# CHEMISTRY

SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer :

1. Consider the given central metal ions of low spin complex and choose the correct increasing order of unpaired electrons
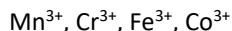
   Mn^{3+}, Cr^{3+}, Fe^{3+}, Co^{3+}

   (1) $Co^{3+} < Fe^{3+} < Mn^{3+} < Cr^{3+}$

   (2) $Co^{3+} < Mn^{3+} < Fe^{3+} < Cr^{3+}$

   (3) $Cr^{3+} < Mn^{3+} < Cr^{3+} < Fe^{3+}$

   (4) $Cr^{3+} < Mn^{3+} < Co^{3+} < Fe^{3+}$

Answer (1)

Sol.

Low spin

$Mn^{3+} \Rightarrow 3d^4 \Rightarrow$ [↑↓|↑|↑| |]
   n = 2

$Cr^{3+} \Rightarrow 3d^3 \Rightarrow$ [↑|↑|↑| |]
   n = 3

$Fe^{3+} \Rightarrow 3d^5 \Rightarrow$ [↑↓|↑↓|↑| |]
   n = 1

$Co^{3+} \Rightarrow 3d^6 \Rightarrow$ [↑↓|↑↓|↑↓| |]
   n = 0
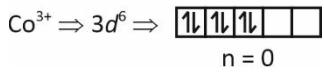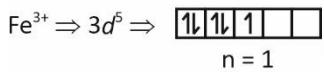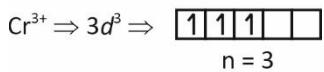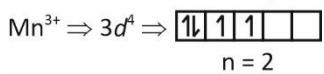
2. Match the following and choose the correct option.

List-I	List-II
(a) $[Ag(NH_3)_2]^+$	(i) Fehling's solution
(b) Zn-Hg/HCl	(ii) Clemmensen reduction
(c) $NH_2 - NH_2/KOH$	(iii) Tollens reagent
(d) Cu^{2+}/OH^-	(iv) Wolff-Kishner reduction

   (1) a(i), b(ii), c(iii), d(iv)

   (2) a(iv), b(iii), c(ii), d(i)

   (3) a(iii), b(ii), c(iv), d(i)

   (4) a(i), b(ii), c(iv), d(iii)

Answer (3)

Sol. a(iii), b(ii), c(iv), d(i)

3. For the reaction given below at 25°C
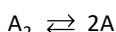
   $A_2 \rightleftarrows 2A$

   Find $\ln K_P$

   Given $\left(\Delta G_f^o\right)_A = -50.384$ kJ/mol

   $\left(\Delta G_f^o\right)_{A_2} = -100$ kJ/mol

   (1) 0.43

   (2) 0.23

   (3) 0.31

   (4) 0.53

Answer (3)

Sol. $A_2 \rightarrow 2A$

   $\left(\Delta G_f^o\right)_{rxn} = -2 \times 50.384 + 100$

   $= -0.768$ kJ

   $\Delta G^o = -RT\ln K_P$

   $-\dfrac{\Delta G^o}{8.3 \times 298} = \ln K_P$

   $\dfrac{0.768 \times 1000}{8.3 \times 298} = \ln K_P = 0.31$

4. **Statement-I :** Sucrose is dextrorotary and upon hydrolysis it becomes laevorotatory.

   Statement-II : Sucrose on hydrolysis gives glucose and fructose such that the laevorotation of glucose is more than dextrorotation of fructose.

   (1) Both Statement-I and Statement-II are correct

   (2) Both Statement-I and Statement-II are incorrect

   (3) Statement-I is correct, Statement-II is incorrect

   (4) Statement-II is correct, Statement-I is incorrect

Answer (3)

Sol. Sucrose $\rightleftharpoons$ Glucose + Fructose

   D(+) glucose   D(−) Fructose

      +52.5°   −92.4°
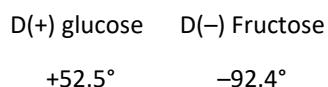
5. Which of the following is the correct order of the reactivity of given nucleophiles when treated with CH_3Br in methanol?

   F^-, I^-, $C_2H_5O^-$, $C_6H_5O^-$

   (1) $I^- > C_2H_5O^- > C_6H_5O^- > F^-$

   (2) $I^- > F^- > C_2H_5O^- > C_6H_5O^-$

   (3) $I^- > C_2H_5O^- > F^- > C_6H_5O^-$

   (4) $C_6H_5O^- > F^- > I^- > C_2H_5O^-$

Answer (1)

Sol. Nucleophilicity order of : $I^- > C_2H_5O^- > C_6H_5O^- > F^-$
Greater the size of anion, greater polarisation, greater nucleophilicity.

6. Reactivity of following on the basis of S_N1 mechanism.
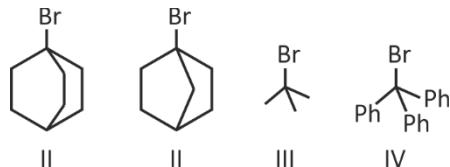
   II   II   III   IV

   (1) IV > III > I > II

   (2) II > IV > II > I

   (3) III > IV > I > II

   (4) IV > III > II > I

Answer (1)

Sol. For S_N1, more stable carbocation means higher reactivity

   II   II   III   IV

   Bridge head   9−αH   Mesomeric
   (non-planar)   of 3 phenyl
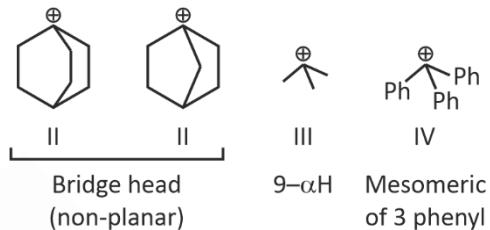
   IV > III > I > II

   II is less stable than I due to higher strain.

7. Given below are two statements.

   Statement I : HX bond length is higher in HCl than HF.

   Statement II : The lowest boiling point in hydride of group 15 element is having covalency 4.

   (1) Both statement I and statement II is correct

   (2) Both statement I and statement II is incorrect

   (3) Statement I is correct but statement II is incorrect

   (4) Statement I is incorrect but statement II is correct

Answer (3)

Sol. Bond length :   HCl   >   HF
               127.4 pm   91.7 pm

   B.P. = $BiH_3 > SbH_3 > NH_3 > AsH_3 > PH_3$
   290 K   254.6 K   238.5 K   210.6 K   185.5 K

8. A compound 'A' with molecular formula $C_9H_{11}NO$ reacts with $Br_2/NaOH$ to give (X). (X) on reaction with $NaNO_2$ in dil. HCl gives compounds (Y). When (Y) is treated with CuCN, followed by hydrolysis gives (Z). The compound (A) on hydrolysis also gives compound (Z). Identify compound (A)

(1) [structure: benzene ring with $CH_2-C(=O)-NH-CH_3$]

(2) [structure: benzene ring with $C(=O)-NH-CH_3$ and CH_3 meta]

(3) [structure: benzene ring with $C(=O)-NH_2$ and CH_2CH_3 para]

(4) [structure: benzene ring with $NH-C(=O)-CH_3$ and CH_3 para]
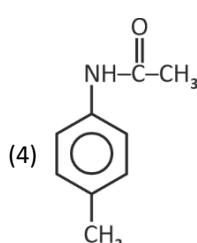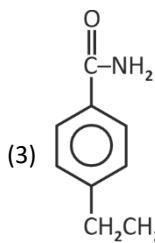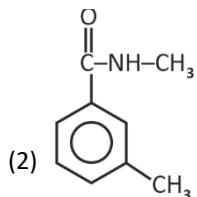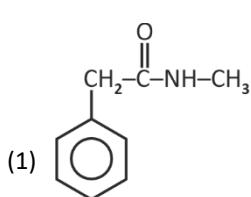
Answer (3)

Sol.
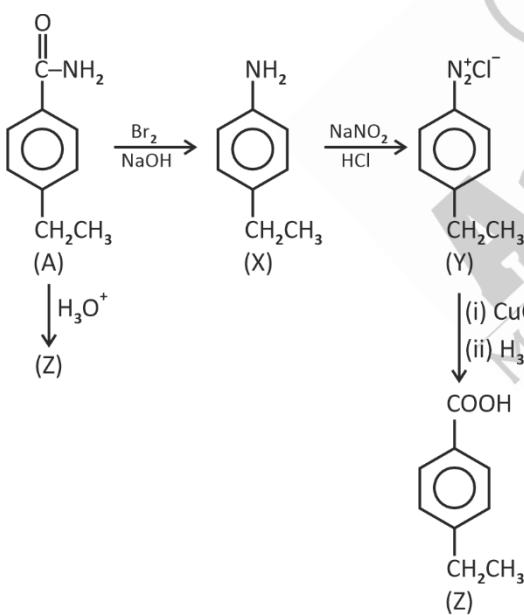
9. Which of the following statement is correct regarding the nature and directive influence of $-NO_2$ group in nitrobenzene.

(1) It is an activating group and ortho/para director

(2) It is a deactivating group and ortho/para director

(3) It is a deactivating group and meta director

(4) It is an activating group and meta director

Answer (3)

Sol. $-NO_2$ group is a deactivating group and meta director.

10. Consider the following sequence of reaction and identify A, B and C respectively.
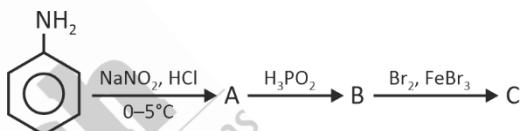
(1) C_6H_5OH, C_6H_6, $C_6H_4Br_2$

(2) $C_6H_5N_2^+Cl^-$, C_6H_6, C_6H_5Br

(3) $C_6H_5NO_2$, C_6H_5OH, C_6H_5Br

(4) C_6H_5Cl, C_6H_5OH, C_6H_6

Answer (2)
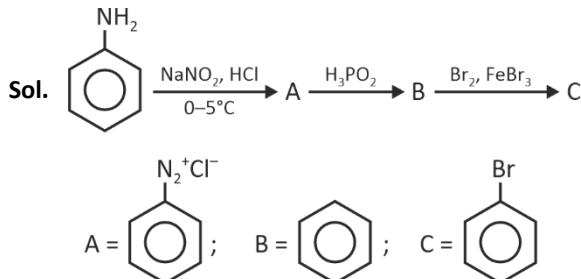
Sol.

11. In the following reaction sequence, identify compound (R).

$$\text{Phenol} \xrightarrow{\text{NaOH}} (P) \xrightarrow{CO_2} (Q) \xrightarrow{H^+} (R)$$

(1) (OH, COOH)

(2) (OH, CHO)

(3) (COOH, OH)

(4) (OH, CHO)
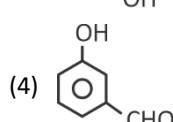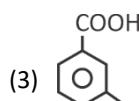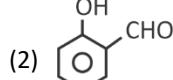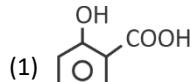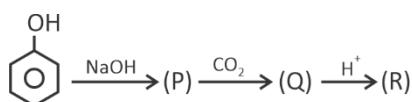
Answer (1)

Sol.
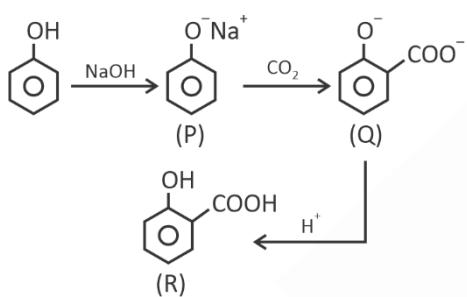
12. Given below are two statements

Statement-I : K_H is constant with change in concentration of gas till solution is dilute at given temperature.

Statement-II : According to Henry's Law, partial pressure of gas in vapour phase is inversely proportional to mole fraction of gas in solution.

(1) Both Statement-I and Statement-II are correct

(2) Both Statement-I and Statement-II are incorrect

(3) Statement-I is correct, Statement-II is incorrect

(4) Statement-I is incorrect and Statement-II is correct

Answer (3)

Sol. According to Henry's Law

$P_{gas} \propto X_{gas}$

Statement-II is incorrect

K_H is dependent on temperature

Statement-I is correct

13. Consider a first order reaction:

A → products

3 different solutions are taken and the rate of reaction of

Solution 1 : 100mL 10M 'A' → r_1

Solution 2 : 200mL 10M 'A' → r_2

Solution 3 : 100mL 10M 'A' + 100mL water → r_3

The correct order of the rates of reactions is,

(1) $r_1 = r_2 = r_3$

(2) $r_1 = r_2 < r_3$

(3) $r_1 = r_2 > r_3$

(4) $r_1 < r_2 = r_3$

Answer (3)

Sol. For a first order reaction

$$\frac{-dA}{dt} = k[A]$$

As [A] decreases rate of reaction decreases

14. Bohr's radius of H-atom is 2.12×10^{-10} m. Calculate the energy of electron at this level.

    (1) -5.44×10^{-19} J

    (2) -2.176×10^{-18} J

    (3) -54.4×10^{-19} J

    (4) -2.3×10^{-19} J

Answer (1)

Sol. $r_n = a_0 \dfrac{n^2}{Z}$

$2.12 \times 10^{-10} = 0.529 \times 10^{-10} \dfrac{n^2}{1}$

$n^2 = 4$

$n = 2$

$E_n = -13.6 \dfrac{Z^2}{n^2}$ eV

$E_n = -13.6 \dfrac{1}{2^2}$ eV

$\quad = -3.4$ eV

$\quad = -3.4 \times 1.6 \times 10^{-19}$ J

$\quad = -5.44 \times 10^{-19}$ J

15. Find the formal charge of $\overset{I}{O}$, $\overset{II}{O}$, $\overset{III}{O}$ and $\overset{IV}{N}$ respectively
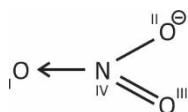

    (1) 0, +1, −1, +2

    (2) −1, −1, 0, +1

    (3) −1, 0, +2, +1

    (4) +1, −1, 0, −1

Answer (2)

**Sol.** Formal charge = Valence e^- − Non-bonding e^- − $\dfrac{1}{2}$ (Bonding e^-)
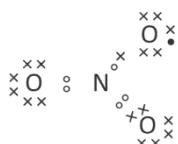
F.C. on O(I) $\Rightarrow 6 - 6 - \dfrac{1}{2}(2) = -1$

F.C. on O(II) $\Rightarrow 6 - 6 - \dfrac{1}{2}(2) = -1$

F.C. on O(III) $\Rightarrow 6 - 4 - \dfrac{1}{2}(4) = 0$

F.C. on N(IV) $\Rightarrow 5 - 0 - \dfrac{1}{2}(8) = +1$

16. For 'P', the incorrect statement is,

    (1) 'P' is less reactive than benzyl chloride towards nucleophilic substitution reaction.

    (2) In 'P', C-Cl bond has partial double bond character

    (3) 'Cl' is an ortho-para directing group towards electrophilic aromatic substitution

    (4) 'P' can undergo nucleophilic substitution reaction at normal conditions

Answer (4)

Sol. Chlorobenzene (P) does not undergo S_N reaction under normal conditions.

17. Which of the following statement is correct regarding element having atomic number 79.

    (1) It's first ionisation enthalpy is maximum in its group

    (2) It's first ionisation enthalpy is minimum in its group

    (3) It belongs to group 10 of periodic table

    (4) It belongs to 5th period of periodic table

Answer (1)

**Sol.** IE_1 (kJ/mol)　　Cu　　Ag　　Au

　　　　　　　　　　745　　730　　890

Au belongs to Group-11 and it is a 6th period element.

18. An element from 1st transition series and another element of 3rd transition series (same group) do not liberate H_2 gas from dilute acids like HCl. Both form halides. The hybridisation state of metal ion halide respectively are

    (1) Both sp^3

    (2) Both dsp^2

    (3) sp^3 and dsp^2

    (4) dsp^2 and sp^3

Answer (3)

Sol. Cu and Au do not liberate H_2 gas with dilute acid.

$CuCl_4^{2-} \Rightarrow sp^3$; $AuCl_4^- \Rightarrow dsp^2$
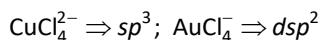
19.

20.

SECTION - B

Numerical Value Type Questions: This section contains 5 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

21. Sodium extract of organic compound of 0.1 g is treated with chlorine water and CCl_4 which dissolves in organic solvent to produce a violet colour. Upon treatment with $AgNO_3$ a yellow ppt. of 0.12 g is produced. Calculate the percentage of halide in organic compound.

Answer (65)

Sol. Layer test confirms the presence of iodine in the organic compound on treatment with $AgNO_3$, AgI precipitate is formed.

$n_{AgI} = \dfrac{0.12}{235} = 5.1 \times 10^{-4}$ mol

mass of I = $5.1 \times 10^4 \times 127$

= 0.0648 g

% of I = $\dfrac{0.0648}{0.1} \times 100 = 64.77 \approx 65\%$

22.

23.

24.

25.