H: CHEMISTRY (COMPULSORY)

Q. 1 – Q. 5 carry one mark each.

Q.1 The molecule having net ‘non-zero dipole moment’ is
(A) CCl₄  (B) NF₃  (C) CO₂  (D) BCl₃

Q.2 The Diels-Alder adduct from the reaction between cyclopentadiene and benzyne is
(A)  (B)  
(C)  (D)  

Q.3 The number of possible enantiomeric pair(s) in HOOC–CH(OH)–CH(OH)–COOH is________

Q.4 For the electrochemical reaction, Cu²⁺(aq) + Zn(s) ⇌ Cu(s) + Zn²⁺(aq)
the equilibrium constant at 25 °C is $1.7 \times 10^{37}$. The change in standard Gibbs free energy ($\Delta G^\circ$) for
this reaction at that temperature will be ________ kJ mol⁻¹ (up to one decimal place).
(Given: $R = 8.314 \text{ JK}^{-1}\text{mol}^{-1}$)

Q.5 Among the following diagrams, the one that correctly describes a zero order reaction
(X → product) is
(Given: $[X]_o =$ initial concentration of reactant X; $[X] =$ concentration of reactant X at time $t$
and $t_{1/2} =$ half-life period of reactant X)
Q. 6 – Q. 15 carry two marks each.

Q.6 If the radius of first Bohr orbit is 0.53 Å, then the radius of the third Bohr orbit is
(A) 2.12 Å  (B) 4.77 Å  (C) 1.59 Å  (D) 3.18 Å

Q.7 If 50 mL of 0.02 M HCl is added to 950 mL of H2O, then the pH of the final solution will be________

Q.8 Stability of [CrCl6]^{3-} (X), [MnCl6]^{3-} (Y) and [FeCl6]^{3-} (Z) follows the order
(Given: Atomic numbers of Cr = 24, Mn = 25 and Fe = 26)
(A) X > Y > Z  (B) X < Y < Z  (C) Y < X < Z  (D) X < Y = Z

Q.9 Among the following pairs, the paramagnetic and diamagnetic species, respectively, are
(A) CO and O_2^-  (B) NO and CO  (C) O_2^- and CO  (D) NO^+ and O_2^-

Q.10 In compounds K_4[Fe(CN)_6] (P) and Fe(CO)_5 (Q), the iron metal centre is bonded to
(A) C of CN^- in P and C of CO in Q  (B) N of CN^- in P and C of CO in Q
(C) C of CN^- in P and O of CO in Q  (D) N of CN^- in P and O of CO in Q

Q.11 Among the following reactions, the one that produces achiral alcohol (after hydrolysis) is
(A) \[
\begin{array}{c}
\text{H}_3\text{C} \\
\text{O} \\
\text{H} \\
\text{C} \\
\text{H} \\
\text{CH}_2\text{MgBr}
\end{array}
\]
\[+\]
\[
\begin{array}{c}
\text{CH}_3\text{CH}_2\text{MgBr}
\end{array}
\]

(B) \[
\begin{array}{c}
\text{H}_3\text{C} \\
\text{C} \\
\text{Ph} \\
\text{O} \\
\text{C}
\end{array}
\]
\[+\]
\[
\begin{array}{c}
\text{CH}_3\text{CH}_2\text{MgBr}
\end{array}
\]

(C) \[
\begin{array}{c}
\text{H}_3\text{C} \\
\text{O} \\
\text{Et} \\
\text{O}
\end{array}
\]
\[+\]
\[
\begin{array}{c}
\text{CH}_3\text{CH}_2\text{MgBr}
\end{array}
\]

(D) \[
\begin{array}{c}
\text{H}_3\text{C} \\
\text{C} \\
\text{H}_3 \\
\text{O}
\end{array}
\]
\[+\]
\[
\begin{array}{c}
\text{CH}_3\text{CH}_2\text{MgBr}
\end{array}
\]
Q.12  The major product from the following reaction is

\[
R \xrightarrow{1)} \text{SO}_3, \text{H}_2\text{SO}_4 \quad 2) \text{HNO}_3, \text{H}_2\text{SO}_4 \quad 3) \text{H}^+, \text{H}_2\text{O}, \text{heat}
\]

\[R = \text{tert-Butyl} \]

\[\text{(A)} \quad \text{(B)} \quad \text{(C)} \quad \text{(D)}\]

Q.13  The order of resonance energy for the following molecules is

\[
(1) \quad (2) \quad (3) \quad (4)
\]

(A)  (1) > (3) > (2) > (4)  (B)  (1) > (3) > (4) > (2)

(C)  (1) > (4) > (2) > (3)  (D)  (1) > (4) > (3) > (2)

Q.14  The molar enthalpy of vaporization for a liquid (normal boiling point = 78.3 °C) is 39 kJ mol\(^{-1}\). If the liquid has to boil at 25 °C, the pressure must be reduced to ________Torr (up to one decimal place).

(Given: \(R = 8.314 \text{JK}^{-1}\text{mol}^{-1}\); 1 atm = 760 Torr)

Q.15  For the process, \(\text{H}_2\text{O}(l) \rightleftharpoons \text{H}_2\text{O}(s)\) at 0 °C and 1 atm, the correct statement is

(A) \(\Delta S_{\text{system}} = 0\)  (B) \(\Delta S_{\text{total}} > 0\)  (C) \(\Delta S_{\text{total}} = 0\)  (D) \(\Delta S_{\text{total}} < 0\)

END OF THE QUESTION PAPER