SECTION A

Questions no. 1 to 16 are Multiple Choice type Questions, carrying 1 mark each. $16 \times 1 = 16$

1. Which of the reactions is used in the conversion of a ketone into hydrocarbon ?

   (A) Reimer-Tiemann reaction (B) Wolff-Kishner reduction

   (C) Aldol condensation (D) Stephen reaction

2. Which of the following reagents are used to prepare primary amines by Hoffmann bromamide degradation reaction ?

   (i) $R-\overset{\overset{O}{\|}}{C}-NH_2$ (ii) NaOH

   (iii) Br_2 (iv) $CHCl_3$

   (A) (i), (ii) and (iv) (B) (i) and (iii)

   (C) (i), (ii) and (iii) (D) (i), (iii) and (iv)

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3. The major product of carbylamine reaction is :

(A) Carboxylic acid (B) Aldehyde

(C) Cyanide (D) Isocyanide

4. Actinoids show larger number of oxidation states :

(A) because they are radioactive in nature

(B) because they have large atomic numbers

(C) because they have large atomic masses

(D) due to comparable energies of 5f, 6d and 7s orbitals

5. Consider the following reaction and identify A and B :

$$CH_3Cl + NaI \xrightarrow{\text{dry acetone}} A + B$$

(A) $A = CH_3I$, $B = NaCl$

(B) $A = CH_3OH$, $B = NaCl$

(C) $A = CH_3CHO$, $B = NaCl$

(D) $A = C_2H_6$, $B = CH_3I$

6. The correct formula of Hinsberg's reagent is :

(A) C_6H_5COCl

(B) $C_6H_5SO_2Cl$

(C) $C_6H_5CONHCH_3$

(D) $C_6H_5CH_2NH_2$

7. Half-life ($t_{1/2}$) of a first order reaction is 1386 s. The value of rate constant is :

(A) $0{\cdot}5 \times 10^{4}\ s^{-1}$

(B) $5{\cdot}0 \times 10^{-4}\ s^{-1}$

(C) $0{\cdot}5 \times 10^{-5}\ s^{-1}$

(D) $0{\cdot}5 \times 10^{-2}\ s^{-1}$

8. Which of the following ligands forms a chelate complex ?

(A) Ammonia

(B) Water

(C) NO_2^-

(D) Oxalate ion

9. Primary, secondary and tertiary alcohols can be distinguished by :

(A) Lucas test

(B) Fehling's test

(C) Tollens' test

(D) Hinsberg's test

10. Consider the following compounds :

$C_2H_5NH_2$, $(C_2H_5)_2NH$, $C_6H_5CH_2NH_2$, NH_3, $C_6H_5NH_2$

The correct increasing order of the above compounds on the basis of their basic strength is :

(A) $C_6H_5NH_2 < NH_3 < C_6H_5CH_2NH_2 < C_2H_5NH_2 < (C_2H_5)_2NH$

(B) $NH_3 < C_6H_5NH_2 < C_6H_5CH_2NH_2 < C_2H_5NH_2 < (C_2H_5)_2NH$

(C) $C_6H_5CH_2NH_2 < (C_2H_5)_2NH < NH_3 < C_6H_5NH_2 < C_2H_5NH_2$

(D) $C_2H_5NH_2 < C_6H_5NH_2 < NH_3 < C_6H_5CH_2NH_2 < (C_2H_5)_2NH$

11. Identify the polysaccharide among the following :

(A) Fructose

(B) Maltose

(C) Glucose

(D) Cellulose

12. The polypeptide chain in a protein has amino acids linked with each other in a specific sequence. This specific sequence of amino acids is called :

(A) Primary structure of protein

(B) Secondary structure of protein

(C) Tertiary structure of protein

(D) Quaternary structure of protein

Assertion (A) is false, but Reason (R) is true.

13. *Assertion (A) :* D (+) – Glucose is dextrorotatory in nature.

Reason (R) : (+) represents dextrorotatory nature and D represents the configuration.

14. *Assertion (A) :* Highest oxidation state of Mn is +7 in first series of transition elements.

Reason (R) : Transition metals exhibit variable oxidation states.

15. *Assertion (A) :* p-nitrophenol is more acidic than phenol.

Reason (R) : Nitro group is an electron-withdrawing group, it stabilises phenoxide ion by dispersal of negative charge.

16. *Assertion (A) :* All aliphatic aldehydes give a positive Fehling's test.

Reason (R) : Aliphatic aldehydes are reduced by Fehling's reagent.

SECTION B

17. (a) 1·00 molal aqueous solution of trichloroacetic acid is heated to its boiling point. Boiling point of this solution was found to be 100·18°C. Calculate the van't Hoff factor for trichloroacetic acid.

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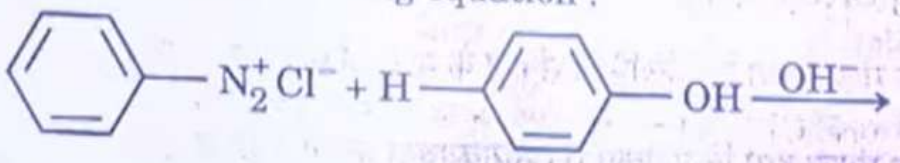
(b) State Henry's law. Calculate the mole fraction of CO_2 in water at 298 K under 760 mm Hg.

(Given : K_H for CO_2 in H_2O at 298 K = $1{\cdot}25 \times 10^6$ mm Hg)

18. (a) Name the cell which was used in the Apollo space programme for providing electrical power.

(b) Define limiting molar conductivity.

19. (a) Complete the following equation :



(b) How will you convert nitromethane to methyl isocyanide ?

20. (a) What are the products obtained on hydrolysis of sucrose ?

(b) What are essential amino acids ?

21. (a) Write any two fat soluble vitamins.

(b) How will you confirm the presence of five – OH groups in a glucose molecule, which are attached to different carbon atoms? *1+1*

SECTION C

22. Calculate emf of the following cell at 298 K : *3*

$$Cr\,(s)\,|\,Cr^{3+}(aq)\,(0{\cdot}1\ M)\,||\,Fe^{2+}(aq)\,(0{\cdot}01\ M)\,|\,Fe\,(s)$$

(Given : $E^{o}_{Cr^{3+}/Cr} = -0{\cdot}74\ V$, $E^{o}_{Fe^{2+}/Fe} = -0{\cdot}44\ V$, [log 10 = 1])

23. (a) Define order of a reaction.

(b) The rate for the following reaction is given by : $A + B \rightarrow C$

Rate $= k[A][B]^2$

(i) How is the rate of reaction affected if we double the concentration of B ?

(ii) Write the overall order of a reaction if 'A' is present in large excess.

1+2=3

24. The rate of the chemical reaction doubles when the temperature is raised from 298 K to 308 K. Calculate activation energy (E_a) for this reaction assuming that it does not change with temperature. *3*

(Given : $R = 8{\cdot}314\ J\ mol^{-1}\ K^{-1}$, $\log 2 = 0{\cdot}30$)

25. (a) Write the IUPAC name of the following complex : *1*

$K_3[Cr(C_2O_4)_3]$

(b) Differentiate between homoleptic complex and heterolyptic complex. *1*

(c) Which type of isomerism is exhibited by the following complex : *1*

$[Pt(NH_3)_2Cl_2]$

26. (a) A coordination compound $CrCl_3 \cdot 6H_2O$ is mixed with excess of $AgNO_3$ solution, two moles of AgCl are precipitated per mole of the compound. Write the structural formula of the coordination compound. 1

(b) Write the oxidation state and hybridisation of the central metal in the following complex :

$[Fe(H_2O)_6]^{3+}$ [Atomic number of Fe = 26] 1

(c) Why is $[Ni(H_2O)_6]^{2+}$ coloured ? [Atomic number of Ni = 28] 1

27. How do you convert the following ? 3

(a) Acetophenone to Benzoic acid

(b) Acetonitrile to Acetone

(c) Benzoic acid to Benzene

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28. (a) (i) Arrange the following compounds in increasing order of their acidic strengths :

$$CH_3\underset{\displaystyle Br}{\underset{|}{C}}HCH_2COOH,\quad CH_3-\underset{\displaystyle CH_3}{\underset{|}{C}}H-COOH,\quad CH_3CH_2\underset{\displaystyle Br}{\underset{|}{C}}HCOOH$$

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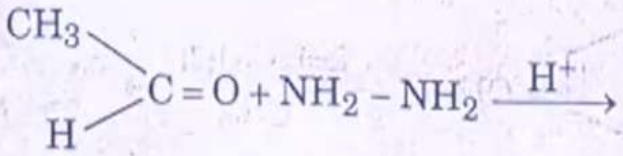
(ii) Why is CH_3CHO more reactive than acetone towards reaction with HCN ?

(iii) Complete the equation :



1+1+1=

OR

(b) An organic compound with the molecular formula C_8H_8O forms 2,4-DNP derivative, reduces Tollens' reagent and undergoes Cannizzaro reaction. On vigorous oxidation it gives Benzene-1,2-dicarboxylic acid. Identify the compound and write the reactions of compound 2,4-DNP and when it undergoes Cannizzaro reaction.

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Answer the following questions :

(a) Predict the products of electrolysis in each of the following : 2

(i) An aqueous solution of $CuCl_2$ with platinum electrodes.

(ii) A concentrated solution of H_2SO_4 with platinum electrodes.

(b) (i) How much charge in faraday is required for the reduction of 1 mol of Ag^+ to Ag ? 1

OR

(b) (ii) State Faraday's second law of electrolysis. 1

(c) The following reactions occur at the anode during the electrolysis of aqueous sodium chloride solution :

$$Cl^-(aq) \longrightarrow \frac{1}{2}Cl_2(g) + e^- \quad E^o_{(cell)} = 1{\cdot}36\ V \qquad (I)$$

$$2H_2O(l) \longrightarrow O_2(g) + 4H^+(aq) + 4e^- \quad E^o_{(cell)} = 1{\cdot}23\ V \qquad (II)$$

Which reaction is feasible at the anode and why ? 1

SECTION E

SECTION E

31. (a) (i) Calculate the freezing point of a solution when 10·5 g of $MgBr_2$ was dissolved in 250 g of water, assuming $MgBr_2$ undergoes complete dissociation. 3

(Given : Molar mass of $MgBr_2$ = 184 g mol^{-1},

K_f for water = 1·86 K kg mol^{-1})

(ii) Write two differences between ideal and non-ideal solutions. 1+1

OR

(b) (i) A solution is prepared by dissolving 0·025 g of potassium sulphate in 2 L of water at 27°C. Assuming potassium sulphate is completely dissociated, determine its osmotic pressure. 3

(Given : R = 0·082 L atm K^{-1} mol^{-1},

Molar mass of K_2SO_4 = 174 g mol^{-1})

(ii) What type of azeotrope will be formed by a solution of acetone and chloroform ? Give reason. 2

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32. (a) (i) (I) Why do transition metals show variable oxidation states ? *1*

(II) Out of Mn^{2+} and Ti^{2+} which will be more paramagnetic and why ? [Atomic No. : Ti = 22, Mn = 25] *1*

(III) Which ion is the strongest oxidising agent in the options given below :

Cr^{3+}, V^{3+}, Mn^{3+}

Give reason: *1*

[Atomic No. : Cr = 24, V = 23, Mn = 25]

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(ii) Complete and balance the following equations : *1+1*

(I) $2MnO_2 + 4KOH + O_2 \longrightarrow$

(II) $5C_2O_4^{2-} + 2MnO_4^- + 16H^+ \longrightarrow$

OR

(b) (i) What is meant by lanthanoid contraction ?

(ii) Why do transition metals form coloured compounds ?

(iii) Why are $E^{\circ}_{M^{2+}/M}$ values for Mn and Zn more negative than expected ?

(iv) Which is the most stable oxidation state of Cu and why ?

(v) Why is Ce^{4+} in aqueous solution a good oxidising agent ? *5×1=5*