic attack by hydroxyl ions?
    (a) **Diethyl ether** (b) Acetonitrile (c) Acetamide (d) Methyl acetate

10. Which one of the following compounds will react with $NaHCO_3$ solution to give sodium salt and carbon dioxide?
    (a) **Acetic acid** (b) n-hexanol (c) Phenol (d) Both b and c

11. Which of the following bases is not present in DNA?
    (a) Adenine (b) Guanine (c) Cytosine **(d) Uracil**

12. The example of biopolymer-
    (a) Teflon (b) Nylon-6,6 (c) neoprene **(d) DNA**

13. Which of the following forms cationic micelles above certain concentration?
    (a) **Sodium dodecyl sulphate** (b) Sodium acetate (c) Urea (d) Cetyltrimethylammonium bromide

14. α-D glucose and β-D glucose are

(a) epimers (b) **anomers** (c) enantiomers (d) diastereomers

SECTION-II
GROUP-A

Answer the following questions. (Alternatives are to be noted)   **MARKS: 1X4=4**

1. Can you store copper sulphate solution in a zinc pot? Explain.

    Ans. Zinc is more reactive than Cu. so Zn can displace Cu from its salt solution. So $CuSO_4$ solution cannot be stored in a zinc pot.

2. Why adsorption is always exothermic?

    Ans. Adsorption causes a decrease in the surface energy of the adsorbent so adsorption is always exothermic.

OR

In the series Sc (**Z=21**) to Zn (**Z=30**), the enthalpy of atomization of zinc is the lowest, i.e. **126** KJ/mol - explain why?

Ans. Due to absence of unpaired electrons, the inter atomic electronic bonding is the weakest in zinc and as a result it has least enthalpy of atomization.

3. What happens when dichromate ion is dissolved in alkali?

    Ans. Orange colour of the dichromate solution turns to yellow colour chromate solution.

4. "Pickles have a long shelf life and do not get spoilt for months" –Explain why?

    Ans. Plenty of salts and cover of oil act as preservatives, which do not allow moisture and air to enter to the material and hence bacteria cannot thrive on them.

OR

What is the role of phosphate in detergent powder?

Ans. Phosphate softened hard water by binding with Ca^{+2} and Mg^{+2} ions. In this way they prevent the lime in water from depositing or settling on the textile fibre.

GROUP-B

Answer the following questions. (Alternatives are to be noted)   **MARKS: 2X5=10**

5. An element with density **2.8** gcm^{-3} forms an FCC unit cell with edge length **4X10^{-8}** cm. Calculate the molar mass of the element.

    Ans. Volume=$(4×10^{-8})^3$= $64×10^{-24}$cm^3

    Number of atoms in FCC unit cell=4

    Mass of unit cell= density × volume= 2.8×64×10^{-24}=179×10^{-24}g

    This is the mass of 4atoms

    Therefore molar mass of the element is M=((179×10^{-24})×(6.023×10^{23}))/4 = 26.952g

6. Why do physisorption and chemisorption behave differently with rise in temperature?

    Ans. Physisorption involves weak V-W forces which weaken with rise in temperature. The chemisorption involves formation in chemical bonds involving activation energy and like any other chemical reaction is favoured by rise in temperature.

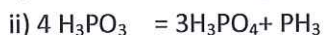**OR**

Define the following terms: 1+1=2

ii)   ii) **Dialysis:** the separation of particles in a liquid on the basis of difference in their ability to pass through membrane.

7. Write balanced equation for the following: 1+1=2

   i) $HNO_3 + 3HCl = NOCl(g) + 2H_2O + Cl_2$

   ii) $4 H_3PO_3 = 3H_3PO_4 + PH_3$

8. Explain the following:

   i) Bi (V) is a stronger oxidizing agent than Sb (V).

Ans. Due to inert pair effect and presence of highly reletivistically contracted $6s^2$ orbital Bi always tries to attain Bi(+3) and act as stronger oxidizing agent than Sb(+5)

   iii) $R_3P=O$ exists but $R_3N=O$ doesn't.

   Ans. In $R_3P=O$ there is a ppi-dpi back bonding takes place between P and O ,it is due to presence of vacant 'd' orbital in P it exists but in N there is a absence of vacant 'd' orbital ,so no scope of ppi-dpi bonding. so it doesn't exist.

   1+1=2

<center>OR</center>

   What is vulcanization? Why is it done?

Ans. It is a chemical process used to harden rubber. It is the treatment of natural rubber with sulphur. It is used to make rubber hoses, shoe soles, tires etc. it makes rubber higher tensile and resistance to swelling and abrasion and elastic over greater range of temperature.

1+1=2

9. Give one example of each oh high spin and low spin compounds of Iron (III) and indicate the state of hybridisation of iron in these two compounds.

Ans. Low spin complex of iron: $[Fe (CN)_6]^{-3}$ Hybridization of Fe is d^2sp^3

High spin complex of iron: $[Fe (H_2O)_6]^{+3}$ Hybridization of Fe is sp^3d

<center>OR</center>

   Mention the monomeric units of the following polymers:

   i)   ABS :monomers of acrylonitrile ,butadiene and styrene

      Glyptal : monomers of phthalic anhydride and glycerol

      1+1=2

<center>**GROUP-C**</center>

<center>**Answer the following questions. (Alternatives are to be noted)**   **MARKS: 3X9=27**</center>

10. (a) Copper crystallises into a FCC lattice with edge length $3.61X10^{-8}$ cm. Show that the calculated density of Cu is in agreement with its measured value of **8.92 gcm^{-3}**.

Ans. Volume=$(3.61×10^{-8})^3$=47.04 $×10^{-24}cm^3$

Number of atoms in FCC unit cell =4

Mass of one atom =$63/(6.02×10^{23})$

mass of unit cell =$4× 63/(6.02×10^{23})$g

density = mass of unit cell/volume of unit cell=$(4×63)/(6.02×47.04×10^{23}×10^{-24})$=8.8gcm^{-3}

   (b) In a cubic close packed structure of a mixed oxide one-eighth of tetrahedral voids are occupied by divalent ions X^{2+}, while one half of the octahedral voids are occupied by trivalent ions Y^{3+}. What is the formula of the compound?

   Ans. This is a spinel structure i.e an oxide of type $XO.Y2O3$ in which X is present at tetrahedral void. So 1/8 th void of 1 and Y is present at octahedral voids so ½ of which is 2. oxide ions

present at corners so $(1/8*8)=1$ and face centres so $1/2*6=3$ total oxides are 4 hence formula is XY_2O_4. $\hspace{2cm}$ 1+2=3

OR

(a) What is the effect of Frenkel defect on electrical conductivity of solid?

Ans. Compounds having Frankel defect conduct electricity to a small extent, it conducts electricity across the crystal due to presence of holes stability or lattice energy of the crystal decreases.

(b) Niobium crystallises in a body centered cubic structure. If the density is **8.55g cm^{-3}**. Calculate atomic radius of Niobium using its atomic mass **93u**.

Ans. The no. of atoms per unit cell for BCC structure is =2

Density=$(z\times M)/(a^3 \times N_A \times 10^{-30})$gcm^{-3}

$a =3.305 \times 10^7$

$a = 3.305 \times 10^2$ pm

$4r=\sqrt{3}$ a

$r = 143$ pm $\hspace{3cm}$ 1+2=3

11. The conductivity of **0.001** M acetic acid is **4X10^{-5}** Scm^{-1}. Calculate the dissociation constant of acetic acid, if molar conductivity at infinite dilution for acetic acid is **390** Scm^{2}mol^{-1}.

Ans. $\wedge$= (k×1000)/M=40Scm^{2}mol^{-1} ,$\wedge°$=390.5 Scm^{2}mol^{-1}

$\alpha = \wedge/\wedge° = 40/390.5 = 0.102$

$K=C\alpha^2 = 0.001 \times (0.102)^2 = 1.04 \times 10^{-5}$ $\hspace{2cm}$ 3

OR

Determine the equilibrium constant for the given redox reaction:

$Fe^{2+}(aq) + Ce^{4+}(aq) \longrightarrow Fe^{3+}(aq) + Ce^{3+}(aq)$

Given: $E°_{Ce^{4+}/Ce^{3+}}$= **1.44V** and $E°_{Fe^{3+}/Fe^{2+}}$= **0.77V**

$E°_{cell}$= 1.44-0.77= 0.67

T=298K, R= 8.314JK^{-1}mol^{-1}

-RTlnK$_{Eq}$=-nF $E°_{cell}$

K_{eq}=2.15×10^{11} $\hspace{3cm}$ 3

12. (a) What is the role of depressant in froth floatation process?

Ans. It helps to separate two sulphide ores by selective prevention of floth formation by one ore and allowing the other to come into floth.

(c) Why is leaching of gold by metal cyanides carried out in the presence of oxygen?

Ans. Because it is an oxidation reaction where Au is oxidized to Au^{+1}, which combines with CN^{-1} to form soluble AuCN.
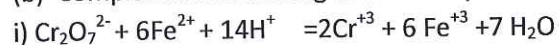
(c) Metals usually do not occur in nature as nitrates-Why?

Ans. Metals have more affinity to oxygen and also nitrates is not present in as much abundant than that of oxygen . Metal nitrates are readily ionizable and extremely soluble due to which they will not be found as solids. $\hspace{3cm}$ 1+1+1=3

13. (a) Which metal in the first transition series of transition metals exhibits (+1) oxidation state most frequently and why?

Ans. Cu^{+1} because [Ar] $3d^{10}$, the completely filled d-orbital makes it highly stable.

(b) Complete the following chemical equations:

i) $Cr_2O_7^{2-} + 6Fe^{2+} + 14H^+ = 2Cr^{+3} + 6 Fe^{+3} + 7 H_2O$

ii) $2\ MnO_4^- + 5\ C_2O_4^{2-} + 16H^+ = 10CO_2 + 2Mn^{+2} + 8H_2O$

1+1+1=3

OR

Explain the following:
i)   Principle of Liquation process

Ans. It is a metallurgical process to purify mineral metals. It is employed to separate valuable metals from ores, that are a mixture of two or more valuable metals. This process involves heating the ore until the metal with a lower melting point is separated from the one with higher melting point.

ii)   Why $FeCO_3$ ore cannot be used in blast furnace for the extraction of iron.

Ans. Carbonate ores is more difficult to smelt than a haematite ore or other oxide ores. Driving off the carbonate as carbon di oxide requires more energy that destroy blust furnace.

2+1=3

14. i) Why is the highest oxidation state of a metal exhibited in its oxide or fluoride only?

Ans.   Fluorine and oxygen have small size high electro negativity and high negative electron gain enthalpy. They can oxidize a metal to the highest oxidation state.

iii)   Which is a stronger reducing agent, Fe^{3+} or Cr^{2+} and why?

Ans. Cr^{+3} is more stronger reducing agent as reduction potential is negative for chromium and reduction potential is positive for iron. lower the $E°$ value more stable the oxidation state.

1+2=3

15. (a) Mention the role of dry ether during the chemical reaction of Grignard Reagent.

Ans. Grignard reagent is not prepared in the solvent which has acidic hydrogen because it react to form alkane. Dry ether does not give H to the Grignard reagent so it is used as solvent.

(b) Explain with reasons:

i) Ethyl iodide undergoes S_N2 reaction faster than ethyl bromide.

Ans. As iodide is a good leaving group.

ii)   C-X bond length in halobenzene is smaller than C-X bond length in **CH_3-X**.

Ans. Halogen atom has lone pair of electrons which contribute to the resonance form multiple bonds hence C-X bond length is smaller.   1+1+1=3

16. i) Mention the drawbacks of Williamson synthesis for an ether.

Ans. Tertiary alkyl halide / sterically hindered primary / secondary alkyl halide tends to undergo E2 in the presence of alkoxide that in addition to bring a nucleophile also acts as a base.

ii) Phenol is heated with chloroform and caustic alkali_____ Give the proper chemical reaction for the reaction.   Ans. $C_6H_5OH + CHCl_3 + OH^- = $ 2-hydroxybenzaldehyde

2+1=3

17. (a) How will you convert the following:

i) Benzene into aspirin

ans. Benzene+ propene (in presence of O_2) = PHENOL (on treatment with CO_2 and NaOH)= o-hydroxy benzoic acid (treatment with acidic anhydride)= aspirin

iii)   Methanol to Optically active Lactic acid.

Ans. Methanol after reacting with $SOCl_2$ followed by Mg dry ether and HCHO, H_2O produce Ethanol. Ethanol on treatment with PCC followed by HCN and after acidic hydrolysis produces Lactic Acid.

(b) What happens when benzene diazonium chloride solution is added to Phenol dissolved in sodium hydroxide?   Ans. Coupling reaction occurs organic compounds containing –N=N- (azo) functional group formed.   (1x2)+1=3

18. (a) What is isoelectric pH? (b) What is denaturation of protein? (c) What is a glycosidic linkage?
1+1+1=3

Ans. It is the pH at which a molecule carries no net electrical charge or is electrically neutral in the statistical mean.

b) it involves the disruption and possible destruction of both the secondary and tertiary structure of protein.

c) it is a type of covalent bond that joins a carbohydrate molecule to another group which may or may not be another carbohydrate.

OR

(a) The deficiency of which vitamin causes "pernicious anaemia"? **Ans.** B12

(b) What is Inversion of Cane Sugar?

Ans. Chemical conversion of sucralose in solution of glucose and fructose .process is enhanced by acid and high temperature. The angle of rotation of plane polarized light sent through the solution changes during the process of inversion.

(c) What is the basic difference between Nucleoside and nucleotide?

Ans. Nucleoside consists of nitrogenous base covalently attached to a sugar but without phosphate group. A nucleotide consists of nitrogenous base a sugar and one to 3 phosphate group.

1+1+1=3

GROUP- E

Answer the following questions. (Alternatives are to be noted)   **MARKS: 5X3=15**

(N.B.: The word limit must not exceed beyond 100 for each 5 mark question)

19. (a) <u>Explain the following</u>:

i) In the redox titration of $KMnO_4$ against Oxalic acid, externally heat must be applied before initiating the titration. **Ans.** The reduction of permanganate to Mn^{+2} ion is autocatalytic, meaning the product of the reaction speeds up the reaction . heating is needed to produce at least some amount of Mn^{+2} ions and then the reaction is fast enough at room temperature.

ii) An inhibitor always retards the rate of chemical reaction.

Ans. There are substances that influence the velocity of chemical reaction, while not being consumed in the process, such substances are referred to as catalysts if they accelerate reaction and inhibitor slow it down.

        (c)   At **380°C**, the half-life period for the first order decomposition of H_2O_2 is **360** min. The energy of activation of the reaction is **200** KJ/mol. Calculate the time required for **75%** decomposition at **450°C**.

        Ans. K_1 at 380°C= 0.693/360 min^{-1}, K_2=0.067min^{-1}

        Log K_1/K_2=E_A/2.303R(1/T_1-1/T_2)

        t =(2.030/k) log[N°]/[N]=20.69 min

                                  (1x2) +3=5

OR

(a) <u>Explain the following terms</u>:

i) **Order of a reaction**: The power dependence of the rate on the concentration of each reactant. It is experimentally determined parameter and has functional value.

ii) **Temperature coefficient of reaction rate**: The ratio of rate constants of a chemical reaction gets affected by 10°C rise in temperature for every 10°C rise in temperature rate of reaction is doubled.

(b) The time required for **10%** completion of a first order chemical reaction at **298K** is equal to that required for its **25%** completion at **308K**. If the value of A is **$4 \times 10^{10} s^{-1}$**, calculate the value of K at **318K** and the energy oof activation.

Ans. $K_{308}/k_{298} = \log(100/75)/\log(100/90) = 2.733$

According to Arrhenius equation-

$\log K_2/K_1 = E_A/2.303R(1/T_1 - 1/T_2)$ $E_A = 76658 Jmol^{-1}$

$\log k_{308} = \log(4 \times 10^{10}) - (76658/2.303 \times 8.314 \times 308)$

$K_{308} = 4.02 \times 10^{-3} s^{-1}$ $(1 \times 2) + 3 = 5$

20. (a) Draw the structure and also find out the hybridization state of the following compound:

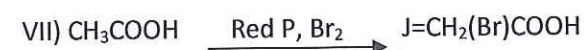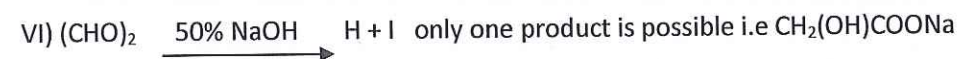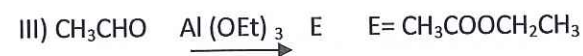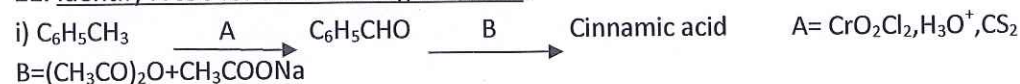i) XeO_2F_2: dsp^3 see saw ii) IF_7: pentagonal bi pyramidal sp^3d^3 iii) ClF_3: T-shaped sp^3d

(b) **Explain the following observations:**

i) H_3PO_2 is a stronger reducing agent than H_3PO_3. **Ans.** The H atom in OH bond are ionizable and are acidic, whereas the P-H bonds have reducing property, the number of P-H bonds is more in H_3PO_2 than H_3PO_3, so H_3PO_2 is a stronger reducing agent

ii) XeF_2 and IBr_2^- assume the same molecular shape. **Ans.** Both having sp^3d hybridization and linear structure according to VSEPR theory. $(1 \times 3) + (1 \times 2) = 5$

21. Identify A to J for the following reactions: $1/2 \times 10 = 5$

i) $C_6H_5CH_3$ $\xrightarrow{A}$ C_6H_5CHO $\xrightarrow{B}$ Cinnamic acid $A = CrO_2Cl_2, H_3O^+, CS_2$

$B = (CH_3CO)_2O + CH_3COONa$

II) $C_6H_5CONH_2$ $\xrightarrow{C}$ Aniline $\xrightarrow{D}$ Azo-dye $C = Br_2/KOH$ $D = HNO_2$, Conc. HCl(0-5)°C, phenol/ β - napthol

III) CH_3CHO $\xrightarrow{Al(OEt)_3}$ E $E = CH_3COOCH_2CH_3$

IV) CH_3COCH_3 $\xrightarrow{F}$ $CH_3CCl_2CH_3$ $F = PCl_5$

V) CH_3COOH $\xrightarrow{G}$ CH_3CH_2COOH $G = SOCl_2, CH_2N_2, Ag^+/H_2O$ dioxane

VI) $(CHO)_2$ $\xrightarrow{50\% NaOH}$ H + I only one product is possible i.e $CH_2(OH)COONa$

VII) CH_3COOH $\xrightarrow{Red P, Br_2}$ $J = CH_2(Br)COOH$

OR

(a) Give chemical tests to distinguish between the following pairs of compounds:

i) Acetic acid and isopropyl alcohol

ACETIC ACID	ISOPROPYL ALCOHOL
Turns blue litmus red	No action on litmus paper
Reacts with sodium bicarbonate to give effervescence of CO_2	No reaction with sodium bi carbonate

ii) Banzaldehyde and Acetaldehyde

Banzaldehyde	Acetaldehyde
Give silver mirror test positive. With Tollen's reagent	Doesn't give positive Tollen's test

(b) How will you convert?

i) Toluene to Mandelic acid :toluene reacts with $CrO_2Cl_2/CS_2/H_3O+$ produce benzaldehyde that on treatment with $NaHSO_3$,NaCN and H_3O^+ produce mandelic acid

ii) Ethanol to 2, 3-dimethylbutane 2,3-diol. : ethanol on $KMnO_4$ oxidation produces acetone, that on treatment with Mg-Hg& conc. HCl dimerizes & produces 2,3- diol

(c) What happens when Fomaldehyde is treated with Ammonia

Ans. Production of hexamethylenetetramine or Urotropine $[(CH_2)_6N_4]$

(1x2)+(1x2)+1=5