APEEJAY SCHOOL PANCHSHEEL PARK

Class XII
Subject – Chemistry
MIDTERM EXAMINATION (2024-25)

Name of the student:
Time Allowed: 3hr

Date:
M.M.:70

General Instructions:

Read the following instructions carefully.

a) There are 33 questions in this question paper with internal choice.
b) SECTION A consists of 16 multiple - choice questions carrying 1 mark each.
c) SECTION B consists of 5 short answer questions carrying 2 marks each.
d) SECTION C consists of 7 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. For the reaction $N_2 + 3H_2 \rightarrow 2NH_3$
   if $\Delta[NH_3]/\Delta t = 2 \times 10^{-4}$ mol $L^{-1}s^{-1}$, the value of $-\Delta[H_2]/\Delta t$ would be:
   a) 1×10^{-4} mol $L^{-1}s^{-1}$ b) 3×10^{-4} mol $L^{-1}s^{-1}$ c) 4×10^{-4} mol $L^{-1}s^{-1}$ d) 6×10^{-4} mol $L^{-1}s^{-1}$ | 1

2. IUPAC name of $CH_2=CH-CH_2-I$:
   a) Ethyliodide   b) 1-Iodoprop-3-ene   c) 3-Iodoprop-1-ene   d) 1,3-Propdiene | 1

3. Which of the following has the maximum number of unpaired electrons?
   a) Mn^{4+} b) Ti^{3+} c) V^{3+} d) Fe^{3+} | 1

4. The molarity of the solution containing 14.2 g of Na_2SO_4 in 50 ml of aqueous solution is:
   a) 2 M   b) 0.5 M   c) 1 M   d) 0.05 M | 1

5. The emf of the cell:
   Ni / Ni^{2-} (1.0 M) // Au^{3+} (1.0 M) / Au;
   ($E^\circ = +0.25$ V for Ni/Ni^{2+}; $E^\circ = 1.5$ V for Au^{3+}/Au) is:
   a) 1.25 V   b) -1.25 V   c) 1.75 V   d) 2.0 V | 1

6. Vic-dibromide is:
   a) $CH_3CH(Br)CH_2(Br)$ b) $CH_2(Br)CH_2CH_3$ c) $CH_3C(Br_2)CH_3$ d) $CH_3CH(Br)CH_3$ | 1

7. Which of the following solutions will have the highest conductivity at 298 K?
   a) 0.01 M HNO_3 solution   b) 0.1 M HNO_3 solution
   c) 0.01 M CH_3CH_2COOH solution   d) 0.1 M CH_3CH_2COOH solution | 1

8. Which of the following observation will be shown by 2-phenyl ethanol with Lucas Reagent? | 1
   a) Turbidity will be observed within five minutes
   b) No turbidity will be observed
   c) Turbidity will be observed immediately
   d) Turbidity will be observed at room temperature but will disappear after five minutes.

1

9. Phenol reacts with conc. H_2SO_4 and conc. HNO_3 to give:
 a) o-Nitrophenol b) o-and p-nitrophenols c) p-Nitrophenol d) 2,4,6-Trinitrophenol

10. If the initial concentration of substance A is 1.5 M and after 120 seconds the concentration of substance A is 0.75 M, the rate constant for the reaction if it follows zero - order kinetics is:
 a) 0.00625 mol $L^{-1}s^{-1}$ b) 0.00625 L mol^{-1}s^{-1} c) 0.00578 mol $L^{-1}s^{-1}$ d) 0.00578 L mol^{-1}s^{-1}

11. Acetaldehyde when reacted with Grignard reagent and followed by hydrolysis form:
 a) $3°$ alcohol   b) $2°$ alcohol   c) ether   d) no reaction

12. In the following compounds:
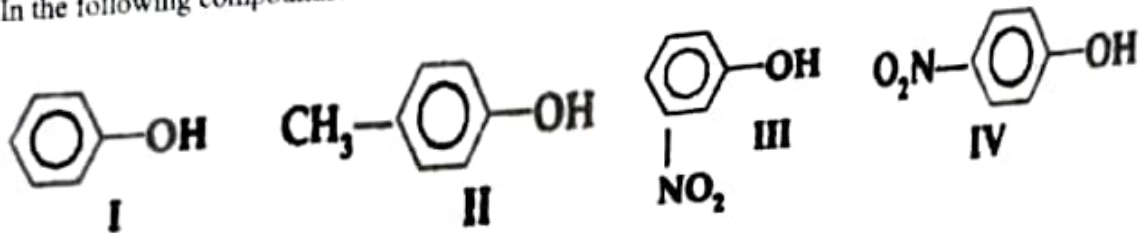
The order of acidity is:
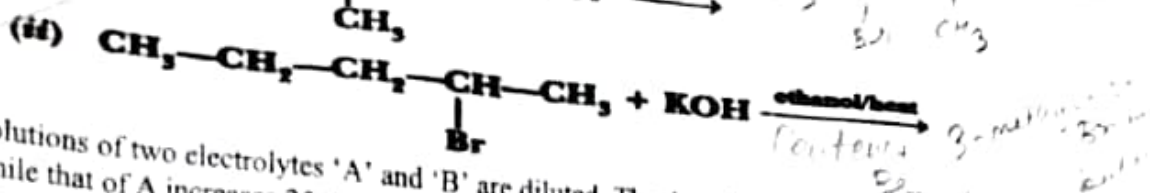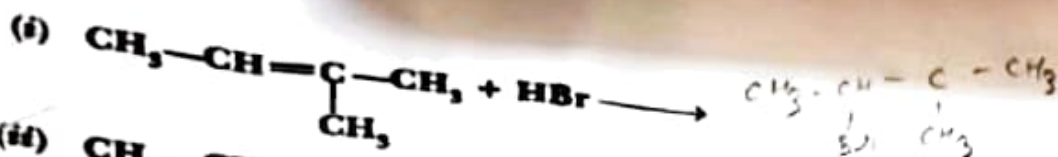 a) III > IV > I > II   b) I > IV > III > II   c) II > I > III > IV   d) IV > III > I > II

For Questions 13-16, two statements are labelled as Assertion (A) and Reason (R).
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.

13. Assertion (A): When NaCl is added to water a depression in freezing point is observed.
 Reason (R): The lowering of vapour pressure of a solution causes depression in the freezing point.   (c)

14. Assertion (A): Exposure of ultraviolet rays to human causes the skin cancer, disorder and disrupt the immune system.   (c)
 Reason (R): Carbon tetrachloride is released into air rises to atmosphere and depletes the ozone layer.

15. Assertion (A): Alcohols react both as nucleophiles and electrophiles.
 Reason (R): The bond between C–O is broken when alcohols react as nucleophiles.

16. Assertion (A): Separation of Zr and Hf is difficult.
 Reason (R): Zr and Hf lie in the same group of the periodic table.

SECTION B

This section contains 5 questions with internal choice in one question. The following questions are very short answer type and carry 2 marks each.

17. A reaction is second order with respect to a reactant. How is the rate of reaction affected if the concentration of the reactant is
 i) doubled
 ii) reduced to half?

18. Write the structures and IUPAC names of the major product in each of the following reactions:

2

(i) $CH_3-CH=C-CH_3 + HBr \longrightarrow$ $CH_3-CH-C-CH_3$
$\qquad\qquad\quad |$
$\qquad\qquad CH_3$ $\qquad\qquad\qquad\qquad\qquad\qquad |\quad |$
$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad CH_3$

(ii) $CH_3-CH_2-CH_2-CH-CH_3 + KOH \xrightarrow{\text{ethanol/heat}}$ 2-methyl 3-methyl
$\qquad\qquad\qquad\qquad\qquad |$
$\qquad\qquad\qquad\qquad\qquad Br$

19. Solutions of two electrolytes 'A' and 'B' are diluted. The Λ_m of 'B' increases 1.5 times while that of A increases 25 times. Which of the two is a strong electrolyte? Justify your answer. **2**

20. How do you convert the following:
i) Benzene to benzyl alcohol **2**
ii) Anisole to 2-methoxytoluene

OR

Predict the major products of the following reaction:

(i) $CH_3-CH=CH_2 \xrightarrow[\text{(ii) } 3H_2O_2/OH^-]{\text{(i) } B_2H_6}$?
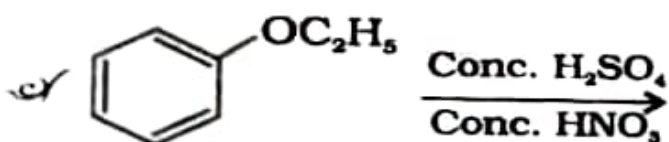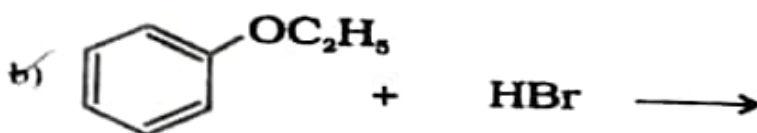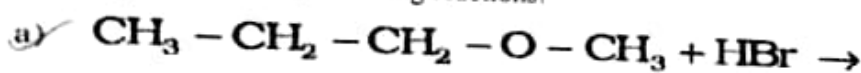
(ii) $C_6H_5-OH \xrightarrow{Br_2(aq)}$?
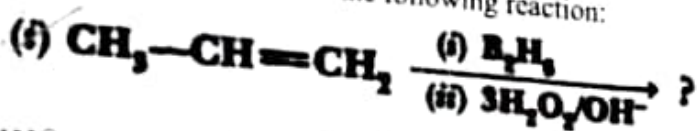
21. Account for the following:
a) Zinc is not regarded as a transition element.
b) Highest fluoride of Mn is MnF_4 whereas the highest oxide for Mn is Mn_2O_7. **2**

SECTION C

This section contains 7 questions with internal choice in one question. The following questions are short answer type and carry 3 marks each.

22. Predict the products of the following reactions:

a) $CH_3 - CH_2 - CH_2 - O - CH_3 + HBr \rightarrow$ **3**

b) [benzene ring]$-OC_2H_5$ $+$ $HBr \longrightarrow$

c) [benzene ring]$-OC_2H_5$ $\xrightarrow{\text{Conc. } H_2SO_4}{\text{Conc. } HNO_3}$

23. A reaction is second order w.r.t A and third order w.r.t B. **3**
a) Write the differential rate equation.
b) How is the rate affected on increasing the concentration of B two times?
c) How is the rate affected when the concentrations of both A and B are quadrupled?

24. If a current of 0.5 ampere flows through a metallic wire for 2 hours, then how many electrons would flow through the wire? **3**

25. Write the equations involved in the following reactions: (Any Three) **3**
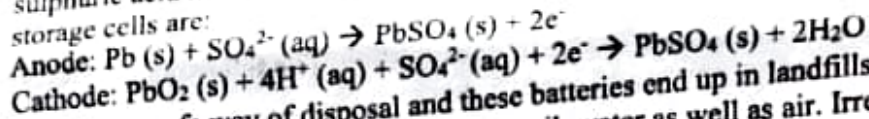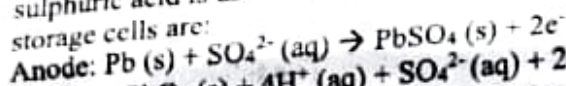a) Reimer - Tiemann reaction
b) Kolbe's reaction
c) Acylation of Anisole
d) Preparation of Phenol from Cumene

26. Account for the following:
a) Of the d^4 species, Cr^{2+} is strongly reducing while manganese (III) is strongly oxidising.
b) Cobalt (II) is stable in aqueous solution but in the presence of complexing reagents it is easily oxidised.
c) The d^1 configuration is very unstable in ions.

27. 18 g of glucose, $C_6H_{12}O_6$ (Molar mass - 180 g mol⁻¹) is dissolved in 1 kg of water in a sauce pan. At what temperature will this solution boil? (K_b for water = 0.52 K kg mol⁻¹, boiling point of pure water = 373.15 K)

28. Arrange the compounds of each set in order of reactivity towards SN_2 mechanism:
a) 2-Bromo-2-methylbutane, 1-Bromopentane, 2-Bromopentane
b) 1-Bromo-3-methylbutane, 2-Bromo-2-methylbutane, 2-Bromo-3-methylbutane
c) 1-Bromobutane, 1-Bromo-2,2-dimethylpropane, 1-Bromo-2-methylbutane, 1-Bromo-3-methylbutane.

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.

29. The lead-acid battery represents the oldest rechargeable battery technology. Lead acid batteries can be found in a wide variety of applications including small-scale power storage such as UPS systems, ignition power sources for automobiles, along with large, grid-scale power systems. The spongy lead act as the anode and lead dioxide as the cathode. Aqueous sulphuric acid is used as an electrolyte. The half-reactions during discharging of lead storage cells are:
Anode: $Pb (s) + SO_4^{2-} (aq) \rightarrow PbSO_4 (s) + 2e^-$
Cathode: $PbO_2 (s) + 4H^+ (aq) + SO_4^{2-} (aq) + 2e^- \rightarrow PbSO_4 (s) + 2H_2O$
There is no safe way of disposal and these batteries end up in landfills. Lead and sulphuric acid are extremely hazardous and pollute soil, water as well as air. Irrespective of the environmental challenges it poses, lead-acid batteries have remained an important source of energy.
Designing green and sustainable battery systems as alternatives to conventional means remains relevant. Fuel cells are seen as the future source of energy. Hydrogen is considered a green fuel. Problem with fuel cells at present is the storage of hydrogen. Currently, ammonia and methanol are being used as a source of hydrogen for fuel cell. These are obtained industrially, so add to the environmental issues.
If the problem of storage of hydrogen is overcome, is it still a "green fuel?" Despite being the most abundant element in the Universe, hydrogen does not exist on its own so needs to be extracted from the water using electrolysis or separated from carbon fossil fuels. Both of these processes require a significant amount of energy which is currently more than that gained from the hydrogen itself. In addition, this extraction typically requires the use of fossil fuels. More research is being conducted in this field to solve these problems. Despite the problem of no-good means to extract Hydrogen, it is a uniquely abundant and renewable source of energy, perfect for our future zero-carbon needs.

Answer the following questions:
a) How many coulombs have been transferred from anode to cathode in order to consume one mole of sulphuric acid during the discharging of lead storage cell?
b) How much work can be extracted by using lead storage cell if each cell delivers about 2 V of voltage? (1 F = 96500 C)
c) Do you agree with the statement – "Hydrogen is a green fuel." Give your comments for

and against this statement and justify your views.

OR

c) Imagine you are a member of an agency funding scientific research. Which of the following projects will you fund and why?

i) safe recycling of lead batteries

ii) extraction of hydrogen

30.

Raoult's law states that for a solution of volatile liquids, the partial vapour pressure of each component of the solution is directly proportional to its mole fraction present in solution. Dalton's law of partial pressure states that the total pressure (p_{total}) over the solution phase in the container will be the sum of the partial pressures of the components of the solution. There are two types of solution, Ideal and non-ideal solutions. An ideal solution of two liquids is a solution in which each component follows Raoult's law. However, there are many solutions which do not obey Raoult's law. In other words, they show deviation from ideal behaviour which may be positive or negative. However, in either case corresponding to a particular composition they form a constant boiling mixture is called azeotropes.

a) Solution of alcohol + water will show positive or negative deviation? Explain.

b) What do you infer about volatility of second component from the graph given below:
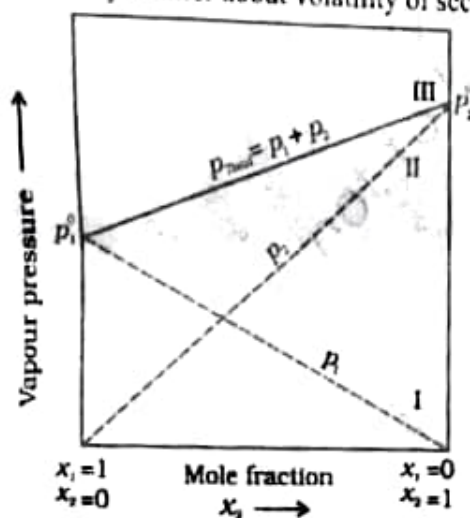
c) Calculate the mass of a non-volatile solute (molecular mass 40 g mol^{-1}) that should be dissolved in 114 g of octane to reduce its pressure to 80%.

OR

c) The partial pressure of ethane over a solution containing 6.56×10^{-3} g of ethane is 1 bar. If the solution contains 5.00×10^{-2} g of ethane, then what shall be the partial pressure of the gas?

SECTION E

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

31.

Attempt **any five** of the following:

a) In order to protect iron from corrosion, which one will you prefer as a sacrificial electrode, Ni or Zn? Why? (Given standard electrode potentials of Ni, Fe and Zn are -0.25 V, -0.44 V and -0.76 V respectively.)

b) The second ionization enthalpies of chromium and manganese are 1592 and 1509 kJ/mol respectively. Explain the lower value of Mn.
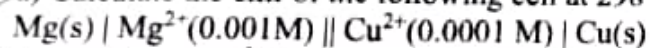
5

c) Write the ionic equation for reaction of KI with acidified KMnO4⁻.

d) What is actinoid contraction? What causes actinoid contraction?

e) What is the oxidation state of chromium in chromate ion and dichromate ion?

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

32. a) Write structures of the compounds whose IUPAC names are as follows: 5
i) 1-Phenylpropan-2-ol
ii) 2-Ethoxy-3-methylpentane

b) Give equations of the following reactions:
i) Phenol is treated with CH_3Cl / Anhyd. $AlCl_3$.
ii) Propene is treated with H_2O / Dil. H_2SO_4.
iii) Aniline is treated with $NaNO_2$ and HCl (0°C-5°C) followed by warm water.

OR

Name the reagents used in the following reactions:
a) Oxidation of a primary alcohol to aldehyde.
b) Bromination of phenol to 2,4,6-tribromophenol.
c) Benzyl alcohol to benzoic acid.
d) Dehydration of propan-2-ol to propene
e) Butan-2-one to butan-2-ol.

33. a) Calculate the emf of the following cell at 298 K: 5
$Mg(s) | Mg^{2+}(0.001M) || Cu^{2+}(0.0001 M) | Cu(s)$
(Given E°_{cell} (Mg^{2+}/Mg) = – 2.36 V, E°_{cell} (Cu^{2+}/Cu) = 0.34 V)

b) What type of battery is the lead storage battery? Write the anode and the cathode reactions and the overall reaction occurring in a lead storage battery when current is drawn from it?

OR

a) The molar conductivity of 0.025 mol L^{-1} methanoic acid is 46.1 S cm^2 mol^{-1}. Calculate its degree of dissociation and dissociation constant. Given $\lambda^\circ(H^+)$ = 349.6 S cm^2 mol^{-1} and $\lambda^\circ(HCOO^-)$ = 54.6 S cm^2 mol^{-1}.

b) How much charge is required for the following reductions?
i) 1 mol of Al^{3+} to Al
ii) 1 mol of Cu^{2+} to Cu