



ITL PUBLIC SCHOOL
ANNUAL EXAMINATION (2023-24)

Date: 19.02.24

Class: XI

CHEMISTRY (043) – SET A

Time: 3hrs

M. M: 70

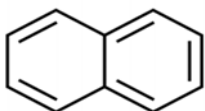
General Instructions:

- There are 33 questions in this question paper with internal choice.
- Section A consists of 16 very short questions carrying 1 mark each.
- Section B consists of 5 short answer questions carrying 2 marks each.
- Section C consists of 7 short answer questions carrying 3 marks each.
- Section D consists of 2 case - based questions carrying 4 marks each.
- Section E consists of 3 long answer questions carrying 5 marks each.
- All questions are compulsory.
- Use of log tables and calculators is not allowed.

SECTION – A

This section contains 16 questions. There is no internal choice in this section. The following questions are very short answer type carrying 1 mark each.

- 1 Name the quantum numbers through which we determine the energy of the orbitals. 1
- 2 Predict the shape of SF₄ according to VSEPR theory. 1
- 3 Predict whether entropy increases/decreases in the following reaction: 1
$$X_2(g) \rightarrow 2X(g). \text{ Justify your answer.}$$
- 4 For an exothermic reaction, when the temperature of the system is increased, the reaction goes in which direction? Justify. 1
- 5 Justify whether the thermal decomposition of calcium carbonate reaction is redox or not? 1
- 6 Identify the type of fission -as a homolytic or heterolytic and write the reactive intermediate produced. 1
$$RO-OR \xrightarrow{\Delta \text{ or } h\nu} 2 RO\cdot$$
- 7 Calculate the number of carbon atoms in 3 g of ethane. (Atomic mass of C = 12 u , H =1 u) 1
- 8 Write all the four quantum numbers of the 19th electron of copper. (Atomic number of Cu = 29) 1
- 9 Out of benzene, nitrobenzene, and phenol which will undergo nitration(Electrophilic substitution reaction) most easily and why? 1
- 10 Aniline acts as ortho and para-directing for incoming electrophiles. Explain by showing resonating structures. 1
- 11 Identify the reagents shown in bold in the following equations as nucleophiles or electrophiles: 1
(a) $CH_3CH_2Cl + \text{OH}^- \rightarrow CH_3CH_2OH + Cl^-$
(b) $C_6H_6 + Cl^+ \rightarrow C_6H_5Cl + H^+$
- 12 Is the given species aromatic or non-aromatic? Support your answer with a reason. 1



Given below are two statements labeled 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:** Methane cannot be obtained by Wurtz reaction. 1
Reason: Wurtz reaction leads to the formation of symmetrical alkane having an even number of carbon atoms.
- 14 **Assertion:** Ethyne is more acidic than propyne. 1
Reason: +I effect increases the acidic character on alkynes.
- 15 **Assertion:** Smaller the size of an atom, greater is the electronegativity. 1
Reason: Electronegativity refers to the tendency to gain an electron from an isolated gaseous atom.
- 16 **Assertion:** BCl_3 acts as a Lewis acid. 1
Reason: BCl_3 can accept a lone pair of electrons from species like ammonia.

SECTION – B

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

- 17 At what minimum atomic number would a transition from $n = 2$ to $n = 1$ energy level result in emission of X-rays with wavelength = $3 \times 10^{-8} \text{ m}$? (given $R_H = 1.1 \times 10^7 \text{ m}^{-1}$) 2
- 18 Calculate $\Delta_r G^\circ$ for conversion of oxygen to ozone, $3/2 \text{ O}_2(\text{g}) \rightarrow \text{O}_3(\text{g})$ at 298 K. if K_p for this conversion is 2.47×10^{-29} at 298 K. ($\log 2.47 = 0.39$, $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$) 2
- 19 Which of the following will produce **only ketones** on ozonolysis followed by hydrolysis? 2
2-methyl but-2-ene; 2,3 dimethyl but -2 -ene
Also, give the reaction and name of products formed.

OR

An alkene 'A' on ozonolysis gives a mixture of ethanal and pentan-3-one. Write structure and IUPAC name of 'A'.

- 20 CaCO_3 reacts with aqueous HCl to give CaCl_2 and CO_2 according to the reaction- 2
$$\text{CaCO}_3(\text{s}) + 2 \text{HCl}(\text{aq}) \rightarrow \text{CaCl}_2(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$$

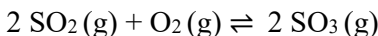
What moles of CaCO_3 is required to react completely with 50 mL of 0.2 M HCl ?
- 21 Using M.O. Theory, compare the bond lengths and magnetic character of O_2 and O_2^{2-} 2

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 A solution contains 50 % solute (by mass) with molar mass 200 g/mol, and the density of the solution is 1.2 g/mL. Calculate the molarity and molality of the solution. 3
- 23 Answer the following: 3
(a) Predict hybridization of P in PCl_5 molecule.
(b) Justify that BH_3 is non-polar while NH_3 is polar.
(c) Calculate the formal charge on all the atoms of ozone molecule.
- 24 (a) State Heisenberg's uncertainty principle.
(b) If the position of the electron is measured with an accuracy of 0.002 nm, calculate the uncertainty in the velocity of electron. (Planck's constant = $6.626 \times 10^{-34} \text{ Js}$; mass of electron = $9.1 \times 10^{-31} \text{ Kg}$).

- 25 The reaction between gaseous sulfur dioxide and oxygen is a key step in the industrial synthesis of sulfuric acid: 3



A mixture of SO_2 and O_2 was maintained at 800 K until the system reached equilibrium. The equilibrium mixture contained $5.0 \times 10^{-2} \text{ M SO}_3$, $2.5 \times 10^{-3} \text{ M O}_2$, and $2.0 \times 10^{-3} \text{ M SO}_2$.

Calculate K_c and K_p at this temperature. (use $R = 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1}$)

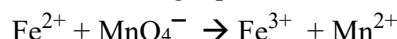
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- 26 (a) Arrange in increasing order of acidic character
 CH_3COOH , FCH_2COOH , ClCH_2COOH .
 (b) Write the positional isomers of $\text{C}_4\text{H}_9\text{OH}$.
 (c) What happens when 2-chlorobutane is treated with alcoholic KOH ? Write the reaction involved.

- 27 (a) Which of the following species, do not show disproportionation reaction and why? 3

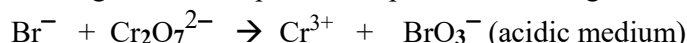


- (b) Balance the following equation in the acidic medium-



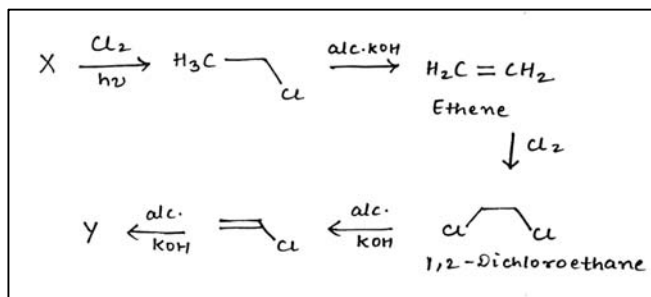
OR

- (a) Predict which one out of P and Q is a better oxidizing agent if $E^\circ_{\text{P}_2/\text{P}} = +2.34\text{V}$ and $E^\circ_{\text{Q}_2/\text{Q}} = +3.65\text{V}$. Also give reason for the same.
 (b) Balance the given ionic equations as per the medium given below:



- 28 (a) Give the reaction of 2-chloropropane with Na and dry ether. Also write the IUPAC name of the product formed.

- (b) Draw the least stable sawhorse conformation of X. Give one chemical test to distinguish between X and Y.



3

SECTION – D

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

- 29 There are many observable patterns in the physical and chemical properties of elements as we descend in a group or move across a period in the Periodic Table. For example, within a period, chemical reactivity tends to be high in Group 1 metals, lower in elements towards the middle of the table, and increases to a maximum in the Group 17 non-metals. Likewise within a group of representative metals (say alkali metals) reactivity increases on moving down the group, whereas within a group of non-metals (say halogens), reactivity decreases down the group. But why do the properties of elements follow these trends? And how can we explain periodicity? To answer these questions, we must look into the theories of atomic structure and properties of the atom. 4

29 Answer the following questions-

4

- Arrange the following in their decreasing order of size- Na^+ , F^- , Al^{3+} , N^{3-}
- According to IUPAC conventions, what will be the name of the element with atomic number 115?
- Nitrogen has positive electron gain enthalpy whereas oxygen has negative. However, oxygen has lower ionization enthalpy than nitrogen. Explain.

OR

- Among the elements- O, F, Cl, Ne
 - which has the most negative electron gain enthalpy?
 - which has the highest positive electron gain enthalpy?
 Give reasons for both .

- 30 All substances that conduct electricity in aqueous solutions are called electrolytes. Acids, bases and salts are electrolytes and the conduction of electricity by their aqueous solutions is due to anions and cations produced by the dissociation or ionization of electrolytes in aqueous solution. The strong electrolytes are completely dissociated. In weak electrolytes there is equilibrium between the ions and the unionized electrolyte molecules. According to Arrhenius, acids give hydrogen ions while bases produce hydroxyl ions in their aqueous solutions. Bronsted-Lowry on the other hand, defined an acid as a proton donor and a base as a proton acceptor. When a Bronsted-Lowry reacts with a base, it produces its conjugate base and a conjugate acid corresponding to the base with which it reacts. Thus a conjugate pair of acid-base differs only by one proton.

4

Answer the following questions :-

- Write the conjugate base of H_2S .
- Give one example showing the application of 'Common ion effect'.
- The concentration of weak acid HF is 0.01M. Calculate its pH if ionization constant of HF is 3.6×10^{-5} .

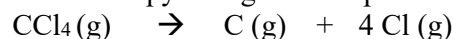
OR

- The solubility of $\text{Fe}(\text{OH})_3$ is 0.001 M at 298 K. Calculate its K_{sp} .

SECTION – E

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

- 31 (a) Calculate the enthalpy change for the process :-



(3+2)

$$\begin{aligned} \Delta_{\text{vap}}H^\circ(\text{CCl}_4) &= 30.5 \text{ kJ mol}^{-1} & (\Delta_{\text{vap}}H^\circ \text{ is enthalpy of vaporisation}) \\ \Delta_f H^\circ(\text{CCl}_4) &= -135.5 \text{ kJ mol}^{-1} & (\Delta_f H^\circ \text{ is enthalpy of formation}) \\ \Delta_a H^\circ(\text{C}) &= 715.0 \text{ kJ mol}^{-1} & (\Delta_a H^\circ \text{ is enthalpy of atomisation}) \\ \Delta_a H^\circ(\text{Cl}_2) &= 242 \text{ kJ mol}^{-1} \end{aligned}$$

- Draw the born Haber cycle of $\text{NaCl}(\text{s})$

OR

- Calculate the standard enthalpy of formation of methanol from the given data:

$$\text{Standard enthalpy of Combustion of methanol} = -726 \text{ kJ mol}^{-1}$$

$$\text{Standard enthalpy of formation of carbon dioxide} = -393 \text{ kJ mol}^{-1}$$

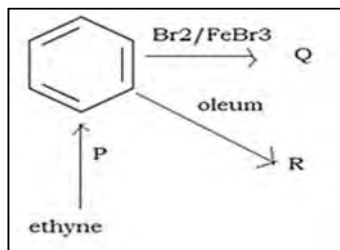
$$\text{Standard enthalpy of formation of water} = -286 \text{ kJ mol}^{-1}.$$

- Find out the internal energy change (ΔU) for the reaction $\text{A}(\text{l}) \rightarrow \text{A}(\text{g})$ at 373 K. Heat of vaporisation (ΔH) is 40.66 kJ/mol. ($R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}$)

32

- (a) Identify the variables P, Q and R. What product is obtained when Q is treated with nitrating mixture?

(2+1+2)



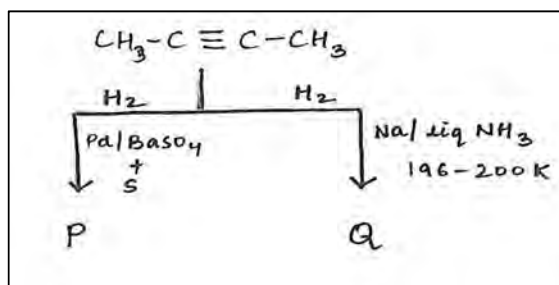
- (b) On addition of HBr to Propene, Z is formed as a major product. Identify Z and give the reaction.

- (c) Convert

- (i) Phenol to acetophenone
(ii) Benzene to para-chloronitrobenzene

OR

- (a) Consider the reaction in given figure and answer the following questions:

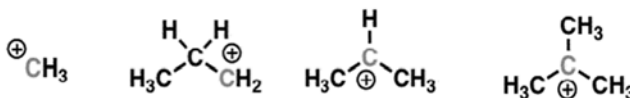


- (i) Identify the variables P and Q.
(ii) P and Q show what type of stereoisomerism?
(iii) Out of P and Q, which one has a higher boiling point and why?
- (b) Sodium salt of which acid will produce n-butane using decarboxylation method? Give reaction.
- (c) Convert
- (i) Ethyne to Toluene
(ii) Benzene to meta-chloronitrobenzene

33

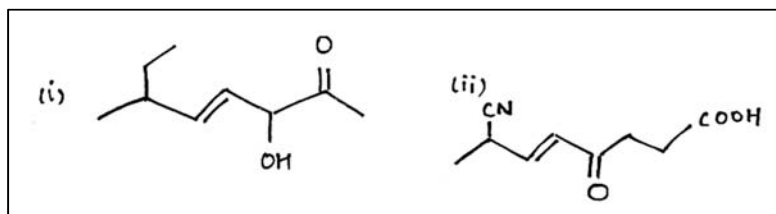
- (a) Arrange the following carbocations in decreasing order of stability. Explain the reason using inductive effect.

(2+1+2)



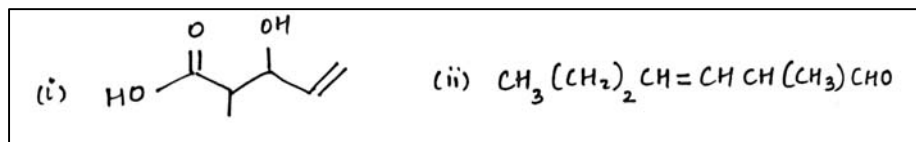
- (b) Draw the structure of 3-ethyl-2-methyl-5-oxo hex-2-enal.

- (c) What is the IUPAC name of the given organic compounds-



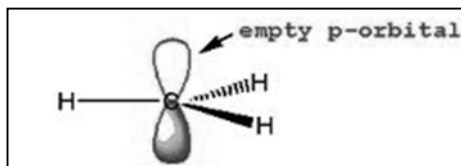
OR

(a) What is the IUPAC name of the given organic compounds -



(b) Draw the structure of 3-tert-butylcyclohex-1-ene.

(c) Identify and give any one characteristic property of the given species:



What happens to the stability of above species if one H is replaced by methyl group.

Atomic Masses

H=1u , C=12u , N=14u , O=16u , Na=23u , Mg=24u , Al=27u , Si=28u , P=31u , S=32u , Cl=35.5u , K=39u , Ca=40u , Ag=108 u , F=19u, He =4u, Ne=20u, Ar=40u , Mn=55u , Fe=56u, Cu=63.5u, Zn=65.3u, Br=80u, I=127u, Ba=137.3u, Au=197u, Pb=207u, B=11u, Hg=200.6u

Atomic Numbers

H=1, He=2 , Li=3 , Be=4 , B=5, C=6, N=7, O=8 , F=9, Ne=10, Na=11, Mg=12, Al=13, Si=14, P=15, S=16, Cl=17, Ar=18, K=19, Ca=20, Sc=21, Ti=22, V=23, Cr=24, Mn=25, Fe=26, Co=27, Ni=28, Cu=29, Zn=30

Some useful constants: -

Speed of light 'c' = $3 \times 10^8 \text{ ms}^{-1}$

Planck's constant 'h' = $6.63 \times 10^{-34} \text{ Js}$

Mass of electron = $9.1 \times 10^{-31} \text{ Kg}$, Mass of proton = $1.67 \times 10^{-27} \text{ Kg}$

1eV = $1.6 \times 10^{-19} \text{ J}$

Na = 6.022×10^{23} entities

Rydberg constant = $1.1 \times 10^7 \text{ m}^{-1} = 2.18 \times 10^{-18} \text{ J}$

R = $8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ or $0.083 \text{ L bar K}^{-1} \text{ mol}^{-1}$ or $0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1}$

Log Values

base 10 logs	calculator values
log 1	0.000
log 2	0.301
log 3	0.477
log 4	0.602
log 5	0.699
log 6	0.778
log 7	0.845
log 8	0.903
log 9	0.954
log 10	1.000