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CBSE

CENTRAL BOARD SECONDARY EXAMINATION

2022

CLASS XII

Questions & Solutions

Date: 07 May, 2022 | TIME : (10.30 a.m. to 12.30 p.m)

Duration: 2 hrs. | Max. Marks: 35

SUBJECT: CHEMISTRY

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SET-1

Code No. **56/3/1**

Roll No. | | | | | | | |

Candidates must write the Code on the title page of the answer-book

CHEMISTRY

Time allowed: 2 hours **Maximum Marks: 35**

- Please check that this question paper contains 12 printed pages.
- Q.P. Cede number given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.
- Please check that this question paper contains 12 questions.
- **Please write down the Serial Number of the question in the answer book before attempting it.**
- 15 minute time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a,m. to 10.30 a.m., the candidates will read the question paper only and will not write any answer on the answer-book during this period.

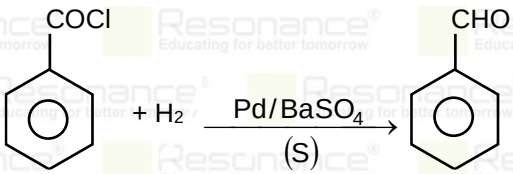
General Instructions:

Read the following instructions very carefully and strictly follow them:

(j) This question paper contains **12** questions. All questions are compulsory.
(ii) This question paper is divided into three Sections – Section **A, B** and **C**.
(iii) **Section - A** Q. Nos. **1** to **3** are very short answer type questions carrying 2 marks each.
(iv) **Section - B** Q. Nos. **4** to **11** are short answer type questions carrying 3 marks each.
(u) **Section - C** Q. No. **12** is case based question carrying 5 marks.
(vi) Use of log tables and calculators is NOT allowed.

SECTION–A

1. Predict the reagent for carrying out the following transformations: **(Any two)**
(i) Benzoyl chloride to Benzaldehyde
(ii) Ethanal to 3-hydroxy butanal
(iii) Ethanoic acid to 2-chloroethanoic acid **[1 × 2 = 2]**

Ans. (i) 

(ii) $CH_3 - CHO \xrightarrow{\text{dil NaOH}} CH_3 - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_2 - CHO$

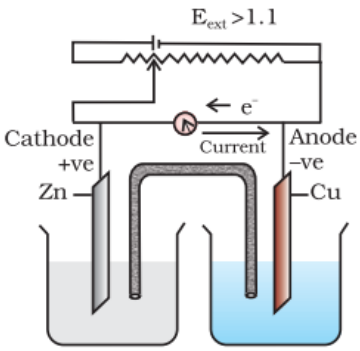
(iii) $CH_3 - COOH \xrightarrow[HVZ]{P_{red} + Cl_2} \underset{\displaystyle Cl}{\underset{|}{CH_2}} - COOH$

2. (i) Why on dilution to ^m of CH_3COOH increases very fast, while that of CH_3COONa increases gradually?

(ii) What happens if external potential applied becomes greater than E^o cell of electrochemical cell? **[1 × 2 = 2]**

Ans. (i) Weak electrolytes like acetic acid have lower degree of dissociation at higher concentrations and hence for such electrolytes, the change in $\wedge_m$ with dilution is due to increase in the degree of dissociation and consequently the number of ions in total volume of solution that contains 1 mol of electrolyte. In such cases $\wedge_m$ increases steeply on dilution.

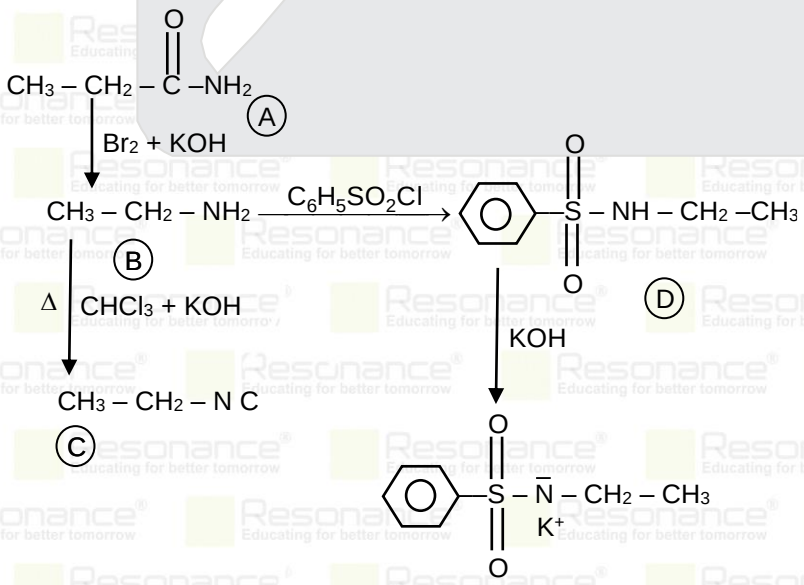
(ii)



When E_{ext} >1.1V
(i) Electrons flow from Cu to Zn and current flows from Zn to Cu.
(ii) Zinc is deposited at the zinc electrode and copper dissolves at copper electrode.

3. An Organic compound (A) with molecular formula C_3H_7NO on heating with Br_2 and KOH forms a compound (B). Compound (B) on heating with $CHCl_3$ and alcoholic KOH produces a foul smelling compound (C) and on reacting with $C_6H_6SO_2Cl$ forms a compound (D) which is soluble in alkali. Write the structure of (A), (B), (C) and (D). **[2]**

Ans.



SECTION–B

4. Account for the following:
(i) Cu^{2+} salts are coloured while Zn^{2+} salts are white.
(ii) E^o value for the Mn^{3+}/Mn^{2+} coulpe is much more positive than that for Cr^{3+}/Cr^{2+}.
(iii) Transition metals form alloys. **[1 × 3 = 3]**

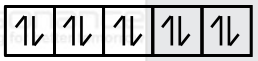
Ans. $_{24}Cu \rightarrow |Ar|\ 3d^{10}4s$

$Cu^{2+}|Ar|3d^9$

Unpaired e^-

$_{30}Zn \rightarrow |Ar|\ 3d^{10}4s^2$

$Zn^{2+} \rightarrow |Ar|\ 3d^{10}$



Zero unpaired e^-

(ii) Much larger third ionisation energy of Mn (where the required change is d^5 to d^4) is mainly responsible for this.

(iii) Due to similar radil.

5. (a) Calculate $\Delta_r G^o$ and log K_c for the following cell:
$Ni(s) + 2Ag^+(aq) \rightarrow Ni^{2+}(aq) + 2Ag(s)$
Given that $E^o cell = 1.05V$, IF = 96,500 $Cmol^{-1}$. **[3]**

OR

(b) Calculate the e.m.f. of the following cell at 298K:
$Fe(s) \mid Fe^{2+}(0.001M) \parallel H^+(0.0M) \mid H_2(g)$ (1 bar) $\mid Pt(s)$
Given that E^o cell = +0.44 V
[log2 = 0.3010 log3 = 0.4771 log10 = 1] **[3]**

Ans. (a) For reaction

$(\Delta G)_r = -n f \sum_{cell}^{o}$

$= -2 \times 96500 \times 1{\cdot}05$

$= -202650$ J

$= -202.65$ kJ Ans.

$\Delta G = -2{\cdot}303\ RT \log K_C$

$nf \sum_{cell}^{o} = -2{\cdot}303\ RT \log K_C$

$$\log K_C = \frac{nf\sum_{cell}^{o}}{2.303\,RT} = \frac{2\times 96500\times 1{\cdot}05}{2{\cdot}303\times 8{\cdot}314\times 298}$$

log KC = 35·51 Ans.

(b) For cell $\sum_{cell}^{o}$ at 298 K

$$\sum_{cell} = \sum_{cell}^{o} - \frac{0.059}{2}\log\frac{\left(Fe^{+2}\right)\left(P_{H_2}\right)^1}{\left(H^+\right)^2}$$

$$= +0.44 - \frac{0.059}{2}\log\frac{\left(10^{-3}\right)(1)}{\left(10^{-2}\right)^2}$$

$$= +0.44 + \frac{0.0591}{2}\log 10$$

$= 0.44 + 0.0295 = 0.4695 \approx 0.47$ V Ans.

6. (a) Using valence bond theory, predict the hybridization and magnetic character of following:
$[CoF_6]^{3-}$ [Atomic number of Co = 27]

(b) Write IUPAC name of the following complex:
$[CoBr_2(en)_2]^+$

(c) How many ions are produced from the complex $[Co(NH_3)_6]Cl_2$ in solution? **[1 × 3 = 3]**

Ans. (a) $\left[Co(F_6)\right]^{3-}$

$Co^{3+} \rightarrow |\ Ar\ | 3d^6$

CN = 6

hybridisation $\rightarrow$ **Sp^3d^2**

unpaired e^-4

paramagnetic

(b) $\left[Co(Br)_2(en)_2\right]^+$

Dibromidobis (ethane–1,2 diamine) Cobalt (III) ion

(c) $\left[Co(NH_3)Cl_2\right] \rightleftharpoons \left[Co(NH_3)_6\right]^{2+} + 2Cl^-$

Total number of ion = 3

7. (a) Differentiate between the following:
(i) Adsorption and Absorption
(ii) Lyophobic Sol and Lyophilic Sol
(iii) Multimolecular Colloid and Macromolecular colloid. **[1 × 3 = 3]**

OR

(b) (I) Define the following terms:
(i) Zeta Potential
(ii) Coagulation

(II) Why a negatively charged sol is obtained when $AgNO_3$ solution is added to KI solution? **[3]**

Ans. **(a)**
(i) In adsorption, the substance is concentrated only at the surface and does not penetrate through the surface to the bulk of the adsorbent, while in absorption, the substance is uniformly distributed throughout the bulk of the solid. For example, when a chalk stick is dipped in ink, the surface retains the colour of the ink due to adsorption of coloured molecules while the solvent of the ink goes deeper into the stick due to absorption. On breaking the chalk stick, it is found to be white from inside.

(ii)

Lyophobic		Lyophilic	
(A)	Directly formed by mixing of substances.	(A)	Special method used for the preparation.
(B)	Reversible sol eg. starch, gum etc.	(B)	Irreversible sol eg. gold sol, sulphur sol. etc.

(iii)

Multimolecular		Macromolecular	
(A)	Particles having diameter < 1nm aggregate to form particles having diameter 1 – 1000 nm	(A)	Particles having diameter > 1000nm form particles having diameter 1 – 1000nm
(B)	Lyophobic eg. Sulphur, gold sol.	(B)	Lyophilic eg. Starch, cellulose

Ans. **(b)**

(i) Zeta potential difference between the fixed layer and the diffused layer of opposite charge is called zeta potential.

(ii) Coagulation $\rightarrow$ The process of setting of colloidal particles is called coagulation.

(iii) AgI/I^- (AgI ppt. adsorb I^- ions from solution).

8. Define transition metals. Why Zn, Cd and Hg are not called transition metals? How is the variability in oxidation states of transition metals different from that of p-block elements? **[3]**

Ans. Transition metal $\rightarrow$ having (n-1) d partially filled

Zn, Cd, are not transition metals. because completely filled (n-1)d. orbital. (d^{10} configuration).

In the transition metals (n-1)d and ns participate in the oxidation state but in the p – block elements only ns, np, e^- participate in the oxidation state.

9. (a) What happens when

(i) Propanone is treated with CH_3MgBr and then hydrolysed?

(ii) Ethanal is treated with excess ethanol and acid?

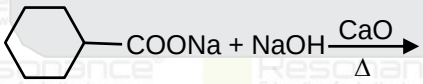
(iii) Methanal undergoes Cannizzaro reaction? **[1 × 3 = 3]**

OR

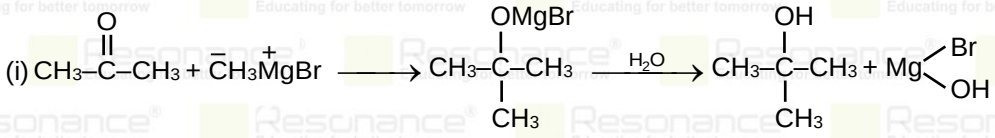
(b) Write the main product in the following reactions:

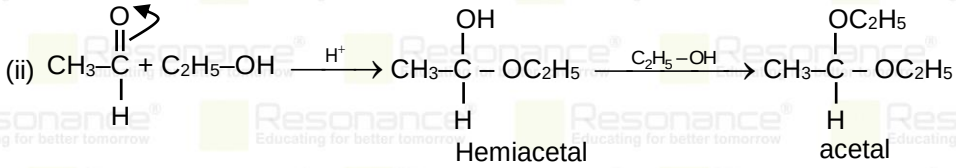
(i) $2CH_3COCl + (CH_3)_2Cd \rightarrow$

(ii) $CH_3CH_2CHO \xrightarrow{Zn(Hg)/Conc.HCl}$

(iii)  **[1 × 3 = 3]**

Ans. (a)

(i) 

(ii) 

(iii) $HCHO + HCHO \xrightarrow[\Delta]{Conc.NaOH} HCOONa + CH_3–OH$

OR

(b)

(i) $2CH_3COCl + (CH_3)_2CCl \longrightarrow 2CH_3COCH_3 + CdCl_2$

(ii) $CH_3–CH_2–CHO \xrightarrow[\text{Conc .HCl}]{\text{Zn–Hg}} CH_3–CH_2–CH_3$

(iii)  $+ Na_2CO_3$

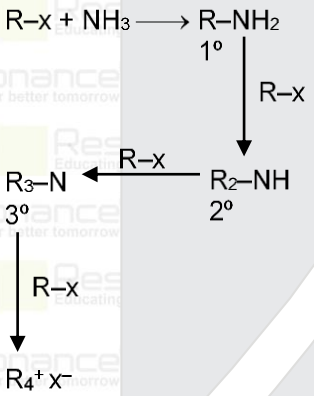
10. Give reasons:

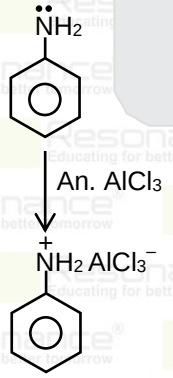
(i) Ammonolysis of alkyl halides is not a good method to prepare pure primary amines.

(ii) Aniline does not give Friedel-Crafts reaction.

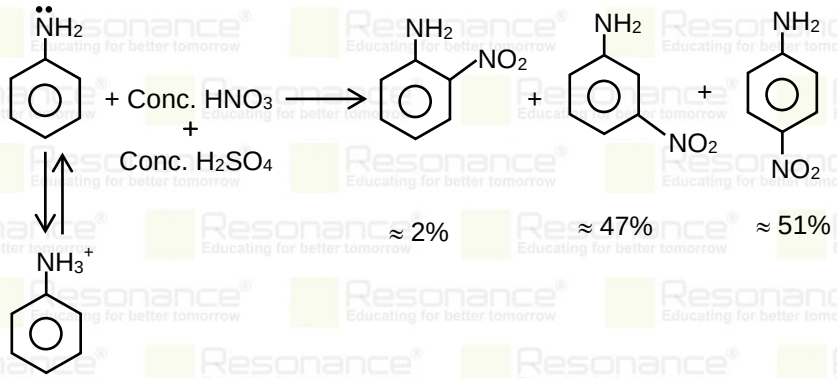
(iii) Although $–NH_2$ group is o/p directing in electrophilic substitution reactions, yet aniline on nitration gives good yield of m-nitroaniline. **[1 × 3 = 3]**

Ans. (i) Because it gives a mixture of 1º, 2º, 3º amines and tetra ammonium salt.



(ii)  + R–x $\xrightarrow{\text{An. } AlCl_3}$ not give product

Deactivate benzene ring and not produce E^+ (R^+)

(iii) 

11. (a) (i) Which acid of the following pair would you expect to be stronger?

$F–CH_2–COOH$ or $CH_3–COOH$

(ii) Arrange the following compounds in increasing order of their boiling points:

$CH_3–CH_2OH$, $CH_3–CHO$, $CH_3–COOH$

(iii) Give simple chemical test to distinguish between Benzaldehyde and Acetophenone.

[1 × 3 = 3]

OR

(b) (i) Which will undergo faster nucleophilic addition reaction?

Acetaldehyde or Propanone

(ii) What is the composition of Fehling's reagent?

(iii) Draw structure of the semicarbazone of Ethanal. **[1 × 3 = 3]**

Ans. (a)

(i) $F–CH_2–COOH > CH_3–COOH$

(ii) $CH_3–COOH > CH_3–CH_2–OH > CH_3 – CHO$

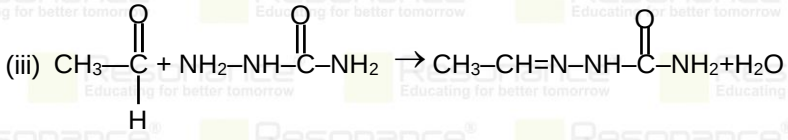
(iii) $C_6H_5–CHO \rightarrow$ give silver mirror with Tollen's reagent.

$C_6H_5COCH_3 \rightarrow$ not react with Tollen's regent

OR

(b) (i) $CH_3–CHO$

(ii) Fehling reagent
- A → $CuSO_4$ aqs
- B → Sodium potassium tartarate (Roshcell salt)

(iii) 

SECTION–C

12. Read the following passage and answer the questions that follow:

The rate of reaction is concerned with decrease in concentration of reactants or increase in the concentration of products per unit time. it can be expressed as instantaneous rate at a particular instant of time and average rate over a large interval of time. A number of factors such as temperature, concentration of reactants, catalyst affect the rate of reaction. Mathematical representation of rate of a reaction is given by rate law:

$$\text{Rate} = k[A]^x[B]^y$$

x and y indicate how sensitive the rate is to the change in concentration of A and B. Sum of x + y gives the overall order of a reaction.

When a sequence of elementary reactions gives us the products, the reactions are called complex reactions. Molecularity and order of an elementary reaction are same. Zero order reactions are relatively uncommon but they occur under special conditions. All natural and artificial radioactive decay of unstable nuclei take place by first order kinetics.

(a) What is the effect of temperature on the rate constant of a reaction?

(b) For a reaction A + B $\rightarrow$Product, the rate law is given by, Rate = $k[A]^2[B]^{1/2}$. What is the order of the reaction?

(c) How order and molecularity are different for complex reactions?

(d) A first order reaction has a rate constant $2 \times 10^{-3}s^{-1}$. How log will 6g of this reactant take to reduce to 2g?

OR

The half life for radioactive decay of ^{14}C is 6930 years. An archaeological artifact containing wood had only 75% of the ^{14}C found in a living tree. Find the age of the sample.

[log4 = 0.6021 log3 = 0.4771 log2 = 0.3010 log10 = 1] **[1 + 1 + 1 + 2]**

Sol. (a) Rate constant of reaction depends on temp. acc to Arrhenius equation on increasing temp rate constant increase $\left(k = Ae^{-\frac{Ea}{RT}}\right)$

$$\ln \frac{k_2}{k_1} = \frac{Ea}{R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

(b) Order of reaction = $2 + \frac{1}{2} = 2.5$ according to rate law $\Rightarrow$ Rate = $K[A]^2[B]^{\frac{1}{2}}$

(d) For Ist order reaction'

$$Kt = 2.303 \log \frac{W_o}{W_t}$$

$$t = \frac{2.303}{k} \log \frac{W_o}{W_t}$$

$$t = \frac{2.303}{2\times10^{-3}}\log\frac{6}{2} = \frac{2.303}{2\times10^{-3}}\log 3$$

$$t = \frac{2.303}{2\times10^{-3}} \times 0.4771 = 549.380 \text{ sec}$$

OR

Radio active decay is Ist order reaction

$$\lambda = \frac{0.693}{t_{1/2}} = \frac{0.693}{6930}\left(\text{year}^{-1}\right) = \frac{0.693}{6930} = 10^{-4}\left(\text{year}^{-1}\right)$$

$N_o = 100$ $N = 75$ of C^{14}

$$t = \frac{2.303}{\lambda}\log\frac{N_o}{N} = \frac{2.303}{10^{-4}}\log\frac{100}{75} = \frac{2.303}{10^{-4}}\log\frac{4}{3} = 2763.6 \text{ year.}$$