

**Question Paper** for workshop KV No. 3 Pathankot

By Vijesh Kumar (PGT Chemistry) KV Leh :

Subject : Chemistry

Max.Marks: 70

Duration: 3 Hr.

**Section:A**

1. What is Total no. of atoms per unit cell in fcc crystal structure?
2. Express the relation between the conductivity and molar conductivity of a solution?
3. Why is the froth floatation method selected for the concentration of sulphide ores?
4. Why is Bi(V) a stronger oxidant than Sb(V) ?
5. Write the structure of 2-Bromo-3-methylbut-2ene-1-ol.
6. Why is alkyLamine more basic than ammonia?
7. Give an example of Elastomers.
8. What does the part 66,6 represent in the nylon -6,6 ?
9. Arrange the following compounds in an increasing order of basic strength in their aqueous solutions.



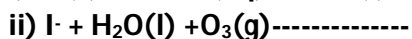
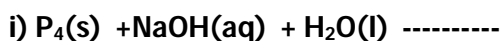
**Section: B**

10. What type of cell is lead storage battery ? Write anode and the cathode reaction and the overall cell reactions occurring in the use of a lead storage battery.

11. Draw the structure of the following molecules :



12. Complete the following chemical reactions :



13. For the decomposition reactions the values of rate constant K at two different temperatures given below:  $K_1 = 2.15 \times 10^{-8} \text{ L mol}^{-1} \text{ s}^{-1}$  at 650K

$K_2 = 2.39 \times 10^{-7} \text{ L mole}^{-1} \text{ s}^{-1}$  at 700k

Calculate the value of  $E_a$  for this reaction ( $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$ )

14. Give chemical reaction in support of the following observations :

a) Sulphuric acid has low volatility.

b) Iodide ion can be oxidized by oxygen in acidic medium.

Q15.: Propose the mechanism of the reaction taking place when :

a) (-) - 2 - bromo-octane reacts with sodium hydroxide to form (+) -octane -2 - ol.

b) 2- Bromo-pentane is heated with (alc.) KOH to form alkenes.

Q : 16. What is flux? What is the role of flux in the metallurgy of iron and Cu?

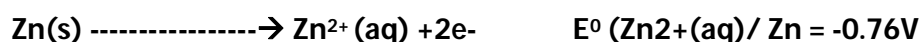
Q17. Sodium Crystallizes in a BCC unit cell .Calculate the approximate number of unit cells in 9.2 g of Na? (Atomic mass of Na( 23) .

Q. 18. What is semiconductor ? Describe the two main types of semiconductors.

#### Section :C

Q19. A) Calculate the charge in coulombs required for the oxidation of 2 mole of water to oxygen? (Given  $1F = 96500C\ mol^{-1}$ )

B) Zn/AgI oxide cell is used in hearing aids and electric watches .hte following reactions occurs:



Calculate the i) Standard potential of the cell ii) standard Gibbs energy.

Q20. Give reasons for the following observations:

- Colloids stabilize due to Brownian movement.
- Cottrell's smoke precipitator is fitted at the mouth of chimney used in factories.
- Colloidal gold is used for intramuscular injection.

21. a) Write the Zwitter ion structure of glycine.

b) What is meant by inversion of sugar?

c) Name the vitamin in each case whose deficiency causes:

i) Night blindness ii) Poor coagulation of blood.

Q22. Write chemical reaction for the following reactions: a) oxidation of nitrite ion by  $MnO_4$  in acidic medium. B) Acidification of potassium chromate solution.

C) Disproportionate of manganese (VI) in acidic medium.

Q23. Give plausible reason for each of the following:

(a) Ortho-nitrophenol is more acidic than n-methoxyphenol.

b) Alcohols are easily protonated in comparison to phenols

c) The relative ease of dehydration of alcohols is  $3^\circ > 2^\circ > 1^\circ$  ..

Q24.a) Give one reaction of D-glucose which cannot be explained by its open chain structure.

b) Give one example each for the essential and non-essential amino acids.

c) Differentiate between keratin and insulin.

Q 25. A) Identify aliphatic biodegradable polyester which is used in packaging and orthopedic devices.

i) Write its full form ( name )

ii) Give the structure of monomers from which it is formed.

lii) Show the formation of polymer.

Q26. A) Justify the following:

i) Sleeping pills are recommended to patients suffering from sleeplessness but it is not advisable to take them without consulting the doctor.

ii) li) Why do we require artificial sweetening agents?

Q27. A) Give chemical test to distinguish between :

i) Isopropyl alcohol and n-polyalcohol.

ii) Phenol and alcohol

iii) li) Methyl ethanoate and ethyl ethanoate.

#### Section: D

Q28. Methanol is a crystalline substance with peppermint taste. A 6.2% solution of methanol in cyclohexane freezes at  $-1.95^\circ\text{C}$ . Determine the formula mass of methanol. The freezing point and molal depression constant of cyclohexane are  $6.5^\circ\text{C}$  and  $20.2\text{ K m}^{-1}$  respectively.

b) State Henry's law and mention its two applications.

c) which of the following has higher boiling point and why? 0.1 M NaCl or 0.1 M glucose

Or Define azeotropes and explain briefly minimum boiling point azeotropes by taking suitable examples.

b) The vapour pressure of pure liquid A and B are 450mm and 700 mm of Hg respectively at 50 K. Calculate the composition of liquid mixture if total vapor pressure is 600mm of Hg .also find the composition of the mixture in vapor phase.

Q29. A) i) Which is stronger reducing agent  $\text{Cr}^{2+}$  or  $\text{Fe}^{2+}$  and why?

ii) Explain why  $\text{Cu}^+$  ion is not stable in aqueous solutions?

iii) Explain why  $\text{Ce}^{4+}$  is a strong oxidizing agent?

iv) Describe the oxidizing property of  $\text{KMnO}_4$  in neutral or faintly alkaline medium for its reaction with iodide ions and thiosulphite ions.

Q30 a) Account for the following:

i) Oxidizing power in the series  $\text{VO}_2^+ < \text{Cr}_2\text{O}_7^{2-} < \text{MnO}_4^-$ .

ii) IN the first transition series only Cu has positive electrode potential.

iii) Oxoanions of a metal show higher oxidation state.

b) Which is the last element in the series of actinides? Write the electronic configuration of this element. Comment on the possible oxidation states of this element.

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**Answer Keys** for workshop KV No. 3 Pathankot

By Vijesh Kumar (PGT Chem.)KVLLeh :

Ans1. There are 4 atoms per unit cell in fcc crystal structure.

Ans 2.  $\Lambda_m = K/C$  ,  $\Lambda_m$  is molar conductivity.

K is conductivity.

C is the concentration in  $\text{mol L}^{-1}$ .

Ans3. Because sulphide ore particles are preferentially wetted by the oil and gangue particles by water. Thus, the sulphide ore particles become lighter and come to the froath leaving behind impurities in water.

Ans4 : In Bi (V) the inert pair effect is more prevalent than Sb(V) , so , it accepts two electrons and easily changes to Bi(III)  $\text{Bi}^{5+}$  to Bi (III)

$\text{Bi}^{5+} + 2 e \rightarrow \text{Bi}^{3+}$

Ans 5. : Structure of 2-Bromo-3-methylbut-2ene-1-ol.

Ans6: Due to presence of +I effect of alkyl group in alkyl amine , the electron density on nitrogen is further increased , so electron pair in alkylamine is readily available for donation.

Ans 7. Buna-S.

Ans 8. In nylon 6,6 is synthesized by the condensation of adipic acid and hexamethylene diamine molecules. Because both of these molecules contain six C – atoms , hence 6,6 is written after their polymer i.e Nylon.

Ans9 :  $\text{NH}_3 < (\text{CH}_3)_3\text{N} < \text{CH}_3\text{NH}_2 < (\text{CH}_3)_2\text{N}$

#### Section :B

Ans 10 .The cell which can be recharged for further use by passing current through it in opposite direction is known as secondary cell .A good secondary cell can be recharged no. of times after its discharging. Lead storage battery and Ni –Cd cell are examples of secondary cell. Lead storage battery : It consists of lead anode and a grid of lead packed with  $\text{PbO}_2$  as cathode. These anodes and cathodes are arranged alternatively. 38% solution of  $\text{H}_2\text{SO}_4$  is taken as electrolyte. When the battery is in use , following cell reactions will taken place.

Anode:  $\text{Pb}(\text{s}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{PbSO}_4 + 2\text{e}^-$

Cathode:  $\text{PbO}_2(\text{s}) + \text{SO}_4^{2-} + 4\text{H}^+ + 2\text{e}^- \rightarrow \text{PbSO}_4(\text{s}) + 2\text{H}_2\text{O}$

Overall reaction will be :  $\text{Pb}(\text{s}) + \text{PbO}_2(\text{s}) + 2\text{H}_2\text{SO}_4(\text{aq}) \rightarrow 2\text{PbSO}_4(\text{s}) + 2\text{H}_2\text{O}(\text{l})$

On charging the battery cell is operated like an electrolyte cell and reaction is reversed i.e.  $\text{PbSO}_4$  deposited on electrodes is converted back into Pb and  $\text{PbSO}_4$  and  $\text{H}_2\text{SO}_4$  is reproduced.

Reverse the reaction:

Ans 11: Structure of  $\text{XeF}_4$  and  $\text{BrF}_3$

Ans 12.  $\rightarrow 3\text{NaH}_2\text{PO}_4 + \text{PH}_3(\text{g})$

$\rightarrow \text{I}_2(\text{g}) + \text{O}_2(\text{g}) + 2\text{OH}^-$

Ans13 .:  $\log K_2/k_1 = E_a/2.303R [ T_2 - T_1/T_1T_2 ]$

Given :  $k_1 = 2.15 \times 10^{-8}$ ,  $K_2 = 2.39 \times 10^{-7}$ ,  $t_1 = 650\text{K}$ ,  $t_2 = 700\text{K}$

$R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$

$E_a = 2.303 \times 8.314 \text{ Jmol}^{-1}\text{K}^{-1} \times 650\text{K} \times 700\text{K} / 700\text{K} - 600\text{K} \log 2.39 \times 10^{-7} / 2.15 \times 10^{-8}$

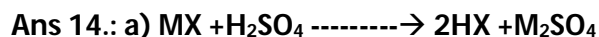
$(1.045 \text{ Jmol}^{-1})$

$E_a = 182.16 \text{ KJmol}^{-1}$

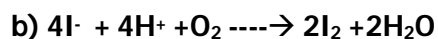
14. Give chemical reaction in support of the following observations :

a) Sulphuric acid has low volatility.

b) Iodide ion can be oxidized by oxygen in acidic medium.



(where X = F-, Cl-, NO<sub>3</sub><sup>3-</sup> and Mn+ is metal ion.

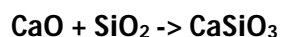


Ans 15. : a) show the reaction like SN1 mechanism .

b) 2-Bromo pentene is major product.

Ans.16. Flux is a substance that is added to the roasted or the calcined ore during reduction. Its purpose is to remove the gaunge still present in the ore.

In the metallurgy of Cu : flux silica combines with iron oxide impurities to form iron silicate slag.  $FeO + SiO_2 \rightarrow FeSiO_3$ . In the metallurgy of iron : In the blast furnance limestone is added to calcium oxide (actual flux ) and removes the impurities of silica:



Previously  $CaCO_3 \xrightarrow{\text{heat}} CaO + CO_2$ .

Ans 17. No Of atoms per unit cell (Z) for BCC =2.

Cos No of atoms in 23 g of Na: =  $6.022 \times 10^{23}$

so No of atoms in 9.2 g of Na+  $9.2 \text{ g} / 23 \text{ g} \times 6.022 \times 10^{23}$

No of Na atoms =  $2.4 \times 10^{23} \text{ atoms} / 2 \text{ atoms unit cell}^{-1} = 1.2.44 \times 10^{23}$

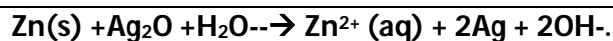
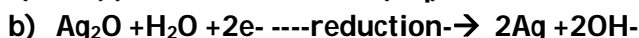
Ans. 18.Semiconductor is solid having conductivity in the intermediate range from  $10^{-6}$  to  $10^4$  ohm<sup>-1</sup> cm<sup>-1</sup>. Two types of semiconductors are : N type of semiconductor : These semiconductors have excess of electrons e.g. Ge doped with As. P type semiconductors: These semiconductors have lack of electrons or electron vacancy e.g. Si doped with B .



2mol

4mol or 4F)

Therefore , charge (Q) required for converting 2 moles of H2O to Oxygen =  $4F = 4 \times 96500 \text{ C mol}^{-1} = 386000 \text{ C mol}^{-1}$



i)  $E^0_{\text{cell}} = E^0_{\text{Cathode}} - E^0_{\text{anode}} = 0.344 - (-0.76V) = 1.104V$

ii)  $\Delta G^0 = -nFE^0_{\text{Cell}} = -2 \times 96500 \times 1.104 = -2.13 \times 10^5 \text{ J mol}^{-1}$

Ans.:20 a) Brownian movement is random motion of the colloidal particles in a colloidal solution. It counters the force of gravity on the colloidal particles and hence helps in providing stability to colloidal solutions by not allowing them to settle down.

b) The precipitator contains plates having a charge opposite to that carried by smoke particles which lose their charge and get precipitated and smoke is thus free from carbon and dust particles after passing through chimney.

c) Because colloidal gold has greater surface area and easily get assimilated with the colloidal blood.

Ans 21. : a)  $\text{H}-\text{CH}(\text{NH}_2)-\text{COOH} = \text{HCH}(\text{NH}_3^+)-\text{COO}^-$  (Zwitter ion.)

b) The specific rotation of sugar from dextro-rotation to laevorotation is called inversion of sugar.

c) The change of specific rotation of sugar from dextro-rotation to laevo rotation is called laevorotation is called invert sugar.

d) Vitamin A ii) vitamin K.

Ans 22:  $5\text{NO}_2^- + 2\text{MnO}_4^- + 6\text{H}^+ \rightarrow 2\text{Mn}^{2+} + 3\text{H}_2\text{O} + 5\text{NO}_3^-$

b)  $\text{K}_2\text{Cr}_2\text{O}_7 + 2\text{H}^+ \rightarrow \text{K}_2\text{Cr}_2\text{O}_7 + 2\text{K}^+ + \text{H}_2\text{O}$

c)  $3\text{MnO}_4^{2-} + 4\text{H}^+ \rightarrow 2\text{MnO}_4^{2-} + \text{MnO}_2 + 2\text{H}_2\text{O}$ .

Ans: 23 a) Due to strong -R and -I effect of -NO<sub>2</sub> group, electron density in the O bond decreases.

b) In alcohols, lone pair of electrons on the oxygen is available for proton due to the absence of resonance.

or Lone pair of electrons at oxygen atom are not available for donation due to resonance in phenols. c) Due to order of stability of carbocations  $3^\circ > 2^\circ > 1^\circ \dots$

Or tertiary alcohols form more substituted alkenes.

Ans 24.: a) Despite of having the presence of aldehyde group, glucose does not give 2, 4 DNP test / Schiff test, does not form the hydrogen sulphide addition product with NaHCO<sub>3</sub>.

b) Essential amino acids – valine

Non-Essential amino acids: glycine..

c) Keratin is a fibrous protein whereas insulin is a globular protein.

Ans 25. A) PHBV

B) 3-Hydroxy butanoic acid and 3-Hydroxy pentanoic acid.

c) Reaction of formation of PHBV.

Ans26: Because most of the drugs act as position in high doses and may lead to death.

i) Artificial sweetening agents are required to control the calorie intake and act as a substitute of sugar for diabetics.

c) Composition of Dettol : Chloroxylenol and terpinol.

Ans 27. i) Isopropyl alcohol and n-propyl alcohols:

On adding NaOH/I<sub>2</sub> and NaOI and heating isopropyl alcohol forms yellow ppt. of iodoform (CHI<sub>3</sub>)

Whereas n-propyl alcohol does not.

ii) Phenol and alcohol

On adding neutral FeCl<sub>3</sub> solution, phenol red-violet complex whereas alcohol does not.

iii) Methyl ethanoate and ethyl ethanoate: On hydrolysis, ethylethanoate gives ethanol which on heating with NaOI gives yellow ppt of CHI<sub>3</sub> whereas methyl ethanoate on hydrolysis gives negative test.

ANS. 28. Let the mass of the solution = 100g

$$W_A = 100 - 6.2 = 93.8 \text{ g} \quad W_b = 6.2 \text{ g}$$

$$\Delta T_f = 6.5 - (-1.95) = 8.450 \text{ C} = 8.45 \text{ K}$$

$$\Delta T_f 45 \text{ K} = K_f m = K_f X W / M_b X 1000 \text{ g} / W_a$$

$$= 20.2 \text{ K kg mol}^{-1} X 6.2 \text{ g} / M_b X 1000 \text{ g} / 93.8 \text{ g}$$

$$M_b = 158 \text{ g mol}^{-1}$$

b) Henry's law: This law states that the solubility of gas in a liquid is directly proportional to the pressure of the gas. Application:

- 1) Solubility of CO<sub>2</sub> is increased at high pressure.
- 2) Mixture of He and O<sub>2</sub> are used by deep sea divers because He is less soluble than nitrogen.

c) 0.1 M NaCl has higher boiling point than 0.1 M. Glucose because 0.1 M NaCl dissociates in solution and furnishes greater number of particles per unit volume while glucose does not dissociate.

Or Azeotropes is a liquid mixture which boils at constant temperature without undergoing change in composition.



Example A mixture of 95% ethanol and 3% water by mass forms minimum boiling azeotropes i.e. it boils at a temperature lower than expected from ideal behavior, as it shows positive deviation from ideal behavior.

$$b) pA^0 = 450\text{mmHg}, pB^0 = 700\text{mmHg}$$

$$p = pA^0X_A + pB^0X_B$$

$$600 = 450(X_A) + 700(1 - X_A)$$

On solving, we get  $X_A = 0.4$ ,  $X_B = 0.6$

In vapor phase

$$P_A = 0.4 \times 450\text{mmHg} = 180\text{mmHg}$$

$$P_B = 0.6 \times 700\text{mmHg} = 420\text{mmHg}$$

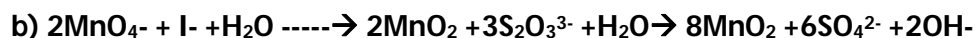
$$X_A = 180\text{mm} / 600\text{mm} = 0.3$$

$$X_B = 1 - X_A = 1 - 0.3 = 0.7$$

Ans.29 I)  $\text{Cr}^{2+}$  is a strong reducing agent than  $\text{Fe}^{2+}$  due to its change from  $d^4$  configuration to stable  $d^3$  configuration in case of  $\text{Cr}^{2+}$  to  $\text{Cr}^{3+}$  than  $d^6$  to  $d^5$  change in  $\text{Fe}^{2+}$  to  $\text{Fe}^{3+}$ .

ii) Because  $\text{Cu}^+$  in aqueous solution undergoes disproportionation to more stable  $\text{Cu}^{2+}$  to  $\text{Cu}$ .

iii) Because  $\text{Ce}$  is more stable in +3 oxidation state.



or

Ans 30 . I) this is due to the increasing stability of the lower species to which they are reduced.

ii)  $\text{Cu}$  has high ionization enthalpy for transforming  $\text{Cu}(s)$  to  $\text{Cu}^{2+}(aq)$  and this is not balanced by its hydration enthalpy.

iii) Due to high electronegativity and multiple bond formation with metal and oxygen.

iv) Lawrencium (Lr) ( $Z = 103$ )

electronic configuration =  $[\text{Rn}] 5f^{14} 6d^1 7s^2$

Possible oxidation state = +3.

