B.K. Birla Centre For Education

Date: 17-12-2025 | PRE BOARD EXAMINATION-II | **Duration**: 3 Hrs

Class: XII | Chemistry | **Total Marks** : 70

Instructions to the Students

- Write only question numbers clearly outside the margin (1, 2, 3.i, 5.b, 4.c.ii, etc.).
- Do not write questions or any titles. (For ex. - Do not write **II. Answer the following**).
- After every answer, give a one-line space.
- For Multiple choice Questions - Both Option and Answer should be written.
- Bullet points & Sub-points should be written inside the margin.
- Do not fold / staple the paper.

Section A

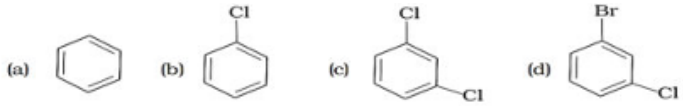
1. What is the correct order of reactivity of the following towards nucleophilic addition? [1]

a) Methanal > Ethanal > Acetone
b) Acetone > Ethanal > Methanal
c) Methanal > Acetone > Ethanal
d) Ethanal > Methanal > Acetone

Answer 🔑

a) Methanal > Ethanal > Acetone (1)

2. Arrange the following compounds in the increasing order of their densities. [1]



a) (a) < (b) < (c) < (d)
b) (a) < (c) < (d) < (b)
c) (d) < (c) < (b) < (a)
d) (b) < (d) < (c) < (a)

Answer 🔑

a) (a) < (b) < (c) < (d) (1)

3. Coordination number of Fe in $[Fe(C_2O_4)^3]^{3-}$ is : [1]

a) 6 b) 3 c) 4 d) 5

Answer 🔑

a) 6 (1)

4. Match the following amines with their correct characteristics or reactions: [1]

	Column A (Amines)		Column B (Characteristics/Reactions)
1	Methylamine	A	Forms diazonium salts upon reaction with nitrous acid
2	Aniline	B	Undergoes nucleophilic substitution with alkyl halides
3	Ethylamine	C	Exhibits strong basicity in aqueous solution
4	Benzenediazonium chloride	D	Undergoes electrophilic substitution at ortho/para positions

a) 1-C 2-B 3-A 4-D b) 1-D 2-B 3-C 4-A c) 1-A 2-C 3-B 4-D d) 1-C 2-D 3-B 4-A

Answer 🔑

d) 1-C 2-D 3-B 4-A (1)

5. The freezing point of one molal KCl solution, assuming KCl to be completely dissociated in water, is : (K_f for water = 1·86 K kg mol^{-1}) [1]

a) – 3·72°C b) + 3·72°C c) – 1·86°C d) + 2·72°C

Answer 🔑

a) – 3·72°C (1)

6. Which of the following alkyl halides will undergo S_N1 reaction most readily? [1]

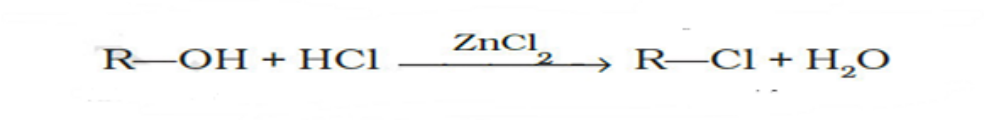
a) $(CH_3)_3C—F$ b) $(CH_3)_3C—Cl$

c) $(CH_3)_3C—Br$ d) $(CH_3)_3C—I$

Answer 🔑

d) $(CH_3)_3C—I$ (1)

7. What is the correct order of reactivity of alcohols in the following reaction? [1]



a) 1° > 2° > 3° b) 1° < 2° > 3° c) 3° > 2° > 1° d) 3° > 1° > 2°

Answer 🔑

c) 3° > 2° > 1° (1)

8. Furanose ring of fructose is formed due to reaction between : [1]

a) C_1 and C_5 b) C_2 and C_5

c) C_1 and C_4 d) C_1 and C_2

Answer 🔑

b) C_2 and C_5 (1)

9. Which of the following lanthanoids show +2 oxidation state besides the characteristic oxidation state +3 of lanthanoids? [1]

a) Ce b) Eu c) Tb d) Dy

Answer 🔑

b) Eu (1)

10. Which cell will measure standard electrode potential of copper electrode? [1]

a) Pt(s)| H_2 (g, 0.1 bar)| H^+ (aq., 1 M) || Cu^{2+} (aq., 1M)| Cu(s)

b) Pt(s)| H_2 (g, 1 bar) | H^+ (aq., 1 M) || Cu^{2+} (aq., 2M)| Cu(s)

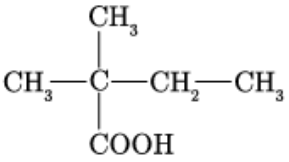
c) Pt(s)| H_2 (g, 1 bar) | H^+ (aq., 1 M) || Cu^{2+} (aq., 1M)| Cu(s)

d) Pt(s)| H_2 (g, 1 bar) | H^+ (aq., 0.1 M)|| Cu^{2+} (aq., 1M)| Cu(s)

Answer 🔑

c) Pt(s)| H_2 (g, 1 bar) | H^+ (aq., 1 M) || Cu^{2+} (aq., 1M)| Cu(s) (1)

11. What is the correct IUPAC name of the given compound ? [1]

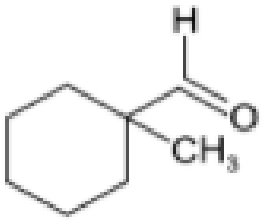
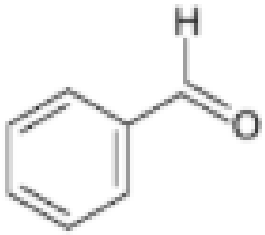


a) 2-carboxyl-2-methylpropanoic acid
b) 2-ethyl-2-methylpropanoic acid
c) 3-methylabutane carboxylic acid
d) 2, 2-dimethylbutanoic acid

Answer 🔑

d) 2, 2-dimethylbutanoic acid (1)

12. Which of the following aldehydes doesnot undergo Cannizzaro's reaction? [1]

a)  b)  c) HCHO

d) CH_3CHO

Answer 🔑

d) CH_3CHO (1)

13. **Assertion (A) :** Boiling point of $(C_2H_5)_2NH$ is lower than that of n-$C_4H_9NH_2$. [1]

Reason (R) : Hydrogen bonding is much more extensive in n-$C_4H_9NH_2$ as compared to $(C_2H_5)_2NH$.

a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A)
c) Assertion (A) is true, but Reason (R) is false.
d) Assertion (A) is false, but Reason (R) is true.

Answer 🔑

a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (1)

14. **Assertion (A) :** Aquatic species are more comfortable in cold water than in warm water. [1]

Reason (R) : Solubility of oxygen gas in water decreases with increase in temperature.

a) Both Assertion (A) and Reason (R) are true & Reason (R) is the correct explanation of the Assertion (A).
b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
c) Assertion (A) is true, but Reason (R) is false.
d) Assertion (A) is false, but Reason (R) is true.

Answer 🔑

a) Both Assertion (A) and Reason (R) are true & Reason (R) is the correct explanation of the Assertion (A). (1)

15. **Assertion (A) :** Alpha (α)- amino acids exist as internal salt in solution as they have amino and carboxylic acid groups in near vicinity. [1]

Reason (R) : H^+ ion given by carboxylic group (COOH) is captured by amino group (NH_2) having lone pair of electrons.

a) Both (A) and (R) are true and (R) is the correct explanation of (A)
b) Both (A) and (R) are true but (R) is not the correct explanation of (A)
c) (A) is correct but (R) is wrong
d) (A) is wrong but (R) is correct

Answer 🔑

a) Both (A) and (R) are true and (R) is the correct explanation of (A) (1)

16. **Assertion (A) :** The conductivity of a electrolytic solutions increases with increase of temperature. [1]

Reason (R) : Electronic conductance decreases with increase of temperature

a) Both (A) and (R) are true and (R) is the correct explanation of (A)
b) Both (A) and (R) are true but (R) is not the correct explanation of (A)
c) (A) is correct but (R) is wrong
d) (A) is wrong but (R) is correct

Answer 🔑

b) Both (A) and (R) are true but (R) is not the correct explanation of (A) (1)

Section B

17.I. Answer the following: [2]

i. Teacher asked a student to bring a boiled egg to class to understand the concept of osmosis. Next day teacher placed the egg in a solution containing more than 0.9% sodium chloride solution. What would have happened to that egg when it was placed for some time?

ii. When 50 mL of Ethyl bromide and 50 mL of Ethyl Iodide are mixed, predict whether the volume of the solution is equal to, greater than or less than 100 mL. Give reason to support your answer.

Answer 🔑

I) The solution is hypertonic, so water moves out of the egg by osmosis. As a result, the egg shrinks and becomes smaller and wrinkled. (1)

II) The final volume will be less than 100 mL. This is because the molecules of the two liquids fit into each other's intermolecular spaces, leading to volume contraction. (1)

(OR)

17.II. Answer the following: [2]

i. Outer hard shells of two eggs are removed. One of the eggs is placed in saturated solution of sodium chloride and the other egg is placed in pure water. What change will be observed in both the eggs and why?

ii. What would be the value of van't Hoff factor for a dilute solution of K_2SO_4 in water. Assume that K_2SO_4 is completely ionised.

Answer

I) Egg in saturated NaCl solution shrinks (water moves out). Egg in pure water swells (water moves in). This happens due to osmosis. (1)

K_2SO_4 dissociates as: $K_2SO_4 \rightarrow 2\,K^+ + SO_4^{2-}$ (1)

Number of particles produced = 3

Van't Hoff factor (i) = 3

18. a) Imagine that you are studying the age of a dead biological sample in forensic lab. During the studies, you found that the sample decomposed by following first order kinetics. If 50% of the sample is decomposed in 120 minutes, how long will it take for 90% of the sample to decompose? [2]

b) How does a catalyst affect the rate of reaction?

Answer

b) A catalyst increases the rate of reaction by providing an alternative pathway with lower activation energy, without being consumed in the reaction. (1)

a)

For a first-order reaction:

If 50% decomposes in 120 min → this is the **half-life ($t_{1/2}$)**.

$$t_{1/2} = 120 \text{ min}$$

For 90% decomposition, 10% remains:

$$k = \frac{0.693}{t_{1/2}} = \frac{0.693}{120}$$

Time for 90% decomposition:

$$t = \frac{2.303}{k} \log \frac{100}{10}$$

$$t = \frac{2.303}{0.693/120} \log 10$$

$$t \approx 4 \times 120 = 480 \text{ min}$$

A (1)

19. Complete the following reactions: [2]

(i) $C_6H_5N_2Cl + CH_3CH_2OH \longrightarrow$

(ii) $C_6H_5N_2Cl + H_3PO_2 + H_2O \longrightarrow$

Answer

I) $C_6H_5N_2Cl + CH_3CH_2OH \rightarrow C_6H_5OC_2H_5 + N_2 + HCl$ (1)

(Product: Ethoxybenzene / Phenetole)

II) $C_6H_5N_2Cl + H_3PO_2 + H_2O \rightarrow C_6H_6 + N_2 + H_3PO_3 + HCl$ (1)

(Product: Benzene)

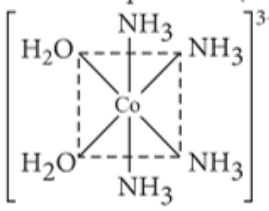
20. Write the name and draw the structures of each of the following complex compounds: [2]

(i) $[Co(NH_3)_4(H_2O)_2]Cl_3$

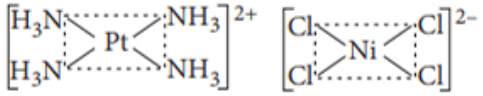
(ii) $[Pt(NH_3)_4][NiCl_4]$

Answer

(i) Tetraamminediaquacobalt (III) chloride.



i) Tetraammineplatinum(II)tetrachloridonickelate(II)



I (1)

II (1)

21. Explain the following observations : [2]

(i) The boiling point of ethanol is higher than that of methoxymethane.

(ii) Phenol is more acidic than ethanol.

Answer

(i) Due to presence of intermolecular H-bonding, associated molecules are formed, hence ethanol has high boiling point while methoxymethane does not have intermolecular H-bonding. (1)

(ii) Phenol on losing H+ ion forms phenoxide ion, and ethanol on losing H+ ion forms ethoxide ion. Phenoxide ion is more stable than ethoxide ion as phenoxide ion exists in resonance structure. Due to this phenol is more acidic than ethanol. (1)

Section C

22. An aqueous solution of NaOH was made and its molar mass from the measurement of osmotic pressure at 27° C was found to be 25 g mol^{-1}. Calculate the percentage dissociation of NaOH in this solution. [Atomic mass : Na = 23 u, O = 16 u, H = 1 u] [3]

Answer

True molar mass of NaOH = 23 + 16 + 1 = 40 g/mol (0.5)

i= $\frac{Normal(true)molarmass}{observed\,molarmass} = \frac{40}{25} = 1.6$ (0.5)

$i=1+(n-1)\alpha$ (1)

Here, =1.6,n=2.

$1.6=1+(2-1)\alpha$

$1.6=1+\alpha$

$\alpha=0.6$

% dissociation=$\alpha\times100=0.6\times100=60\%$ (1)

23. Calculate Λ°_m for acetic acid and its degree of dissociation (α) if its molar conductivity is 48.1 Ω^{-1} cm^2 mol^{-1}. [3]

Given that

Λ°_m (HCI) = 426 Ω^{-1} cm^2 mol^{-1}

Λ°_m(NaCl) = 126 Ω^{-1} cm^2 mol^{-1}

Λ°_m (CH_3COONa) = 91 Ω^{-1} cm^2 mol^{-1}

Answer

1) $\Lambda^\circ_{m(HAc)} = \Lambda^\circ_{m(HCl)} + \Lambda^\circ_{m(NaAc)} - \Lambda^\circ_{m(NaCl)}$ (0.5)

2) $= (426 + 91 - 126)$ (0.5)

3) $= 391 Scm^2\ mol^1$ (0.5)

4) $\alpha = \frac{\Lambda_m}{\Lambda^\circ_m}$ (0.5)

5) $= \frac{48.1}{391}$ (0.5)

6) $= 0.123$ (0.5)

24. Write the structure of the major organic product in each of the following reactions:(any 3) [3]

(i) $CH_3CH_2CH{=}CH_2 + HBr \xrightarrow{peroxide}$

(ii) $C_6H_5ONa + C_2H_5Cl \longrightarrow$

(iii) $CH_3CH(Br)CH_2CH_3 + NaOH \xrightarrow{water}$

(iv) $CH_3CH_2CH_2Cl + NaI \xrightarrow[heat]{acetone}$

Answer

i)$CH_3CH_2CH_2Br$ (1-bromobutane) (1)

ii) $C_6H_5O-C_2H_5$ (ethyl phenyl ether). (1)

iii) $CH_3CH(OH)CH_2CH_3$ (2-butanol) + NaBr. (1)

iv) $CH_3CH_2CH_2I$ (1-iodopropane) + NaCl. (1)

25. (i) When pyrolusite ore MnO_2 is fused with KOH in presence of air, a green coloured compound (A) is obtained which undergoes disproportionation reaction in acidic medium to give purple coloured compound (B). [3]

(a) Write the formulae of (A) & (B).

(b) What happens when compound (B) is heated.

(ii) What is 'Misch metal' ? Give its one use.

Answer

(i) A= K_2MnO_4 B= $KMnO_4$ (1)

(ii) $2KMnO_4 \longrightarrow K_2MnO_4 + MnO_2 + O_2$ (2)

(ii) Misch metal is an alloy containing about 95% lanthanides (mainly cerium and lanthanum) and about 5% iron and traces of other metals. Use: It is used in making flints for cigarette lighters. (1)

26. Account for the following: - [3]

(a) Ortho nitro phenol is more volatile than para nitro phenol

(b) Phenol is more easily nitrated than benzene.

(c) Sodium metal can be used for drying Di ethyl ether but not ethyl alcohol.

Answer

-(a)Ortho nitro phenol has intramolecular hydrogen bonding and so molecules are less associated with each other whereas para nitro phenol has intermolecular hydrogen bonding. (1)

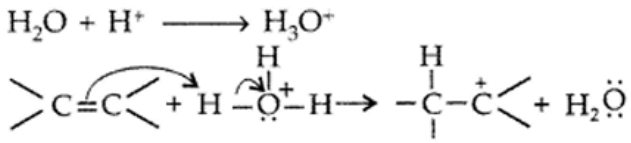
(b) Phenol has activating group -OH which shows +R effect and so increases electron density at ortho and para position. so, phenol gets easily nitrated (1)

(c) Sodium metal does not react with ether whereas it reacts with alcohol. (1)

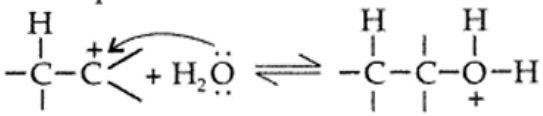
27. Explain the mechanism of acid catalysed hydration of an alkene to form corresponding alcohol. [3]

Answer

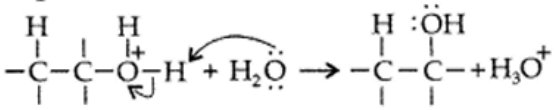
(i) Protonation of alkene to form carbocation by electrophilic attack of H_3O^+



(*ii*) Nucleophilic attack of water on carbocation



(*iii*) Deprotonation to form an alcohol



i (1)

ii (1)

iii (1)

28. Account for the following: [3]

(i) Name an oxo anion having oxidation number of metal (3d series) equal to its group number.

(ii) In the series Sc (Z = 21) to Zn (Z = 30), the enthalpy of atomisation of zinc is the lowest.

(iii) Most of the transition metals and their compounds act as good catalysts.

Answer

(i)Sc (1)

(ii)because in the formation of metallic bonds, no electrons from 3d-orbitals are involved in case of zinc, while in all other metals of the 3d series, electrons from the d-orbitals are always involved in the formation of metallic bonds. (1)

(iii)The catalytic activity of transition metal ions is due to following two reasons: Variable oxidation states & Large surface area. (1)

Section D

29. A galvanic cell is constructed using Zn/Zn^{2+} and Cu/Cu^{2+} half-cells at 25°C.
$Zn(s)+Cu^{2+}(aq)\rightarrow Zn^{2+}(aq)+Cu(s)$
The standard electrode potentials are:

$$E^{\circ}_{Zn^{2+}/Zn} = -0.76\ V, \qquad E^{\circ}_{Cu^{2+}/Cu} = +0.34\ V$$

29.a. What is the value of n (number of electrons transferred) in the Zn–Cu galvanic cell? [1]

Answer

2 (1)

29.b. Write the cell expression for the galvanic cell involving Zn/Zn^{2+} and Cu/Cu^{2+}. [1]

Answer ⊶

$Zn(s)|Zn^{2+}(aq)||Cu^{2+}(aq)|Cu(s)$ (1)

29.c. Calculate the standard Gibbs free energy change (ΔG°) for the Zn–Cu cell. [2]

Given $E^\circ_{cell} = 1.10$ V, n=2, F=96485 C mol^{-1}

Answer ⊶

$\Delta G^\circ = -nFE^\circ = -2 \times 96485 \times 1.10$ (1)

$= -212{,}267$ J $mol^{-1} \approx -212$ kJ mol^{-1} (1)

(OR)

29.d. Calculate the cell potential at 25°C using the Nernst equation. [2]

Also given $E^\circ cell = 1.10$ V and $\log(0.10) = -1$

Answer ⊶

1) $E_{cell} = E^\circ_{cell} - \frac{0.0591}{2} \log\left(\frac{[Zn^{2+}]}{[Cu^{2+}]}\right)$ (0.5)

2) $E_{cell} = 1.10 - \frac{0.0591}{2} \log\left(\frac{0.10}{1.0}\right) = 1.10 - 0.02955 \log(0.10)$ (0.5)

3) $E_{cell} = 1.10 - 0.02955(-1)$ (0.5)

4) $E_{cell} = 1.13$ V (0.5)

30. Valence bond theory considers the bonding between the metal ion and the ligands as purely covalent. On the other hand, crystal field theory considers the metal–ligand bond to be ionic, arising from electrostatic interaction between the metal ion and the ligands. In coordination compounds, the interaction between the ligand and the metal ion causes the five d-orbitals to split up. This is called crystal field splitting, and the energy difference between the two sets of energy levels is called crystal field splitting energy (Δ_o). The actual configuration of complexes depends on the relative values of Δ_o and P (pairing energy). If $\Delta_o < P$, then complex will be high spin. If $\Delta_o > P$, then complex will be low spin.

30.a. What is the nature of the bond between the metal ion and ligands as per valence bond theory? [1]

Answer ⊶

Covalent bond. (1)

30.b. What is meant by crystal field splitting? [1]

Answer ⊶

The splitting of the five degenerate d-orbitals of a metal ion into two sets of orbitals of different energies due to the interaction with ligands is called crystal field splitting. (1)

30.c. How does the magnitude of $\triangle_0$ decide the actual configuration of d orbitals in a coordination entity? [2]

Answer ⊶

If Δ_o < Pairing energy (P) → electrons prefer to occupy higher energy orbitals → high-spin complex. (1)

If Δ_o > Pairing energy (P) → electrons get paired in lower energy orbitals → low-spin complex. (1)

(OR)

30.d. Distinguish between valence bond theory and crystal field theory with respect to bonding. [2]

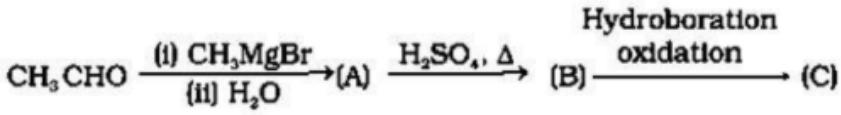
Answer ⊶

the metal–ligand bond as covalent, formed by overlap of ligand orbitals with vacant orbitals of the central metal ion. (1)

the metal–ligand bond as ionic, arising from electrostatic interaction between negatively charged ligands and the central metal ion. (1)

Section E

31.I. (i) Identify the compounds A, B and C in the following reaction. [5]

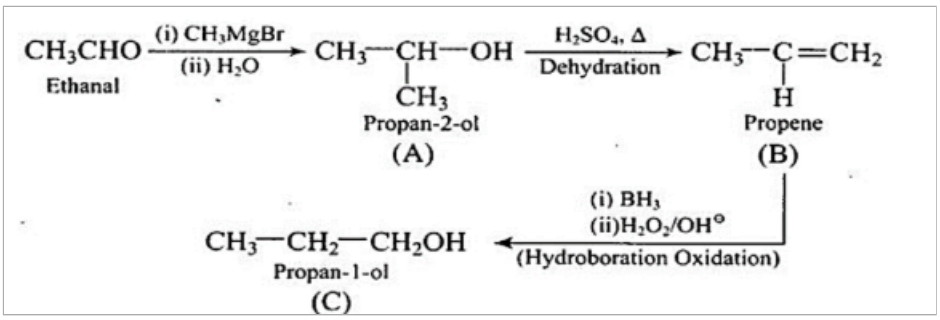


(ii) Draw structures for the derivatives The 2,4-dinitrophenylhydrazone of benzaldehyde

(iii) Why pK_a of F-CH_2COOH is lower than that of Cl–CH_2COOH?

Answer

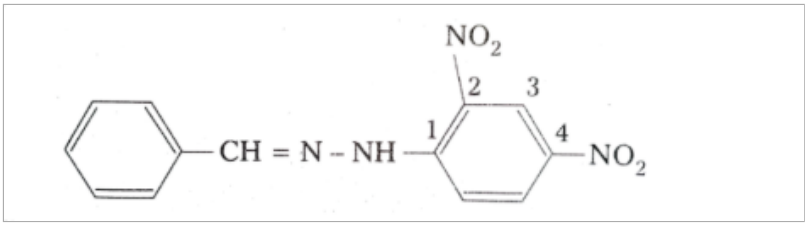
Stronger –I effect of fluorine makes F-CH2COOH to be stronger acid than Cl–CH2COOH and has less Pka. (1)



A (1)

B (1)

C (1)



(ii) (1)

(OR)

31.II. (a)Write the reactions involved in the following: [5]

(i) Clemenson reduction

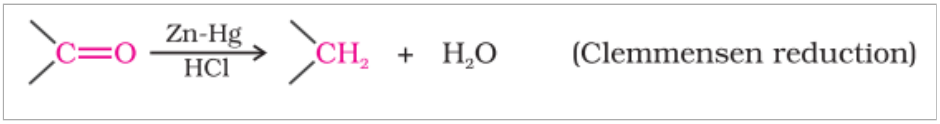
(ii) Tollen's test

(b) Give reason

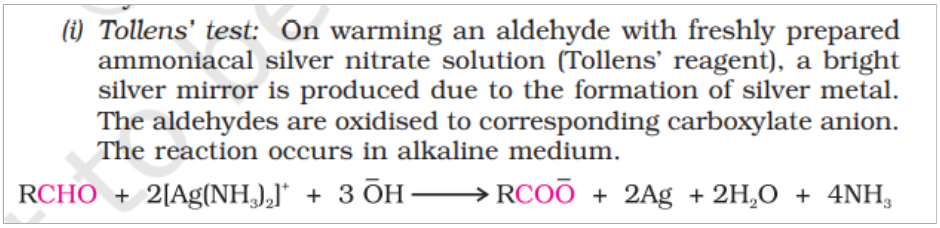
(i) Aldehydes are more reactive than ketones for nucleophilic addition reactions.

(ii) The alpha hydrogen of aldehydes and ketones is acidic in nature.

(iii)Carboxylic acids do not give reactions of carbonyl group.



i (1)



ii (1)

Answer

(b) Reasons (i) Aldehydes are more reactive than ketones because the carbonyl carbon in aldehydes is less hindered (fewer alkyl groups) and more electrophilic, making it easier for nucleophiles to attack. (1)

(ii) The alpha hydrogen of aldehydes and ketones is acidic because the carbanion formed after deprotonation is stabilized by resonance with the adjacent carbonyl group. (1)

(iii) Carboxylic acids do not give reactions of the carbonyl group because the carbonyl carbon is less electrophilic due to resonance with the –OH group, which delocalizes the positive character on carbon. (1)

32.I. Explain the following: [5]

(i) Starch and cellulose both contain glucose units as monomers yet they are structurally different.

(ii) Pentaacetate of glucose does not react with hydroxyl amine.

(iii) Write chemical reactions to show that open structure of D-glucose contains the following

(a) Straight chain

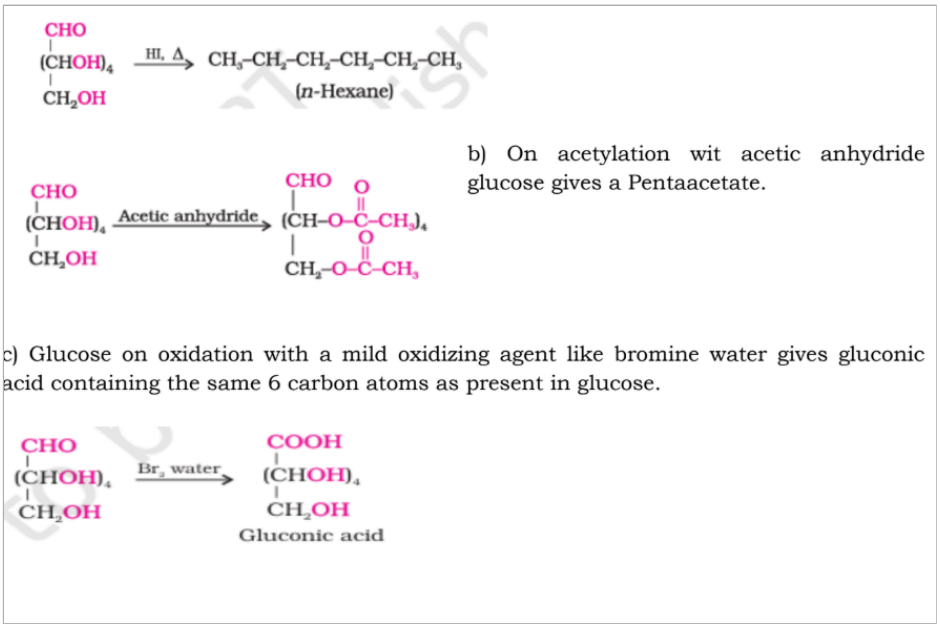
(b) 5 alcohol groups

(c) Aldehyde as carbonyl group

Answer

a) The basic structural difference between starch as cellulose is of linkage between the glucose units. In starch there is - D – glycosidic linkage. Both the components of starch, amylose and amylopectin are polymers of - D – glycose. On the other hand, cellulose is a linear polymer of β – D-glucose in which C1 of one glucose unit is connected to C4 of the other through β – D- glycosidic linkage. (1)

b) As glucose forms a six membered ring in which – CHO group combines with – OH group at C5, pentaacetate of glucose does not react with hydroxyl amine due to absence of free – CHO group. (1)



a (1)

b (1)

c (1)

(OR)

32.II. I. Identify and give any one point of difference between the carbohydrate present in cane sugar and carbohydrate present in milk. [5]

II. Glucose is an aldohexose and a monosaccharide. Which oxidising agent should be used to bring about oxidation of only the aldehydic group present in glucose?

III. A doctor advises sunlight exposure and vitamin D-rich diet. What deficiency is being treated?

IV. Name the two major molecular shapes formed due to the folding of secondary structure of proteins.

V. Ashish's gums bleed frequently. The doctor's prescription mentioned that Ashish is suffering from scurvy. Help him to identify two food sources to help him recover faster.

Answer

I. Carbohydrate present in cane sugar is sucrose which is a disaccharide composed of glucose and fructose while the carbohydrate present in milk is lactose which is a disaccharide composed of glucose and galactose (1)

II. Glucose is an aldohexose and a monosaccharide. Bromine water is a mild oxidising agent which can be used to bring about oxidation of only the aldehydic group present in glucose. (1)

III. The deficiency being treated is Vitamin D deficiency, which can lead to rickets (in children) or osteomalacia (in adults). (1)

IV. The two major molecular shapes formed due to the folding of secondary structure of proteins are alpha helix and beta pleated sheets (1)

V. Ashish is suffering from scurvy, which occurs due to deficiency of Vitamin C The sources of food are – Citrus fruits, amla and green leafy vegetables (1)

33.I. A) Answer the following questions: [5]

(i)The rate of a reaction triples when the temperature changes from 298 K to 318 K. Calculate the energy of activation of the reaction assuming that it does not change with temperature. (Given R = 8.314 $JK^{-1}mol^{-1}$, log 3 = 0.4771)

(ii) For the reaction A + B → C, you find that the rate = $k[A]^2$. Calculate order of the reaction and what does this imply about the mechanism of the reaction?

Given:

- Rate triples when $T_1 = 298\,\text{K} \rightarrow T_2 = 318\,\text{K}$
- R = 8.314 J/mol·K
- log 3 = 0.4771

Use the **Arrhenius equation in logarithmic form**:

$$\ln\frac{k_2}{k_1} = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$\ln 3 = \frac{E_a}{8.314}\left(\frac{1}{298} - \frac{1}{318}\right)$$

$$1.0986 = \frac{E_a}{8.314}\left(\frac{318 - 298}{298 \cdot 318}\right)$$

$$1.0986 = \frac{E_a}{8.314} \cdot \frac{20}{94764}$$

$$E_a = \frac{1.0986 \times 8.314 \times 94764}{20}$$

$$E_a \approx 43200\,\text{J/mol} \approx 43.2\,\text{kJ/mol}$$

formula (1)

substitute (1)

ans (1)

Answer

Given rate law: (1)

Rate=$k[A]^2$

Order of reaction: 2 (since exponent of [A] is 2)

Implication for mechanism: The reaction likely involves two molecules of A in the rate-determining step, indicating a bimolecular elementary step. (1)

(OR)

33.II. i)For the reaction A + B →Product, following data was obtained: [5]

Experiment number	Initial concentration of [A] (mol L–1)	Initial concentration of [B] (mol L–1)	Initial Rate (mol L–1 min–1)
1	0.15	0.15	9.6×10^{-2}
2	0.30	0.15	3.84×10^{-1}
3	0.15	0.30	1.92×10^{-1}
4	0.30	0.30	7.68×10^{-1}

Calculate the following:

(a)The overall order of the reaction

(b)The rate law equation

(c)The value of rate constant

(ii) In a graph ln [reactant] was plotted vs. time, it gave a straight line, predict the order of the reaction also give the expression of its half-life and rate constant.

Answer

The integrated rate law for a first-order reaction is expressed as: (1)

$\ln[A]_t = -kt + \ln[A]_0$

k=-slope

$k = \frac{1}{t} - \ln \frac{[A]_0}{[A]}$

Order of reaction: 1 (First-order reaction), because a plot of gives a straight line. (0.5)

$t_{1/2} = \frac{0.693}{k}$ (0.5)

Let the rate of equation be:

Rate = $K[A]^x [B]^y$

In experiment 1

Rate = $K[0.15]^x [0.15]^y = 9.6 \times 10^{-2}$ ...(1)

In experiment 2

Rate = $K[0.30]^x [0.15]^y = 3.84 \times 10^{-1}$ ...(2)

In experiment 3

Rate = $K[0.15]^x [0.30]^y = 1.92 \times 10^{-1}$ ...(3)

In experiment 4

Rate = $K[0.30]^x [0.30]^y = 7.68 \times 10^{-1}$ ...(4)

Dividing eq. (2) by eq. (1)

$$\frac{3.84 \times 10^{-1}}{9.6 \times 10^{-2}} = \frac{K[0.30]^x[0.15]^y}{K[0.15]^x[0.15]^y}$$

$4 = [2]^x$

$x = 2$

Thus, the order of reaction with respect to [A] is 2.

Dividing eq. (3) by eq. (1),

$$\frac{1.92 \times 10^{-1}}{9.6 \times 10^{-2}} = \frac{K[0.15]^x[0.30]^y}{K[0.15]^x[0.15]^y}$$

$2 = [2]^y$

$y = 1$

Thus, the order of reaction with respect to [B] is 1.

i. The overall order of reaction is 2 + 1 = 3

I (1)

ii. The rate law equation

Rate = $K[A]^2 [B]^1$

iii. Rate constant (K)

From eq. (1),

Rate = $K[0.15]^2 [0.15]^1$

$= 9.6 \times 10^{-2}$

$$K = \frac{9.6 \times 10^{-2}}{[0.15]^2[0.15]^1}$$

$= 28.44 \text{ mol}^{-2} \text{ L}^2 \text{ min}^{-1}$

Thus, the value of the rate constant is 28.44 $\text{mol}^{-2} \text{ L}^2 \text{ min}^{-1}$.

II (1)

III (1)