CBSE Sample Paper 7

Class XII 2022-23

Chemistry

Time: 3 Hours **Max. Marks: 70**

General Instructions:

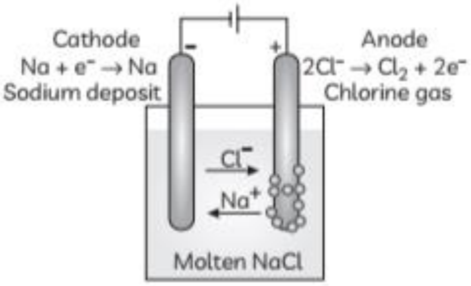
1. There are 35 questions in this question paper with internal choice.
2. SECTION A consists of 18 multiple-choice questions carrying 1 mark each.
3. SECTION B consists of 7 very short answer questions carrying 2 marks each.
4. SECTION C consists of 5 short answer questions carrying 3 marks each.
5. SECTION D consists of 2 case-based questions carrying 4 marks each.
6. SECTION E consists of 3 long answer questions carrying 5 marks each.
7. All questions are compulsory.
8. Use of log tables and calculators is not allowed.

SECTION - A

18 Marks

(The following questions are multiple-choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.)

1. The ionic compounds are good conductors of heat and electricity. NaCl is an ionic compound. Ionic compound is a chemical compound of ions held together by electrostatic forces of attractions which are termed as ionic bonding.



On the basis of this, state the reason behind the conductivity of molten NaCl:

(a) Free ions (b) Free electrons

(c) Free molecules (d) Atoms of Na and Cl 1

2. Boiling of egg is an example of:

(a) breaking of peptide linkage

(b) hydrolysis of lactose

(c) breaking of protein into amino acids

(d) denaturation of protein 1

3. The molarity of pure water is:

(a) 55.5 (b) 50.5

(c) 60.5 (d) 18 1

4. Zr and Hf have almost equal atomic and ionic radii because:

(a) of diagonal relationship

(b) of lanthanoid contraction

(c) of actinoid contraction

(d) both belong to f-block of elements 1

5. Which of the following reaction does not produce amine?

(a) Gabriel's Synthesis

(b) Hoffmann Bromamide Reaction

(c) Carbylamine Reaction

(d) Ammonolysis Reaction 1

6. The oxidation state of nickel in $Ni(CO)_4$ is +4 state:

(a) True (b) False

(c) Anomalous (d) None of these 1

7. All Cu(II) halides are known except iodide. The reason for this is:

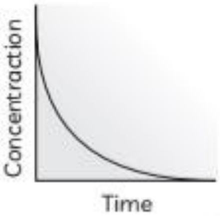
(a) iodide ion is a bulky ion.

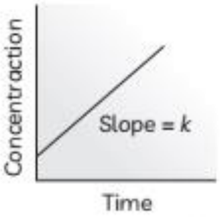
(b) Cu^{2+} oxidizes iodide to iodine.

(c) $Cu^{2+}_{(aq)}$ has much more negative hydration enthalpy.

(d) Cu^{2+} ion has smaller size. 1

8. A reaction in which reactants (R) are converted into products (P) follows second order kinetics.





If concentration of R is increased by four times, what will be the increase in the rate of formation of P?

(a) 9 times (b) 4 times
(c) 16 times (d) 8 times 1

9. Complete the following analogy:
Benzene to Chlorobenzene: A: : R-Cl to R-F: B

(a) A: Nucleophilic substitution, B: Electrophilic substitution
(b) A: Electrophilic substitution, B: Halogen exchange
(c) A: Halogen exchange, B: Electrophilic substitution
(d) A: Electrophilic addition, B: Nucleophilic addition 1

10. An example of ambidentate ligand is:

(a) Ammine (b) Aquo
(c) Oxalato (d) Thiocyanato 1

11. Which of the following is a secondary allylic alcohol?

(a) But-3-en-2-ol (b) But-2-en-2-ol
(c) Prop-2-enol (d) Butan-2-ol 1

12. The carbonyl compound formed when ethanol gets oxidised using this copper-based catalyst can also be obtained by the ozonolysis of:

(a) But-1-ene (b) But-2-ene
(c) Ethene (d) Pent-1-ene 1

13. $Cr_2O_7^{2-} + X \rightarrow Cr^{3+} + H_2O$ + Oxidised product of X. X in the above reaction cannot be:

(a) Fe^{2+} (b) S^{2-}
(c) Cr^{2+} (d) Cr_2O^{4-} 1

14. Electrical conductance through metals is called metallic or electronic conductance and is due to the movement of electrons. The electronic conductance depends on:

(a) the nature and structure of the metal
(b) the number of valence electrons per atom
(c) change in temperature
(d) all of these 1

In the following questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

(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 true but (R) is false
(d) (A) is false but (R) is true

15. Assertion: D-(+)–Glucose is dextrorotatory in nature.
Reason: 'D' represents its dextrorotatory nature. 1

16. Assertion: The enthalpy of reaction remains constant in the presence of a catalyst.
Reason: A catalyst participating in the reaction, forms a different activated complex and lowers down the activation energy but the difference in energy of reactant and product remains the same. 1

17. Assertion: Molarity of a solution in liquid state changes with temperature.
Reason: The volume of a solution changes with change in temperature. 1

18. Assertion: Compounds containing -CHO group are easily oxidized to corresponding carboxylic acids.
Reason: Carboxylic acids can be reduced to alcohols by treatment with $LiAlH_4$. 1

SECTION - B

14 Marks

(The following questions are very short answer type with internal choice in two questions and carry 2 marks each.)

19. Aryl chlorides and bromides can be easily prepared by electrophilic substitution of arenes with chlorine and bromine respectively in the presence of Lewis acid catalysts. But why does preparation of aryl iodides require presence of an oxidizing agent?

OR

Carryout the following conversions in not more than 2 steps:

(A) Aniline to bromobenzene

(B) 2-Bromopropane to 1-bromopropane 2

20. (A) Name the base that is found in nucleotide of RNA only.

(B) Glucose on reaction with HI gives *n*-hexane. What does it suggest about the structure of glucose? 2

21. (A) The spin only magnetic moment of $[MnBr_4]^{2-}$ is 5.9 BM. Predict the geometry of the complex ion?

(B) Write the IUPAC name of the coordination complex: $[Pt(NH_3)_2Cl(NO_2)]$ 2

22. Show that in a first order reaction, time required for completion of 99.9% is 10 times of half-life ($t_{1/2}$) of the reaction.

OR

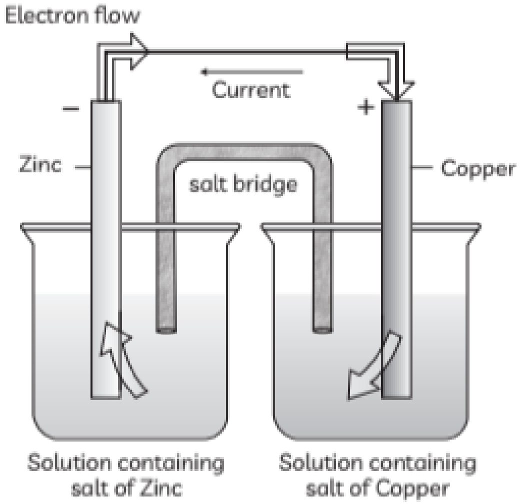
For the reaction: $2A + B \rightarrow C + D$

Determine the rate law and the rate constant for the reaction.

Experiment	[A]/mol L^{-1}	[B]/mol L^{-1}	Initial rate of formation of D/mol L^{-1} min^{-1}
I	0.1	0.1	6.0×10^{-3}
II	0.3	0.2	7.2×10^{-2}
III	0.3	0.4	2.88×10^{-1}
IV	0.4	0.1	2.40×10^{-2}

2

23.



(A) State two functions of the salt bridge used in above figure.

(B) Give the cell representation of the above cell. 2

24. What happens when (write the reaction involved):

(A) N-ethylethanamine reacts with benzenesulphonyl chloride.

(B) aniline reacts with chloroform in the presence of alcoholic potassium hydroxide. 2

25. Give reasons to support the answer:

(A) Presence of alpha hydrogen in aldehydes and ketones is essential for aldol condensation.

(B) Ketones cannot be oxidised by Tollen's reagent. 2

SECTION - C

15 Marks

(The following questions are short answer type with internal choice in two questions and carry 3 marks each.)

26. (A) What is name given to reactions used to prepare dyes? Which linkage or group joins the two aromatic rings in the dyes?

(B) Draw the structure of any azo dye.

(C) State two applications of diazonium salts.

OR

Account for the following:

(A) Aniline cannot be prepared by the ammonolysis of chlorobenzene under normal conditions.

(B) N-ethylethanamine boils at 329.3K and butanamine boils at 350.8K, although both are isomeric in nature.

(C) Acylation of aniline is carried out in the presence of pyridine. 3

27. For a decomposition reaction the values of rate constant *k* at two different temperatures are given below:

$k_1 = 2.15 \times 10^{-8}$ L mol^{-1} s^{-1} at 650 K

$k_2 = 2.39 \times 10^{-7}$ L mol^{-1} s^{-1} at 700 K

Calculate the value of activation energy for this reaction.

($R = 8.314\ J\ K^{-1}\ mol^{-1}$) 3

28. **Answer any three questions:**

(A) Represent Glycine in the zwitter ionic form.

(B) Name four types of intermolecular forces which stabilize 2° and 3° structure of proteins.

(C) Vitamins like A, D, E, and K are fat soluble. Where are these vitamins stored in our body?

(D) Write a reaction which shows that all the carbon atoms in glucose are linked in a straight chain. 3

29. **(A) Explain the following:**

(i) Low spin octahedral complexes of nickel are not known.

(ii) The π-complexes are known for transition elements only.

(B) Give the formula of the following coordination entity and write its IUPAC name : Ni^{2+} ion is bound to two ammonia molecules and two oxalate ions. 3

30. **(A) Amongst the isomeric alkanes of molecular formula C_5H_{12}, identify the one that on photochemical chlorination yields a single monochloride.**

(B) Draw the structure of 4-tertbutyl-3-iodoheptane.

(C) Give a simple test to distinguish among $CH_3 - CH = CHCl$, $CH_3CH_2CH_2Cl$ and $CH_2 = CH - CH_2Cl$. 3

SECTION - D

8 Marks

(The following questions are case-based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.)

31. *Alcohols play very important role in our daily life. Ordinary spiritused as an antiseptic contains methanol. Ethanol is present in coughsyrups, tonics, wine, beer and whisky, sugar, starch, cellulose are carbohydrates which also contain large number of —OH groups. Phenol is also an antiseptic in low concentration (0.2%) whereas 2% solution of phenol is used as disinfectant. The fragrance of roseisdue to citronellol (unsaturated alcohol).*

Phenol is used for preparation of many useful compounds like aspirin, methyl salicylate (lodex) and phenyl salicylate (salol) used as intestinal antiseptic.

(A) Phenol is prepared from cumene. What is advantage of this method? 1

(B) Why does phenol turn pink after long standing? 1

(C) (i) Distinguish between phenol and benzyl alcohol?

(ii) How to convert phenol to picric acid?

OR

(i) How is phenol converted into salicylic acid?

(ii) Name the reagents used in the following reactions:

(a) $CH_3\text{-}CO\text{-}CH_3 \rightarrow (CH_3)_2CH\text{-}OH$

(b) $CH_2 = CH\text{-}CH_2OH \rightarrow CH_2 = CH\text{-}CHO$

2

32. *The potential of each electrode is know as electrode potential. Standard electrode potential is the potential when concentration of each species taking part in electrode reaction is unityand the reaction is taking place at 298 K. By convention, the standard electrode potential of hydrogen (SHE) is 0.0 V.*

+ 0.54	$I_{2(s)} + 2e^- \rightarrow 2I^-_{(aq)}$	Measured against the Standard Hydrogen Electrode
+ 0.40	$O_{2(g)} + 2H_2O_{(l)} + 4e^- \rightarrow 4OH^-_{(aq)}$	
+ 0.34	$Cu^{2+}_{(aq)} + 2e^- \rightarrow Cu_{(s)}$	
0	$2H^+_{(aq)} + 2e^- \rightarrow H_{2(g)}$	
− 0.28	$Ni^{2+}_{(aq)} + 2e^- \rightarrow Ni_{(s)}$	
− 0.44	$Fe^{2+}_{(aq)} + 2e^- \rightarrow Fe_{(s)}$	
− 0.765	$Zn^{2+}_{(aq)} + 2e^- \rightarrow Zn_{(s)}$	
− 0.83	$2H_2O_{(l)} + 2e^- \rightarrow H_{2(g)} + 2OH^-_{(aq)}$	

Table of Reduction Potential

The electrode potential value for each electrode process is a measure of relative tendency of the active species in the process to remain in the oxidised/reduced form. The negative electrode potential means that the redox couple is stronger reducing agent than H^+/H_2 couple. A positive electrode potential means that the redox couple is a weaker reducing agent than the H^+/H_2 couple. Metals which have higher positive value of standard reduction potential form the oxides of greater thermal stability.

(A) Why it is not possible to determine the potential of single electrode? 1

(B) Write the Nernst equation for the electrode involving the process of oxidation. 1

(C) Define the following:

(i) SEP

(ii) Reference electrode potential

OR

Calculate the electrode potentials of the following half cells at 298 K:

(i) Fe^{2+} (0.1 M)/Fe

(ii) Pt, H_2 (2 atm)/H^+ (0.02 M)

Given that $E^\circ_{Fe^{2+}/Fe} = -0.44$ V and $E^\circ_{H^+/½H_2} = 0.0$ V. 2

SECTION - E

15 Marks

(The following questions are long answer type and carry 5 marks each. Two questions have an internal choice.)

33. An aromatic compound 'A' (Molecular formula C_8H_8O) gives positive 2, 4-DNP test. It gives a yellow precipitate of compound 'B' on treatment with iodine and sodium hydroxide solution. Compound 'A' does not give Tollen's or Fehling's test. On drastic oxidation with potassium permanganate it forms a carboxylic acid 'C'(Molecular formula $C_7H_6O_2$), which is also formed along with the yellow compound in the above reaction. Identify A, B and C and write all there actions involved. 5

34. (A) Give reason for the following:

(i) Osmotic pressure is considered to be the best colligative property for determining the molar masses of biomolecules and polymers.

(ii) Oxygen is mixed with helium for use by deep sea divers?

(B) Define isotonic solution.

(C) Calculate the mass percentage of carbon tetrachloride (CCl_4) if 122 g of carbon tetrachloride is mixed with 22g of benzene.

OR

(A) Give reason for the following:

(i) Patients having sore throat are advised saline gargles.

(ii) Salt is added to water to get hard boiled eggs.

(B) Calculate the mole fraction of benzene in solution containing 30% by mass of it in Carbon tetrachloride.

(Given molar mass of benzene = 78gmol^{-1} and that of carbon tetrachloride is 154gmol^{-1})

(C) The molar mass of a solute is 120 g/mol and it's van't hoff factor is 4. What is its abnormal molar mass? 5

35. (A) Give reasons for the following:

(i) Most of transition elements are coloured.

(ii) Silver atom has completely filled d orbitals ($4d^{10}$) in its ground state. How can you say that it is a transition element?.

(iii) In the series Sc (Z = 21) to Zn (Z = 30), the enthalpy of atomisation of zinc is the lowest, *i.e.*, 126 kJ mol^{-1}.

(B) Complete the following chemical equations:

(i) $MnO_{4(aq)} + S_2O_3{}^{2-}{}_{(aq)} + H_2O_{(l)} \longrightarrow$

(ii) $Cr_2O_7{}^{2-}{}_{(aq)} + Fe^{2+}{}_{(aq)} + H^+{}_{(aq)} \longrightarrow$

OR

(A) Why do the transition elements exhibit higher enthalpies of atomisation?

(B) Which of the 3*d* series of the transition metals exhibits the largest number of oxidation states and why?

(C) Why is Cr^{2+} reducing and Mn^{3+} oxidising when both have d^4 configuration?

(D) Describe the preparation of potassium permanganate. 5

SOLUTION

SECTION - A

1. *(a) Free ions*

Explanation: In molten sodium chloride, ions of NaCl are free to move and conduct electric current.

2. *(d) denaturation of protein*

Explanation: During denaturation, hydrogen bonds are disturbed due to this globules unfold and helix gets uncoiled and protein loses its biological activity.

3. *(a) 55.5*

Explanation: Density of water $=1 g/cm^3$ and its molecular weight = $18\ g\ mol^{-1}$

Therefore, 1000 cm^3 of water will weigh 1000g of water.

Let us find the mass of one litre of water:

Mass of 1 litre = Density of water × Volume

Mass of 1 litre = 1000 grams

Moles of 1 kg of water = Mass/Molar Mass = 1000/18

Moles of 1 kg of water = 55.56

Molarity = Moles of solute/Volume of the solution

Molarity = 55.56/1

Molarity of water = 55.56 M.

4. *(b) of lanthanoid contraction*

Explanation: This is because of poor screening effect by 4f-electrons which leads to the lanthanoid contraction.

5. *(c) Carbylamine Reaction*

Explanation: Carbylamine reaction: Aliphatic/aromatic primary amines are heated with chloroform/alcoholic KOH to form foul-smelling alkyl isocyanides or carbylamines.

6. *(b) False*

Explanation: Let x be the oxidation number of Ni in $Ni(CO)_4$.

Since the overall charge on the complex is 0, the sum of oxidation states of all elements in neutral species, it should be equal to 0.

Therefore, $x + 4(0) = 0$

Hence, $x = 0$.

Thus, the oxidation number of Ni in $Ni(CO)_4$ is 0.

7. *(b) Cu^{2+} oxidizes iodide to iodine*

Explanation: $2Cu^{2+} + 4I^- \rightarrow 2CuI_2$

The CuI_2 immediately decomposes to liberate I_2 and insoluble copper(I) iodide.

$$2CuI_2 \rightarrow 2CuI + I_2$$

8. *(c) 16 times*

Explanation: $R \rightarrow P$

For a second order reaction, rate = $k[R]^2$

If conc. of R is increased by four times, rate = $k\,[4R]^2$

Hence, the rate of formation of P increases by 16 times.

9. *(b) A: Electrophilic substitution, B: Halogen exchange*

Explanation: Benzene can be converted to chlorobenzene by electrophilic substitution reaction and RCl can be converted to R-F by halogen exchange method (Swarts reaction).

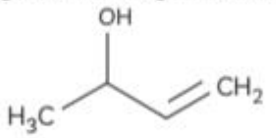
10. *(d) Thiocyanato*

Explanation: A ligand is an ion or molecule, which donates a pair of electrons to the central metal atom or ion to form a coordination complex. Ambidentate ligand is a type of ligands which have the ability to bind to the central atom via the atoms of two different elements.

Examples: Thiocyanate ion(NCS^-) which can bind to the central metal atom or ion with either nitrogen or sulphur atoms.

11. *(a) But-3-en-2-ol*

Explanation: The allyl alcohol is an organic compound with the structural formula $CH_2{=}CHCH_2OH$ structure of But-3-en-2-ol shown alongside is an allylic alcohol.



12. *(b) But-2-ene*

Explanation: The oxidation of ethanol based on the copper catalyst is carried out by the ozonolysis and the following product is obtained:

$$CH_3-CH_2OH \xrightarrow[(573K)]{Cu} CH_3CHO$$

$$CH_3-CH{=}CH-CH_3 \xrightarrow{Ozonoalysis} CH_3CHO$$

13. *(a)* Fe^{2+}

Explanation: In electrochemical series, Fe is placed above hydrogen so it acts as the strong reducing agents and have negative values of standard reduction potentials.

14. *(d) all of these*

Explanation: The electronic conductance depends on:

(i) the nature and structure of the metal,

(ii) the number of valence electrons per atom

(iii) temperature (it decreases with increase of temperature).

15. *(c) (A) is true but (R) is false*

Explanation: `D(+)` glucose is dextrorotatory because it rotates the plane polarised light to right. Here, D represents relative configuration of glucose with respect to glyceraldehyde.

16. *(a) Both (A) and (R) are true and (R) is the correct explanation of (A).*

Explanation: It is assumed that the catalyst provides an alternate pathway or reaction mechanism by reducing the activation energy between reactants and products and hence lowering the potential energy barrier but the enthalpy of reaction remains constant.

17. *(a) Both (A) and (R) are true and (R) is the correct explanation of (A).*

Explanation: Volume of solution is a function of temperature which varies with temperature. Hence, molarity of solution in liquid state changes with temperature.

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

Explanation: Compounds containing —CHO group do easily oxidised to corresponding carboxylic acids, but the reason behind it is that aldehydes get easily oxidised even with mild oxidising agents as the H atom(which is more acidic) on carboxyl carbon(–CHO) changes easily to hydroxyl group (–OH) without any cleavage of any other bond.

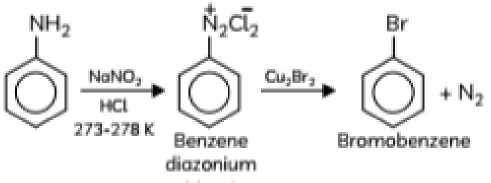
SECTION - B

19. In the case of electrophillic substitution reaction of aryl iodide, HI is produced which is a reducing agent. It reduces aryl iodide back to aromatic hydrocarbon and iodine. This reaction is reversible. Hence, oxidising agents such as HgO, HNO_3 are used to remove HI produced in the reaction as follows:

$$4HI + 2HNO_3 \rightarrow 2N_2O_3 + 2I_2$$

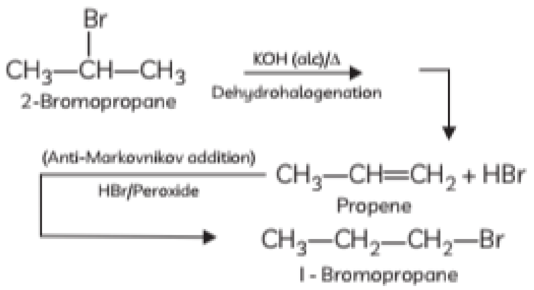
OR

(A)



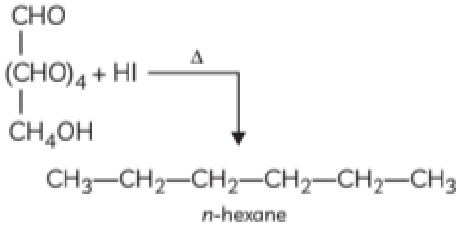
This reaction is called Sandmeyer's reaction.

(B)



20. (A) Uracil is found in nucleotide of RNA only.

(B) On prolonged heating with HI, it forms *n*-hexane, shows that all the six carbon atoms are linked in a straight chain :



21. (A) Magnetic moment = $\sqrt{n\,(n+2)} = 5.9$ (given)

$\therefore$ $35 = n(n+2)$ or $n = 5$

Magnetic moment is 5.9BM means unpaired electrons are 5.

Bromine is a type of weak field ligand, so back pairing will not occur.

So, the geometry of the compound is tetrahedral and hybridisation is sp^3.

(B) Diamminechloridonitrito-N-platinum(II)

$Pt(NH_3)_2Cl(NO_2)]$

O. N. of Pt : $m - 2 = 0$ or $m = +2$

$(NH_3)_2 \rightarrow$ Diammine,

$Cl \rightarrow$ Chlorido,

$NO_2 \rightarrow$ Nitrito-N.

22. For first order reaction:

$$t = \frac{2.303}{k}\log\frac{[R_0]}{[R]}$$

$$t_{99\%} = \frac{2.303}{k}\log\frac{100}{1} = \frac{2.303}{k}\times 2 \quad ...(1)$$

$$t_{90\%} = \frac{2.303}{k}\log\frac{100}{10} = \frac{2.303}{k} \quad ...(2)$$

divide (1) by (2)

$$\frac{t_{99\%}}{t_{90\%}} = 2.$$

OR

Rate Law : Rate $= k[A]^x[B]^y$

$\text{Rate}_1 = 6.0 \times 10^{-3} = k\,[0.1]^x\,[0.1]^y$ ...(1)

$\text{Rate}_2 = 7.2 \times 10^{-2} = k\,[0.3]^x\,[0.2]^y$ ...(2)

$\text{Rate}_3 = 2.88 \times 10^{-1} = k\,[0.3]^x\,[0.4]^y$ ...(3)

$\text{Rate}_4 = 2.40 \times 10^{-2} = k\,[0.4]^x\,[0.1]^y$ ...(4)

$$\frac{\text{Rate}_1}{\text{Rate}_4} = \frac{6.0\times10^{-3}}{2.40\times10^{-2}} = \frac{k[0.1]^x[0.1]^y}{k[0.4]^x[0.1]^y}$$

$$\Rightarrow \quad \frac{1}{4} = \frac{[0.1]^x}{[0.4]^x}$$

$$\Rightarrow \quad \left(\frac{1}{4}\right) = \left(\frac{1}{4}\right)^x$$

Now, $$\frac{\text{Rate}_2}{\text{Rate}_3} = \frac{7.2\times10^{-2}}{2.88\times10^{-1}} = \frac{k[0.3]^x[0.2]^y}{k[0.3]^x[0.4]^y}$$

So, $x = 1$

$$\Rightarrow \quad \frac{1}{4} = \frac{[0.2]^y}{[0.4]^y}$$

$$\Rightarrow \quad \left(\frac{1}{2}\right)^2 = \left(\frac{1}{2}\right)^y$$

So, $y = 2$

Therefore, Rate law is Rate $= k[A]^1\,[B]^2$

or $$k = \frac{\text{Rate}}{[A][B]^2}$$

$$\Rightarrow \quad k = \frac{7.2\times10^{-2}\,\text{mol}\,L^{-1}\,\text{min}^{-1}}{(0.3\,\text{mol}\,L^{-1})(0.2\,\text{mol}\,L^{-1})^2}$$

$$\Rightarrow \quad k = 60\ \text{mol}^2\,L^{-2}\,\text{min}^{-1}.$$

23. (A) Two functions of the salt bridge are:

(1) It connects the solutions in two half-cells and completes the cell circuit.

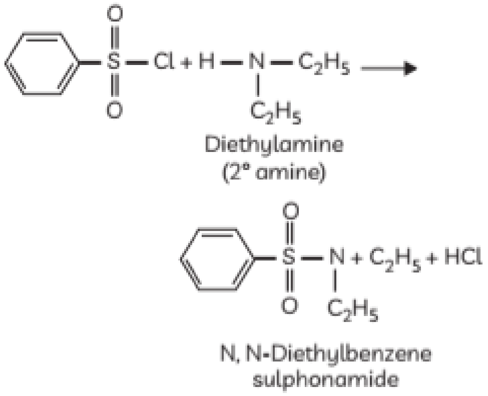
(2) It maintains the electrical neutrality of solutions in the two half-cells by diffusion of ions through it.

(B) Daniel Cell Representation :

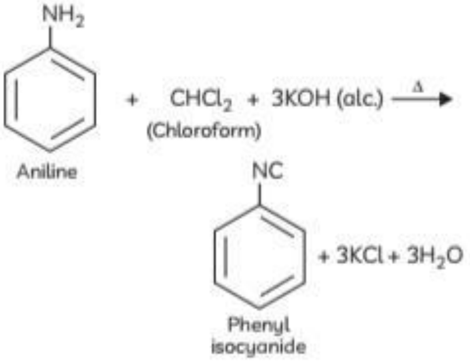
$Zn \mid Zn^{2+}_{(aq)} \parallel Cu^{2+}_{(aq)} \mid Cu$

The symbol double vertical lines (||) represents the salt bridge. The left part is oxidation half cell and the right part is reduction half cell.

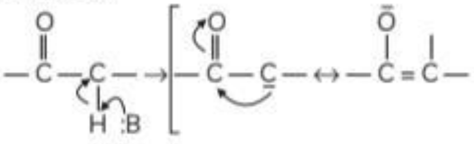
24. (A) N-ethylethanamine (Diethylamine) reacts with benzenesulphonyl chloride.



(B) Aniline reacts with chloroform in the presence of alcoholic potassium hydroxide.



25. (A) Presence of alpha hydrogen in aldehydes and ketones is essential for aldol condensation. The alpha hydrogen atoms are acidic in nature due to the presence of electron withdrawing carbonyl group. These can be easily removed by a base and the carbanion formed is resonance stabilised.



Acidity of α-hydrogen

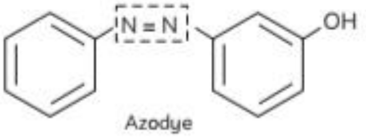
(B) Ketones cannot be oxidised by Tollen's reagent because ketones do not have that particular hydrogen atom. They are resistant to oxidation and only very strong oxidation agents able to oxidise ketones.

SECTION - C

26. (A) Diazotization reaction is the reaction of primary aromatic amines with nitrous acid to form diazonium salt. This reaction is used to make dyes.

The azo products obtained when diazonium salts react with aromatic compounds have an extended conjugated system through N = N bond, known as azo group. This reaction is called a coupling reaction.

(B) Orange dye: p-hydroxy azo benzene



Azodye

(C) (i) They find application in the dye and pigment industries and are used to produce dyed fabrics.

(ii) They are used as intermediates for introducing –F, –Br, –Cl, –I, $-NO_2$, –OH and –CN groups into the aromatic ring.

OR

(A) In case of chlorobenzene, the C—Cl bond is quite difficult to break as it acquires a partial double bond character due to conjugation. So under the normal conditions, ammonolysis of chlorobenzene does not yield aniline.

(B) Primary and secondary amines are engaged in intermolecular association due to hydrogen bonding between nitrogen of one and hydrogen of another molecule. Due to the presence of three hydrogen atoms, the intermolecular association is more in primary amines than in secondary amines as there are two hydrogen atoms available for hydrogen bond formation in it.

(C) During the acylation of aniline, stronger base pyridine is added. This is done in order to remove the HCl so formed during the reaction and to shift the equilibrium to the right hand side.

27. Given: $k_1 = 2.15 \times 10^{-8}$ L mol^{-1} s^{-1}, $T_1 = 650$ K

$k_2 = 2.39 \times 10^{-7}$ L mol^{-1} s^{-1}, $T_2 = 700$ K

$R = 8.314$ J K^{-1} mol^{-1} $E_a = ?$

According to formula:

$$\log \frac{k_2}{k_1} = \frac{E_a}{2.303R}\left[\frac{T_2 - T_1}{T_1 T_2}\right]$$

$$\text{or } \log \frac{2.39 \times 10^{-7}}{2.15 \times 10^{-8}} = \frac{E_a}{2.303 \times 8.314}\left[\frac{700 - 650}{700 \times 650}\right]$$

$$\text{or } \log 1.111 \times 10 = \frac{E_a}{19.147}\left[\frac{50}{455000}\right]$$

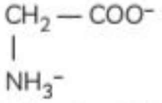
$$\text{or } \log 1.111 + \log 10 = \frac{E_a}{19.147} \times \frac{50}{455000}$$

$$\text{or } \quad 0.0457 + 1 = \frac{E_a}{19.147} \times \frac{1}{9100}$$

$$\text{or } \quad E_a = 1.0457 \times 19.147 \times 9100$$

$$\therefore \quad E_a = 1{,}82{,}200.36 \text{ J} = 182.20 \text{kJ}$$

28. (A)



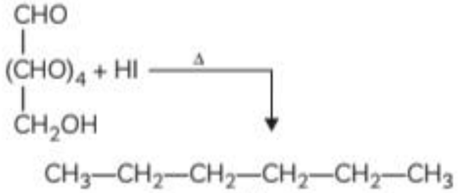
$$\underset{\displaystyle NH_3^-}{\underset{|}{CH_2}} - COO^-$$

Zwitter ion of glycine

(B) The main forces which stabilize the secondary and tertiary structures of proteins are hydrogen bonds, disulphide linkages, van der waals and electrostatic forces of attraction.

(C) Fat soluble vitamins are stored in liver and adipose (fat storing) tissues in our body.

(D) On prolonged heating with HI, it forms n-hexane, shows that all the six carbon atoms are linked.



$$\begin{matrix} CHO \\ | \\ (CHO)_4 + HI \xrightarrow{\Delta} \\ | \\ CH_2OH \end{matrix} \quad CH_3-CH_2-CH_2-CH_2-CH_2-CH_3$$

n-Hexane

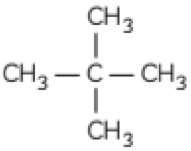
29. (A) (i) The electronic configuration of Ni is [Ar] $3d^8$ $4s^2$ which shows that it can only form two types of complexes i.e. square planar (dsp^2) in presence of strong ligand and tetrahedral (sp^3) in presence of weak ligand. There are four empty orbitals in Ni while octahedral complexes require six empty orbitals.

(ii) Due to presence of empty d-orbitals in transition metals, they can accept electron pairs from ligands containing π electrons and hence can form π -bonding complexes.

(B) $[Ni(NH_3)_2(C_2O_4)_2]^{-2}$

IUPAC name : Diammineoxalatonickelate (II)

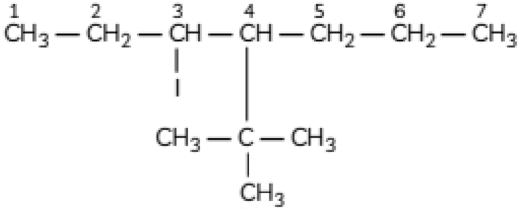
30. (A) In neopentane (C_5H_{12}), all the H-atoms are equivalent and hence, on photochemical chlorinationyields only one type of monohalogen derivative.



$$CH_3-\overset{CH_3}{\underset{CH_3}{C}}-CH_3$$

Neopentane
(2, 2-Dimethylpropane)

(B)



$$\overset{1}{CH_3}-\overset{2}{CH_2}-\overset{3}{\underset{I}{CH}}-\overset{4}{\underset{CH_3-\underset{CH_3}{C}-CH_3}{CH}}-\overset{5}{CH_2}-\overset{6}{CH_2}-\overset{7}{CH_3}$$

4-tert-Butyl-3-iodoheptane

(C) The Cl in $CH_2 = CHCH_2\ Cl$ is very reactive. This reacts rapidly with $AgNO_3$ in the cold to give a white precipitate of AgCl.

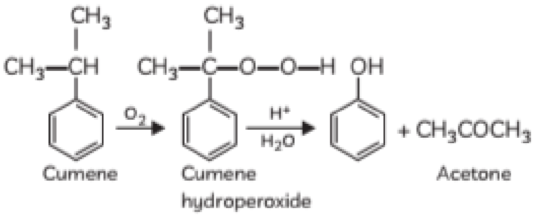
$CH_3CH_2CH_2Cl$ gives white precipitate when warmed with $AgNO_3$ as it is comparatively less reactive.

$CH_3CH = CHCl$ is inert and does not form white precipitate with $AgNO_3$.

SECTION - D

31. (A) Acetone is obtained which is a useful by-product.

Explanation:



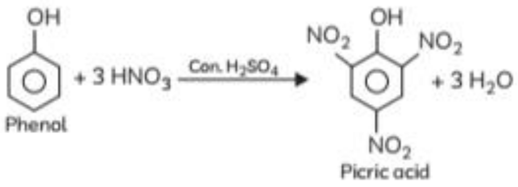
(B) On standing for a long time phenol gets oxidized in the presence of air and turns pink in colour. During oxidation, phenol gets oxidised to quinone and then quinone combines with the phenol to give phenoquinone, which is pink in colour.

(C) (i) Add neutral $FeCl_3$. Phenol gives violet colour where as benzyl alcohol does not.

Explanation: Ferric chloride can be used to distinguish between phenol and benzyl alcohol because, phenols react with neutral ferric chloride solution to give blue, violet or green colouration whereas alcohols do not react.

(ii) By nitration

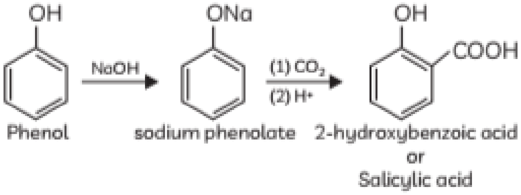
Explanation:



OR

(i) Kolbe's reaction

Explanation:



(ii) (a) $LiAlH_4$ (Lithium Aluminium Hydride)

(b) PCC (Pyridinium chlorochromate)

32. (A) Due to the fact that a half cell containing a single electrode cannot function independently and that charge cannot flow through a single electrode on its own, measuring the potential of a single electrode is not feasible.

(B) $E_{oxi} = E^0_{oxi} - \frac{RT}{nF} \log \frac{[\text{Oxidized state}]}{[\text{Reduced state}]}$

(C) (i) A measurement of the potential for equilibrium is the standard electrode potential. The potential of the electrode is the difference in potential between the electrode and the electrolyte. The electrode potential is referred to as the standard electrode potential when unity represents the concentrations of all the species involved in a semi-cell.

(ii) An electrode with a consistent and well-known electrode potential is referred to as a reference electrode. Typically, a redox system with consistent (buffered or saturated) concentrations of each redox reaction participant is used to achieve the high stability of the electrode potential.

OR

(i) The half cell reaction corresponding to the given half cell is:

$$Fe^{2+}\ (0.1\ M) + 2e^- \longrightarrow Fe_{(s)}$$

Thus, $n = 2, [Fe^{2+}] = 0.1\ M$

According to the Nernst equation, at 298 K

$$E_{Fe^{2+}/Fe} = E^{o}_{Fe^{2+}/Fe} - \frac{0.059}{n} \log_{10} \frac{1}{[Fe^{2+}]}$$

Substituting the values, we have

$$E_{Fe^{2+}/Fe} = 0.44 - \frac{0.059}{n} \log_{10} \frac{1}{(0.1)}$$

$$= -0.44 - (0.0295)$$

$$= -0.4695\ V.$$

(ii) The electrode reaction is:

$$H^+\ (0.02\ M) + e^- \longrightarrow \frac{1}{2} H_2\ (2\ atm)$$

According to the Nernst equation at 298 k

$$E = E^\circ - \frac{0.059}{1} \log_{10} \frac{[\text{Reduced state}]}{[\text{Oxidised state}]}$$

$$\text{Or,}\quad E_{H^+/½H_2} = E^{o}_{H^+/½H_2} - \frac{0.059}{1} \log_{10} \frac{P^{\frac{1}{2}}_{H_2}}{[H^+]}$$

Substituting the values, we have,

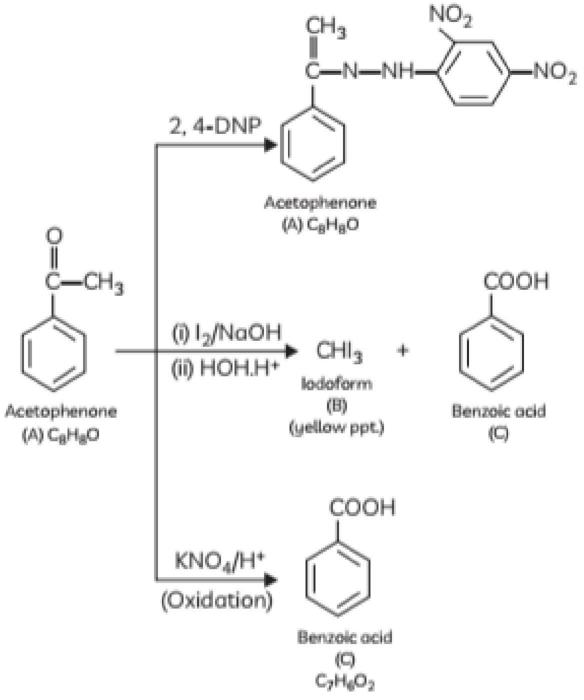
$$E_{H^+/½H_2} = 0 - \frac{0.059}{1} \log_{10} \frac{(2)^{½}}{0.02}$$

$$= 0 + (-0.109)$$

$$= -0.109\ V.$$

SECTION - E

33. Molecular formula of the compound is C_8H_8O. It is given that 'A' does not give Tollens' or Fehling's test, making it a ketone. Since we get positive test with 2, 4-DNP and iodoform test, it means it is methyl ketone.



34. (A) (i) Because macromolecules such as proteins and polymers are generally not stable at higher temperature and osmotic pressure is measured at room temperature.

(ii) The main reason for adding helium with oxygen to the breathing mix is to reduce the proportions of nitrogen and oxygen to allow the gas mix to be breathed safely on deep dives.

(B) Two solutions having the same osmotic pressure across a semipermeable membrane is referred to as isotonic solution. It has the same osmolarity (solute concentration), as another solution. A solution is isotonic when its effective mole concentration is the same as that of another solution.

(C) Mass of solution = Mass of benzene + Mass of carbon tetrachloride

$= 22\,g + 122\,g = 144\,g$

Mass percentage of benzene

$$= \frac{\text{Mass of benzene}}{\text{Mass of solution}} \times 100 = \frac{22g}{144g} \times 100$$

$$= 15.28\%.$$

Mass percentage of CCl_4

$$= \frac{\text{Mass of } CCl_4}{\text{Mass of solution}} \times 100 = \frac{122}{144} \times 100$$

$$= 84.72\%$$

OR

(A) (i) The salt solution (saline water) is hypertonic when we gargle with it, comes in contact of infection causing bacteria in the throat. The water present in bacterial cells comes out due to osmosis and they get killed giving us relief from infection.

(ii) NaCl or salt is added to the water when boiling eggs as the addition of salt or other non-volatile solid help in reducing the vapour pressure of the liquid. Which in turn increases, the boiling point *i.e* the temperature at which the vapour pressure equals the atmospheric pressure.

(B) Mass percent of benzene

$$= \frac{\text{Mass of benzene}}{\text{Mass of benzene + mass of } CCl_4}$$

$$\frac{30}{100} = \frac{\text{Mass of benzene}}{\text{Total mass of solution}}$$

∴ Mass of benzene = 30 g

Mass of CCl_4 = 100 – 30 = 70 g

($n_{C_6H_6}$) moles of benzene

$$= \frac{\text{mass}}{\text{molecular weight}} = \frac{30}{78}$$

$$= 0.385$$

$$(n_{CCl_4}) \text{ moles of } CCl_4 = \frac{\text{mass}}{\text{molecular weight}}$$

$$= \frac{70}{154}$$

$$= 0.455$$

$$\text{Mole fraction of } C_6H_6 = \frac{n_{C_6H_6}}{n_{C_6H_6} + n_{CCl_4}}$$

$$\text{Mole fraction of } C_6H_6 = \frac{0.385}{0.385 + 0.455}$$

$$= 0.4583$$

(C) Normal Molar mass = 120 g mol^{-1} (Given)

$$\text{Van } t \text{ off factor (i)} = \frac{\text{Normal molar mass}}{\text{Abnormal molar mass}}$$

$$i = 4$$

So, Abnormal molar mass ÷ 4 Normal molar mass

$$= \frac{120}{4}$$

Abnormal molar mass = 30 g

35. (A) (i) Transition metal ions generally possess one or more unpaired electrons. When visible light falls on a transition metal compound or ion, the unpaired electrons present in the lower energy d-orbital get promoted to high energy d-orbitals, called d-d transition, due to the absorption of visible light. Since, the energy involved in d-d transition is quantised, only a definite wavelength gets absorbed, remaining wavelengths present in the visible region got transmitted. Therefore, transmitted light shows some colour complementary to the absorbed colour.

(ii) Silver (Ag) belongs to group 11 of d-block and its ground state electronic configuration is $4d^{10}\ 5s^1$. It shows an oxidation state of +2 in its compounds like AgO and AgF_2 in which its electronic configuration is d^9 so it is a transition element.

(iii) Zinc ($4d^{10}\ 5s^2$) has completely filled d-orbital and has no unpaired electron to take part in the formation of metallic bonds.

(B) To write balanced reactions is mandatory.

(i) $8MnO_{4(aq)} + 3S_2O_3{}^{2-}{}_{(aq)} + H_2O_{(l)} \longrightarrow 8MnO_{2(s)} + 6SO_4{}^{2-}{}_{(aq)} + 2OH^-{}_{(aq)}$

(ii) $Cr_2O_7^{2-}{}_{(aq)} + 14H^+{}_{(aq)} + 6Fe^{2+}{}_{(aq)} \longrightarrow 2Cr^{3+}{}_{(aq)} + 6Fe^{3+}{}_{(aq)} + 7H_2O_{(l)}$

OR

(A) Transition metals have large number of unpaired electrons, due to which strong interatomic interactions are possible and bonding becomes stronger and hence, these have higher enthalpies of atomisation.

(B) Manganese (Z = 25) exhibits largest number of oxidation states. This is because its electronic configuration is $3d^5 4s^2$ and it has maximum number of electrons (five d-electrons and two s electrons) to lose or share. Thus, it can exhibit an oxidation state of +2 to +7 which is the maximum number.

(C) Cr^{2+} is reducing agent as its configuration changes from d^4 to d^3, when it is oxidized to Cr^{3+}. The d^3 configuration have a half-filled t_{2g} level which is very stable. On the other hand, the reduction of Mn^{3+} to Mn^{2+} results in the half-filled (d^5) configuration which has extra stability hence Mn^{3+} acts as oxidizing agent.

(D) Preparation of potassium permanganate, $KMnO_4$ from pyrolusite ore MnO_2.

(i) Pyrolusite ore is fused with KOH (or K_2CO_3) in presence of air (or oxidising agents such as KNO_3 or $KClO_3$) to give potassium manganate K_2MnO_4 (green mass).

$$2MnO_2 + 4KOH + O_2 \xrightarrow{\Delta} 2K_2MnO_4 + 2H_2O$$

(ii) Extraction of green mass with water followed by oxidation with chlorine (or ozone or CO_2) gives potassium permanganate.

$2K_2MnO_4 + Cl_2 \longrightarrow 2KCl + 2KMnO_4$

On concentrating the solution, dark purple crystals of potassium permanganate separate out.