Utkarsh Verma

(25)

GYAN BHRATI SCHOOL
PRE BOARD EXAMINATION - II (2023-24)
CLASS – SS2
Subject – Chemistry (043)

Maximum Marks: 70
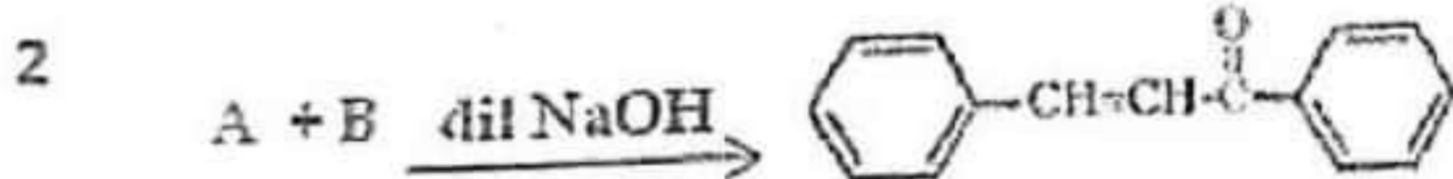
Time: 3 Hours

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.
R= 8.314 $JK^{-1}Mol^{-1}$, Atomic number: Ti = 22, Cr = 24, Fe = 26, Co = 27, Ni = 28, Zn = 30

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 solutions will have the highest conductivity at 298 K?
(a) 0.01 M HCl solution   (b) 0.1 M HCl solution
(c) 0.01 M CH_3COOH solution   (d) 0.1 M CH_3COOH solution

2
A + B $\xrightarrow{\text{dil NaOH}}$ (image of structure: phenyl–CH=CH–C(=O)–phenyl)

Identify A and B:
(a) A = 1-phenylethanal , B = acetophenone   (b) A = Benzophenone B = formaldehyde
(c) A= Benzaldehyde , B = Acetophenone   (d) A = Benzophenone , B = Acetophenone

3   The vitamins which can be stored in our body are:
(a) Vitamin A, B, D and E   (b) Vitamin A, C, D and K
(c) Vitamin A, B, C and D   (d) Vitamin A, D, E and K

4   What is IUPAC name of the ketone A, which undergoes iodoform reaction to give
$CH_3CH= C(CH_3)COONa$ and yellow precipitate of CHI_3 ?
(a) 3-Methylpent-3-en-2-one   (b) 3-Methylbut-2-en- one
(c) 2, 3-Dimethylethanone   (d) 3-Methylpent-4-one

5   Which of the following is not correct?   1
    (a) In haloarenes, the electron pairs on halogen atom are in conjugation with π-electrons of the ring.
    (b) The carbon-magnesium bond is covalent and non-polar in nature.
    (c) During SN1 reaction, the carbocation formed in the slow step being sp2 hybridised is planar.
    (d) Out of $CH_2= CH-Cl$ and $C_6H_5CH_2Cl$, $C_6H_5CH_2Cl$ is more reactive towards S_N1 reaction

6   Match the properties with the elements of 3d series: 1

    (i)   lowest enthalpy of atomisation   (p) Sc
    (ii) shows maximum number of oxidation states   (q) Mn
    (iii) transition metal that does not form coloured compounds   (r) Zn
                                                                           (s) Ti

    (a) (i) (r), (ii) (q), (iii) (p)   (b) (i) (r), (ii) (s), (iii) (p)
    (c) (i) (p), (ii) (q), (iii) (r)   (d) (i) (s), (ii) (r), (iii) (p)

7   Which of the following statement is true?   1
    (a) Molecularity of reaction can be zero or a fraction.
    (b) Molecularity has no meaning for complex reactions.
    (c) Molecularity of a reaction is an experimental quantity
    (d) Reactions with the molecularity three are very rare but are fast.

8   In which of the following solvents, the $C_4H_8NH_3{}^+X^-$ is soluble;   1
    (a) ether   (b) acetone
    (c) water   (d) bromine water

9   Which of the following observation is 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.

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

11 Anisole undergoes bromination with bromine in ethanoic acid even in the absence of iron (III)   1
    bromide catalyst
    (a) Due to the activation of benzene ring by the methoxy group.
    (b) Due to the de-activation of benzene ring by the methoxy group.
    (c) Due to the increase in electron density at ortho and para positions
    (d) Due to the formation of stable carbocation.

12 The trend of which property is represented by the following graph?   1
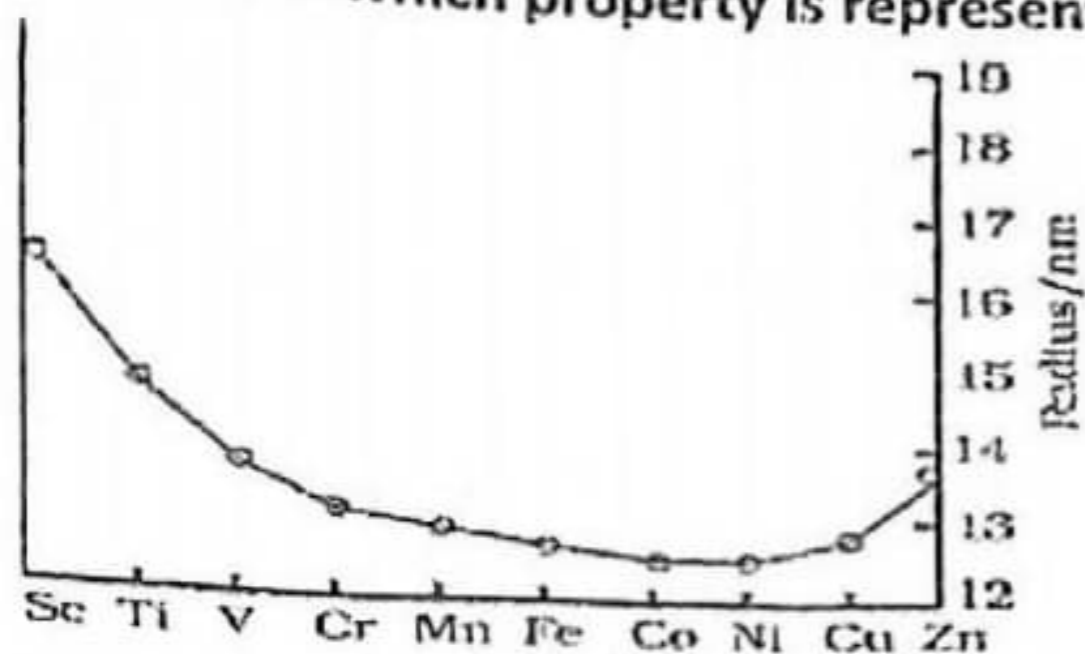
(a) ionization enthalpy   (b) atomic radii

(c) enthalpy of atomization   (d) melting point

Q. Nos. 13-16 consist of two statements, one is Assertion and the other is Reason. 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): Alcohols react both as nucleophiles and electrophiles.   1

Reason (R): The bond between C–O is broken when alcohols react as nucleophiles.

14 Assertion (A): Strong oxidising agents oxidise toluene and its derivatives to benzoic acids.   1

Reason (R): It is possible to stop the oxidation of toluene at the aldehyde stage with suitable reagents.

15 Assertion (A): Enzymes are very specific for a particular reaction and for a particular substrate.   1

Reason (R): Enzymes are biocatalysts.

16 Assertion (A): During electrolysis of aqueous copper sulphate solution using copper electrodes copper is deposited at the cathode.   1

Reason (R): The electrode potential of Cu^{2+}/Cu is greater than that of H^+/H_2

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. Radioactive decay follows first - order kinetics. The initial amount of two radioactive elements X and Y is 1 gm each. What will be the ratio of X and Y after two days if their half-lives are 12 hours and 16 hours respectively?   1

b. The hypothetical reaction $P + Q \rightarrow R$ is half order w.r.t 'P' and zero order w.r.t 'Q'. What is the unit of rate constant for this reaction?   1

18) A 5% solution of $Na_2SO_4.10H_2O$ (MW = 322) is isotonic with 2% solution of non- electrolytic, non volatile substance X. Find out the molecular weight of X.

2

19) (a) Arrange the isomeric dichlorobenzene in the increasing order of their boiling point and melting points.

1

(b) Explain why the electrophilic substitution reactions in haloarenes occur slowly and require more drastic conditions as compared to those in benzene.

1

1

20) (a) Out of p-tolualdehyde and p-nitrobenzaldehyde, which one is more reactive towards nucleophilic addition reactions, why?

1

(b) Write the structure of the product formed when acetone reacts with 2, 4 DNP reagent.

1

OR

Convert the following:

1

(a) Benzene to m-nitrobenzaldehyde

1

(b) Bromobenzene to benzoic acid

21) (a) DNA fingerprinting is used to determine paternity of an individual. Which property of DNA helps in the procedure?

1

(b) What structural change will occur when a native protein is subjected to change in pH?

1

SECTION C

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

22) (a) Write the formula for the following coordination compound Bis-(ethane-1,2-diamine) dihydroxidochromium(III) chloride

1

(b) Does ionization isomer for the following compound exist? Justify your answer. $Hg[Co(SCN)_4]$

1

(c) Is the central metal atom in coordination complexes a Lewis acid or a Lewis base? Explain.

1

23) (a) Calculate the λ^0m for Cl- ion from the data given below:
Λ^0m $MgCl_2$ = 258.6 Scm^2mol^{-1} and λ^0m Mg^{2+} = 106 Scm^2mol^{-1}

1

(b) The cell constant of a conductivity cell is 0.146 cm^{-1}. What is the conductivity of 0.01 M solution of an electrolyte at 298 K, if the resistance of the cell is 1000 ohm?

2

24) Write the name of the reaction, structure and IUPAC name of the product formed when :

1

(a) Phenol reacts with $CHCl_3$ in the presence of NaOH followed by hydrolysis.

1

(b) $CH_3CH_2CH(CH_3)CH(CH_3)ONa$ reacts with C_2H_5Br

(c) CH_3CH_2CN reacts with stannous chloride in the presence of hydrochloric acid followed by hydrolysis

1

25) You are given four organic compounds "A", "B", "C" and "D". The compounds "A", "B" and "C" form an orange- red precipitate with 2,4 DNP reagent. Compounds "A" and "B" reduce Tollen's reagent while compounds "C" and "D" do not. Both "B" and "C" give a yellow precipitate when heated with iodine in the presence of NaOH. Compound "D" gives brisk effervescence with sodium bicarbonate solution. Identify "A", "B", "C" and "D" given the number of carbon atoms in three of these carbon compounds is three while one has two carbon atoms. Give an explanation for your answer.

3

26) When sucrose is hydrolysed the optical rotation values are measured using a polarimeter and are given in the following table:

S.No.	Time (hours)	Specific Rotation
1	0	$+66.5°$
2	∞	$-39.9°$

(a) Account for the two specific rotation values.

(b) What is the specific name given to sucrose based on the above observation?

(c) One of the products formed during the hydrolysis of sucrose is a glucose, that reacts with hydroxylamine to give compound A. Identify compound A.

1
1
1

27) An organic compound A with the molecular formula $(+)$ - C_4H_9Br undergoes hydrolysis to form $(+)$ - C_4H_9OH. Give the structure of A and write the mechanism of the reaction.

3

28) The rate constants of a reaction at 200K and 500K are $0.02s^{-1}$ and $0.20s^{-1}$ respectively. Calculate the value of Ea (Given $2.303R = 19.15\ JK^{-1}mol^{-1}$)

3

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) Metal complexes show different colours due to d-d transitions. The complex absorbs light of specific wavelength to promote the electron from t2g to eg level. The colour of the complex is due to the transmitted light, which is complementary of the colour absorbed.

The wave number of light absorbed by different complexes of Cr ion are given below:

Complex	Wavenumber of light absorbed (cm-1)	Energy of light absorbed(kJ/mol)
$[CrA_6]^{3-}$	13640	163
$[CrB_6]^{3+}$	17830	213
$[CrC_6]^{3+}$	21680	259
$[CrD_6]^{3-}$	26280	314

Answer the following questions:

(a) Out of the ligands "A", "B", "C" and "D", which ligand causes maximum crystal field splitting? Why?

1

OR

1

Which of the two, "A" or "D" will be a weak field ligand? Why?

(b) Which of the complexes will be violet in colour? $[CrA_6]^{3-}$ or $[CrB_6]^{3+}$ and why? (Given: If 560 - 570 nm of light is absorbed, the colour of the complex observed is violet.)
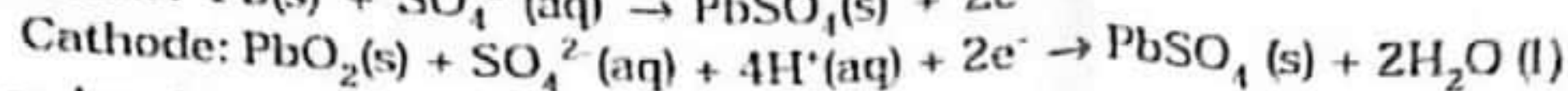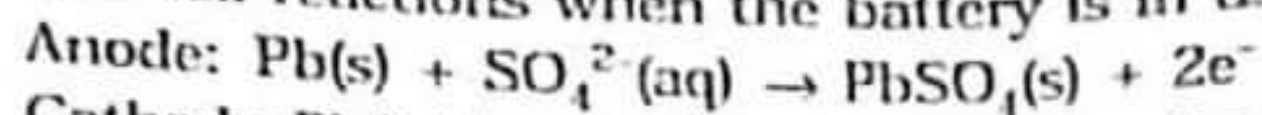
1

(c) If the ligands attached to Cr^{3+} ion in the complexes given in the table above are water, cyanide ion, chloride ion, and ammonia (not in this order)

1

(c) (d)Identify the ligand, write the formula and IUPAC name of the following: (i) $[CrA_6]^{3-}$ (ii) $[CrC_6]^{3+}$

1

(d) .

30 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 cell reactions when the battery is in use are given below:

Anode: $Pb(s) + SO_4^{2-}(aq) \rightarrow PbSO_4(s) + 2e^-$

Cathode: $PbO_2(s) + SO_4^{2-}(aq) + 4H^+(aq) + 2e^- \rightarrow PbSO_4(s) + 2H_2O(l)$

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. Problem with fuel cells at present is the storage of hydrogen. 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.

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? 1

(b) Write the chemical reaction taking place in Hydrogen – Oxygen fuel cell. 1

(c) How much work can be extracted by using lead storage cell if each cell delivers about 2.0 V of voltage? (1 F = 96500 C) 2

OR

(i) Name one substance that can substitute Hydrogen in a fuel cell.

(ii) The cell potential of mercury cell remains constant during its life. Why? 2

SECTION E

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

31 a) Blackish brown coloured solid (A) which is an oxide of manganese, when fused with alkali metal hydroxide and an oxidizing agent like KNO_3, produces a dark green coloured compound (B). Compound (B) on disproportionation in neutral and acidic solution gives a purple coloured compound (C). Identify A, B and C and write the reaction involved when compound (C) is heated to 513 K. 3

b) (i) $E^0 M^{3+} / M^{2+}$ values for the first series of transition elements are given below. 1

| $E^{0'}(V)$	Ti	V	Cr	Mn	Fe	Co
M^{3+}/M^{2+}	-0.37	-0.26	-0.41	+1.57	+0.77	+1.97

Identify the two strongest oxidizing agents in the aqueous solution from the above data.

c. The highest oxidation state of a metal is exhibited in its oxide. Why? 1

OR

(a) Write balanced equations to represent what happens when
   (i) Cu^{2+} is treated with KI.
   (ii) Acidified potassium dichromate solution is reacted with iron (II) solution.(ionic equation)
(b) The figure given below illustrates the first ionization enthalpies of first, second and third series of transition elements.
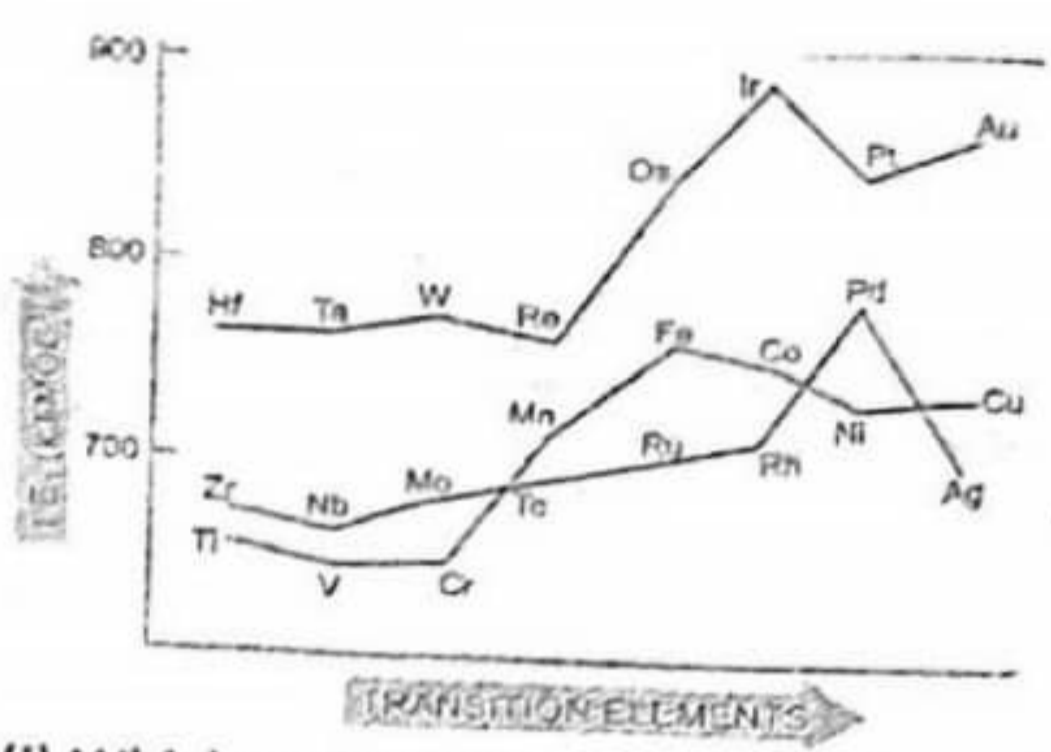
(i) Which series amongst the first, second and third series of transition elements have the highest first ionization enthalpy and why?
(ii) Separation of lanthanide elements is difficult. Explain.   1
(iii) Sm^{2+}, Eu^{2+} and Yb^{2+} ions in solutions are good reducing agents but an aqueous solution of Ce^{4+} 1
   is a good oxidizing agent. Why?

32   (a) Consider following diagram:
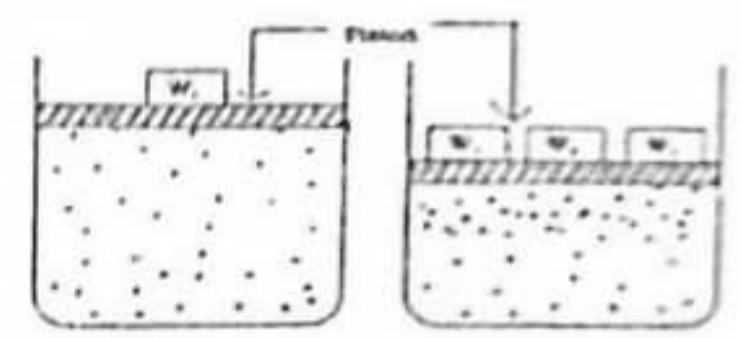
   (i) Name the law on which the diagram is based.   2
   (ii) State the law.
   (iii) What is the effect of pressure on the phenomenon shown in the diagram?
   (iv) Give one application of the law
(b) Assuming complete ionization, calculate the expected freezing point of solution prepared by   3
   dissolving 10 g of Glauber's salt ($Na_2SO_4.10H_2O$), in 0.1 kg of water.
   (K_f for water = 1.86 K kgmol^{-1}, Atomic masses Na=23, S=32, H=1, O=16 u)

OR

(a) Assuming 84 % dimerization of acid Calculate the boiling point of a solution containing 0.61 g   3
   of benzoic acid (C_6H_5COOH) in 5 g of CS_2,. (Boiling point of CS_2 is 46.2 C, molal elevation
   constant of CS_2 is 2.3 K kgmol^{-1}.   (Atomic mass H = 1, C = 12, O = 16, and S = 32 u)
(b) When equal volumes of liquid A and B are mixed at same temperature, the solution becomes   2
   warmer.
(i) What type of deviation is shown by this mixture?

(ii) Explain the reason for this observation.
(iii) Draw a vapour pressure diagram for the same.

5
3

33 A mixture of two compounds A and B was separated by dissolving in chloroform followed by extraction with aqueous KOH solution. The organic layer containing A when heated with alcoholic KOH produced a compound C (C_7H_5N) associated with unpleasant odor. The alkaline aqueous layer on the other hand when heated with chloroform and then acidified gives a mixture of two isomeric compounds D and E of molecular formula $C_7H_6O_2$. Identity A to E and write their structure

OR

(a) How will you convert :

2

(i) 4-Nitrotoluene to 2-bromobenzoic acid?
(ii) Aniline into 1,3,5 – tribromobenzene.

(b) Account for the following:

3

(i) Gabriel phthalimide synthesis is preferred for synthesising primary amine.
(ii) Aniline is acetylated first to prepare 4- Bromoaniline.
(iii) Primary amines have higher boiling point than tertiary amines.

****