|JEE MAIN 2025 | DATE : 23 JAN 2025 (SHIFT-1) MORNING

CHEMISTRY

SECTION 1

[:Q.51] Given below are two statements:

Statement I: In Lassaigne's test, the covalent organic molecules are transformed into ionic compounds.

Statement II: The sodium fusion extract of an organic compound having N and S gives prussian blue colour with $FeSO_4$ and $Na_4[Fe(CN)_6]$

In the light of the above statements, choose the correct answer from the options **given below**

[:A] Statement I is false but Statement II is true

[:B] Statement I is true but Statement II is false

[:C] Both Statement I and Statement II are true

[:D] Both Statement I and Statement II are false

[:ANS] **C**

[:Q.52] The correct set of ions (aqueous solution) with same colour from the following is:

[:A] Zn^{2+}, V^{3+}, Fe^{3+}

[:B] V^{2+}, Cr^{3+}, Mn^{3+}

[:C] Ti^{4+}, V^{4+}, Mn^{2+}

[:D] $Sc^{3+}, Ti^{3+}, Cr^{2+}$

[:ANS] **B**

[:SOLN] Zn^{2+} | Ti^{4+} -colourless

v^{2+} | Mn^{3+} | Cr^{3+} -violet

v^{4+} | Cr^{2+} -Blue

Mn^{2+} – Light pink

[:Q.53] **Match the List I with List II**

LIST-I (Classification of molecules based on octet rule)		LIST-II (Example)	
A.	Molecules obeying octet rule	I.	NO, NO_2
B.	Molecules with incomplete octet	II.	$BCl_3, AlCl_3$
C.	Molecules with incomplete octet with odd electron	III.	H_2SO_4, PCl_5
D.	Molecules with expanded octet	IV.	CCl_4, CO_2

Choose the correct anwer from the options given below:

[:A] A-II, B-IV, C-III, D-I

[:B] A-IV, B-I, C-III, D-II

[:C] A-IV, B-II, C-I, D-III

[:D] A-III, B-II, C-I, D-IV

[:ANS] **C**

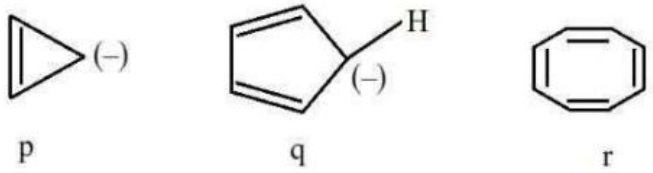
[:SOLN] **A.** Molecule obey octet rule - CCl_4, CO_2 -(IV)

B. Molecules with incomplete octet- $BCl_3, AlCl_3$ ……(ii)

C. Molecule with incomplete octet and odd e- NO , NO_2 .(i)

D. Molecules with experted octet- H_2SO_4, PCl_5 ….(iii)

[:Q.54] **The correct stability order of the following species /molecules is:**



p q r

[:A] p > q > r

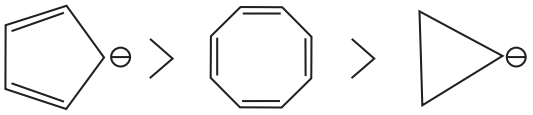
[:B] q > p > r

[:C] r > q > p

[:D] q > r > p

[:ANS] **D**

[:SOLN]



Aromtic Non Aromatic Anti Aromatic

q > r > p

[:Q.55] What amount of bromine will be required to convert 2 g of phenol into 2,4,6-tribromophenol? (Given molar mass in g mol^{-1} of C, H, O, Br are 12, 1, 16, 80 respectively)

[:A] 4.0g

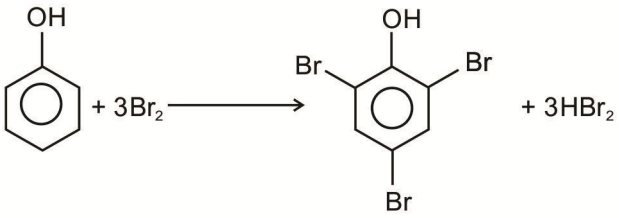
[:B] 10.22g

[:C] 6.0g

[:D] 20.44g

[:ANS] **B**

[:SOLN]



[:SOLN]

$$n_{Phenel}\,(moles) = \frac{2g}{94\ g/mol}$$

$$n_{Br_2} = \frac{3\times 2}{94} mol$$

$\therefore$ Mass of Bromine

$$= \frac{6}{94}\times 160$$

=10.22 g

[:Q.56] Propane molecule on chlorination under photochemical condition gives two di-chloro products, "x" and "y". Amongst "x" and "y", "x" is an optically active molecule. How many tri-chloro products (consider only structural isomers) will be obtained from "x" when it is further treated with chlorine under the photochemical condition?

[:A] 5

[:B] 2

[:C] 3

[:D] 4

[:ANS] **C**

[:Q.57] The element that does not belong to the same period of the remaining elements (modern periodic table) is:

[:A] Iridium

[:B] Platinum

[:C] Osmium

[:D] Palladium

[:ANS] **D**

[:SOLN] $\underbrace{Ir, Pt, OS}_{\downarrow \text{P.N.}-6}$ $\underbrace{Pd}_{\downarrow \text{P.N}-5}$

[:Q.58] The incorrect statement among the following is

[:A]. SO_2 can act as an oxidizing agent, but not as a reducing agent.

[:B]. NO_2 can dimerise easily.

[:C] PF_3 exists but NF_5 does not.

[:D] PH_3 shows lower proton affinity than NH_3.

[:ANS] **A**

[:SOLN] **(a)** SO_2 as act as both O.A as well as R.A

(b) $2NO_2 \rightarrow N_2O_4$

(c) PF_3 exist-NF_5 not exist due to absence of d-orbit

(d) proton affinity : $NH_3 > PH_3$

OR

$An \rightarrow SO_2 \rightarrow$ Has Sulphur in + 4 oxidation state,

So it can act both as oxidicing as well as Reducing Agent

[:Q.59] $CrCl_3.xNH_3$ can exist as a complex. 0.1 molal aqueous solution of this complex shows a depression in freezing point of 0.558°C. Assuming 100% ionisation of this complex and coordination number of Cr is 6, the complex will be (Given K_f = 1.86 K kg mol^{-1})

[:A] $[Cr(NH_3)_3Cl_3]$

[:B] $[Cr(NH_3)_4Cl_2]\,Cl$

[:C] $[Cr(NH_3)_6]\ Cl_3$

[:D] $[Cr(NH_3)_5Cl]\ Cl_2$

[:ANS] **D**

[:SoLN] $CrCl_3.XNH_3\ (0.1M)$

$\Delta T_f = 0.558°C$

$C.N - Six$

$K_f = 1.86 k\,kg\,mol^{-1}$

$0.558 = 1.86 \times 0.1 \times i \times m$

$I = 3$

$\left[Co(NH_3)_5\ Cl\right]Cl_2$

[:Q.60] Given below are two statements:

Statement I: Fructose does not contain an aldehydic group but still reduces Tollen's reagent

Statement II: In the presence of base, fructose undergoes rearrangement to give glucose.

In the light of the above statements, choose the correct answer from the options given below

[:A] Both Statement I and Statement II are true

[:B] Statement I is false but Statement II is true

[:C] Both Statement I and Statement II are false

[:D] Statement I is true but Statement II is false

[:ANS] **C**

[:Soln] Both statement (i) and Statement (ii) are true

[:Q.61] Which of the following happens when NH_4OH is added gradually to the solution containing 1 M A^{2+} and 1 M B^{3+} ions?

Given: $K_{sp}[A(OH)_2] = 9 \times 10^{-10}$ and $K_{sp}[B(OH)_3] = 27 \times 10^{-18}$ at 298 K.

[:A] $A(OH)_2$ and $B(OH)_3$ will precipitate together

[:B] $B(OH)_3$ will precipitate before $A(OH)_2$

[:C] Both $A(OH)_2$ and $B(OH)_3$ do not show precipitation with NH_4OH

[:D] $A(OH)_2$ will precipitate before $B(OH)_3$

[:ANS] **A**

[:SOLN] 1 M A^{2+} and 1 M B^{3+}

Requirement of OH^- by $\left[A(OH)_2\right]$

$A(OH)_2 \rightarrow A^{2+} + 2OH^-$

$9\times10^{-10} = (1)\times[OH]^2$

$\left[OH^-\right] = 3\times[OH]^2$

Requirement of OH^- by $B(OH)_3$

$B(OH)_3 \rightarrow B^{3+} + 3OH^-$

$27\times10^{-18} = 1\times\left[OH^-\right]^3$

$\left[OH^-\right] = 3\times10^{-6}$

$\therefore B(OH)_3$ precipitates first

[:Q.62] The d-electronic configuration of an octahedral Co(II) complex having magnetic moment of 3.95 BM is:

[:A] $t_{2g}^5 e_g^2$

[:B] $e^4 t_2^3$

[:C] $t_{2g}^3 e_g^0$

[:D] $t_{2g}^6 e_g^1$

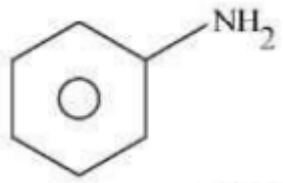
[:ANS] **A**

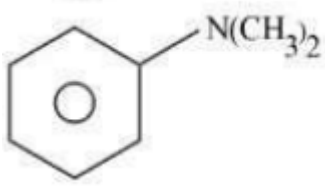
[:SOLN] $Co(II) - 3d^7\,4 - t2g^5\,eg^2$

n =3

$\mu_s = 3.95$ B.M

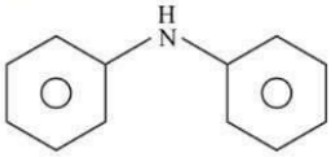
[:Q.63] **Which among the following react with Hinsberg's reagent?**

[:A] 

[:B] 

[:C] $CH_3 - NH_2$

[:D] $N(CH_3)_3$

[E] 

Choose the correct answer from the options given below:

[:A] B and D only

[:B] A, C and E only

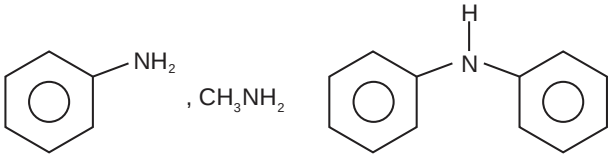
[:C] C and D only

[:D] A, B and E only

[:ANS] **B**

[:SOLN] A, C and E

i.c.



Hinsberg reaqent-react with 1º and 2º Amine

[:Q.64] The complex that shows Facial-meridional isomerism is:

[:A] $[Co(NH_3)_3Cl_3]$

[:B] $[Co(en)_3]^{3+}$

[:C] $[Co\,(en)_2\,Cl_2]^+$

[:D] $[Co\,(NH_3)_4\,Cl_2]^+$

[:ANS] **D**

[:SOLN] $[Ma_3b_3]$ type complex show facial -meriodional isomerism.

$\left[Co(NH_3)_3\,Cl_3\right]$

[:Q.65] Ice at -5°C is heated to become vapor with temperature of 110°C at atmospheric pressure. The entropy change associated with this process can be obtained from

[:A] $\int_{268K}^{383K} C_p\,dT + \frac{\Delta H_{melting}}{273} + \frac{\Delta H_{boiling}}{373}$

[:B] $\int_{268K}^{383K} C_p\,dT + \frac{q_{rev}}{T}$

[:C] $\int_{268K}^{273K} C_{p,m}\,dT + \frac{\Delta H_{m,fusion}}{T_f} + \frac{\Delta H_{m,vaporisation}}{T_b} + \int_{273K}^{373K} C_{p,m}\,dT + \int_{373K}^{383K} C_{p,m}\,dT$

[:D] $\int_{268K}^{273K} \frac{C_{p,m}}{T}\,dT + \frac{\Delta H_{m,fusion}}{T_f} + \frac{\Delta H_{m,vaporisation}}{T_b} + \int_{273K}^{373K} \frac{C_{p,m}\,dT}{T} + \int_{373K}^{383K} \frac{C_{p,m}\,dT}{T}$

[:ANS] **C**

[:SOLN] $-5°C\ ice \rightarrow 110°C\ steam$

$$\int_{268}^{273} \frac{Cp_1 dT}{T} + \frac{\Delta Hf}{273} + \int_{273}^{373} \frac{Cp_2 dT}{T} + \frac{\Delta Hv}{373} + \int_{373}^{583} \frac{Cp_3 dT}{T}$$

[:Q.66] Heat treatment of muscular pain involves radiation of wavelength of about 900 nm. Which spectral line of H atom is suitable for this?

Given: Rydberg constant $R_H = 10^5 cm^{-1}, h = 6.6 \times 10^{-34} Js, e = 3 \times 10^8 m/s$ **)**

[:A] Paschen series, $5 \rightarrow 3$

[:B] Balmer series, $\infty \rightarrow 2$

[:C] Lyman series, $\infty \rightarrow 1$

[:D] Paschen series, $\infty \rightarrow 3$

[:ANS] **D**

[:SOLN] Limiting line of Parchen

$$\frac{1}{\lambda_l} = 10^7 \times 1^2 \left(\frac{1}{9}\right)$$

$$\therefore \lambda_l = 900 \text{ nm}$$

[:Q.67] $FeO_4^{2-} \xrightarrow{+2.0V} Fe^{3+} \xrightarrow{0.8V} Fe^{2+} \xrightarrow{-0.5V} Fe^0$

In the above diagram, the standard electrode potential are given in volts (over the arrow).

The value of $E^{\ominus}_{FeO_4^{2-}/Fe^{2+}}$ is

[:A] 2.1V

[:B] 1.4 V

[:C] 1.2 V

[:D] 1.7 V

[:ANS] **D**

[:SOLN] $FeO_4^{2-} \xrightarrow{(+2.0V)} Fe^{3P} \xrightarrow{(+0.8)} Fe^{+2} \xrightarrow{(-0.5V)} Fe$

$$3e^- + Fe\,O_4^{2-} \rightarrow \cancel{Fe^{+3}} \quad \Delta G = -2 \times F \times 3$$

$$\cancel{Fe^{+3}} + e^- \rightarrow Fe^{+2} \Rightarrow \Delta G = -1 \times F \times 0.8$$

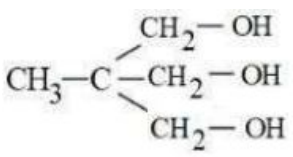
$$FeO_4^{2-} + 4e^- \rightarrow Fe^{+2} \Rightarrow \Delta G = -4 \times F \times E$$

$$\therefore \quad E = \left(\frac{-6 - 0.8}{-4}\right)$$

$$= \frac{-6.4}{-4} = 1.7V$$

[:Q.68] **The major product of the following reaction is:**

$$CH_3CH_2CH{=}O \xrightarrow[\text{reflux}]{\text{excess HCHO, alkali}} ?$$



[:A]

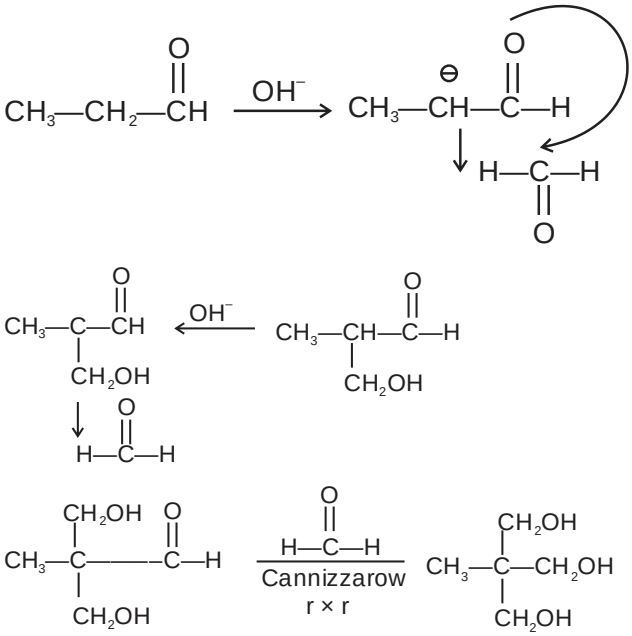
[:B] $CH_3-CH_2-CH_2-OH$

[:C] $CH_3-C(=CH_2)-CH=O$

[:D] $CH_3-CH(CH_2-OH)-CH=O$

[:ANS] **A**

[:SOLN]



[:Q.69] 2.8×10^{-3} mol of CO_2 is left after removing 1021 molecules from its 'x' mg sample. The mass of CO_2 taken initially is

Given: $N_A = 6.02\times10^{23}$ mol^{-1}

[:A] 196.2 mg

[:B] 98.3 mg

[:C] 48.2 mg

[:D] 150.4 mg

[:ANS] **A**

[:SOLN] 10^{21} molecules $\Rightarrow \frac{10^{21}}{6.02\times10^{23}} = \frac{10^{-2}}{6.02}$ mol

$\therefore$ Total CO_2 initially

$=1.66\times10^{-3}+2.8\times10^{-3}$

$=4.46 \times 10^{-3}$ mol

$\therefore\ W_{CO_2}=196.24$ mg

[:Q.70] Match the list I with list II

LIST-I Name reaction		LIST-II Product obtainable	
A.	Swarts reaction	I.	Ethyl benzene
B.	Sandmeyer's reaction	II.	Ethyl iodide
C.	Wurtz Fittig reaction	III.	Cyanobenzene
D.	Finkelstein reaction	IV.	Ethyl fluoride

Choose the correct answer from the options given below:

[:A] A-IV, B-I, C-III, D-II

[:B] A-II, B-I, C-III, D-IV

[:C] A-II, B-III, C-I, D-IV

[:D] A-IV, B-III, C-I, D-II

[:ANS] D

[:SOLN]

Swart r × n → (iv) Ethyl Fluoride

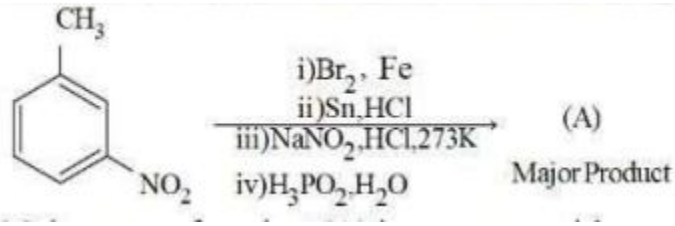
Sandmeri's r × n → (iii) Cyanoberzeno

Wurtez Fittig r × n → Ethyl benzeno

Fenkelsteen r × n → Elhyl lodide

Numerical

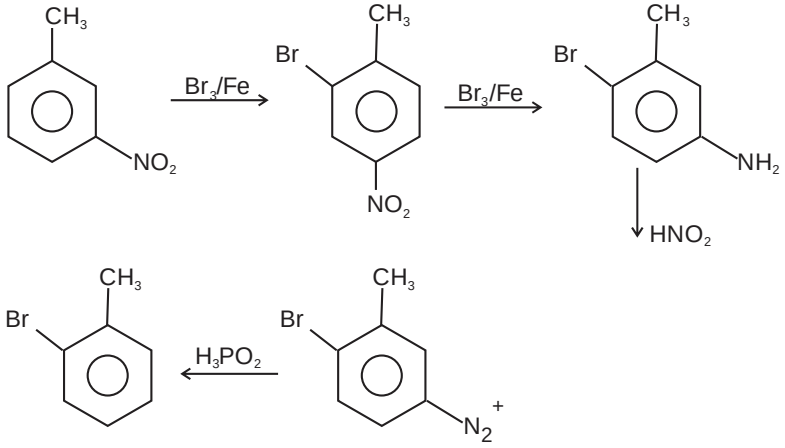
[:Q.71] Consider the following sequence of reactions to produce major product (A)



Moalr mass of product (A) is _____ g mol^{-1}

[:ANS] **171**

[:SOLN]



84 + 7 + 80 = 171

[:Q.72] During "S" estimation, 160 mg of an organic compound gives 466 mg of barium sulphate. The percentage of Sculpture in the given compound is _____%.

(Given molar mass in $gmol^{-1}$ of Ba : 137, S : 32, O : 16)

[:Ans] **70**

[:SOLN] % of S = $\frac{32}{233} \times \frac{466}{160} \times 100$

= 39.99

= 40

[Q.73] The standard enthalpy and standard entropy of decomposition of N_2O_4 to NO_2 are 55.0 kJ mol^{-1} and 175.0 J/K mol respectively. The standard free energy change for this reaction at 25°C in J mo^{l-1} is _____ (Nearest intger)

[:Ans] **2850**

[:SoLN] $N_2O_4 \rightleftharpoons 2NO_2$

$\Delta H = 55000 J/mol$

$\Delta S = 173 J/K\,mol$

T = 295 K

$\Delta G = 55000 - 298 \times 175$

= 2850 J/mol

[:Q.74] If 1 mM solution of ethylamine produces pH = 9, then the ionization constant (K_b) of ethylamine is 10^{-x}. The value of x is _____ (nearest integer).

[The degree of ionization of ethylamine can be neglected with respect to unity.]

[:Ans] **7**

[:SOLN] $1nM = 10^{-3}$ mol l^{1} $CH_3CH_2NH_2$

PH = ?

K_b= ?

$\alpha << 1 \rightarrow$ Given

$\therefore POH = 5$

$\therefore \left|OH^-\right| = 10^{-5}$

$10^{-5} = \sqrt{C \times K_6}$

$\left(10^{-5}\right)^2 = 10^{-3} \times K_b$

$K_b = 10^{-7}$

X = 7

[:Q.75] For the thermal decomposition of $N_2O_5(g)$ at constant volume, the following table can be formed, for the reaction mentioned below.

$2N_2O_5(g) \rightarrow 2N_2O_4(g) + O_2(g)$

Sr. No.	Time's	Total pressure (atm)
1	0	0.6
2	100	'x'

$x = \_\_\_\_\_ \times 10^{-3}$ atm [nearest integer]

Given : Rate constant for the reaction is $4.606 \times 10^{-2}\ s^{-1}$.

[:Ans] **900**

[:SOLN]

$2N_2O_5\ lg \rightarrow 2N_2O_4 + O_2(g)$

t = 0 s a mol 0 0

t = t a – z z $\frac{z}{z}$

$\therefore a \propto 0.6$

$$a+\frac{z}{z}\propto x$$

$$\frac{z}{z}\propto (x-0.6)$$

$$z\propto 2(x-0.6)$$

$$\ln\frac{a}{a-z}=Kt$$

$$\ln\frac{0.6}{0.6-(2x-1.2)}=4.606\times10^{-2}\times100$$

$$2.303\log\frac{0.6}{1.8-2x}=4.606$$

$$\frac{0.6}{1.8-2x}=100$$

$$200x=180-0.6$$

$$x=\left(\frac{179.4}{200}\right)=0.897\,atm$$

$$=897\times10^{-3}\,atm$$