

**KOTHARI INTERNATIONAL SCHOOL, NOIDA**  
**ANNUAL EXAMINATION, SESSION: 2023-24**  
**GRADE: 11    SUBJECT: CHEMISTRY (043)**  
**SET A**

**DATE & DAY: 14<sup>th</sup> FEB 2024**

**MAXIMUM MARKS: 70**

**NAME: \_\_\_\_\_**

**TIME ALLOTTED: 3 HOURS**

**ROLL NO: \_\_\_\_\_**

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**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.*

- Q1. A chemical equation is balanced according to the law (1)
- (a) Definite proportion
  - (b) Multiple proportion
  - (c) Avogadro Law
  - (d) Conservation of mass
- Q2. Which of the following is **dependent** on temperature? (1)
- (a) Molarity
  - (b) Molality
  - (c) Mole fraction
  - (d) Mass percentage

- Q3. Which of the following series of transitions in the spectrum of hydrogen falls in visible region ? (1)  
(a) Paschen series  
(b) Lyman series  
(c) Balmer series  
(d) Brackett series
- Q4. Which one of the following statement rules out the existence of definite paths of electrons and other similar particles? (1)  
(a) Pauli's exclusion principle  
(b) de Broglie relationship  
(c) Aufbau principle  
(d) Heisenberg Uncertainty Principle
- Q5. Which of the following property increases down the group? (1)  
(a) electronegativity  
(b) electropositive nature of element  
(c) atomic size  
(d) both b and c
- Q6. An element which is an essential constituent of all organic compounds belongs to: (1)  
(a) group 1  
(b) group 14  
(c) group 15  
(d) group 16
- Q7. The axial overlap between the two orbitals leads to the formation of a: (1)  
(a) sigma bond  
(b) pi bond  
(c) multiple bond  
(d) none of these
- Q8. The work done in case of isothermal free expansion is (1)  
(a) maximum  
(b) minimum  
(c) zero  
(d) positive

Q9. The oxidation number of Mn is maximum in (1)  
(a)  $\text{MnO}_2$   
(b)  $\text{K}_2\text{MnO}_4$   
(c)  $\text{Mn}_3\text{O}_4$   
(d)  $\text{KMnO}_4$

Q10. What is the state of hybridization of carbon in carbanion? (1)  
(a) sp  
(b)  $\text{sp}^2$   
(c)  $\text{sp}^3$   
(d)  $\text{sp}^3\text{d}$

Q11. An organic compound, ethane and ethene can be distinguished by (1)  
(a) Bromine water  
(b) Tollen's reagent  
(c) Fehling's solution  
(d) Ammonical silver nitrate solution

Q12. The anion  $\text{O}^-$  is isoelectronic with (1)  
(a) Ne  
(b)  $\text{N}^{2-}$   
(c)  $\text{N}^{3-}$   
(d)  $\text{F}^-$

Q13. Given below are two statements labelled as Assertion (A) and Reason(R). (1)

Assertion (A): Electron gain enthalpy becomes less negative as we go down a group.

Reason (R): Size of the atom increases on going down the group and the added electron would be farther from the nucleus.

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.

Q14. Given below are two statements labelled as Assertion (A) and Reason(R). (1)

Assertion (A):  $\text{BF}_3$  molecule has zero dipole moment.

Reason (R): F is electronegative and B–F bonds are polar in nature.

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.

Q15. Given below are two statements labelled as Assertion (A) and Reason(R). (1)

Assertion (A): A reaction in which randomness of the system increases, will always be spontaneous.

Reason (R): According to second law of thermodynamics, spontaneous reaction is accompanied by increase in randomness of the universe.

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.

Q16. Given below are two statements labelled as Assertion (A) and Reason(R) (1)

Assertion: For any chemical reaction at a particular temperature, the equilibrium constant is fixed and is a characteristic property.

Reason: Equilibrium constant is independent of temperature.

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

- Q17. How many moles of methane are required to produce 22g CO<sub>2</sub> (g) after combustion? (2)
- Q18. Predict the shapes of the following molecules using VSEPR theory. (2)  
(i) BeCl<sub>2</sub>  
(ii) SiCl<sub>4</sub>
- Q19. The value of K<sub>c</sub> for the reaction,  $2A \rightleftharpoons B + C$  is  $2 \times 10^{-3}$ . At a given time, the composition of reaction mixture is  $[A]=[B]=[C]=3 \times 10^{-4}$  M. In which direction the reaction will proceed? (2)
- Q20. For the reaction,  $2Cl(g) \rightarrow Cl_2(g)$ , what are the signs of  $\Delta H$  and  $\Delta S$  ? (2)

**OR**

Predict the entropy change in-

- (i) A liquid crystallizes into solid  
(ii) Temperature of a crystallize solid raised from 0K to 115K
- Q21. (i) How will you separate a mixture of camphor and CaSO<sub>4</sub>? (2)  
(ii) Boiling point of chloroform is 334K and that of aniline is 457K. Which method will be suitable to separate mixture of aniline and chloroform?

## 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.*

- Q22. A compound made up of two elements A and B has A = 70 %, B = 30 %. Their relative number of moles in the compound are 1.25 and 1.88. Calculate: (3)  
(i) Atomic masses of the elements A and B  
(ii) Molecular formula of the compound, if its molecular mass is found to be 160

**OR**

Dinitrogen and dihydrogen react with each other to produce ammonia according to the following chemical equation:  $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

- (i) Will any of the two reactants remain unreacted?  
(ii) If yes, which one and what would be its mass?

- Q23. An atom of an element contains 29 electrons and 35 neutrons. Deduce: (3)
- number of protons.
  - electronic configuration of the element.
  - number of unpaired electrons.

- Q24. The first( $\Delta_i H_1$ ) and the second ( $\Delta_i H_2$ ) ionization enthalpies (in KJ mol<sup>-1</sup>) and ( $\Delta_{eg} H$ ) electron gain enthalpy((in KJ mol<sup>-1</sup>) of a few elements are given below: (3)

Elements	$\Delta_i H_1$	$\Delta_i H_2$	$\Delta_{eg} H$
<b>I</b>	520	7300	-60
<b>II</b>	419	3051	-48
<b>III</b>	1681	3374	-328
<b>IV</b>	1008	1846	-295
<b>V</b>	2372	5251	+48
<b>VI</b>	738	1451	-40

Which of the above elements is likely to be:

- the least reactive element.
  - the most reactive metal.
  - the most reactive non-metal.
- Q25. Compare the relative stability of the following species and indicate their magnetic properties: O<sub>2</sub>, O<sub>2</sub><sup>+</sup>, O<sub>2</sub><sup>-</sup> (Superoxide) (3)
- Q26. Balance the given redox reaction in acidic medium. (Steps of balancing to be shown) (3)
- $$\text{Fe}^{2+}_{(\text{aq})} + \text{Cr}_2\text{O}_7^{2-}_{(\text{aq})} \rightarrow \text{Fe}^{3+}_{(\text{aq})} + \text{Cr}^{3+}_{(\text{aq})}$$
- Q27. On the basis of Le-Chatelier principle explain how temperature and pressure can be adjusted to increase the yield of ammonia in the following reaction. (3)
- $$\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g}) \quad \Delta H = -92.38 \text{ KJmol}^{-1}$$
- What will be the effect of addition of argon to the above reaction mixture at constant volume?
- Q28. (i) Draw the cis- and trans-structures for **hex-2-ene**. (3)
- (ii) Which isomer will have higher boiling point and why?

## SECTION – D

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

Q29. Read the passage given below and answer the following questions: (1×4)

The capacities of shells with a given principal quantum number are fixed by

- (1) the rules governing the permitted values of the quantum numbers and
- (2) the Pauli Exclusion Principle.

The permitted values of the quantum numbers are:

Principal quantum number	$n$	1 to $\infty$
Azimuthal quantum number	$l$	0 to $n-1$ ( $n$ values)
Magnetic quantum number	$m_l$	$-l$ to $+l$ , ( $2l+1$ values)
Spin quantum number	$m_s$	$-\frac{1}{2}$ or $+\frac{1}{2}$ (2 values)

The Pauli Exclusion Principle states that no two electrons in the same atom may have the same values of all four quantum numbers. It follows that, for a given value of  $n$ , there are  $2n^2$  different sets of values for the quantum numbers, because  $l$  may have the values 0, 1, . . . ,  $n-1$ , and for each value of  $l$  there are  $2l+1$  values of  $m_l$  and for each set of values of  $l$  and  $m$  there are just two choices for  $m_s$ .

(Reference : Thomas H. Hazlehurst, *J. Chem. Educ.* 1941, 18, 12, 580 Publication Date: December 1, 1941, *Journal of American Chemical Society*).

**Answer the following questions on the basis of above data:**

- (i) Azimuthal quantum number defines:
  - (a) e/m ratio of electron
  - (b) spin of electron
  - (c) angular momentum of electron
  - (d) magnetic momentum of electron
- (ii) What is the maximum number of electrons having  $n = 3$  and  $l = 1$ ?
- (iii)
  - (a) Write the name of quantum number which determines the orientation of orbitals.
  - (b) Pauli exclusion principle helps to calculate the maximum number of electrons that can be accommodated in any.....
    - (1) orbital
    - (2) subshell
    - (3) shell
    - (4) All of these

**OR**

(iii) (b) Match the following:

List-I	List-II	List-III
a. $2s$	p. Dough not shape	i. along z-axis
b. $2p_x$	q. Spherical	ii. In between x & y-axis
c. $3d_{xy}$	r. Dumb bell	iii. non-directional
d. $3d_{z^2}$	s. Double dumb bell	iv. along x-axis

Q30. **Read the passage given below and answer the following questions:** (1×4)

August Kekule in 1865 proposed the planar structure for benzene having cyclic arrangement of six carbon atoms with alternate single and double bonds and one hydrogen atom attached to each carbon atom. Thus, benzene has a cyclic planar hexagonal structure. Benzene is found to be a resonance hybrid of two Kekule structures. The hybrid structure is represented by inserting a circle in the hexagon. Besides satisfying Huckel's rule benzene is planar and involves delocalization of  $\pi$ -electrons. Hence, benzene is aromatic in nature.

**Answer the following questions on the basis of above data:**

- (i) Name the phenomenon that imparts stability to benzene.
- (ii) Name the product formed when ozone is added to benzene in presence of inert solvent.
- (iii) Benzene is considered as the resonance hybrid of how many Kekule structures?
- (iv) Benzene contains:
  - (a)  $6\pi$  electrons
  - (b)  $12\pi$  electrons
  - (c)  $16\pi$  electrons
  - (d)  $18\pi$  electrons

**OR**

- (iv) The Kekule's structure of benzene failed to explain
  - (a) its unusual stability
  - (b) preference to substitution over addition reactions
  - (c) preference to addition over substitution reactions
  - (d) both (a) and (b)



## SECTION E

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

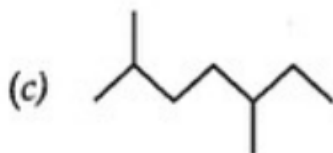
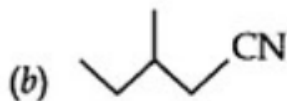
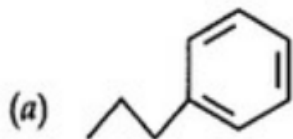
- Q31. (i) What are extensive and intensive properties? Explain with 2 examples. (2+3=5)  
(ii) Calculate the standard enthalpy of formation of  $\text{CH}_3\text{OH}(\text{l})$  from the following data:  
 $\text{CH}_3\text{OH}(\text{l}) + 3/2 \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l}) ; \Delta_r H^\circ = -726 \text{ kJ mol}^{-1}$   
 $\text{C}(\text{graphite}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) ; \Delta_c H^\circ = -393 \text{ kJ mol}^{-1}$   
 $\text{H}_2(\text{g}) + 1/2 \text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l}) ; \Delta_f H^\circ = -286 \text{ kJ mol}^{-1}$

**OR**

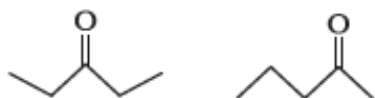
- (i) Predict the change in internal energy for an isolated system at constant volume.  
(ii) For the reaction  $2\text{A}(\text{g}) + \text{B}(\text{g}) \rightarrow 2\text{D}(\text{g})$  at 298 K  $\Delta U^\circ = -10.5 \text{ kJ}$  and  $\Delta S^\circ = -44.1 \text{ JK}^{-1}$ . Calculate  $\Delta G^\circ$  for the reaction, and predict whether the reaction may occur spontaneously. (Given:  $R = 8.314 \times 10^{-3} \text{ kJ K}^{-1} \text{ mol}^{-1}$ ) (1+4=5)
- Q32. (i) Write IUPAC names of the products obtained by the ozonolysis of the following compound Pent-2-ene. (2+3)  
(ii) Draw Newman and Sawhorse projections for the eclipsed and staggered conformations of ethane. Which of these conformation is more stable?

**OR**

- (i) Give the IUPAC names of the following compounds: (1×5)



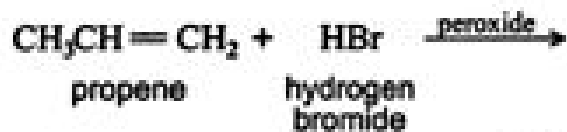
- (ii) What type of isomerism is present in the following pairs?



(iii) Deduce the structure of **Cyclohex-2-en-1-ol**.

Q33. (i) Complete the following reaction:

(1+1+3)



(ii) Name the **intermediate**(free radical, carbocation or carboanion) that gets formed in the reaction.

(iii) Outline the detailed mechanism for the above reaction indicating the major and minor product.

**OR**

(i) What happens when benzene is treated with

(2+1+1+1)

(a) Br<sub>2</sub> in presence of anhydrous AlCl<sub>3</sub>

(b) Conc. H<sub>2</sub>SO<sub>4</sub> at 330 K.

(ii) How would you convert Acetylene to Benzene.(Write chemical equation)

(iii) Name the alkane that cannot be prepared by Wurtz reaction.

(iv) Arrange the following in the **increasing order** of acidic character.

