CHEMISTRY
JEE-MAIN (July-Attempt)
29 July (Shift-1) Paper Solution

SECTION - A

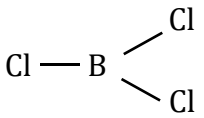
1. Which of the following pair of molecules contain odd electron molecule and an expanded octet molecule ?

(A) BCl_3 and SF_6 (B) NO and H_2SO_4 (C) SF_6 and H_2SO_4 (D) BCl_3 and NO

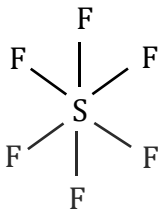
Sol. **B**

Expanded octet – Central atom has more than $8e^-$

Odd electron species ⇒ Number of total electrons in valence shell is odd.

(i) $BCl_3 \Rightarrow$  ⇒ total electrons for boron ⇒ $6e^-$

(valence shell) for each chloride ⇒ $8e^-$

(ii) $5F_6 \Rightarrow$  → total electron (valence shell)

⇒ $12e^-$ For sulphur for 'F' each ⇒ 8

$6 \times 2 \Rightarrow 12$

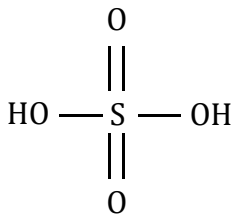
(iii) No ⇒ · N = O total valence electron in nitrogen is 5e–

Total valence electron in oxygen is 8e–

So total electron is 13e–

⇓

∵ It is odd electronic species Odd number

(iv) $H_2SO_4 \Rightarrow$  → Here also it is not odd electronic species

Now if we want to identify expanded octet

(i) BCl_3	(ii) SF_6	(ii) NO	(iv) H_2SO_4
⇓	⇓	⇓	⇓
$6e^-$	$12e^-$	$5e^-$	$2e^-$

2. $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$
20g 5g
Consider the above reaction, the limiting reagent of the reaction and number of moles of NH_3 foremed respectively are :
(A) H_2, 1.42 moles (B) H_2, 0.71 moles (C) N_2, 1.42 moles (D) N_2, 0.71 moles

Sol. **C**
$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
W_2 = 20g 5
$n = \frac{20}{28}$ 5/2
Stoichiometric Amount.
$N_2 \rightarrow \frac{20/28}{1} = \frac{20}{28} H_2 \rightarrow \frac{5/2}{3} = \frac{5}{6}$
∴ N2 is the limiting reagent
$\therefore n(NH_3) = 2 \times n(N_2) = 2 \times \frac{20}{28}$
= 1.42

3. 100 mL of 5% (w/v) solution NaCl in water was prepared in 250 mL beaker. Albumin from the egg was poured into NaCl solution and stirred well. This resulted in a/an :
(A) Lyophilic sol (B) Lyophobic sol (C) Emulsion (D) Precipitate

Sol. **A**
Standard method for the preparation of lyophilic

4. The first ionization enthalpy of Na, Mg and Si, respectively, are : 496, 737 and 786 kJ mol^{-1}. The first ionization enthalpy (kJ mol^{-1}) of Al is :
(A) 487 (B) 768 (C) 577 (D) 856

Sol. **C**
Order of 1st I.E. I.E. ↑ → along the period
But Mg has more ionization energy because of stable electronic configuration

Na < Al < Mg < Si
496 731 786

So the value of I.E. of Al must lie in between 496 and 737 i.e. ⇒ **(C) 577**

5. In metallurgy the term "gangue" is used for :
(A) Contamination of undesired earthy materials.
(B) "Contamination of metals, other than desired metal.
(C) Minerals which are naturally occurring in pure form.
(D) Magnetic impurities in an ore.

Sol. **A**
gangue : Ore usually contaminated with earthly or undesired materials known as gangue. [direct from n.c.e.r.t.]

6. The reaction of zinc with excess of aqueous alkali, evolves hydrogen gas and gives :

(A) $Zn(OH)_2$ (B) ZnO (C) $[Zn(OH)_4]^{2-}$ (D) $[ZnO_2]^{2-}$

Sol. **C, D**

$NaOH(aq.) + Zn \longrightarrow Na_2[Zn(OH)_4] + H_2\uparrow$

∴ so we can write it in ionic form as $[Zn(OH)_4]$.

$NaOH(aq.) + Zn \longrightarrow Na_2ZnO_2 + H_2\uparrow$

so we can write it in ionic form as $(ZnO_2)^{-2}$

So Correct option is (C, D)

7. Lithium nitrate and sodium nitrate, when heated separately, respectively, give :

(A) $LiNO_2$ and $NaNO_2$ (B) LiO_2 and Na_2O

(C) LiO_2 and $NaNO_2$ (D) $LiNO_2$ and Na_2O

Sol. **C**

All alkali nitrates on heating breakdown into nitrites and O_2 except lithium nitrate.

$NaNO_3 \xrightarrow{\Delta} NaNO_2 + O_2$

$LiNO_3 \xrightarrow{\Delta} Li_2O + NO_2 + O_2$

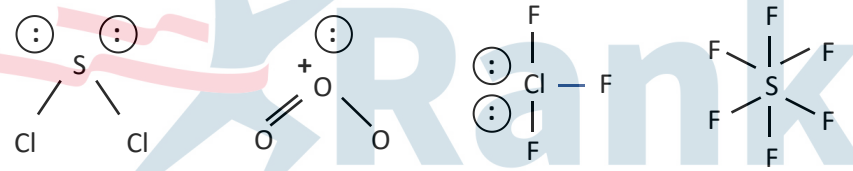
It breaks into its oxide, $NO_2(g)$ and dioxygen gas.

So correct option is (C) $NaNO_2$ & Li_2O

8. Number of lone pairs of electrons in the central atom of SCl_2, O_3, ClF_3 and SF_6, respectively, are :

(A) 0, 1, 2 and 2 (B) 2, 1, 2 and 0 (C) 1, 2, 2 and 0 (D) 2, 1, 0 and 2

Sol. **B**



no. of l.p = 2 no. of l.p = 1 no. of l.p = 2 no. of l.p = 0

Correct option is 'B'.

9. In following pairs, the one in which both transition metal ions are colourless is :

(A) Sc^{3+}, Zn^{2+} (B) Ti^{4+}, Cu^{2+} (C) V^{2+}, Ti^{3+} (D) Zn^{2+}, Mn^{2+}

Sol. **A**

The transition metal whose either all d orbitals are completely filled or vacant in either neutral or ionic state is colorless or in other words.

→ that transition metal will show color which has at least one unpaired electron.

$_{21}Sc \rightarrow [Ar]3d^1\ 4s^2$; $Sc^{3+} \rightarrow [Ar]\ 3d^0\ 45^0$

$_{30}Zn \rightarrow [Ar]3d^{10}\ 4s^2$; $Zn^{3+} \rightarrow [Ar]\ 3d^{10}\ 45^0$

$_{22}Ti \rightarrow [Ar]3d^2\ 4s^2$; $Ti^{4+} \rightarrow [Ar]\ 3d^0\ 45^0$

$_{23}V \rightarrow [Ar]3d^3\ 4s^2$; $V^{2+} \rightarrow [Ar]\ 3d^3$

$_{29}Cu \rightarrow [Ar]3d^{10}\ 4s^1$; $Cu^{2+} \rightarrow [Ar]\ 3d^9\ 45^0$

$_{25}Mn \rightarrow [Ar]3d^5\ 4s^2$; $Mn^{2+} \rightarrow [Ar]\ 3d^5\ 45^0$

The colorless ions are :– Sc^{3+}, Zn^{2+}

So the correct option is 'A'.

10. In neutral or faintly alkaline medium, $KMnO_4$ being a powerful oxidant can oxidize, thiosulphate almost quantitatively, to sulphate. In this reaction overall change in oxidation state of manganese will be :

(A) 5 (B) 1 (C) 0 (D) 3

Sol. **D**

Reaction of $KMnO_4$ in neutral medium;

→ In neutral medium $MnO_4^- \longrightarrow MnO_2$

$$\overset{+7}{MnO_4^-} + S_2O_3^{2-} \longrightarrow \overset{+4}{MnO_2} + SO_4^{2-}$$

Change of oxidation state of Mn = 7 – 4 = 3

∴ **so option (D)**

11. Which among the following pairs has only herbicides ?

(A) Aldrin and Dieldrin (B) Sodium chlorate and Aldrin

(C) Sodium arsenate and Dieldrin (D) Sodium chlorate and sodium arsinite

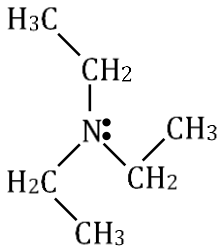
Sol. **D**

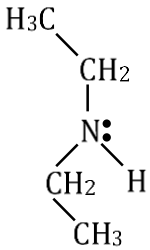
Sodium chlorate and sodium arsinite are used as herbicides

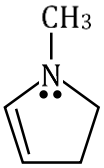
⇒ DDT, BHC, Aldrin, Dieldrin ⇒ insecticides

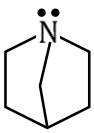
∴ **Option (D)**

12. Which among the following is the strongest Bronsted base ?

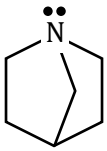
(A) 

(B) 

(C) 

(D) 

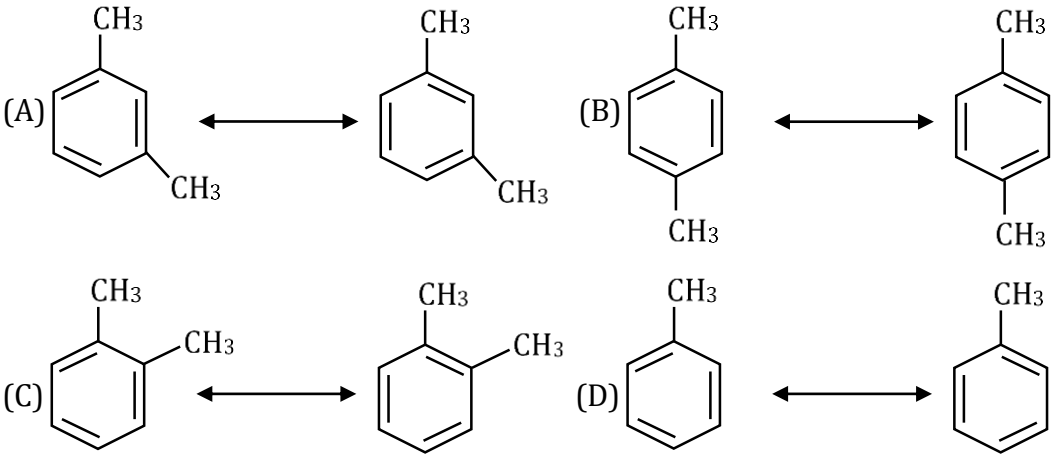
Sol. **D**



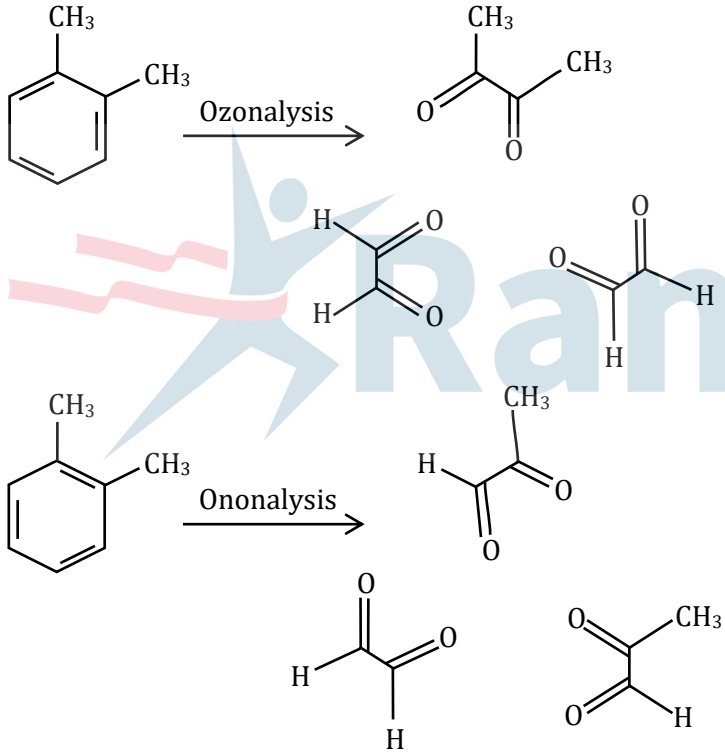
This is bridged alkyl amine. It is also 3°, hence lone pair is more available.

Amine inversion is also not possible.

13. Which among the following pairs of the structures will give different products on ozonolysis ? (Consider the double bonds in the structures are rigid and not delocalized.)

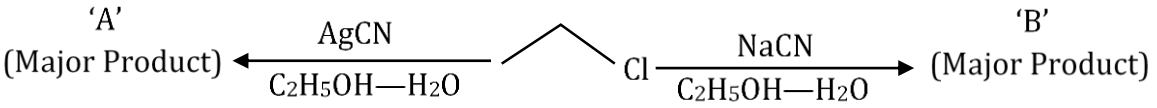


Sol. **C**

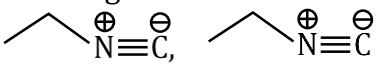


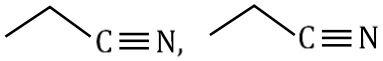
Rankers

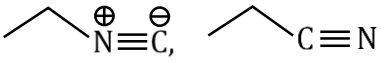
14.

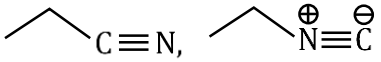


Considering the above reactions, the compound 'A' and compound 'B' respectively are :

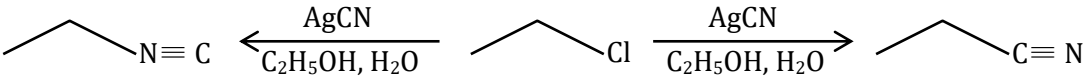
(A) 

(B) 

(C) 

(D) 

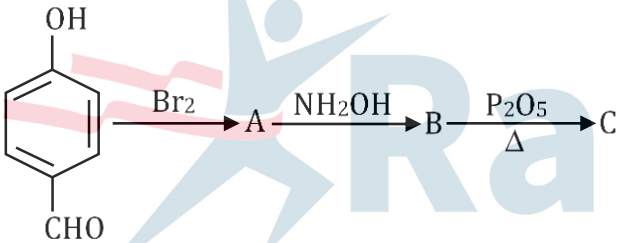
Sol. **C**



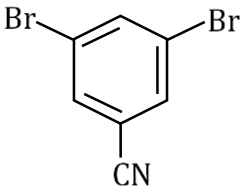
(major) (major)

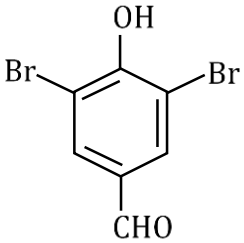
NaCN is ionic in nature , So in CN^- anion 'c' act as nucleophile, and AgCN is covalent in nature, So 'N' act as nucleophile, as we know CN is ambidentate ligand,

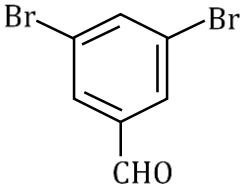
15.

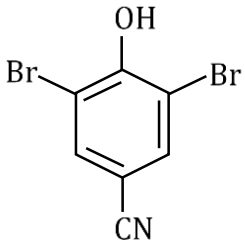


Consider the above reaction sequence, the Product 'C' is :

(A) 

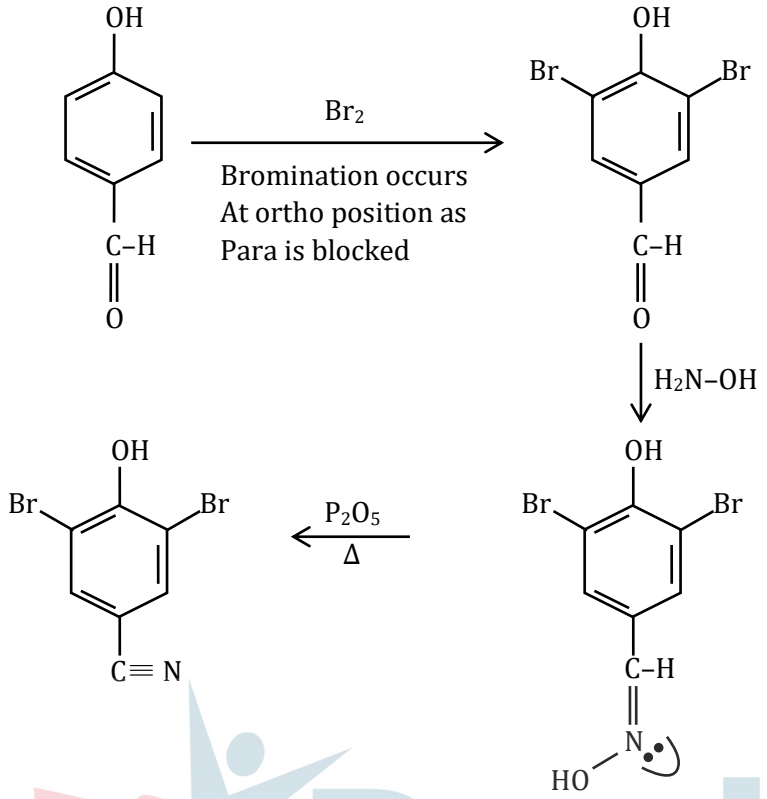
(B) 

(C) 

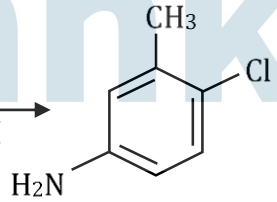
(D) 

Rankers

Sol. **D**

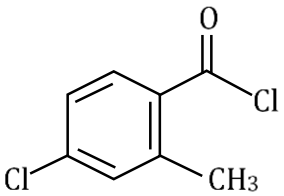


16. 'A'($C_8H_6Cl_2O$) $\xrightarrow{NH_3}$ C_8H_8ClNO $\xrightarrow[NaOH]{Br_2}$

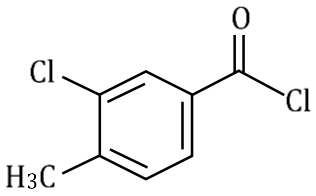


Consider the above reaction, the compound 'A' is :

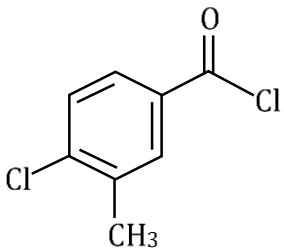
(A)



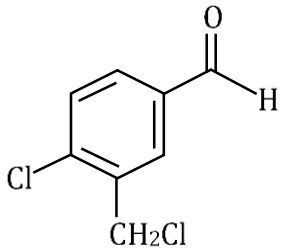
(B)



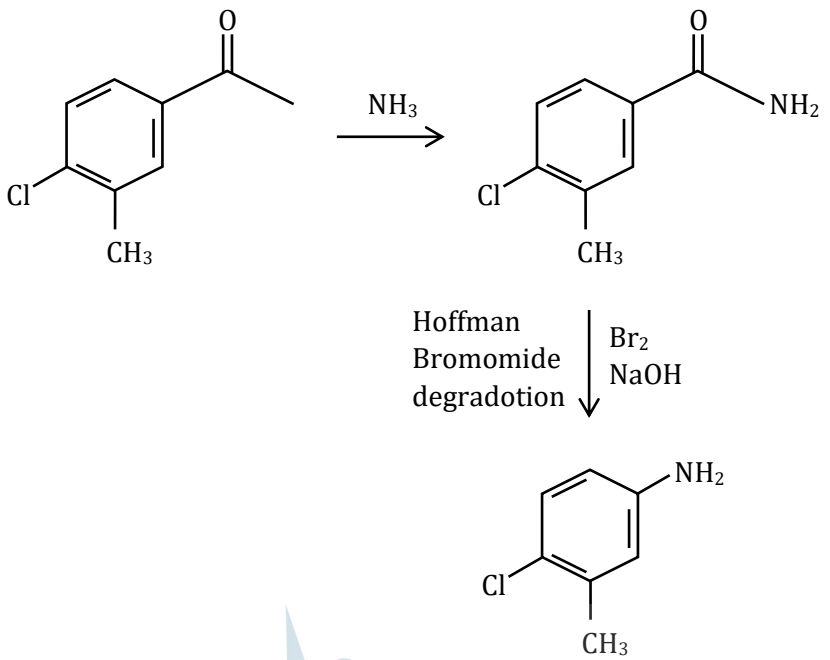
(C)



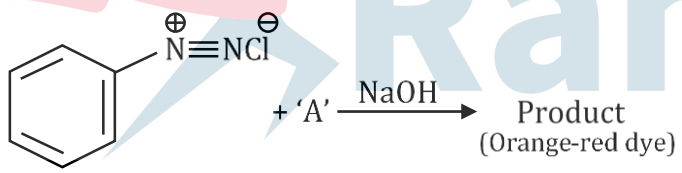
(D)



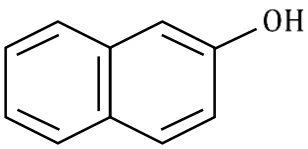
Sol. **C**

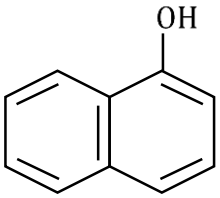


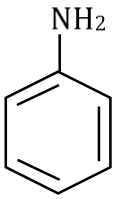
17.

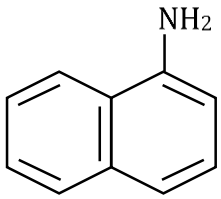


Which among the following represent reagent 'A'

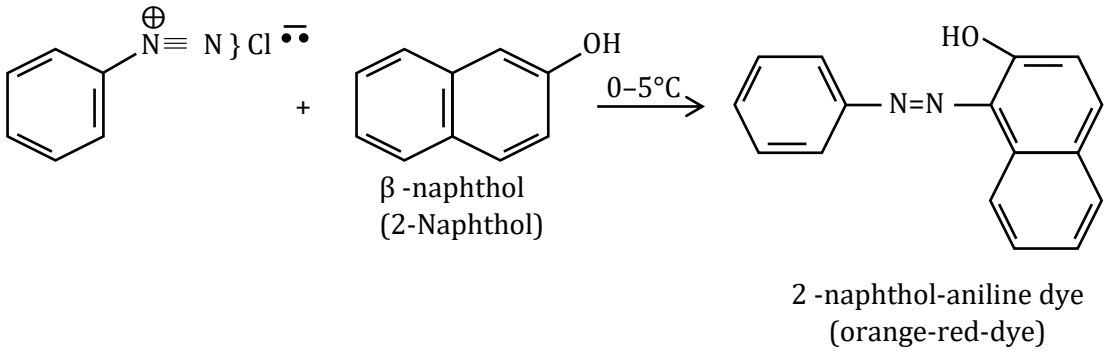
(A) 

(B) 

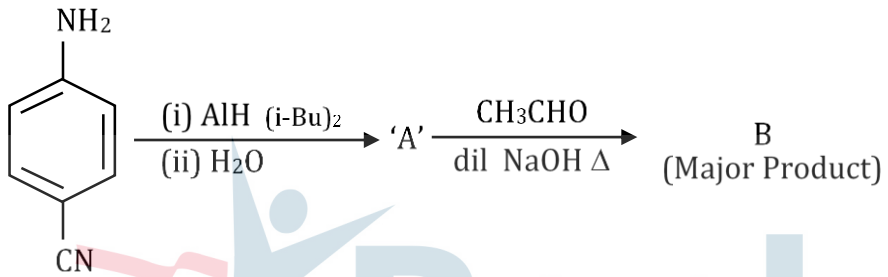
(C) 

(D) 

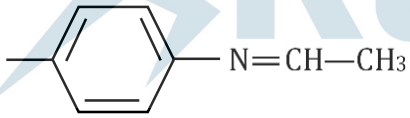
Sol. **(A)**

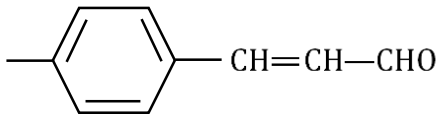


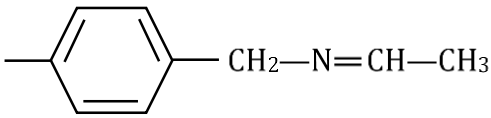
18. Consider the following reaction sequence :

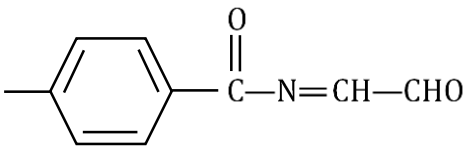


The product 'B' is :

(A) 

(B) 

(C) 

(D) 

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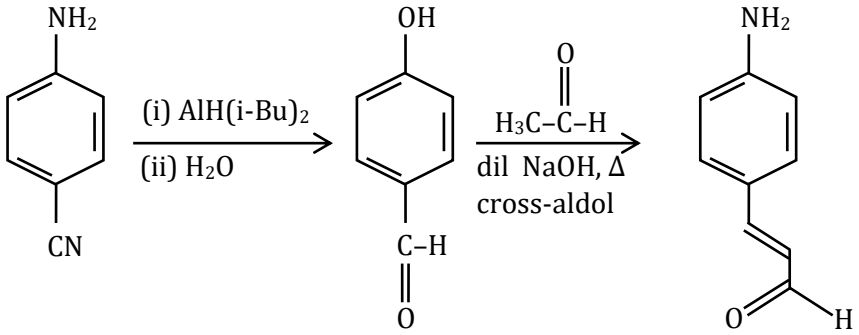
Sol. **B**



19. Which of the following compounds is an example of hypnotic drug ?

(A) Seldane (B) Amytal (C) Aspartame (D) Prontosil

Sol. **B**

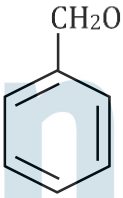
Amytol is hypnotic drug

Amytal is derivative of barbiturate is sedative-hypnatic drug.

20. A compound 'X' is acidic and it is soluble in NaOH solution but insoluble in $NaHCO_3$ solution. Compound 'X' also gives violet colour with neutral $FeCl_3$ solution. The compound 'X' is :

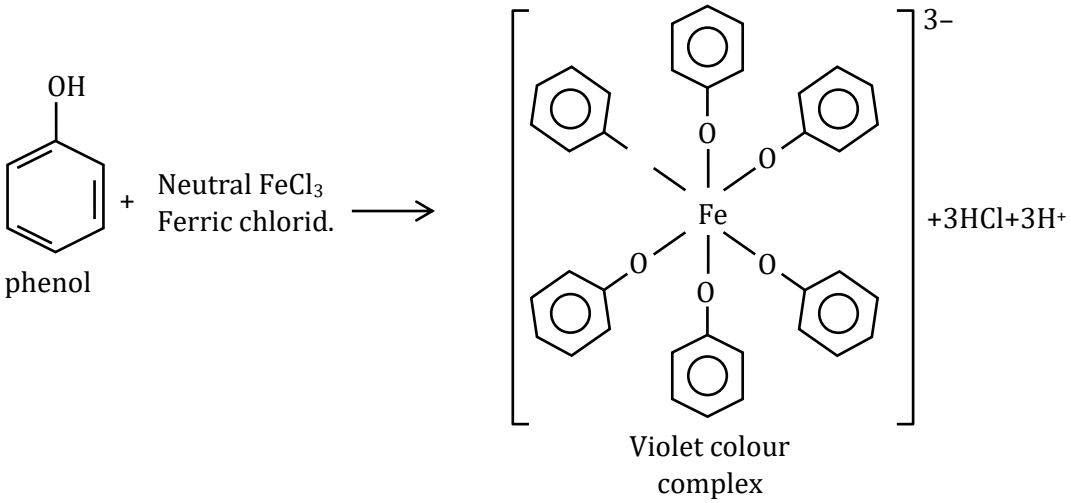
(A)

(B)

(C) 

(D)

Sol. **B**



SECTION - B

21. Resistance of a conductivity cell (cell constant 129 m^{-1}) filled with 74.5 ppm solution of KCl is 100Ω (labelled as solution 1). When the same cell is filled with KCl solution of 149 ppm, the resistance is 50Ω (labelled as solution 2). The ratio of molar conductivity of solution 1 and solution 2 is i.e. $\frac{\Lambda_1}{\Lambda_2} = x \times 10^{-3}$. The value of x is_____. (Nearest integer)

Given, molar mass of KCl is 74.5 g mol^{-1}.

Sol. **1,000**

Given that : - $\frac{\ell}{A} = 129m^{-1}$

Case (I):-

Concentration of KCl solution = 74.5 ppm

Resistance (R_1) = 100 Ω

For solution 1

$k_1 = \frac{1}{R_1} \times \frac{\ell}{A}$

$= \frac{1}{100} \times 129 = \frac{129}{100}$

Molar conductivity $\Rightarrow \wedge_1 = k_1 \times \frac{1000}{M_1}$

M_1 = Molarity of 1st solution

Case II :-

Concentration of KCl solution = 149 ppm

Resistance (R_2) = 50 Ω

For solution 2 :-

$k_2 = \frac{1}{R_2} \times \frac{\ell}{A}$

$= \frac{1}{50} \times 129 = \frac{129}{50}$

Molar conductivity = $\wedge_2 = k_2 \times \frac{1000}{M_2}$

M_2 = Molarity of 2nd solution.

$\frac{\Lambda_1}{\Lambda_2} = \frac{k_1 \times \frac{1000}{M_1}}{k_2 \times \frac{1000}{M_2}} = \frac{k_1}{k_2} \times \frac{M_2}{M_1}$

$= \frac{k_1}{k_2}\frac{(ppm)_2}{(ppm)_1} \left(\because \frac{(ppm)_2}{(ppm)_1} = \frac{M_2}{M_1}\right) = \frac{129/100}{129/50} \times \frac{147}{74.5} = 1 = 1000 \times 10^{-3}$

22. Ionic radii of cation A^+ and anion B^- are 102 and 181 pm respectively. These ions are allowed to crystallize into an ionic solid. This crystal has cubic close packing for B^-. A^+ is present in all octahedral voids. The edge length of the unit cell of the crystal AB is_____pm. (Nearest Integer)

Sol. **566**

Ionic radii of cation (A^+) = r_+ = 102 pm

Ionic radii of anion (B^-) = r_- = 181 pm

For cubic close packing :-

Edge length (a) = $2r_+ + 2r_-$ ($\because$ cations are present in octahedral voids)

= (2 × 102) + (2 × 181) = 566 pm

23. The minimum uncertainty in the speed of an electron in an one dimensional region of length $2a_0$ (where a_0 = Bohr radius 52.9 pm) is _____km s^{-1}.
(Given : Mass of electron = 9.1×10^{-31} kg, Planck's constant h = 6.63×10^{-34} Js)

Sol. **548**

$\Delta x . \Delta P \geq \frac{h}{4\pi}$

$\Delta x = 2a_0$ $\Delta P = m\Delta v$

$a_0 = 52.9$ pm = 52.9×10^{-12} m.

$\Delta x . m\Delta v = \frac{h}{4\pi}$

$\Delta x = \frac{h}{4\pi \times m \times \Delta x} = \frac{6.63\times10^{-34}}{4\times3.14\times9.1\times10^{-31}\times2\times52.9\times10^{-12}}$

= 548273 m/sec.

= 548.273 km/sec.

≈ 548 km/sec.

24. When 600 mL of 0.2 M HNO_3 is mixed 400 mL of 0.1 M NaOH solution in a flask, the rise in temperature of the flask is_____ $\times 10^{-2}$ °C.
(Enthalpy of neutralization = 57 kJ mol^{-1} and specific heat of water = 4.2 JK^{-1} g^{-1})
(Neglect heat capacity of flask)

Sol. **54**

$HNO_3 + NaOH \longrightarrow NaNO_3 + H_2O$

600 ml 400ml

0.2 M 0.1 M

mili moles of HNO_3 = 600 × 0.2 = 120 m mol

mili moles of NaOH = 400 × 0.1 = 40 m mol

$HNO_3 + NaOH \longrightarrow NaNO_3 + H_2O$

120 40

80 0 40

After the reaction

∵ 40 m moles = 40×10^{-3} moles are reacting.

Enthalpy change for reaction

$\Delta_r H = 40 \times 10^{-3} \times 57 \times 10^3$ J

= 2280 J

C = Specific heat of water

M = mass of solution

= density × volume

= 1 gm/ml × 1000 ml

= 1000 gm

$q = mc\Delta T$ ∵ $q = \Delta_r H$

$2280 = 1000 \times 4.2 \times \Delta T$

$\Delta T = 54.286 \times 10^{-2}$ k = 54.286×10^{-2} °C ≈ 54×10^{-2} °C

25. If O_2 gas is bubbled through water at 303 K, the number of millimoles of O_2 gas that dissolve in 1 litre of water is_____. (Nearest Integer)
(Given : Henry's Law constant for O_2 at 303 K is 46.82 k bar and partial pressure of O_2 = 0.920 bar)
(Assume solubility of O_2 in water is too small, nearly negligible)

Sol. **1**

Given that

k_H = 46.82 k bar = 46.82 × 10^3 bar

Partial pressure of O_2 = pO_2 = 0.920 bar

X = mole fraction of dissolved gas

$= \frac{\text{mole of } O_2}{\text{mole of dissolved } O_2 + \text{mole of water}} \approx \frac{\text{mole of } O_2}{\text{mole of water}}$

Mole of water = $\frac{1000}{18}$ ($\because$ mass of 1000 ml water = 1000 gm)

According to Henry's law :-

$P_{O_2} = k_H \times X$

$0.920 = 46.82 \times 10^3 \times \frac{\text{mole of } O_2}{1000/18}$

Mole of O_2 = $\frac{0.920}{46.82 \times 18}$ = $1.09 \times 10^{-3} \approx 1 \times 10^{-3}$

mili moles of O_2 = 1

26. If the solubility product of PbS is 8×10^{-28}, then the solubility of PbS in pure water at 298 K is $x \times 10^{-16}$ mol L^{-1}. The value of x is _____. (Nearest Integer)
[Given : $\sqrt{2} = 1.41$]

Sol. **282**

$Pbs \rightleftharpoons Pb^{2+} + s^{2-}$

$k_{sp} = s^2$ $\quad$ s → Solubility

k_{sp} = solubility product

$s = \sqrt{k_{sp}}$

$= \sqrt{8 \times 10^{-28}}$ $\quad \because$ Given $K_{sp} = 8 \times 10^{-28}$

$= \sqrt{8} \times 10^{-14} = 2\sqrt{2} \times 10^{-14}$

$= 2.82 \times 10^{-14} = 282 \times 10^{-16}$ mol/L = $x \times 10^{-16}$

$\boxed{x = 282}$

27. The reaction between X and Y is first order with respect to X and zero order with respect to Y.

Experiment	[X] / mol L^{-1}	[Y] / mol L^{-1}	Initial rate / mol L^{-1} min^{-1}
I	0.1	0.1	2×10^{-3}
II	L	0.2	4×10^{-3}
III	0.4	0.4	$M \times 10^{-3}$
IV	0.1	0.2	2×10^{-3}

Examine the data of table and calculate ratio of numerical values of M and L. (Nearest Integer)

Sol. **40**

rate (r) = k $[x]^a$ $[y]^b$

k = rate constant

Given that a = 1 : b = 0

For experiment I :-

$r_I = k\,[0.1]^a\,[0.1]^b = 2 \times 10^{-3}$

$k\,[0.1]^1\,[0.1]^0 = 2 \times 10^{-3}$ ----(1)

for experiment II :-

$r_{II} = k\,[L]^1\,[0.2]^0 = 4 \times 10^{-3}$ ----(2)

equation (2) ÷ equation (1)

$\frac{L}{0.1} = \frac{4\times10^{-3}}{2\times10^{-3}}$

$\boxed{L = 0.2}$

For experiment III: -

$r_{III} = k[0.4]^1\,[0.4]^0 = M \times 10^{-3}$ ----(3)

For experiment IV: -

$r_{IV} = k[0.1]^1\,[0.2]^0 = 2 \times 10^{-3}$ ----(4)

Divide equation (3) by equation (4) :-

$\frac{0.4}{0.1} = \frac{M\times10^{-3}}{2\times10^{-3}}$

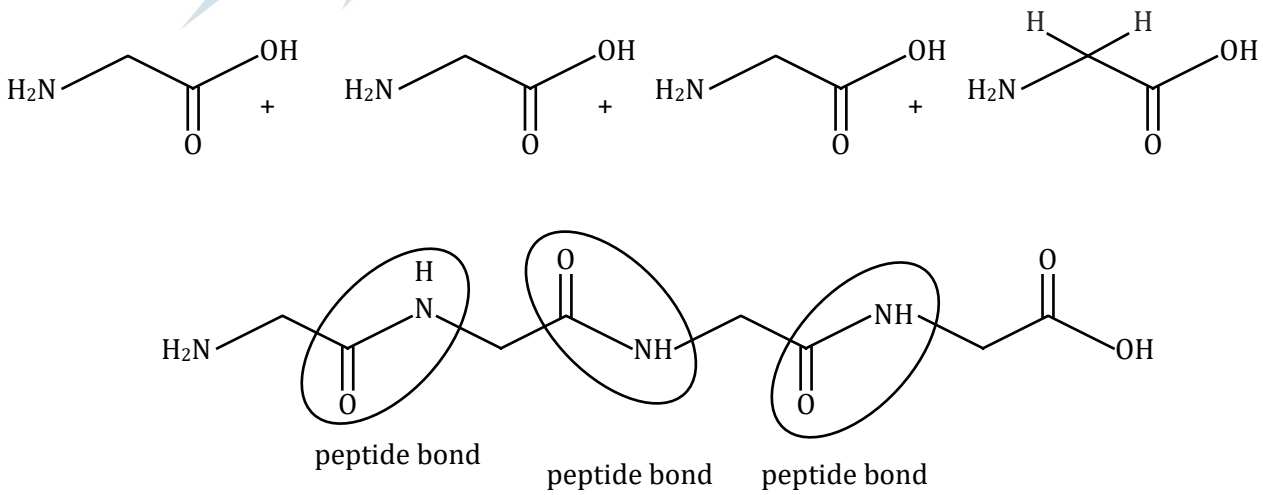
$\boxed{M = 8}$

$\frac{M}{L} = \frac{8}{0.2} = \frac{40}{1}$

Ratio of M and L = 40

28. In a linear tetrapeptide (Constituted with different amino acids), (number of amino acids)–(number of peptide bonds) is_____.

Sol. **1**



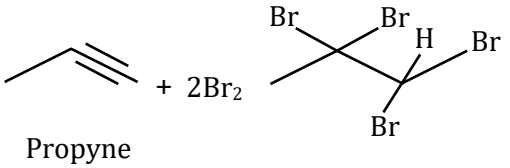
(No of amino acid) – (peptide bond)

4 – 3

⇒ 1

29. In bromination of Propyne, with Bromine 1, 1, 2, 2-tetrabromopropane in 27% yield. The amount of 1, 1, 2, 2-tetravromopropane obtained from 1 g of Bromine in this reaction is _____ $\times 10^{-1}$g. (Nearest Integer)
(Molar Mass : Bromine = 80 g/mol)

Sol. **3**



1, 1, 2, 2-tetrabromopropane

27% yield
MM = 360 g/mol

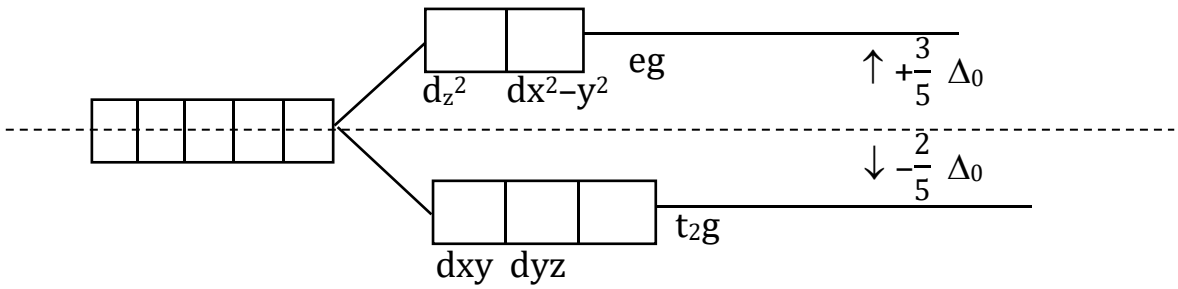
2 mol Br_2 produce 1 mol (1, 1, 2,2-tetrabromopropane)
So,
1 mol Br_2 produce = (1/2) mole tetrabromopropane
1 g Br_2 is given
Mole of Br_2 = (1/160) mol
Amount of tetrabromopropane formed

$$= \left(\frac{1}{160}\right) \times \frac{1}{2} \times 360 \times \left(\frac{27}{100}\right)$$
$$= 0.3037 \text{ g}$$
$$= 3.037 \times 10^{-1} \text{ g}$$

30. $[Fe(CN)_6]^{3-}$ should be an inner orbital complex. Ignoring the pairing energy, the value of crystal field stabilization energy for this complex is (–) ---------- Δ_0 (Nearest Integer)

Sol. **2**

$[Fe(CN)_3]^{3-}$
⇓
$\boxed{\text{C.N.} = 6}$ → as in question it is mentioned inner d complex
Means Hybridization is d^2sp^3 (octahedral)
Splitting of octahedral complex



→ as ligand approaches long the axis in octahedral complex ; so the orbitals who are along the axis will get repulsion.
→ Hence along the axis orbitals i.e. dz^2 & $dx^2 - y^2$ get more energy.

Now, O.N of Fe here is

$[Fe(CN)_6]^{3-}$ $\Rightarrow -3 - \{-1 \times 6\}$

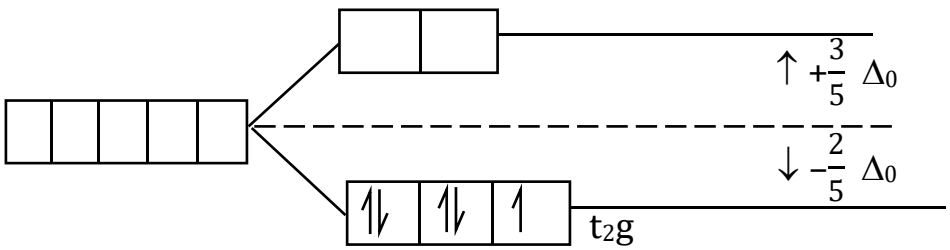
$\Rightarrow +3$

$Fe \rightarrow [Ar]3d^6 4s^2$

$Fe^{+3} \rightarrow [Ar]3d^5 4s^0$

$\Rightarrow$ as here S.F.L. so hunds rule will not followed here, so $\Delta_0 >$ P. E.

$\Rightarrow$ Hence t_{2g} will first filled



C.F.S.E = $(-2/5)\,\Delta_0 \times 5 + np + (\frac{3}{5}\Delta_0) \times 0$

↑

C.F.S.E = $-2\,\Delta_0$ here paring energy is said to ignore in question.

So, the numerical value is '2'.

Rankers