

Sample Question Paper - 26
Chemistry (043)
Class- XII, Session: 2021-22
TERM II

Time allowed : 2 hours

Maximum marks : 35

General Instructions :

Read the following instructions carefully.

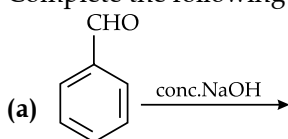
1. There are 12 questions in this question paper with internal choice.
2. SECTION A - Q. No. 1 to 3 are very short answer questions carrying 2 marks each.
3. SECTION B - Q. No. 4 to 11 are short answer questions carrying 3 marks each.
4. SECTION C - Q. No. 12 is case based question carrying 5 marks.
5. All questions are compulsory.
6. Use of log tables and calculators is not allowed.

Section - A

1. Explain redox potential. Reduction potentials of some ions are given below. Arrange them in decreasing order of oxidising power. [2]

Ion	ClO_4^-	IO_4^-	BrO_4^-
Reduction potential E^\ominus/V	$E^\ominus = 1.19\text{V}$	$E^\ominus = 1.65\text{V}$	$E^\ominus = 1.74\text{V}$

2. (a) What is the order of the reaction whose rate constant has same units as the rate of reaction ? [2]
(b) For a reaction $\text{A} + \text{H}_2\text{O} \rightarrow \text{B}$; $\text{Rate} \propto [\text{A}]$. What is the order of this reaction?
3. Complete the following chemical equations: (any two) [2]



Section - B

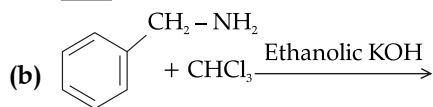
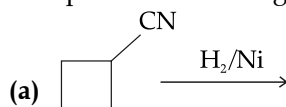
4. Account for the following:
- (a) Iron displaces copper from copper sulphate solution but platinum does not.
 - (b) Salt bridge is used in electrochemical process.

[3]

5. (a) Write one difference between multi-molecular colloid and macro-molecular colloid. [1×3=3] **AI**
 (b) Write the dispersed phase and dispersion medium of milk.
 (c) Write one similarity between physisorption and chemisorption.

6. Complete the following chemical reactions :

[1×3=3] **AI**



(c) Why aniline is a weaker base than cyclohexylamine?

(a) Write the IUPAC name of : $\text{CH}_3 - \underset{\text{NH}_2}{\text{CH}} - \text{CHO}$

[1×3=3] **AI**

(b) Draw the structure of 3-methylpentanal.

(c) Why is it difficult to prepare pure amines by ammonolysis of alkyl halides?

7. Consider the standard electrode potential values (M^{2+}/M) of the elements of the first transition series.

[1×3=3]

Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
-1.63	-1.18	-0.90	-1.18	-0.44	-0.28	-0.25	+0.34	-0.76

Explain:

- (a) E° value for copper is positive.
 (b) E° value of Mn is more negative as expected from the trend.
 (c) Cr^{3+} is a stronger reducing agent than Fe^{2+} .

8. Account for the following:

[1×3=3]

- (a) CuCl_2 is more stable than Cu_2Cl_2 .
 (b) Atomic radii of 4d and 5d series elements are nearly same.
 (c) Hydrochloric acid is not used in permanganate titration.

OR

Out of the following metal ions:

Cr^{2+} , Cu^{2+} , Cu^+ , Fe^{2+} , Fe^{3+} , Mn^{3+}

[1×3=3]

- (a) Why Cr^{2+} is a strong reducing agent?
 (b) Which of the following ions is unstable in aqueous solution?
 (c) Why Mn^{3+} is a strong oxidising agent?

Give suitable reason in each.

9. (a) For the complex $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$, write the hybridisation, magnetic character and spin of the complex. (At. number: Fe = 26). [2+1]

(b) Which of the following will not behave as ligand?
 H_2O , NH_3 , CO and CH_4 .

OR

(a) Draw the structure of:

[2+1]

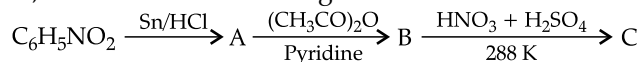
- (i) Pentacarbonyl iron (0)
 (ii) Octacarbonyldicobalt(0)

(b) What is synergic effect?

10. (a) Write the rate law for a first order reaction. Justify the statement that half life for a first order reaction is independent of the initial concentration of the reactant.

- (b) For a first order reaction, show that the time required for 99% completion of a first order reaction is twice the time required for the completion of 90%. [3]

11. Write the structure of A, B and C in the following reactions: [3]



OR

Write the structures of main products when aniline reacts with the following reagents:

(a) Br_2 water

(b) HCl

(c) $(\text{CH}_3\text{CO})_2\text{O}$ / pyridine

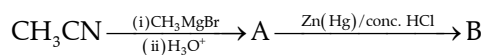
[1×3=3]

Section - C

12. Read the passage given below and answer the questions that follow.

Aldehydes, ketones and carboxylic acids are few of the major classes of organic compounds containing carbonyl group. Aldehydes are prepared by dehydrogenation or controlled oxidation of primary alcohols and controlled or selective reduction of acyl halides. Ketones are prepared by oxidation of secondary alcohols or hydration of alkynes. Carboxylic acids are prepared by the oxidation of primary alcohols, aldehydes and alkenes by hydrolysis of nitriles and by the treatment of Grignard reagents with carbon dioxide.

- Name a method by which both aldehydes and ketones can be prepared.
- How will you distinguish between aliphatic aldehydes and aromatic aldehydes ?
- How ketones are prepared by the oxidation of secondary alcohol?
- Name the compounds A and B formed in the following reaction:



OR

Give a method through which number of carbon atoms can be increased in a chain. [1+1+1+2]

□□□

Solution

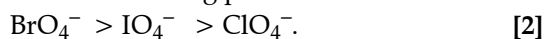
CHEMISTRY - 043

Class 12 - Chemistry

Section - A

1. Redox potential (also known as reduction/oxidation potential) is a measure of the tendency of a chemical species to acquire electrons from or lose electrons to an electrode and thereby be reduced or oxidised respectively. Redox potential is measured in volts (V), or millivolts (mV). The more positive the reduction potential of a species, the greater the species' affinity for the electrons and tendency to be reduced.

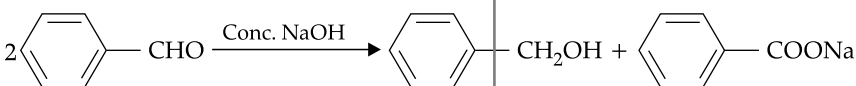
The higher the reduction potential, the higher is its tendency to get reduced. Hence, the order of oxidising power is:



2. (a) Zero order [1]
(b) Pseudo-first order [1]
[CBSE Marking Scheme, 2017]

Detailed Answer:

- (a) Rate of reaction, $R = k[A]^n$
Where, n = Order of the reaction

3. (a)  [1]
- (b) $\text{CH}_3\text{COCH}_3 + 2[\text{H}] \xrightarrow{\text{LiAlH}_4} \text{CH}_3\text{CH}(\text{OH})\text{CH}_3$ [1]
- (c) $\text{CH}_3 - \text{COOH} \xrightarrow[\text{(ii) H}_2\text{O}]{\text{(i) Cl}_2/\text{Red phosphorus}} \text{CH}_2(\text{Cl}) - \text{COOH}$ [1]

Section - B

4. (a) Electrode potential of Fe is more than electrode potential of Cu. So, Fe displaces Cu from copper sulphate while electrode potential of Pt is less than Cu. Due to this reason, Pt cannot displace Cu from copper sulphate. [1]

k = Rate constant

If unit of $[R] = [k]$

Then, $n = 0$ (zero order reaction)

- (b) Given, $A + \text{H}_2\text{O} \rightarrow B$

(excess)

Rate of reaction,

$$R = k[A][\text{H}_2\text{O}]$$

But, if H_2O is in excess, it will not be affecting rate of reaction and remain constant such that,

$$R = k'[A]$$

Thus, $R \propto [A]$

It is considered as pseudo first order reaction.

Commonly Made Error

- Students often confuse between rate of reaction's and rate constants S.I. unit and some of them give same unit.

Answering Tip

- Always use the formula to derive S.I. units of any parameter to avoid confusions.

- (b) In an electrochemical cell, a salt bridge is used to keep solution electrically neutral and allow the flow of ions from one cell to another so that reaction can not stop, otherwise due to accumulation of ions on cathode and anode can stop reactions.

[2]

5. (a) [1]

Multi-molecular colloid	Macro-molecular colloid
These colloids are formed when small particles aggregate to form a particle having size in colloidal range.	These are substances, whose individual molecules have very large size with colloidal dimensions.
Example–Gold sol.	Example–Starch.

(b) Dispersed phase-liquid and Dispersion medium-liquid. [1]

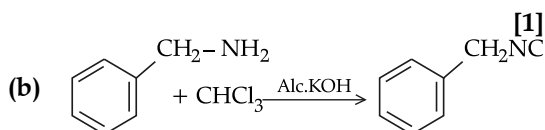
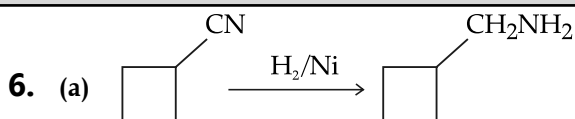
(c) Both are surface phenomena/both increase with increase in surface area (or any other correct similarity) [1]

Commonly Made Error

- Students misunderstand the question and instead of writing the similarity, they write the point of difference.

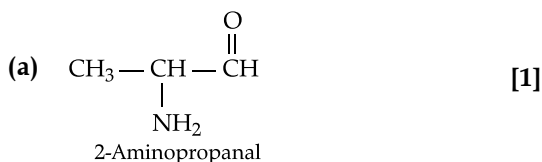
Answering Tip

- Read the question carefully and write only one point of similarity, not more than one as it can lead to deduction of marks.

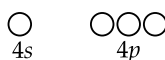


(c) Cyclohexylamine is more basic than aniline because aniline is a resonance hybrid of various resonance structures. As a result, in aniline the electron donating capacity of nitrogen for protonation is considerably decreased than cyclohexylamine. [1]

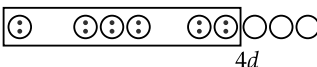
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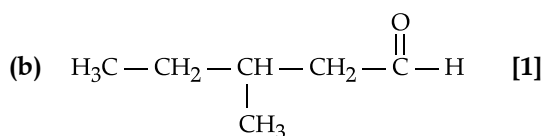
9. (a) $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$
Fe(III)ion



$[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$

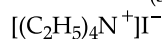
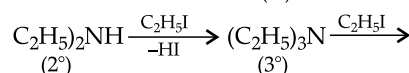
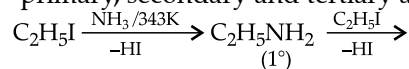


sp^3d^2 hybridisation



3-Methyl pentanal

(c) Ammonolysis of alkyl halides does not give single amine but gives a mixture of primary, secondary and tertiary amines.



Quaternary ammonium salt

[1]

7. (a) The high energy to transform Cu(s) to $\text{Cu}^{2+}(\text{aq})$ is not balanced by its hydration enthalpy. 1

(b) Mn^{2+} has d^5 configuration (stable half-filled configuration) 1

(c) d^5 to d^3 occurs in case of Cr^{2+} to Cr^{3+} . (More stable t_{2g}^3) while it changes from d^6 to d^5 in case of Fe^{2+} to Fe^{3+} . 1

[CBSE Marking Scheme 2017]

8. (a) In CuCl_2 , Cu is in +2 oxidation state which is more stable due to high hydration enthalpy as compared to Cu_2Cl_2 in which Cu is in +1 oxidation state. 1

(b) Due to lanthanoid contraction. 1

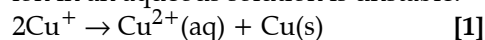
(c) Because HCl is oxidised to chlorine. 1

[CBSE Marking Scheme 2017]

OR

(a) Electronic configuration of Cr^{+2} changes from d^4 to d^3 and have a half-filled t_{2g} level. [1]

(b) Cu^+ in an aqueous medium energy is required to remove one electron from Cu^+ to Cu^{2+} , high hydration energy of Cu^{2+} compensates for it. Therefore Cu^+ ion in an aqueous solution is unstable.



(c) Electronic configuration changes from Mn^{3+} to Mn^{2+} results in the half filled d^5 configuration, which has extra stability. [1]

[1]

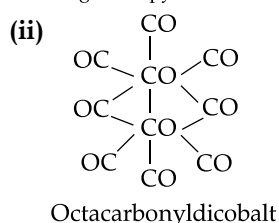
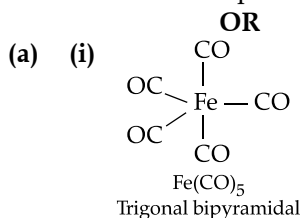
Since, H_2O is a weak field ligand, it cannot cause pairing of electrons. Therefore, the number of unpaired electrons is 5.

$$\mu = \sqrt{n(n+2)} = \sqrt{5(5+2)} = \sqrt{35} \\ = 5.92 \text{ BM}$$

Thus, it is strongly paramagnetic (due to presence of unpaired electrons).

In $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$, outer d -orbitals are used in hybridization to form high spin complex.

- (b) CH_4 will not act as ligand because it does not contain any lone pair of electrons to donate for central metal ion of a coordination sphere. [1]



It has bridged structure in which two cobalt atoms bound to eight carbon monoxide ligand. [2]

- (b) The Metal – Carbon π -bond in metal carbonyls which is formed by the donation of an electron pair from a filled d -orbital of metal into the vacant anti bonding π -orbital of CO, strengthens the M–C σ -bond. This is called synergic effect and is usually observed in metal carbonyls. [1]

10. (a) For a first order reaction

$$k = \frac{2.303}{t} \log \frac{[\text{R}]_0}{[\text{R}]}$$

where $[\text{R}]_0$ = initial concentration, $[\text{R}]$ = conc. after time t

When half of the reaction is completed, $[\text{R}] = [\text{R}]_0/2$. Representing, the time taken for half of the reaction to be completed, by $t_{1/2}$, equation becomes:

$$k = \frac{2.303}{t_{1/2}} \log \frac{[\text{R}]_0}{[\text{R}]_0/2}$$

$$\Rightarrow t_{1/2} = \frac{2.303}{k} \log 2$$

$$\Rightarrow t_{1/2} = \frac{2.303}{k} \times 0.3010$$

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

The above equation shows that half-life of first order reaction is independent of the initial concentration of the reactant.

[1½]

- (b) For a first order reaction

$$t = \frac{2.303}{k} \log \frac{a}{a-x}$$

$$t_{99\%} = \frac{2.303}{k} \log \frac{100}{1}$$

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

$$= \frac{2.303 \times 2}{k}$$

$$= \frac{4.606}{k}$$

$$\text{and } t_{90\%} = \frac{2.303}{k} \log \frac{100}{10}$$

$$t_{90\%} = \frac{2.303}{k} \log 10 = \frac{2.303}{k}$$

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

$$t_{99\%} = 2 \times t_{90\%} \quad [1\frac{1}{2}]$$

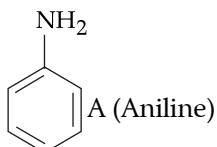
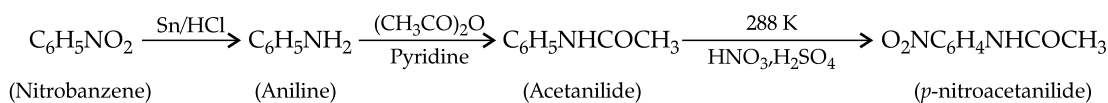
Commonly Made Error

- Students forget formula of first order reaction and instead of having $\log \frac{[\text{R}]_{\text{initial}}}{[\text{R}]_{\text{final}}}$ term mostly students follow $\log \frac{[\text{R}]_{\text{initial}}}{\Delta \text{R}}$ term and write incorrect answer.

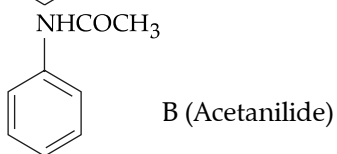
Answering Tip

- Always remember the proper formula of first order reaction such that $\log \frac{[\text{R}]_{\text{initial}}}{[\text{R}]_{\text{final}}}$ are defined as ratio of initial concentration of reactant and the final concentration remained after consumption.

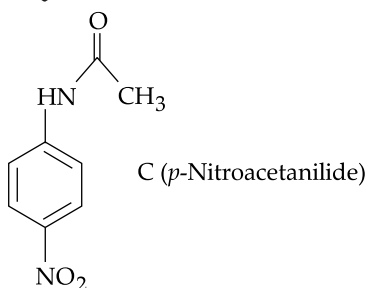
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[1]

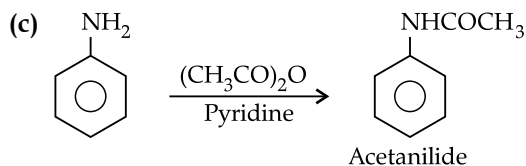
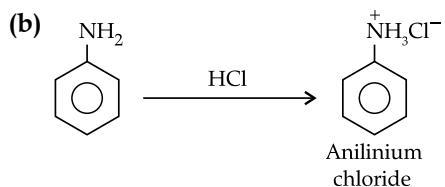
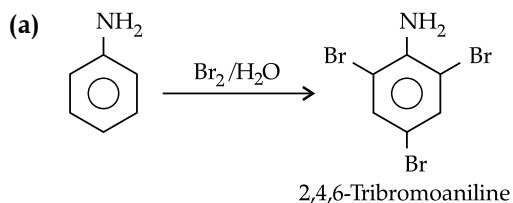


[1]



[1]

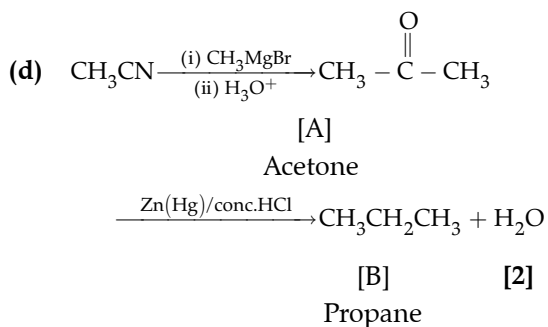
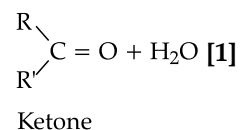
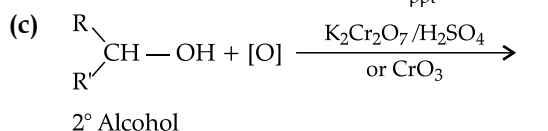
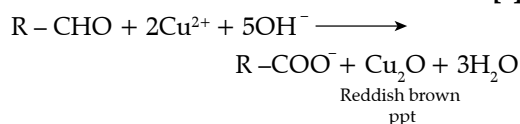
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Section - C

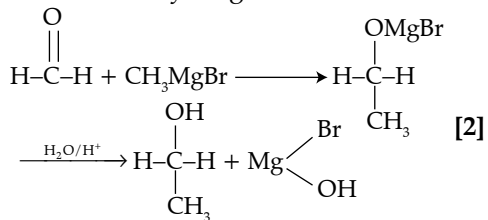
12. (a) Both aldehydes and ketones can be prepared by oxidation of alcohols. [1]

(b) On heating an aldehyde with Fehling's reagent, a reddish brown precipitate is obtained. Aldehydes are oxidised to corresponding carboxylate anion. Aromatic aldehydes do not respond to this test. [1]



OR

The number of C-atoms can be increased in the chain by Grignard reaction.



■■■