SNBP INTERNATIONAL & Sr. SECONDARY SCHOOL, CHIKHALI, PUNE
Affiliation No. 1130703
TERM- II 2024-25

GRADE: XI	SUBJECT: CHEMISTRY (043)	DATE: 12.02.2025	TIME:3 HRS	MARKS: 70

SECTION-A

QI. MULTIPLE CHOICE QUESTIONS:(MCQS) (16Q x 1M=16M)

1. What is the molarity of a solution containing 5.85 g of NaCl (molar mass = 58.5 g/mol) in 500 mL of water?
   a) 0.1 M b) 0.2 M c) 1.0 M d) 2.0 M

2. Which of the following statements is true about the mole concept?

   a) One mole of any gas occupies 22.4 L at STP.
   b) One mole of hydrogen atoms weigh 2 g.
   c) One mole of oxygen atoms contain 6.022×10^{23} molecules.
   d) One mole of water weighs 1 g.

3. Which of the following laws is associated with the relationship between the volume of gases and their stoichiometric coefficients in a chemical equation?
   a) Dalton's Law b) Gay-Lussac's Law c) Avogadro's Law d) Boyle's Law

4. What is the maximum number of electrons that can be accommodated in the n=3 shell?
   a) 2 b) 8 c) 18 d) 32

5. Which of the following discoveries is attributed to J.J. Thomson?

   a) Proton b) Electron c) Neutron d) Nucleus

6. Which of the following elements belongs to the s-block of the periodic table?

   a) Chlorine b) Magnesium c) Iron d) Carbon

7. What is the general trend of ionization energy across a period in the periodic table?

   a) Increases b) Decreases c) Remains constant d) Shows no definite trend

8. Which of the following molecules has a linear shape?

   a) H_2O b) CO_2 c) NH_3 d) CH_4

9. The type of hybridization in BF_3 is:

   a) sp b) sp^2 c) sp^3 d) sp^3d

10. For an isochoric process, which of the following is true?
    a) $\Delta U=q$ b) $\Delta U=w$ c) $q=0$ d) $w=0$

11. Which thermodynamic quantity is always zero in a cyclic process?
    a) Work b) Heat c) Internal energy change (ΔU) d) Enthalpy change (ΔH)

12. Which of the following statements is correct for the first law of thermodynamics?
    a) Energy can be created but not destroyed.

b) Energy can neither be created nor destroyed, only transformed.
c) Energy is always conserved in open systems.
d) Work done in a cyclic process is always zero.

13. Which of the following reactions is a redox reaction?
a) $HCl+NaOH \rightarrow NaCl+H_2O$
b) $2H_2+O_2 \rightarrow 2H_2O + O_2$
c) $AgNO_3+NaCl \rightarrow AgCl+NaNO_3$
d) $H_2SO_4+BaCl_2 \rightarrow BaSO_4+2HCl$

14. Which of the following compounds exhibits resonance?
a) Ethane (C_2H_6)
b) Benzene (C_6H_6)
c) Propane (C_3H_8)
d) Methanol (CH_3OH)

Direction (Q.No. 15-16) In the following questions,an Assertion(A) is followed by corresponding Reason(R) Use the following keys to choose the appropriate answer.
a. Both assertion and Reason are correct, Reason is the correct explanation of Assertion.
b. Both Assertion and Reason are correct, Reason is not the correct explanation of Assertion.
c. Assertion is correct; Reason is incorrect.
d. Assertion is incorrect; Reason is correct.

15. **Assertion (A)**: Benzene does not decolorize bromine water.
Reason (R): Benzene undergoes electrophilic substitution reactions instead of addition reactions. Ans a.
16. **Assertion (A)**: Methane reacts with chlorine in the presence of sunlight to form chloromethane.
Reason (R): The reaction between methane and chlorine is an example of an electrophilic substitution reaction. Ans a

SECTION-B

QII VERY SHORT ANSWER QUESTIONS: (5Q x 2M=10M)

17. State the law of conservation of mass and explain its significance in chemical reactions.
Answer:
The law of conservation of mass states that mass can neither be created nor destroyed in a chemical reaction. It implies that the total mass of the reactants equals the total mass of the products. This law is significant because it helps in balancing chemical equations and ensures that the stoichiometric calculations are accurate.

18. State any two postulates of Bohr's atomic model.
Answer:
- Electrons revolve around the nucleus in specific circular orbits called energy levels without radiating energy.
- The energy of an electron in a given orbit is quantized and remains constant unless it transitions between orbits.

19. What is the VSEPR theory? Explain its significance in predicting molecular shapes.
Answer:
- **VSEPR Theory**: Valence Shell Electron Pair Repulsion (VSEPR) theory states that the shape of a molecule is determined by the repulsion between electron pairs (bonding and lone pairs) in the valence shell of the central atom.
- **Significance**: It helps predict molecular geometry, such as linear, tetrahedral, and bent shapes,

based on minimizing repulsion between electron pairs.

20. Define the terms:
    a) Homolytic cleavage
    b) Heterolytic cleavage

    a) **Homolytic Cleavage**:
    In homolytic cleavage, a covalent bond breaks equally, and each atom retains one electron from the shared pair, forming free radicals.
    Example:
    $Cl2 \rightarrow$UV light $Cl\cdot + Cl\cdot$

    b) **Heterolytic Cleavage**:
    In heterolytic cleavage, a covalent bond breaks unequally, and one atom retains both electrons from the shared pair, forming ions.
    Example:
    $H-Cl \rightarrow H^+ + Cl^-$

21. Write the functional groups present in the following compounds:
    a) Ethanol
    b) Propanone
    Answer:
    a) **Ethanol**: Hydroxyl group (−OH)
    b) **Propanone**: Carbonyl group (C=O)

OR

21. Define the terms:
    a) Aromatic hydrocarbons
    b) Aliphatic hydrocarbons
    Answer:
    a) **Aromatic Hydrocarbons**: Compounds containing conjugated π\piπ-electron systems in a cyclic structure, such as benzene.
    b) **Aliphatic Hydrocarbons**: Non-aromatic hydrocarbons, which can be straight-chain, branched, or cyclic, such as methane and ethene.

SECTION-C

QIII) SHORT ANSWER QUESTIONS: (7Q x 3M=21)

22. A sample of a compound contains 40% carbon, 6.7% hydrogen, and 53.3% oxygen by mass. Determine the empirical formula. (Molar masses: C = 12, H = 1, O = 16)
    - Assume 100 g of the compound:
      - C = 40 g, H = 6.7 g, O = 53.3 g.
    - Moles:
      - C: 40/12=3.33
      - H: 6.7/1=6.7
      - O: 53.3/16=3.33
    - Simplest ratio: C:H:O=1:2:1
    - Empirical formula: CH_2O.

23. Write the electronic configuration of the following and explain the Aufbau principle:

a) Oxygen (Atomic number = 8)
b) Sodium (Atomic number = 11)

Answer:

- **Oxygen**: 1s2 2s2 2p4
- **Sodium**: 1s2 2s2 2p6 3s1
- **Aufbau Principle**: Electrons fill orbitals in order of increasing energy, starting with the lowest energy orbital. For example, 1s is filled before 2s

24. Define electronegativity and explain its periodic trends.
    - **Definition**: Electronegativity is the tendency of an atom to attract a shared pair of electrons in a covalent bond.
    - **Trend Across a Period**: Electronegativity increases from left to right due to increasing nuclear charge and decreasing atomic radius.
    - **Trend Down a Group**: Electronegativity decreases due to an increase in atomic size and shielding effect, which reduces the nucleus's ability to attract electrons.
25. i. Draw the Lewis structure of nitrate ion (NO_3^-) and explain the resonance. (2M)
    ii. Explain the bond parameters: bond length, bond angle. (1M)

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 Bond Length: The distance between the nuclei of two bonded atoms. Shorter bond length indicates stronger bonding.

 Bond Angle: The angle between two adjacent bonds in a molecule, determining the molecule's shape. For example, in H2_22O, the bond angle is 104.5°.

26. One mole of an ideal gas undergoes isothermal expansion at 27°C from an initial volume of 2.5 L to 6.0 L Calculate the work done by the gas. (R=8.314 J $mol^{-1}K^{-1}$, log2=0.3010, log2.4=0.03802,log2.5=0.0397).

Answer:

Given:

- n=1mol,
- T=27∘C=300K,
- V1=2.5L, V2=6.0 L
- R=8.314J $mol^{-1}K^{-1}$.

Substitute values:

$w=-nRT\ln(V2/V1)$

$w=-(1)(8.314)(300)\ln(6.0/2.5)$

$w=-2494.2\ln(2.4)$

$w=-2494.2\times0.875=-2182.4J$

27. Balance the following redox reaction in acidic medium using the ion-electron method:
    $MnO_4^- + Fe^{2+} \rightarrow Mn^{2+} + Fe^{3+}$

Answer:

1. **Write the half-reactions**:

- Oxidation: $Fe^{2+} \rightarrow Fe^{3+}$
- Reduction: $MnO^{4-} \rightarrow Mn^{2+}$

2. **Balance atoms other than O and H**:
   - Oxidation: $Fe^{2+} \rightarrow Fe3+$ (already balanced).
   - Reduction: $MnO^{4-} \rightarrow Mn^{2+}$ (Mn is balanced).
3. **Balance oxygen by adding H2OH_2OH2O**:
   - Reduction: $MnO4- \rightarrow Mn2+4H_2O$
4. **Balance hydrogen by adding H^+**:
   - Reduction: $MnO^{4-}+8H+ \rightarrow Mn^{2+}+4H_2O$
5. **Balance charges by adding electrons**:
   - Oxidation: $Fe^{2+} \rightarrow Fe^{3+}+e-$
   - Reduction: $MnO4-+8H+5e- \rightarrow Mn^{2+}+4H_2O$.
6. **Equalize the number of electrons**:
   - Multiply the oxidation half-reaction by 5: $5Fe^{2+} \rightarrow 5Fe^{3+}+5e-$
7. **Combine the half-reactions**:

$MnO^{4-}+8H+5Fe^{2+} \rightarrow Mn^{2+}+4H_2O+5Fe^{3+}$

Balanced Reaction:

$MnO^{4-}+8H^{+}+5Fe^{2+} \rightarrow Mn^{2+}+4H_2O+5Fe^{3+}$

OR

27. Describe Rutherford's gold foil experiment and its conclusions.

Answer:

- **Experiment**:
  - Rutherford bombarded a thin gold foil with alpha particles and observed their scattering pattern using a fluorescent screen.
- **Observations**:
  - Most alpha particles passed through undeflected.
  - A few were deflected at small angles.
  - Very few were deflected back.
- **Conclusions**:
  - The atom has a small, dense, positively charged nucleus.
  - Most of the atom's volume is empty space.
  - Electrons revolve around the nucleus in the empty space.

28. i. Explain the inductive effect with an example. (2M)

 Definition: The inductive effect is the permanent displacement of electrons along a carbon chain due to the electronegativity difference between atoms. It decreases with distance from the substituent.

 Types:

- **+I Effect**: Electron-donating groups, e.g., alkyl groups (CH3,C2H5).
- **-I Effect**: Electron-withdrawing groups, e.g.Cl, F NO_2

ii. Differentiate between +R and -R effects. (1M)

+R Effect	-R Effect
Increases electron density.	Decreases electron density.

Stabilizes positive charges.

Examples: −OH,−OR,−NH2-OH, -OR, -NH_2−OH,−OR,−NH2

Stabilizes negative charges.

Examples: −NO2,−CN-NO_2, -CN−NO2,−CN.

SECTION-D

QIV) LONG ANSWER QUESTIONS: (3Q x 5M=15M)

29. i) Write any three characteristics of a chemical equilibrium. (3M)

Answer:

1. **Dynamic Nature**: At equilibrium, the forward and reverse reactions continue to occur at the same rate, making the system dynamic.
2. **Constant Concentrations**: The concentrations of reactants and products remain constant at equilibrium, but they are not necessarily equal.
3. **Dependence on Conditions**: The position of equilibrium depends on temperature, pressure, and concentration changes as predicted by Le Chatelier's principle.

ii) The equilibrium constant (K_p) for a reaction is 50 atm^{-1} at 500 K. Calculate K_c for the reaction. Given R=0.0821L atm $mol^{-1}K^{-1}$. Assume Δn =−1. (2M)

The relationship between K_P and K_C is:

$Kp=Kc(RT)^{\Delta n}$

Rearrange for Kc

$Kc=Kp/(RT)^{\Delta n}$

Substitute values:

- $Kp=50atm^{-1}$,
- $R=0.0821\ L\ atm\ mol^{-1}K^{-1}$
- T=500K,
- Δn=−1.

$Kc=50(0.0821\times500)^{-1}=2052.5mol^{-1}L$

Answer: Kc=2052.5 mol−1L

30. i. Write the IUPAC names of the following compounds: (3M)

a) $CH_3−CH(CH_3)−CH_2−CH_3$

b) $CH_3−C(CH_3)_2−CH_2−CH_2OH$

c) $CH_3−CH=CH−COOH$

a) 2-Methylbutane

b) 3,3-Dimethylbutan-1-ol

c) But-2-enoic acid

ii. Explain structural isomerism and give examples of each type. (2M)

1. **structural Isomerism**: Compounds with the same molecular formula but different structural arrangements of atoms.

a) **Chain Isomerism**: Isomers differ in the arrangement of the carbon chain.

Example: C5H12

- $CH_3−CH_2−CH_2−CH_2−CH_3$ (n-pentane)
- $CH_3−CH(CH_3)−CH_2−CH_3$ (2-methylbutane).

b) **Functional Isomerism**: Isomers differ in functional groups.

Example: C_3H_6O

- $CH_3−CH_2−CHO$ (propanal).
- $CH_3−CO−CH_3$ (propanone).

c) **Position Isomerism**: Isomers differ in the position of the functional group.

Example: C_3H_7Cl

- $CH_3–CH_2–CH_2Cl$ (1-chloropropane).
- $CH_3–CHCl–CH_3$ (2-chloropropane).

31. i) Write the chemical reactions involved in the following methods of preparation of hydrocarbons: (3M)

a) Decarboxylation reaction

b) Wurtz reaction.

- Alkane is obtained by heating sodium salt of a carboxylic acid with soda lime : $RCOONa+NaOH \rightarrow \Delta RH+Na_2CO_3$

•Example: $CH3COONa+NaOH \rightarrow CH_4+Na_2CO_3$

Wurtz Reaction:

•Alkyl halides react with sodium in dry ether to form higher alkanes: $2R–X+2Na \rightarrow$ Dry ether $R–R+2NaX$

•Example: $2CH_3Cl+2Na \rightarrow$ Dry ether $C_2H_6+2NaCl$

ii. Write the chemical equations for the following reactions:

a) Combustion of propane (C_3H_8)

b) Reaction of ethene with hydrogen in the presence of a nickel catalyst

a) Combustion of propane:

$C_3H_8+5O_2 \rightarrow 3CO_2+4H_2O$

b) Reaction of ethene with hydrogen (Hydrogenation):

$C_2H_4+H_2 \rightarrow$ Ni catalyst C_2H_6

OR

32. i. Describe any two methods of purification of organic compounds. Mention one application of each method. (3M)

Distillation:

•Used to separate liquids with different boiling points.

•**Application**: Purification of acetone from water.

Crystallization:

•Used to purify solid compounds by dissolving them in a suitable solvent and then cooling to form crystals.

•**Application**: Purification of benzoic acid.

ii. Explain the differences between electrophiles and nucleophiles with suitable examples. (2M)

Answer:

1. **Electrophiles**:
   - Electron-deficient species that accept electron pairs.
   - Examples: H^+, NO^{2+}, BF_3
2. **Nucleophiles**:
   - Electron-rich species that donate electron pairs.
   - Examples: $OH^–$, $CN^–$

SECTION-E

QV) CASE BASED QUESTIONS: (2Q x 4M=8M)

33. Thermodynamics is a branch of chemistry that deals with the energy changes in chemical processes. The enthalpy change (ΔH) is an important thermodynamic parameter used to understand heat exchange during reactions. For example, during the combustion of 1 mole of methane (CH_4), the reaction releases 890 kJ of energy:
$CH_4(g)+2O_2(g)\rightarrow CO_2(g)+2H_2O(l)$ ($\Delta H=-890$ kJ/mol)

This exothermic reaction is a source of energy in many industrial and domestic processes. At constant pressure, the enthalpy change is related to internal energy (ΔU) by the expression:

$\Delta H=\Delta U+P\Delta V$

where PΔV accounts for work done due to volume changes.
i. What does the negative value of ΔH signify for the combustion of methane? (1 Mark)
Answer: The negative value of ΔH indicates that the combustion of methane is exothermic, meaning heat is released to the surroundings.
ii. Calculate the amount of energy released when 2 moles of methane are combusted. (1 Mark)
Answer:
For 1 mole of CH_4, energy released = −890 kJ
For 2 moles of CH_4
$\Delta H=2\times-890=-1780$ kJ.
iii. What is the significance of the term PΔVP in the equation $\Delta H=\Delta U+P\Delta V$ (1 Mark)
Answer:

- PΔVP represents the work done by the system due to the expansion or compression of gases during the reaction.
- In combustion, gaseous products and reactants cause volume changes, and this term adjusts ΔU to give ΔH.

iv. Why is the enthalpy of combustion higher when water is in the liquid state compared to the gaseous state? (1 Marks)
Answer:

- When water forms as a liquid, additional energy is released during condensation.
- This makes the enthalpy of combustion more negative for liquid water than for gaseous water.

34. A student is studying hydrocarbons and observes their reactions under different conditions. She notices that methane burns in the presence of oxygen to produce a blue flame, indicating complete combustion. When ethyne is passed through bromine water, the reddish-brown color disappears, indicating a chemical reaction. She also finds that benzene does not react with bromine water under normal conditions but reacts in the presence of a Lewis acid catalyst like ferric chloride ($FeCl_3$).
i. Which product is formed during the complete combustion of methane?
a) Carbon monoxide and water
b) Carbon dioxide and water
c) Carbon and water
d) Carbon dioxide and hydrogen
ii. What type of reaction occurs when ethyne reacts with bromine water?

a) Substitution b) Addition c) Elimination d) Combustion

iii. Why does benzene require a catalyst to react with bromine?

a) Benzene is highly reactive.

b) Benzene undergoes electrophilic substitution, and a catalyst helps generate the electrophile.

c) Benzene undergoes addition reactions only in the presence of a catalyst.

d) Benzene cannot react with bromine.

iv. Which of the following is the correct order of reactivity towards electrophilic addition reactions?

a) Ethyne > Ethene > Benzene

b) Ethene > Ethyne > Benzene

c) Benzene > Ethyne > Ethene

d) Ethene > Benzene > Ethyne