KOTHARI INTERNATIONAL SCHOOL, NOIDA

ANNUAL EXAMINATION, SESSION: 2024-25

GRADE: 11 SUBJECT: CHEMISTRY (043)

SET B

DAY & DATE: MONDAY- FEBRUARY 17, 2025

MAXIMUM MARKS: 70 **TIME ALLOWED: 3 HOURS**

NAME: _____ **ROLL NO:_____**

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. Which of the following is true about Ψ^2? **(1)**

(A) It represents atomic orbital

(B) Probability of finding electron

(C) Always negative

(D) None of these

Q2. The number of significant figures in 0.001620 are **(1)**

(A) 4

(B) 3

(C) 6

(D) 2

Q3. Which of the following is responsible to rule out the existence of definite paths or trajectories of electrons? **(1)**

(A) Pauli's exclusion principle.
(B) Heisenberg's uncertainty principle.
(C) Hund's rule of maximum multiplicity.
(D) Aufbau principle

Q4. What is mass percent of silicon in 100 g of sodium silicate, Na_2SiO_3? [Na = 23, Si = 28, O = 16u] **(1)**

(A) 16.7%
(B) 23.0%
(C) 28.0%
(D) 82.0 %

Q5. The elements of group 16 are called ———- **(1)**

(A) noble gases
(B) chalcogens
(C) halogens
(D) alkali metals

Q6. Which of the following elements has the maximum negative electron gain enthalpy? **(1)**

(A) Oxygen
(B) Chlorine
(C) Fluorine
(D) Nitrogen

Q7. Which of the following electronic configurations of an atom has the lowest ionisation enthalpy? **(1)**

(A) $1s^2\ 2s^2\ 2p^3$
(B) $1s^2\ 2s^2\ 2p^6\ 3s^1$
(C) $1s^2\ 2s^2\ 2p^6$
(D) $1s^2\ 2s^2\ 2p^5$

Q8. The shape and hybridisation in BF_3 is **(1)**

(A) sp^2, linear
(B) sp^3d, planar
(C) sp^2, planar
(D) sp^3 planar

Q9. Bond dissociation energies of HF, HCl, HBr follow the order **(1)**

(A) HCl > HBr > HF

(B) HF > HBr > HCl

(C) HF > HCl > HBr

(D) HBr > HCl > HF

Q10. The correct thermodynamic conditions for the spontaneous reaction at all temperature is **(1)**

(A) $\Delta H < 0$ and $\Delta S > 0$

(B) $\Delta H < 0$ and $\Delta S < 0$

(C) $\Delta H < 0$ and $\Delta S = 0$

(D) $\Delta H > 0$ and $\Delta S < 0$

Q11. The spontaneity means, having the potential to proceed without the assistance of external agency. The processes which occur spontaneously are **(1)**

(A) flow of heat from colder to warmer body.

(B) gas in a container contracting into one corner.

(C) gas moving from an area of low pressure to high pressure

(D) gas expanding to fill the available volume.

Q12. The reaction quotient (Q) for the reaction **(1)**

$$\mathbf{N_2(g) + 3H_2(g) \leftrightarrow 2NH_3(g)}$$

is given by $Q = [NH_3]^2/[N_2][H_2]^3$. The reaction will proceed from right to left if

(A) Q < Kc

(B) Q > Kc

(C) Q = 0

(D) Q = Kc

For Questions number 13 to 16, two statements are given---- one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

Q13. **Assertion(A)**: Fe reacts with HCl to produce hydrogen gas. **(1)**

Reason(R): Fe is a better reducing agent than H_2

Q14. **Assertion(A)**: Kp for a reaction may be equal to or less than or greater than Kc. **(1)**
Reason(R): The value of Kp or Kc varies with change in temperature.

Q15. **Assertion(A)** : Saturated hydrocarbons are chemically more reactive. **(1)**
Reason(R) : They do not have π - electron.

Q16. **Assertion(A):** Generally unsaturated compounds undergo addition reaction. **(1)**
Reason(R): The unsaturated compounds have presence of electrons in the double and triple bond.

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. Use molecular orbital theory to explain why the He does not exist as He_2 molecule. **(2)**

Q18. How many moles of methane are required to produce 22g CO_2 (g) after combustion? **(2)**

Q19. State whether the entropy increases or decreases in the following transformation: **(2)**
(i) $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$
(ii) H_2O (ice) $\rightarrow$ H_2O (l)

Q20. (i) How will you separate a mixture of ammonium chloride and sodium chloride? **(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?

Q21. ***Attempt either option a or b.*** **(2)**
a. The species: H_2O and HCO_3^- can act both as Bronsted acid and base. For each case give the corresponding conjugate acid and conjugate base.

OR

b. The Haber process for the synthesis of ammonia from molecular hydrogen and nitrogen is represented by the following thermochemical equations.

$$\mathbf{N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g) \quad \Delta H= -92.6kJ/mol}$$

(i) Write the equilibrium constant expression for the reaction taking place during Haber process.
(ii) Write the expression which represents the relationship between Kp and Kc for this reaction.

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. (i) Draw the cis- and trans-structures for **hex-2-ene**. **(3)**
(ii) Which isomer will have higher boiling point and why?

Q23. ***Attempt either option a or b.*** **(3)**

a. A compound contains 4.07% hydrogen, 24.27% carbon and 71.65% chlorine. Its molar mass is 98.96 g. What are its empirical and molecular formulae?

OR

b. The reactant which is entirely consumed in reaction is known as limiting reagent. In the reaction $2A + 4B \rightarrow 3C + 4D$, when 5 moles of A react with 6 moles of B, then
(i) which is the limiting reagent?
(ii) Calculate the amount of C formed.

Q24. Among the elements of the second period Li to Ne ,pick out the element: **(3)**
(i) with the highest first ionisation energy
(ii) with the highest electronegativity
(iii) with the largest atomic radius

Q25. Balance the given redox reaction in **<u>acidic medium</u>*.(Steps of balancing to be shown*)** **(3)**

$$\mathbf{Fe^{2+}_{(aq)} + Cr_2O_7^{2-}{}_{(aq)} \rightarrow Fe^{3+}_{(aq)} + Cr^{3+}_{(aq)}}$$

Q26. (i) State Heisenberg's Uncertainty principle. **(3)**
(ii) Calculate the uncertainty in the position of an electron if the uncertainty in its velocity is 5.7×10^5 m/s.

Given: Planck's constant = 6.6×10^{-34} Jsec
Mass of electron = 9.1×10^{-31} kg

Q27. Compare the relative stability of the following species by calculating bond order and indicate their magnetic properties: O_2, O_2^+, O_2^- (Superoxide) **(3)**

Q28. 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)**

$$\mathbf{N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H = -92.38\ kJmol^{-1}}$$

What will be the effect of addition of argon to the above reaction mixture at constant volume?

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=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 ∞
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	– ½ or + ½ (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 ms.

(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) Shape of a given orbital is determined by

(A) Principle quantum number

(B) Azimuthal quantum number

(C) Magnetic quantum number

(D) Spin quantum number

(ii) What is the maximum number of electrons having n = 2 and l = 0?

(iii)

(a) Write the name of quantum number which determines 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.	$3d_{z2}$	s.	Double dumb bell	iv. along x-axis

Q30. Read the passage given below and answer the following questions: **(1×4=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 π-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) 6π electrons

(B)12π electrons

(C)16π electrons

(D)18π 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.

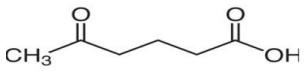
Q31. ***Attempt either option A or B.*** **(1×5=5)**

A. (i) Carry out the following conversion: **Ethyne to Benzene**

(ii) Write the IUPAC name of the following:

(1) $(CH_3)_3C\text{-}CH_2\text{-}C(CH_3)_3$

(2)



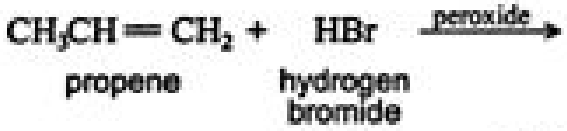
(iii) Deduce the structure of **Cyclohex-2-en-1-ol**.

(iv) For the following bond cleavage, use curved-arrows to show the electron flow and classify the same as homolysis or heterolysis.

$$CH_3O\text{----}OCH_3 \rightarrow CH_3\dot{O} + CH_3\dot{O}$$

OR

B. (i) Complete the following reaction: **(1+1+3=5)**



(ii) Name the **intermediate** that gets formed in the reaction.

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

Q32. ***Attempt either option A or B.*** **(1+1+1+2=5)**

A. (i) How enthalpy change and internal energy change are related for gaseous reaction? Give equation.

(ii) A reaction, A + B → C + D + q is found to have a positive entropy change. Predict the spontaneity of the reaction.

(iii) Define extensive properties. Give one example.

(iv) In a process, 701 J of heat is absorbed by a system and 394 J of work is done by the system. What is the change in internal energy for the process?

OR

B. (i) Predict the change in internal energy for an isolated system at constant volume. **(1+4=5)**

(ii) For the reaction $2A(g) + B(g) \rightarrow 2D(g)$ at 298 K $\Delta U^0 = -10.5$ kJ and $\Delta S^0 = -44.1$ JK^{-1}.Calculate ΔG^0 for the reaction, and predict whether the reaction may occur spontaneously.(Given: $R = 8.314 \times 10^{-3}$ kJ K^{-1} mol^{-1})

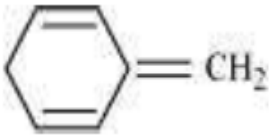
Q33. ***Attempt either option A or B.*** **(1×5=5)**

A. (i) Propanal and pentan-3-one are the ozonolysis products of an alkene? What is the structural formula of the alkene?

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

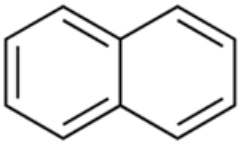
(iii) Identify the following compounds as aromatic or non-aromatic by applying **Huckel's rule*:(Show the steps of calculation)***

(a)



(b)

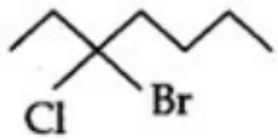
(c)



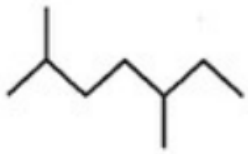
OR

B. (i) Give the IUPAC names of the following compounds: **(1×5=5)**

(a)



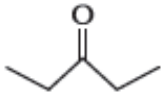
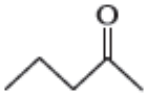
(b)



(c)

Cl_2CHCH_2OH

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

(iii) What happens when benzene is treated with Br_2 in presence of anhydrous $AlCl_3$ (***Write the chemical equation***).