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SESSION : 2022-2023
1st PRE-BOARD EXAMINATION
CHEMISTRY THEORY (043)

MM:70 Time: 3 hours

General Instructions: Read the following instructions carefully.

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

SECTION A

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. Which of the following will not give Cannizzaro reaction?
(a) CH_3CHO
(b) $(CH_3)_3CCHO$
(c) HCHO
(d) C_6H_5CHO

2.Benzoic acid reacts with conc.HNO_3 and conc.H_2SO_4 to give
(a) o-Nitro benzoic acid
(b) p-Nitro benzoic acid
(c) m-Nitro benzoic acid
(d) o,p-Dinitro benzoic acid

3. Which of the following isomer has the highest melting point:
(a) 1,2-Dichloro benzene
(b) 1,3 –Dichloro benzene
(c) 1,4-Dichloro benzene
(d) all isomers have same melting points

4. The IUPAC name of the ether $CH_2 = CH\text{-}CH_2O\ CH_3$ is
(a) 3-Methoxy prop-1-ene
(b) 1-Methoxy prop-2-ene
(c) Alkyl methyl ether
(d) Vinyl dimethyl ether

5. Mixture showing positive deviation from Raoult's law at 35°C is –
(a) Ethyl alcohol + water
(b) Chloroform + acetone
(c) Benzene+ toluene
(d) Nitric acid + water

6. A plant cell shrinks when it is kept in –
(a) hypotonic solution
(b) hypertonic solution
(c) isotonic solution
(d) pure water

7. In the following reaction sequence Z is

$$CH_3-\underset{\underset{OH}{|}}{CH}-CH_3 \xrightarrow{[O]} Y \xrightarrow[H^+/H_2O]{CH_3MgBr} Z$$
(X)

(a) Butan-1-ol

(b) Butan-2-ol
(c) 2-Methyl propan-2-ol
(d) 1, 1-Dimethyl ethanol

8. Which one of the following forms propane nitrile as the major product?
(a) Propyl bromide + KCN
(b) Ethyl bromide + KCN
(c) Propyl bromide + AgCN
(d) Ethyl bromide + AgCN

9.Two faradays of electricity are passed through a solution of $CuSO_4$ .The mass of copper deposited at the cathode (at mass of Cu =63.5 amu)
(a) 2 g
(b) 127 g
(c) 4 g
(d) 63.5 g

10.The rate constant ,the activation energy and the Arrhenius parameter of a chemical reaction at 25^0C are $3.0 \times 10^{-4}\ s^{-1}$,104.4 KJ mol^{-1} and $6.0 \times 10^{14}\ s^{-1}$ respectively .The value of rate constant as $T \rightarrow \infty$ is
(a) $2.0 \times 10^{18}\ s^{-1}$
(b) $6.0 \times 10^{14}\ s^{-1}$
(c) infinity
(d) $3.6 \times 10^{30}\ s^{-1}$

11.A first order reaction is 50% completed in 1.26×10^{14} s .How much time would it take for 100% completion ?
(a) 1.26×10^{15} s
(b) 2.52×10^{14} s
(c) 2.52×10^{28} s
(d) infinite

12.Consider the following statements
(I) $La(OH)_3$ is least basic among hydroxides of lanthanoids
(II) Zr^{4+} and Hf^{4+} possess almost same ionic radii
(III) Ce^{4+} can act as an oxidising agent

Which of the above is /are true ?
(a) I and II
(b) II and III
(c) II only
(d) I and III

13. When 1mol of $CrCl_3.6H_2O$ is treated with excess of $AgNO_3$, 2 moles of AgCl are obtained. The formula of the complex is -
(a) $[CrCl_3(H_2O)_3].3H_2O$
(b) $[CrCl_2(H_2O)_4]Cl.3H_2O$
(c) $[CrCl(H_2O)_5]Cl_2.H_2O$
(d) $[Cr(H_2O)_6]Cl_3$

14.Which one of the following ions is most stable in aqueous solution ?
(a) Mn^{2+}
(b) Cr^{3+}
(c) V^{3+}
(d) Ti^{3+}

15. Given below are two statements labelled as Assertion (A) and Reason (R)
Assertion (A): Aryl halides undergo nucleophilic substitution reactions with ease .
Reason (R): The carbon halogen bond in aryl halides has partial double bond character. .
Select the most appropriate answer from the options given below:
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.

16. Given below are two statements labelled as Assertion (A) and Reason (R)
Assertion (A): All collisions of reactant molecules lead to product formation.
Reason (R): Only those collisions in which molecules have correct orientation and sufficient kinetic energy lead to compound formation .
Select the most appropriate answer from the options given below:
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.

17. Given below are two statements labelled as Assertion (A) and Reason (R)
Assertion (A): Linkage isomerism arises in coordination compounds containing ambidentate ligands .
Reason (R): Ambidentate ligands has two different donor atoms .
Select the most appropriate answer from the options given below:
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.

18. Given below are two statements labelled as Assertion (A) and Reason (R)
Assertion (A): An aqueous solution of NaCl freezes below 273 K.
Reason (R): Vapour pressure of the solution is less than that of the pure solvent .
Select the most appropriate answer from the options given below:
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.

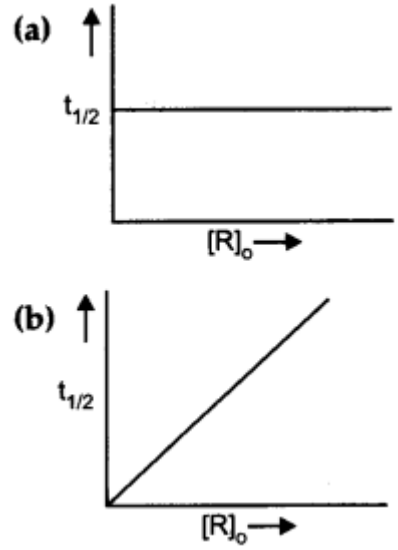
SECTION B

This section contains 7 questions with internal choice in two questions. The following questions are very short answer type and carry 2 marks each.
19. Give reason for the following –
(a) Measurement of osmotic pressure method is preferred for the determination of molar mass of macromolecules .
(b) Aquatic animals are more comfortable in cold water than in warm water.

20. The conductivity of 0.001 mol L^{-1} acetic acid is 4.95×10^{-5} S cm^{-1}. Calculate its degree of dissociation if Λ^0_m for acetic acid is 390.5 S cm^2 mol^{-1}.

21.Write anode and cathode reactions that occur in dry cell .How does a dry cell differ from a mercury cell .
or
What are secondary batteries .Write the anode and cathode reactions that occur in lead storage battery during discharging .

22. Define the order of the reaction. Predict the order of reaction in the given graphs:



where $[R]_0$ is the initial concentration of reactant and $t_{1/2}$ is a half-life.

23. What type of isomerism is shown by the complex $[Co(NH_3)_6]$ $[Cr(CN)_6]$.
Draw its isomers .

24. Which out of the following compounds would undergo S_N1 reaction faster and why?

$CH_3—CH_2—Br$ and $CH_3—\underset{\displaystyle Br}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}—CH_3$

Give the mechanism of S_N1 reaction of your selected compound.
or
What happens when – (Write reaction in support of your answer)
(i) Chlorobenzene is treated with Cl_2/anhy $AlCl_3$.
(ii) Ethyl chloride is treated with $AgNO_2$.

25. Account for the following –
(a) o-Nitro phenol is more steam volatile than p-Nitro phenol .
(b) t-Butyl chloride on heating with sodium methoxide gives 2-Methyl propene instead of t-butyl methyl ether .

SECTION C

This section contains 5 questions with internal choice in two questions. The following questions are short answer type and carry 3 marks each.

26. When $FeCr_2O_4$ is fused with Na_2CO_3 in the presence of air it gives a yellow solution of compound (A). Compound (A) on acidification gives compound (B). Compound (B) on reaction with KCl forms an orange coloured compound (C). An acidified solution of compound (C) oxidises H_2S to (D). Identify (A), (B), (C) and (D).

27.The following data were obtained for the reaction:
$2A + B \rightarrow C + D$

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	2.4×10^{-2}

(a) Find the order of reaction with respect to A and B.
(b) Write the rate law and overall order of the reaction.

Or

The half life for radioactive decay of ^{14}C is 5730 years . An archaeological artifact containing wood had only 80 % of the ^{14}C found in a living tree . Estimate the age of the sample
(Given: log 2 = 0.3010, log 4 = 0.6021)

28. Calculate the amount of NaCl which must be added to one kg of water so that freezing point is depressed by 3K .Given K_f for water is 1.86 K Kg mol^{-1}.
(Atomic masses : Na = 23 , Cl = 35.5)

29. Give reason for the following –
(a) Chloroform is stored in closed dark brown bottles.
(b) (±) Butan-2-ol is optically inactive .
(c) C-X bond length in haloarenes is smaller than C-X bond length in haloalkanes .

Or
How can the following conversions be carried out :
(i) Aniline to Bromo benzene
(ii) Chloro benzene to 2-Chloro acetophenone
(iii) Chloro ethane to Butane

30. An organic compound with the molecular formula $C_9H_{10}O$ 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 all the reactions involved .

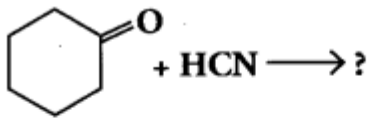
Section D

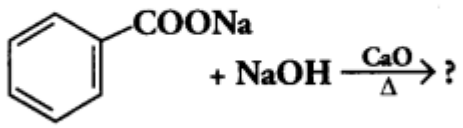
The following questions are case-based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.

31. Aldehydes and ketones undergo nucleophilic addition reactions onto the carbonyl group, however the reactivity of aldehydes is greater than ketones due to steric and electronic reasons . The alpha hydrogen of aldehydes and ketones are acidic .Therefore aldehydes and ketones having at least one alpha hydrogen undergoes Aldol condensation.

Aldehydes are easily oxidised by mild oxidising agents such as Tollens' reagent and Fehling's reagent .Ketones are generally oxidised under vigorous conditions i.e. strong oxidising agents and at elevated temperatures , to give mixture of carboxylic acids having lesser number of C-atoms than the parent ketones .

Answer the following questions –
(a) Give a chemical test to distinguish between Formic acid and Acetic acid.
(b) Arrange the following compound in the increasing order of their reactivity towards nucleophilic addition reaction –
Acetaldehyde ,Acetone ,Di-tert butyl ketone ,Methyl tert –butyl ketone
(c)Write the major product –

(i) 

(ii) 

Or
Convert –
(i) Ethanal to But-2-enal
(ii) Benzoic acid to Benzaldehyde

32. The transition elements have incompletely filled d –subshells in their ground state or in any of their oxidation states .The transition elements occupy positions in between s-and p-blocks in groups 3-12 of the periodic table . In general , the electronic configuration of these elements is $(n-1)d^{1-10}\,ns^{0-2}$ .The d – orbital of the penultimate energy level in their atoms receives electrons giving rise to three rows of transition metals i.e. 3d, 4d, 5d series. However Zn ,Cd and Hg are not regarded as transition elements.All transition elements have typical metallic properties such as high tensile strength,ductility,malleability.Except mercury ,which is liquid at room temperature ,other transition have typical metallic structure . Transition elements exhibit certain characteristics properties like variable oxidation states , complex formation , formation of coloured ions etc .

Answer the following questions –

(a)Which of the following ion is coloured and why ?

Sc^{3+} ,Cu^{2+} ,V^{5+} ,Ti^{4+}

(b) Why Zn ,Cd and Hg are soft and have low melting and boiling points ?

(c)(i) Why transition elements shows variable oxidation states ?

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

Or

(i) Cu^{+} is not stable in aqueous solution .Why ?

(ii) Transition elements form alloys .Why ?

SECTION E

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

33. (a) What is the difference between emf and E°_{cell}?

(b) Write the cell reaction and calculate the e.m.f. of the following cell at 298 K:

$Sn(s) \mid Sn^{2+}$ (0.004 M) || H^{+} (0.020 M) | $H_2(g)$ (1 bar) | Pt(s)

(Given: $E^{\circ}\ Sn^{2+}/Sn = -0.14V$)

Or

(a) State Kohlrausch law of independent migration of ions. Write an expression for the molar conductivity of acetic acid at infinite dilution according to Kohlrausch law.

(b) Define molar conductivity of a substance and describe how molar conductivity varies for weak and strong electrolytes on dilution?

34. (a) How would you obtain -

(i) Picric acid (2, 4, 6-trinitrophenol) from phenol,

(ii) 2-Methyl propene from 2-Methyl propanol

(b) Arrange the following compound groups in the increasing order of their property indicated:

p-nitrophenol, p-methoxyphenol , ethanol, phenol (acidic character)

(c) Explain the mechanism of acid catalysed hydration of an alkene to form corresponding alcohol.

or

(a) Write the equations involved in the following reactions:

(i) Reimer-Tiemann reaction

(ii) Williamson's ether Synthesis

(b) Give chemical tests to distinguish between the following pairs of compounds :

(i) Pentan-2-ol and Pentan-3-ol (ii) Methanol and Phenol

(c) o-Nitro phenol is more acidic than o-Methoxy phenol. Explain why.

35.(a) Write the name , state of hybridization ,shape and magnetic behaviour of $[Ni(CN)_4]^{2-}$

(b) Explain the Crystal field splitting in a tetrahedral complexes (with diagram).

(c)Write the formula of the following coordination compound:

Iron (III) hexacyanoferrate (II)