

2026

CHEMISTRY

(Theory)

Full Marks : 70

Pass Marks : 21

Time : Three hours

All the Questions are compulsory.

The figures in the right margin indicate full marks for the questions.

Question Nos. 1-7 are Very short Answer (VSA) type of 1 mark each.

1. What is the SI unit of amount of substance? 1
2. How many hydrogen atoms are there in 18 g of water? 1
3. Write the IUPAC name of the element with atomic number 122. 1
4. Using VSEPR theory predict the geometry of AB_3 if all atoms have 7 valence electrons. 1
5. Why the standard enthalpy of vaporization of water is higher than that of acetone? 1
6. Chloroethane, CH_3CH_2Cl undergoes heterolytic cleavage of the carbon-chlorine bond. Identify the cation formed in the cleavage. 1

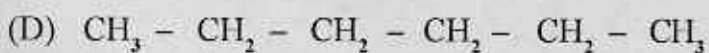
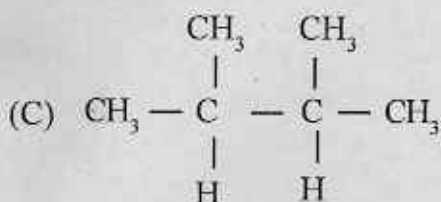
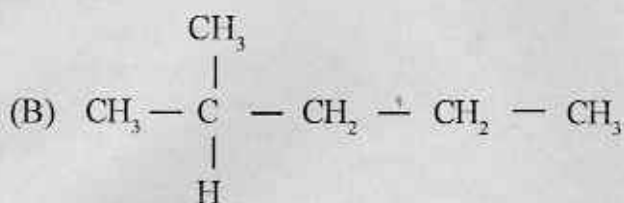
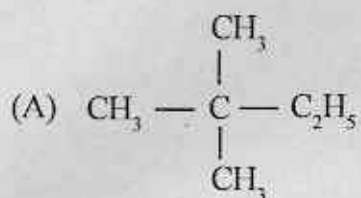
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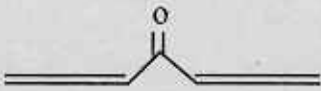
7. An alkyne undergoes hydration with $H_2SO_4 / HgSO_4$ to produce an aldehyde. Identify the alkyne. 1

Question Nos. 8-17 are Objective Type(MCQ) carrying 1 mark each. Choose and rewrite the best answer out of the given alternatives.

8. During photoelectric effect experiment with magnesium metal (work function = $5.8 \times 10^{-19} J$) using radiation of frequency, $\nu = 1.5 \times 10^{15} s^{-1}$ the kinetic energy of the emitted electron is – 1
- (A) $4.1 \times 10^{-19} J$ (B) $2.1 \times 10^{-19} J$
(C) $4.1 \times 10^{-4} J$ (D) $4.1 \times 10^{-34} J$
9. A piece of paper is found to be 5.32 cm long and 2.4 cm broad. The area of the paper expressed with proper significant figures is – 1
- (A) 12.768 cm^2 (B) 12.76 cm^2
(C) 12.8 cm^2 (D) 13 cm^2
10. Elements "A" and "B" obey Octaves law and have similar properties. Number of elements in between them is – 1
- (A) 6 (B) 8
(C) 7 (D) 6 or 13
11. Which of the following compounds has zero dipole moment? 1
- (A) H_2S (B) SO_2
(C) BCl_3 (D) NH_3
12. Which one of the following represents a heterogenous equilibrium? 1
- (A) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
(B) $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$
(C) $CH_3COOC_2H_5(aq) + H_2O(l) \rightleftharpoons CH_3COOH(aq) + C_2H_5OH(aq)$
(D) $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$

13. Among the structural isomers of hexane, the isomer having highest boiling point is - 1



14. The IUPAC name of the organic compound  is - 1

- (A) pent-1, 4- dien-3-one (B) penta-1, 4- dien-3-one
(C) pent-1, 4 diene-3-one (D) penta-1, 4- diene-3-one

15. The oxidation number of chlorine in the molecule $KClO_3$ is – 1

- (A) +1 (B) -1
(C) +2 (D) +5

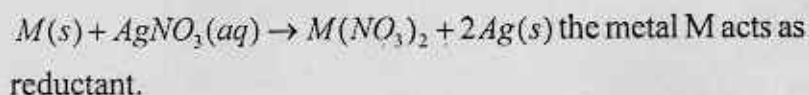
Question Nos. 16 and 17 have two statements labelled as Assertion (A) and Reason (R) respectively. Answer these questions by choosing the correct options (A), (B), (C) and (D) given as follows:

- (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 correct.

16. Assertion (A) : The melting of ice above 0°C is a spontaneous process.

Reason (R) : The enthalpy change of the process is negative ($-\Delta H$). 1

17. Assertion(A) : In the displacement reaction



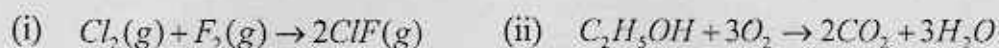
Reason (R) : Reduction potential of metal M is lower than that of silver. 1

Question Nos. 18-27 are Short Answer (SA-II) type of 2 marks each.

18. Illustrate the law of multiple proportion by taking the oxides of sulphur as example. 2

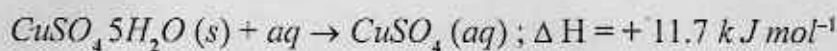
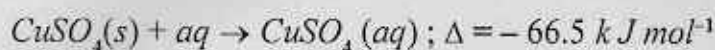
19. A^{2+} is a H like species ($Z=3$). Calculate its ionization potential if that of H atom is 13.6 eV . 2

20. Classify each of the following redox reactions with respect to the categories : combination reaction, decomposition reaction, combustion reaction, and double displacement reaction. 1+1=2



21. A_2 is a diatomic molecule. It has a covalent bond formed by overlapping of the atomic orbitals containing one unpaired electron each. Draw the potential energy curves of the molecule when the two electrons are of (i) opposite spins (ii) parallel spins. 2

22. The dissolutions of anhydrous and hydrated copper sulphate are as follows : 2



Calculate the enthalpy of hydration of copper sulphate $CuSO_4(s)$.

23. Predict the conjugate acid and conjugate base of NH_3 . 2
24. Give an example of a reaction in which a metal displaces a non-metal from its compound. How can you say that it is a redox reaction? 1+1=2
25. 0.500 g of an organic compound burns in excess O_2 to produce 1.25 g of CO_2 and 0.613 g of H_2O . Calculate the percentage composition of C and H in the compound. 2
26. Draw a paper chromatogram showing the separation of two components with different R_f values present in a mixture. 2
27. Why is cyclopentadienyl anion aromatic in nature? 2

Question Nos. 28-33 are Short Answer (SA-I) type of 3 marks each. There is internal option for three questions.

28. **Answer either (a) or (b) :**
- (a) 100 g of an organic acid sample (molecular mass = 60) contains 39.9 g C, 6.7 g H and 53.4 g O. Determine the molecular formula of the acid. 3
- (b) Precipitation of silver chloride is carried out by adding an excess of 0.5 M NaCl solution to 10 ml of 1.0 M AgNO₃ solution. Calculate the amount of silver chloride precipitated in the reaction (Atomic mass of silver = 108). 3
29. State Modern periodic law. How does atomic size vary along the period and group? 1+1+1=3
30. Find out the bond orders and compare the bond strengths for N₂⁺ and N₂⁻. 3
31. Derive the relationship between K_p and K_c for a general reaction represented as aA + bB ⇌ cC + dD in which all reactants and products are gases. 3
32. **Answer either (a) or (b) :**
- (a) Balance the following redox reaction in acidic medium by ion-electron method. $Zn(s) + NO_3^-(aq) \rightarrow Zn^{2+}(aq) + NH_4^+(aq)$ 3
- (b) The standard electrode potentials of two half cells M₁²⁺ / M₁ and M₂²⁺ / M₂ are found to be -0.76V and +0.34V respectively. Which one of the two will be used to construct a galvanic cell in which hydrogen electrode functions as anode? Write the half-cell reactions. 1+1+1=3

Question No. 33 is case-study based question and carries 3 marks. Read the passage carefully and answer the questions that follow.

33. In organic reactions, the organic molecule reacts with an appropriate attacking reagent and leads to the formation of one or more intermediate(s) and finally product(s). It is important to explain how the products of the reaction are formed and this explanation takes the form of a reaction mechanism. The movement of electrons in the mechanism of the organic reactions can be shown by curved-arrow notations. In the mechanism, covalent bond cleavages may take place either in heterolytic way or homolytic way. Reagents that attack the reactive site of the substrate may be either electrophile or nucleophile in nature. The reagent attacks on the basis of polarization of the substrate molecule. There are some important factors that contribute to the polarization of the covalent bonds. The electron displacements like inductive effect, hyperconjugation and resonance cause permanent polarization of the bond while electromeric effect causes temporary electron displacement effects. The degree of polarization due to these electron displacement effects decide the nature of reactions and the reactivity of the substrate molecules.

Write answer of either (a) or (b) :

- (a) Use curve arrow notation to show resonance and use the electron displacement factor to explain how the benzene ring of aniline, $C_6H_5NH_2$ becomes more reactive towards electrophiles. 2+1=3
- (b) Using hyperconjugation and inductive effect factors, explain why the addition of H^+ to propene $CH_3 - CH = CH_2$ takes place preferably at C-1. Show the attack of the reagent using curve arrow notation. 2+1=3

Question Nos. 34-36 are Essay(E) type and each carries 5 marks. Internal options are given for all the questions.

34. Answer either (a) or (b) :

(a) What is the difference between orbit and orbital? For sodium atom identify the set of quantum numbers for the orbital of the valence electron. If the electron has a de Broglie wavelength of 225 nm calculate its speed.

2+1+2=5

(b) Distinguish between an emission spectrum and an absorption spectrum? Why is the energy of an electron in Bohr's orbit negative? Calculate the frequency of light emitted when the electron in a hydrogen atom undergoes a transition from energy level $n = 4$ to level $n = 2$?

2+1+2=5

35. Answer either (a) or (b) :

(a) Define thermodynamic system and surroundings? Classify the systems into different types.

1+1+3=5

(b) State the three laws of thermodynamics. How can energy changes associated with chemical or physical processes be experimentally measured?

1+1+1+2=5

36. Answer either (a) or (b) :

(a) (A), C_4H_6 is an acidic unsaturated hydrocarbon which can form monosodium salt with sodium metal. On reduction with Lindlar's catalyst, A forms compound B which on ozonolysis gives two products C and D. Identify A, B, C, D and write the sequence of reactions.

1+1+1+1+1=5

(b) "A" is an organic compound formed when sodium salt of benzoic acid is heated with soda lime. Compound A on reaction with CH_3Cl /anhydrous $AlCl_3$ gives compound B which on treatment with Cl_2 in the presence of UV light gives a monochloro derivative C. Identify A, B, C and write the sequence of the reactions. What is the named reaction involved in the conversion of A to B.

1+1+1+1+1=5