St. Paul's School

Class XII – Pre-Board Examination (2023-2024)

Chemistry (043)

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

General instructions:

(i) There are 33 questions in this question paper with internal choice.
(ii) Section A consists of 16 multiple-choice questions carrying 1 mark each.
(iii) Section B consists of 5 short answer questions carrying 2 marks each.
(iv) Section C consists of 7 short answer questions carrying 3 marks each.
(v) Section D consists of 2 case-based questions carrying 4 marks each.
(vi) Section E consists of 3 long answer questions carrying 5 marks each.
(vii) All questions are compulsory.
(viii) Use of log tables and calculators is not allowed.

SECTION A

1. The two functional groups present in a typical carbohydrate are: **1**

(a) —OH and —COOH
(b) —CHO and —COOH
(c) >C=O and —OH
(d) —CHO and —COCl

2. ΔG and E°cell for the spontaneous reaction will be **1**

(a) positive, negative
(b) positive, positive
(c) negative, positive
(d) negative, negative

3. $KMnO_4$ is coloured due to: **1**

(a) d-d transitions
(b) charge transfer from ligand to metal
(c) unpaired electrons in the d orbital of Mn
(d) charge transfer from metal to ligand

4. The reaction of one mole of dimethyl ether with an excess of HI gives **1**

(a) one mole of methanol and one mole of methyl iodide
(b) two moles of methyl iodide
(c) two moles of methanol
(d) there will be no reaction

5. The reaction of toluene with Cl_2 in the presence of $FeCl_3$ gives (X). While the reaction of toluene with Cl_2 in the presence of light gives (Y). Thus (X) and (Y)are: **1**

(a) X = benzyl chloride Y = o and p – chlorotoluene

(b) X = m – chlorotoluene Y = p – chlorotoluene

(c) X = o and p–chlorotoluene Y = trichloromethyl benzene

(d) X= benzyl chloride, Y = m-chlorotoluene

6. In a lead storage battery 1

(a) PbO_2 is reduced to $PbSO_4$ at the cathode.

(b) Pb is oxidized to $PbSO_4$ at the anode.

(c) Both electrodes are immersed in the same aqueous solution of H_2SO_4.

(d) All the above are true.

7. $KMnO_4$ acts as an oxidizing agent in an alkaline medium. When alkaline $KMnO_4$ is treated with KI, the iodide ion is oxidized to _____. 1

(a) I_2

(b) IO^-

(c) IO_3^-

(d) IO_4^-

8. IUPAC name of the product formed by the reaction of methyl amine with two moles of ethyl chloride 1

(a) N,N-Dimethylethanamine

(b) N,N-Diethylmethanamine

(c) N-Methyl ethanamine

(d) N-Ethyl - N-methylethanamine

9. What would be the reactant and reagent used to obtain 2, 4-dimethyl pentan-3-ol? 1

(a) Propanal and propyl magnesium bromide

(b) 3-methylbutanal and 2-methyl magnesiumiodide

(c) 2-dimethylpropanone and methyl magnesium iodide

(d) 2- methylpropanal and isopropyl magnesium iodide

10. $C_6H_5CHO + CH_3COCH_3 \xrightarrow[\Delta]{OH^-} C_6H_5CH = CHCOCH_3$ 1

This reaction is known as

(a) Aldol condensation

(b) Cross-Aldol condensation

(c) Friedel-Crafts reaction

(d) Cannizzaro's reaction

11. Name the reagents A and B used in the following reaction: 1

$$RCOOH \xleftarrow{A} RCH_2OH \xrightarrow{B} RCHO$$

(a) A = Cu/573 K, B = PCC

(b) A =Acidified $K_2Cr_2O_7$, B = Alkaline $KMnO_4$

(c) A = Alkaline $KMnO_4$, B = CrO_3

(d) A = $LiAlH_4$, B = H_2/Pt

12. The correct order of acidity in given compounds **1**

(i) FCH_2COOH (ii) $ClCH_2COOH$ (iii) NO_2CH_2COOH (iv) CH_3COOH

(a) i > ii > iii > iv

(b) iv > iii > ii > i

(c) iii > iv > i > ii

(d) iii > i > ii > iv

13. Given below are two statements labelled Assertion (A) and Reason (R) **1**

Assertion (A): Aldehydes and ketones, both react with Tollens' reagent to form a silver mirror.

Reason (R): Both aldehydes and ketones contain a carbonyl group.

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.

14. Given below are two statements labelled Assertion (A) and Reason (R) **1**

Assertion (A): Ce^{4+} is used as an oxidizing agent in volumetric analysis.

Reason (R): Ce^{4+} tends to attain a +3-oxidation state.

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.

15. Given below are two statements labelled Assertion (A) and Reason (R) **1**

Assertion (A): All collisions of reactant molecules lead to the 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.

16. Given below are two statements labelled Assertion (A) and Reason (R) **1**

Assertion (A): Proteins are found to have two different types of secondary structures viz a-helix and β-pleated sheet structure

Reason (R): The secondary structure of proteins is stabilized by hydrogen bonding.

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

17. For the reaction $2N_2O_5(g) \longrightarrow 4NO_2(g) + O_2(g)$ the rate of formation of $NO_2(g)$ is 2.8×10^{-3} Ms^{-1}. Calculate the rate of disappearance of $N_2O_5(g)$. 2

18. Differentiate between an ideal and a non-ideal solution. 2

19. Write the chemical test to distinguish between the following pairs of compounds: 2
    (a) Acetic acid and Formic acid
    (b) Acetophenone and Benzophenone

20. Account for the following:
    (a) t-Butyl bromide is more reactive towards S_N1 reaction as compared to n-Butyl bromide. 2
    (b) The C-Cl bond length in chlorobenzene is shorter than the C-Cl bond length in CH_3-Cl.

21. Define the following:
    (a) Denaturation of protein 2
    (b) Polysaccharides

SECTION C

22. An alkene (A) having molecular formula C_5H_{10} on ozonolysis gives a mixture of two compounds (B) and (C). Compound (B) gives positive Fehling's test and also forms iodoform on treatment with I_2 and NaOH. Compound (C) does not give Fehling's test but forms iodoform. Identify the compounds (A), (B), and (C). Write the reaction for ozonolysis and formation of iodoform from (B) and (C). 3

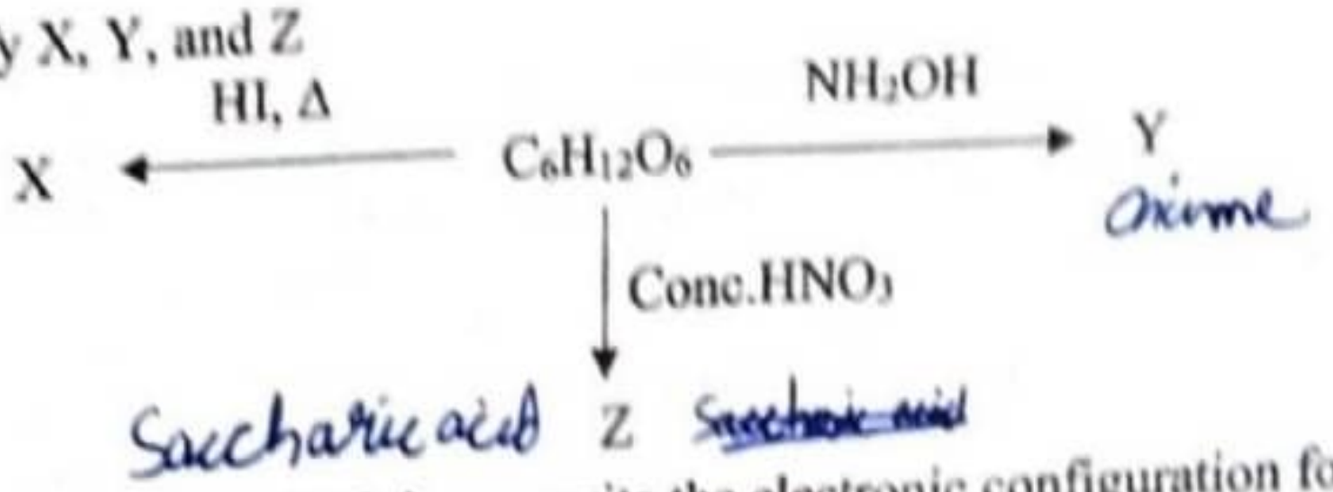
23. A first-order reaction is 50 % complete in 50 minutes at 300 K and the same reaction is again 50 % complete in 25 minutes at 350 K. Calculate the activation energy of the reaction. 3

24. What happens when: 3
    (a) $(CH_3)_3COCH_3$ is treated with HI?
    (b) Anisole is treated with CH_3COCl/anhydrous $AlCl_3$?
    (c) Phenol is treated with Br_2 water?
    (Write chemical equations in support of your answer)

25. A zinc rod is dipped in 0.1 M solution of $ZnSO_4$. The salt is 95% dissociated at this dilution at 298K. Calculate the electrode potential. [$E^\circ_{Zn2+/Zn} = -0.76$ V] 3

3

28. Identify X, Y, and Z



27. (i) Based on crystal field theory write the electronic configuration for d^5 ion with a weak ligand for which $\Delta o < P$. 3

(ii) Explain $[Fe(CN)_6]^{3-}$ is an inner orbital complex whereas $[FeF_6]^{3-}$ is an outer orbital complex. [Atomic number: Fe = 26]

3

28. Convert the following:

(a) Prop-1-ene into1-Flouropropane

(b) 2-Bromopropane into 1- Bromopropane

(c) t-Butyl bromide into Isobutyl bromide

SECTION D

1x4

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

Fuel cells represent a promising technology that has the potential to significantly reduce pollution and mitigate environmental harm caused by traditional combustion-based energy sources. These innovative devices generate electricity through electrochemical reactions, offering a clean and efficient alternative to conventional combustion engines.

One of the key advantages of fuel cells is their minimal environmental impact. Unlike internal combustion engines that burn fossil fuels and release pollutants like carbon dioxide (CO_2), nitrogen oxides (NOx), sulphur oxides (SOx), and particulate matter, fuel cells produce electricity by combining hydrogen with oxygen from the air, yielding water and heat as by-products. This emission-free operation helps mitigate greenhouse gas emissions and reduces air pollution, contributing to cleaner air quality and lessening the impact of climate change.

Moreover, fuel cells exhibit high energy efficiency. The conversion of chemical energy directly into electricity in fuel cells is more efficient than the combustion process in traditional power plants or engines. This increased efficiency means that fuel cells can generate more power using the same amount of fuel, thereby reducing overall fuel consumption and dependence on fossil fuels.

Additionally, the versatility of fuel cells allows for various feedstocks to be used as sources of hydrogen, including renewable sources like solar, wind, and biomass-derived sources. This potential shift towards renewable hydrogen production further promotes sustainability and reduces reliance on finite fossil fuel resources.

Fuel cells have diverse applications across transportation, stationary power generation, and portable electronics. In the transportation sector, fuel cells power electric vehicles (FCVs), offering longer ranges and shorter refuelling times compared to battery electric vehicles. Stationary fuel cells can provide reliable and

clean power for residential, commercial, and industrial use, serving as backup power systems or distributed energy sources.

While fuel cells hold promise in reducing pollution and addressing environmental concerns, there are challenges to widespread adoption, including the cost of production, infrastructure development for hydrogen storage and distribution, and technological advancements for increased durability and efficiency.

In conclusion, fuel cells represent a clean and efficient technology with the potential to significantly reduce pollution and combat climate change. Their adoption and further development could play a crucial role in transitioning towards a more sustainable and environmentally friendly energy future.

Answer the following questions:

(a) What are the potential environmental benefits of using H_2-O_2 fuel cells?

(b) Write the cell reactions involved in H_2-O_2 fuel cells.

(c) Name two materials other than hydrogen that can be used as fuels in fuel cells.

(d) What challenges or limitations might be associated with the widespread adoption of H_2-O_2 fuel cells?

30. Read the passage given below and answer the questions that follow. **1x4**

Complex compounds play multifaceted roles in our daily lives, exerting significant impacts across various domains including medicine, industry, technology, and everyday applications. Their diverse properties and functionalities make them indispensable in numerous aspects of modern life.

Medicine and Healthcare: Many medications and treatments rely on complex compounds. Transition metal complexes are widely used in chemotherapy for cancer treatment. Examples include cisplatin and its derivatives, which form coordination complexes with DNA, disrupting cell division in cancerous cells. Additionally, certain vitamins and enzymes essential for bodily functions are based on complex compounds.

Food and Nutrition: Metal complexes are essential in our diet. Iron, for instance, forms coordination compounds that are crucial in transporting oxygen throughout the body. Cobalt is a component of vitamin B_{12}, a complex organic molecule essential for various biological processes.

Catalysis: Complex compounds serve as catalysts in numerous industrial processes. Transition metal complexes are catalysts in the production of plastics, pharmaceuticals, and agrochemicals. They accelerate chemical reactions and allow for more efficient and sustainable manufacturing processes.

Photography and Electronics: Complex compounds are utilized in imaging technologies, such as photography and inks, due to their light-absorbing and light-emitting properties. They are also used in electronic devices, like OLEDs (organic light-emitting diodes) in display screens and sensors.

Detergents and Cleaning Agents: Some detergents and cleaning agents contain complex compounds that help in water softening by binding to metal ions, preventing them from interfering with the cleaning process.

These examples demonstrate the pervasive presence and importance of complex compounds in our daily lives. Their diverse range of applications showcases their crucial roles in advancing technology, medicine, and industry, thereby enhancing our quality of life and driving innovation in various fields.

Answer the following questions:

(a) Which complex ion is used in the treatment of cancer?

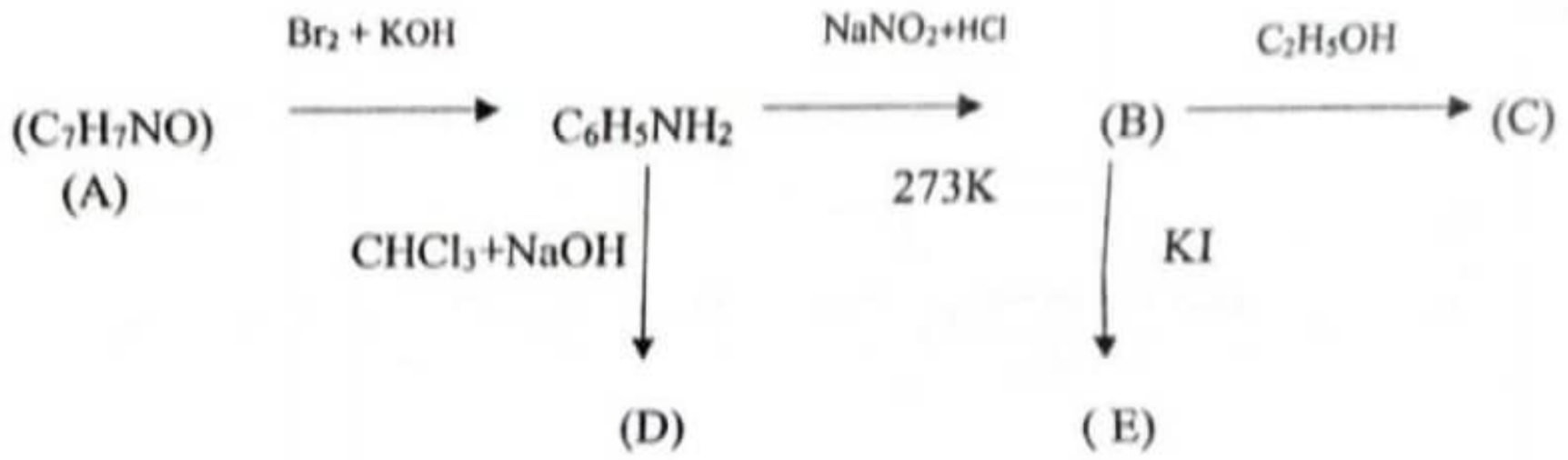
(b) What is the full form of EDTA?
(c) Write any two uses of EDTA.
(d) Why metal carbonyl complexes are more stable than others?

SECTION E

31. An organic compound (A) with molecular formula $C_7H_6O_2$ reacts with NH_3 /Δ to give $C_6H_5CONH_2$, which upon reaction with Br_2 and NaOH gives (B). Compound (B) on heating with $(CH_3CO)_2O$ gives (C). $C_6H_5CONH_2$ reacts further with $LiAlH_4$/Ether to give compound (D). Compound (B) on further reaction with Br_2 water gives a white precipitate of compound (E). Identify the compound (A), (B), (C), (D), and (E); also justify your answer by giving relevant chemical equations. **1x5**

OR

An aromatic compound (A) of molecular formula C_7H_7NO undergoes a series of reactions as shown below. Identify the compounds (A), (B), (C), (D), and (E)



32. Account for the following: **1x5**
(a) Transition metals form complex compounds.
(b) The $E°Mn^{2+}/Mn$ value for manganese is highly negative whereas Mn^{3+}/Mn^{2+} is highly positive.
(c) Cu^{+} ion is unstable in aqueous solution.
(d) Transition metals are used as good catalyst.
(e) The lowest oxide of transition metal is basic whereas the highest oxide is amphoteric or acidic.

33. (a) What is van't Hoff factor? What possible values can it have if the solute molecules undergo dissociation? **2+3**
(b) Determine the osmotic pressure of a solution prepared by dissolving 25 mg of K_2SO_4 in 2 litres of water at 25°C, assuming that it is completely dissociated.