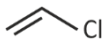
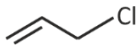
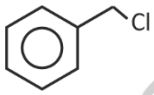
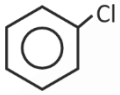
CHEMISTRY

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. Match List-I with List-II.

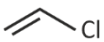
List-I		List-II	
A.	Vinyl halide	(I)	
B.	Allyl halide	(II)	
C.	Benzyl halide	(III)	
D.	Aryl halide	(IV)	

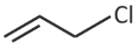
Select the correct option.

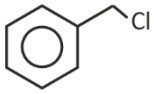
(1) A(II), B(I), C(III), D(IV) (2) A(I), B(II), C(III), D(IV)

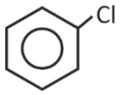
(3) A(I), B(II), C(IV), D(III) (4) A(II), B(I), C(IV), D(III)

Answer (2)

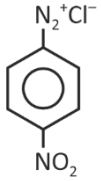
Sol. Vinyl halide → 

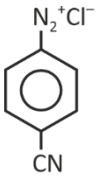
Allyl halide → 

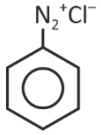
Benzyl halide → 

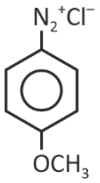
Aryl halide → 

2. The correct order of stability of following diazonium ions is

a. 

b. 

c. 

d. 

(1) a < b < c < d (2) a < b < d < c

(3) c < d < b < a (4) d < c < b < a

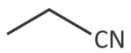
Answer (1)

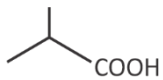
Sol. Stronger the electron withdrawing group attached at para position of $-N_2^+$ in diazonium ion, lesser is the stability and more electrophilicity.

Stability : (d) > (c) > (b) > (a)

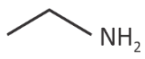
3. $A \xrightarrow[\text{II. } H_3O^+]{\text{I. } SnCl_2/HCl} B \xrightarrow[H^+]{KMnO_4} C \xrightarrow[H_2O]{Cl_2, P} C_3H_5O_2Cl$

Final product has one chiral centre. Structure of A is

(1) 

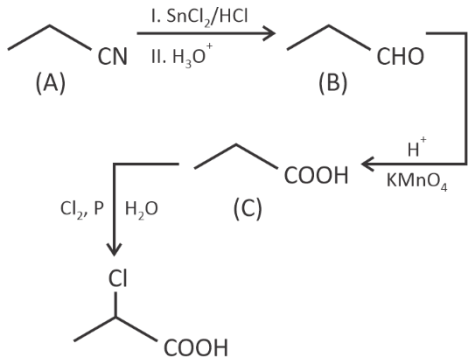
(2) 

(3) 

(4) 

Answer (1)

Sol.



4. Which of following compound contains 3 unpaired electrons?

(1) V_2O_5

(2) $[TiF_6]^{3-}$

(3) $[CoF_6]^{4-}$

(4) $[Fe(CN)_6]^{3-}$

Answer (3)

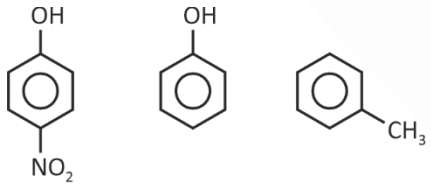
Sol. V_2O_5 : 0 unpaired electrons

$[TiF_6]^{3-}$: Ti^{3+} : [Ar] $4s^0 3d^1$: 1 unpaired e^-

$[CoF_6]^{4-}$: Co^{2+} : [Ar] $4s^0 3d^7$: 3 unpaired e^-

$[Fe(CN)_6]^{3-}$: Fe^{3+} : [Ar] $4s^0 3d^5$: 1 unpaired e^-

5. Consider the following molecules.



The correct order of dipole moment is

(1) A > B > C

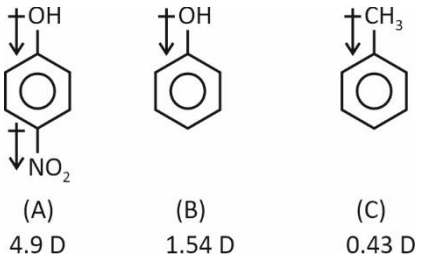
(2) A > C > B

(3) B > A > C

(4) C > A > B

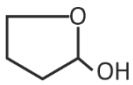
Answer (1)

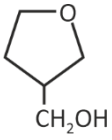
Sol.

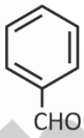


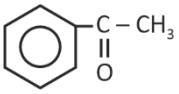
Dipole moment A > B > C

6. Which of the following compounds with give positive Tollen's reagent test?

A. 

B. 

C. 

D. 

(1) A, B and C only

(2) A and C only

(3) A, C and D only

(4) B, C and D only

Answer (2)

Sol. Aldehydes and compounds with hemiacetal linkage gives positive Tollen's test. A and C give +ve T.R. test.

7. $K_2Cr_2O_7 + I^- + H^+ \rightarrow I_2$ (x = number of moles of e^- exchanged per mol I_2)

$K_2Cr_2O_7 + S^{2-} \rightarrow S$ (y = number of moles of e^- exchanged for mole of S)

x + y is

(1) 12

(2) 9

(3) 4

(4) 6

Answer (3)

Sol. $6I^- + Cr_2O_7^{2-} + 7H_2SO_4 \rightarrow 3I_2 + 2Cr^{3+} + 7SO_4^{2-} + 7H_2O$

x = 2

$K_2Cr_2O_7 + 3S^{2-} \rightarrow 2Cr^{3+} + 3S$

y = 2

8. Match the column

	Column-I		Column-II
(A)	IF_3	(I)	sp^3d^3, Pentagonal bipyramidal
(B)	IF_5	(II)	sp^3d, T-shaped
(C)	IF_7	(III)	sp^3, Tetrahedral
(D)	ClO_4^-	(IV)	sp^3d^2, Square pyramidal

(1) (A)-(I); (B)-(II); (C)-(III); (D)-(IV)

(2) (A)-(II); (B)-(I); (C)-(IV); (D)-(III)

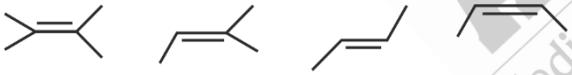
(3) (A)-(II); (B)-(IV); (C)-(I); (D)-(III)

(4) (A)-(II); (B)-(III); (C)-(IV); (D)-(I)

Answer (3)

Sol. (A)-(II); (B)-(IV); (C)-(I); (D)-(III)

9. Consider the following alkene



I II III IV

The correct stability order of alkenes is

(1) II > I > III > IV

(2) I > II > IV > III

(3) I > II > III > IV

(4) III > I > II > IV

Answer (3)

Sol. Alkene stability $\propto$ no. of α-hydrogen

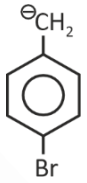
I $\rightarrow$ 12 α – H

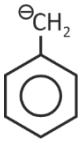
II $\rightarrow$ 9 αH

III & IV $\rightarrow$ 6 αH

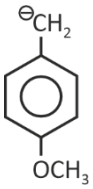
$\therefore$ Trans alkene is more stable than cis.

10. The correct order of stability of following species is

a. 

b. 

c. 

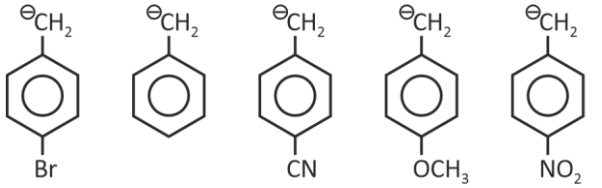
d. 

e. 

(1) e > c > a > b > d (2) d > c > b > a > e

(3) e > a > c > b > d (4) e > a > b > c > d

Answer (1)

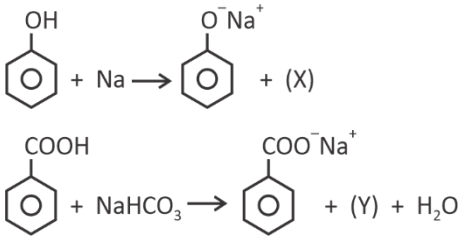
Sol. 

Br CN OCH_3 NO_2

–I Effect –M Effect +M Effect –M Effect

–M of $–NO_2$ is stronger than that of –CN.

11. What is the sum of molar mass of X and Y formed in the given reactions?



(1) 46 (2) 44

(3) 2 (4) 42

Answer (1)

Sol. (X) = H_2, (Y) = CO_2

$M_{H_2} = 2$ $M_{CO_2} = 44$

12.

	Sparingly soluble in cold water	Sparingly soluble at room temp.	Sparingly soluble in hot water
Compared →	x	y	z

x, y and z are

(1) $AlCl_3$, AgCl, Hg_2Cl_2 (2) AgCl, $AlCl_3$, Hg_2Cl_2

(3) $PbCl_2$, AgCl, Hg_2Cl_2 (4) AgCl, $HgCl_2$, $PbCl_2$

Answer (3)

Sol. x → $PbCl_2$

y → AgCl

z → Hg_2Cl_2

13. Given below are two statements.

Statement I: Atomic radius is always more than ionic radius.

Statement II: The correct order of metallic character is K > Mg > Al > B

In the light of above statements, choose the correct option.

(1) Both statement I and statement II are correct

(2) Both statement I and statement II are incorrect

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

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

Answer (4)

Sol. Order of radius : $\underset{\text{cation}}{A^+} < \underset{\text{atom}}{A} < \underset{\text{anion}}{A^-}$

Metallic character : K > Mg > Al > B

On moving along the period of periodic table, metallic character decreases.

14. Match the following.

	Column-I		Column-II
A.	Free expansion	(I)	$W = -P_{ext}\Delta V$
B.	Reversible isothermal	(II)	$W = nC_vdT$
C.	Irreversible isothermal	(III)	$W = 0$
D.	Adiabatic reversible	(IV)	$W = -nRT\ln\frac{V_f}{V_i}$

(1) A(I), B(IV), C(III), D(II) (2) A(III), B(IV), C(I), D(II)

(3) A(IV), B(III), C(II), D(I) (4) A(II), B(I), C(III), D(IV)

Answer (2)

Sol. For free expansion,

$P_{ext} = 0$, $W = 0$

For adiabatic reversible,

$q = 0$, $W = \Delta U = nC_vdT$

For reversible isothermal,

$$W = -nRT\ln\frac{V_f}{V_i}$$

For irreversible isothermal,

$W = -P_{ex}\Delta V$

15. Non-volatile solute A of mass 0.3 g (Molecular mass = 60 g/mol), and non-volatile solute B of mass 0.9 g (Molecular mass = 180 g/mol) are dissolved in 100 mL H_2O at 27°C. (Take i = 1; $d_{H_2O} = 1\,g/mL$)

If $K_b = 0.52\ K \cdot kg \cdot mol^{-1}$, then elevation of boiling point is

(1) 0.52 K

(2) 0.052 K

(3) 0.026 K

(4) 0.083 K

Answer (2)

Sol. mol of A = $\frac{0.3}{60} = \frac{1}{200}$, mol of B = $\frac{0.9}{180} = \frac{1}{200}$

mass of solvent = 100 mL × (1 g/mL) = 100 g

$$\Delta T_f = K_f \times m = 0.52 \times \left(\frac{\frac{1}{200} + \frac{1}{200}}{0.1} \right) = 0.052\ K$$

16. A solution contains two group-IV cations, X^{2+} and Y^{2+}, each at an initial concentration of 0.1 M. H_2S gas is passed through the solution to form a saturated solution. Given

K_{sp} of YS = $2 \times 10^{-27}\ M^2$

K_{sp} of XS = $1 \times 10^{-27}\ M^2$

What is the minimum concentration of sulphide in $[S^{2-}]$ required to begin precipitation of YS?

(1) 2×10^{-26}

(2) 10^{-26}

(3) 3.2×10^{-14}

(4) 0.1

Answer (1)

Sol. For precipitation

$Q_{ip} > K_{sp}$

$YS(s) \rightleftharpoons Y^{2+}(aq) + S^{2-}(aq)$

$[Y^{2+}]\,[S^{2-}] = K_{sp}(YS)$

$[Y^{2+}] = 0.1\ M$

$$[S^{2-}] = \frac{Ksp(Ys)}{0.1}$$

$$= \frac{2 \times 10^{-27}}{0.1}$$

$= 2 \times 10^{-26}\ M$

17. What is the hybridisation and spin only magnetic moment of complex $[Co(CO)_6]Cl_3$?

(1) d^2sp^3, 0 BM

(2) sp^3d^2, 4.90 BM

(3) d^2sp^3, 4.90 BM

(4) sp^3d^2, 0 BM

Answer (1)

Sol. CO is SFL with Co^{3+}

$3d^6 \Rightarrow t_{2g}^6 e_g^0$

hybridisation = d^2sp^3

$$\mu\,(\text{spin only}) = \sqrt{n(n+2)}\ BM$$

n = 0

μ spin only = 0 BM

18.

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. Two solutes A and B of 0.3 g and 0.9 g respectively (molar mass of A and B are 30 g/mol and 90 g/mol respectively) are dissolved in 100 mL water. (Take solutes to be non-electrolyte). Calculate osmotic pressure at 300 K (in atm)

Answer (5)

Sol. $n_A = \frac{0.3}{30} = 10^{-2}$ mol

$n_B = \frac{0.9}{90} = 10^{-2}$ mol

$[A] = \frac{10^{-2}}{100} \times 1000 = 0.1\,M$

$[B] = \frac{10^{-2}}{100} \times 1000 = 0.1\,M$

$\pi = i\,CRT$

$\pi = 1 \times 0.2 \times 0.0821 \times 300 = 4.926 \text{ atm} \approx 5$

22. Minimum energy transition of Balmer series (energy line having minimum energy) of H-atom has energy of L eV. If the value of minimum energy of Lyman series (energy line having minimum energy) of H-atom in terms of L is y, then the value of 10y is _____.

Answer (54)

Sol. $(\Delta E_{min})_{Balmer} = 13.6\left(\frac{1}{4} - \frac{1}{9}\right)$ eV

$= 13.6\frac{5}{36} = L$ eV

$(\Delta E_{min})_{Lyman} = 13.6\left(\frac{1}{1} - \frac{1}{4}\right) = 13.6\frac{3}{4}$ eV

$= 13.6 \times \frac{5}{36} \times \frac{36}{5} \times \frac{3}{4}$

$5.4\ L = y$

$10y = 54$

23. Find % of 'N' in 0.5 g organic compound which gives 34 mL N_2 (g) at 715 mm Hg pressure and 300 K.

(Aq. tension = 15 mm Hg)

(Report to nearest integer) $R = 0.0821 \frac{\text{Lit-atm}}{\text{K-mol}}$

Answer (7)

Sol. $\%\ N = \frac{\frac{715-15}{760} \times 34 \times 10^{-3}}{\frac{0.082 \times 300}{0.5}} \times 28 \times 100 = 7.12\%$

24. Find the value of $\log\left(\frac{k_{catalysed}}{k_{uncatalysed}}\right)$ at 300K if the change in activation energy (ΔEa) is 10 kJ/mol. ($R = 8\ JK^{-1}\ mol^{-1}$) (lnx = 2.3 logx)

Answer (2)

Sol. $k = Ae^{-Ea/RT}$

Ea_1 (catalysed)

Ea_2 (uncatalysed)

$\frac{k_{cat}}{k_{uncat}} = e^{\frac{-Ea_1 + Ea_2}{RT}}$

$\log\frac{k_{cat}}{k_{uncatalysed}} = \frac{-Ea_1 + Ea_2}{2.303RT}$

$(Ea_2 - Ea_1) = 10000$ J/mol

$\log\frac{K_{cat}}{K_{uncatalysed}} = \frac{10000}{300 \times 8 \times 2.3}$

$= \frac{4.167}{2.3}$

$= 1.81$

≈ 2

25.