# FINAL JEE–MAIN EXAMINATION – MARCH, 2021

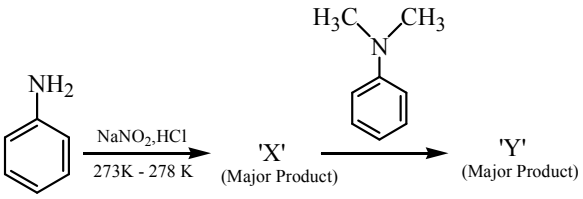
**(Held On Thursday 18th March, 2021) TIME : 9 : 00 AM to 12 : 00 NOON**

## CHEMISTRY

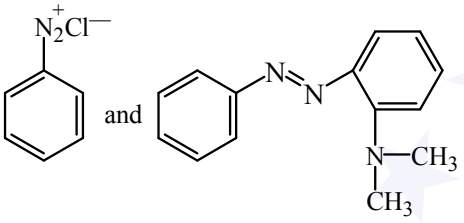
## TEST PAPER WITH ANSWER & SOLUTION

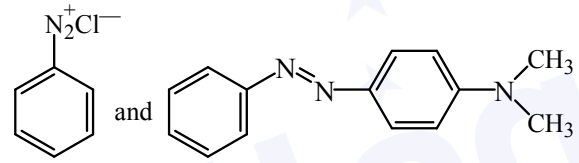
### SECTION-A

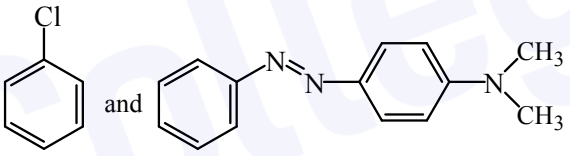
**1.**

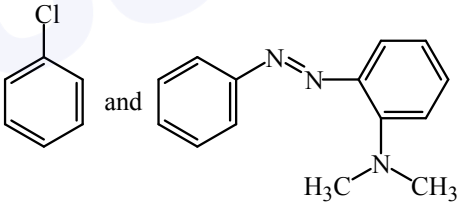



Considering the above reaction, X and Y respectively are :

(1) 

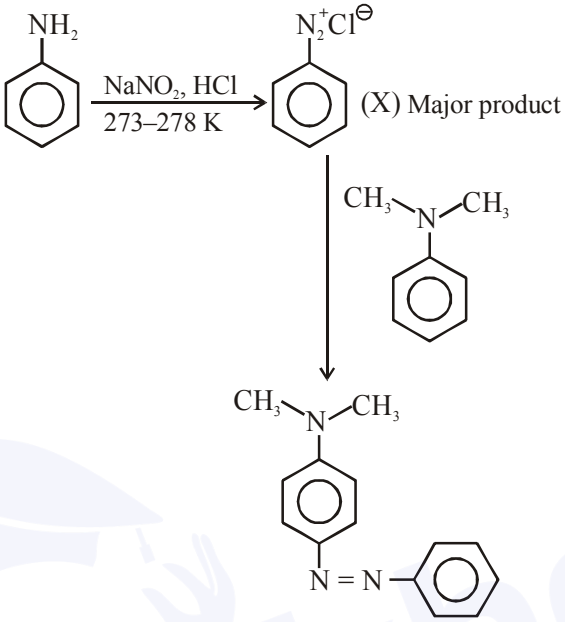

(2) 


(3) 


(4) 


**Official Ans. by NTA (2)**

**Sol.**




**2.** The ionic radius of $Na^+$ ions is 1.02 Å. The ionic radii (in Å) of $Mg^{2+}$ and $Al^{3+}$, respectively, are-

(1) 1.05 and 0.99 (2) 0.72 and 0.54

(3) 0.85 and 0.99 (4) 0.68 and 0.72

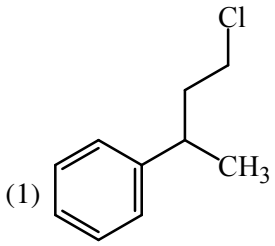
**Official Ans. by NTA (2)**

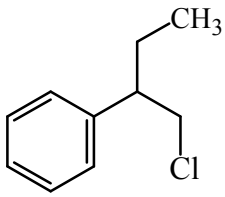
**Sol.** The ionic radii order is

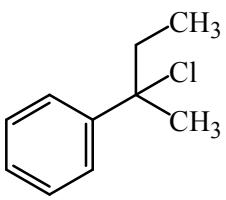
$Na^+ > Mg^{2+} > Al^{3+}$

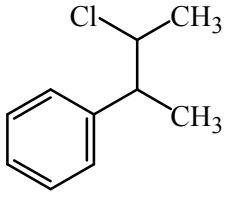
**3.** Reaction of Grignard reagent, $C_2H_5MgBr$ with $C_8H_8O$ followed by hydrolysis gives compound "A" which reacts instantly with Lucas reagent to give compound B, $C_{10}H_{13}Cl$.

The Compound B is :

(1) 


(2) 


(3) 


(4) 

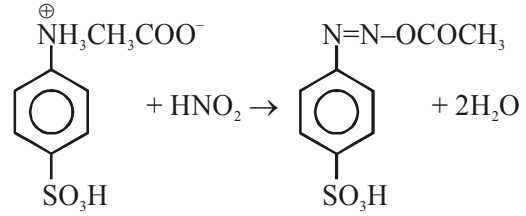
**4.** Reagent, 1-naphthylamine and sulphanilic acid in acetic acid is used for the detection of

(1) $N_2O$ (2) $NO_3^-$ (3) NO (4) $NO_2^-$

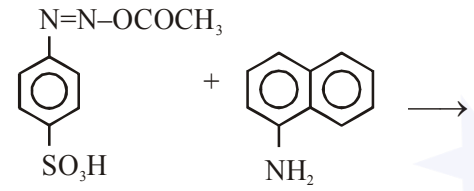
**Official Ans. by NTA (4)**

**Sol.** For detection of $NO_2^-$, the following test is used.

$NO_2^- + CH_3COOH \rightarrow HNO_2 + CH_3COO^-$

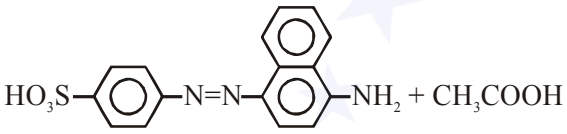



(Sulphanilic acid solution)




Diazotized acid

1-napthyl amine




(Red azo dye)

**5.** A non-reducing sugar "A" hydrolyses to give two reducing mono saccharides. Sugar A is-

(1) Fructose (2) Galactose

(3) Glucose (4) Sucrose

**Official Ans. by NTA (4)**

**Sol.** Sucrose $\xrightarrow{H_2O}$ glucose + Fructose

(Non reducing sugar) (Reducing sugar) (Reducing sugar)

**6.** Match the list -I with list - II

| **List-I (Class of Drug)** | **List-II (Example)** |
|---|---|
| (a) Antacid | (i) Novestrol |
| (b) Artificial sweetener | (ii) Cimetidine |
| (c) Antifertility | (iii) Valium |
| (d) Tranquilizers | (iv) Alitame |

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

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

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

**Official Ans. by NTA (1)**

**Sol.**

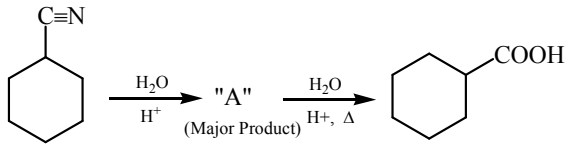
(a) Antacid : Cimetidine

(b) Artifical Sweetener : Alitame

(c) Antifertility : Novestrol

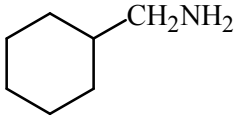
(d) Tranquilizers : Valium

**7.**

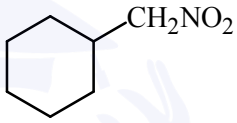



Consider the above chemical reaction and identify product "A"

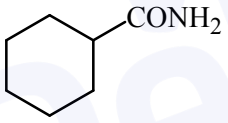
(1)



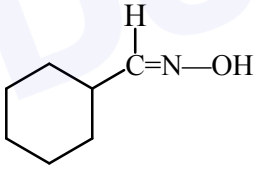

(2)




(3)

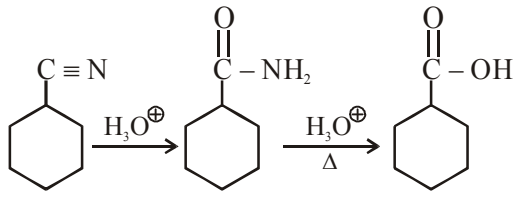



(4)




**Official Ans. by NTA (3)**

**Sol.**




'A'

Major product (partial hydrolysis)

Complete hydrolysis

**8.** Match List-I with List-II

| List-I | List-II |
|---|---|
| (a) Chlorophyll | (i) Ruthenium |
| (b) Vitamin-$B_{12}$ | (ii) Platinum |
| (c) Anticancer drug | (iii) Cobalt |
| (d) Grubbs catalyst | (iv) Magnesium |

Choose the most appropriate answer from the options given below :

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

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

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

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

**Official Ans. by NTA (2)**

**Sol.** Chlorophyll is a coordination compound of magnesium.

Vitamin B-12, cyanocobalamine is a coordination compound of cobalt.

Cisplatin is used as an anti-cancer drug and is a coordination compound of platinum.

Grubbs catalyst is a compound of Ruthenium.

**9.** Match List-I with List-II :

**List-I**

**(Chemicals)**

(a) Alcoholic potassium hydroxide

(b) Pd/ $BaSO_4$

(c) BHC (Benzene hexachloride)

(d) Polyacetylene

**List-II**

**(Use / Preparation / Constituent)**

(i) Electrodes in batteries

(ii) Obtained by addition reaction

(iii) Used for $\beta$ - elimination reaction

(iv) Lindlar's catalyst

Choose the most appropriate match :

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

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

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

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

**Official Ans. by NTA (2)**

**Sol.** (a) Alcoholic potassium hydroxide $\rightarrow$ used for $\beta$-elimination

(b) Pd/ $BaSO_4$ $\rightarrow$ Lindlar's catalyst

(c) BHC (Benzene hexachloride) $\rightarrow$ Obtained by addition reactions

**10.** The satements that are TRUE :

(A) Methane leads to both global warming and photochemical smog

(B) Methane is generated from paddy fields

(C) Methane is a stronger global warming gas than $CO_2$

(D) Methane is a part of reducing smog

Choose the most appropriate answer from the options given below :

(1) (A), (B), (C) only

(2) (A) and (B) only

(3) (B), (C), (D) only

(4) (A), (B), (D) only

**Official Ans. by NTA (1)**

**Sol.** Methane leads to both global warming & photochemical smog.

Methane is generated in large amounts from paddy fields.

$CO_2$ can be absorbed by photosynthesis, or by formation of acid rain etc., while no such activities are there for methane.

Hence methane is stronger global warming gas than $CH_4$.

Methane is not a part of reducing smog.

**11.** Match List-I with List-II

| **List-I** | **List-II** |
|---|---|
| (a) $Ca(OCl)_2$ | (i) Antacid |
| (b) $CaSO_4.\frac{1}{2}H_2O$ | (ii) Cement |
| (c) CaO | (iii) Bleach |
| (d) $CaCO_3$ | (iv) Plaster of paris |

Choose the most appropriate answer from the options given below :

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

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

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

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

**Official Ans. by NTA (3)**

**Sol.** $Ca(OCl)_2$ is Bleach.

$CaSO_4.\frac{1}{2}H_2O$ is plaster of paris.

$CaCO_3$ is used as an antacid.

CaO is major component of cement.

**12.** Compound with molecular formula $C_3H_6O$ can show :

(1) Positional isomerism

(2) Both positional isomerism and metamerism

(3) Metamerism

(4) Functional group isomerism

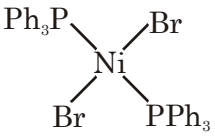
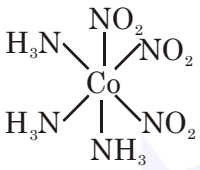
**Official Ans. by NTA (4)**

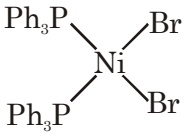
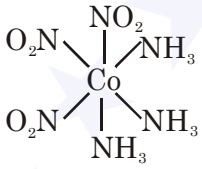
**Sol.** $C_3H_6O \Rightarrow CH_3-CH_2-CH=O$

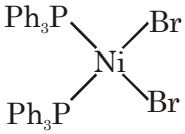
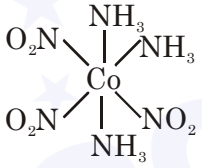
& $CH_3-\underset{\underset{O}{\|}}{C}-CH_3$

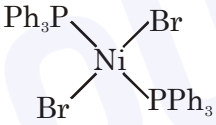
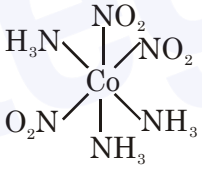
They are functional group isomerism.

**13.** The correct structures of trans-$[NiBr_2(PPh_3)_2]$ and meridonial-$[Co(NH_3)_3(NO_2)_3]$, respectively, are

(1)  and 

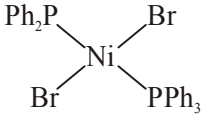
(2)  and 

(3)  and 

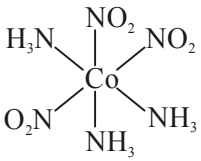
(4)  and 

**Official Ans. by NTA (4)**

**Sol.** trans-$[Ni\ Br_2(PPh_3)_2]$ is



meridional - $[Co(NH_3)_3(NO_2)_3]$ is



**14.** A certain orbital has no angular nodes and two radial nodes. The orbital is :

(1) 2s (2) 3s (3) 3p (4) 2p

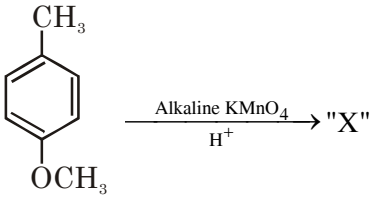
**Official Ans. by NTA (2)**

**Sol.** $l = 0 \Rightarrow$ 's' orbital

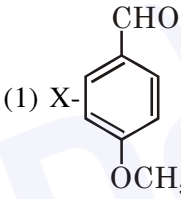
$n - l - 1 = 2$

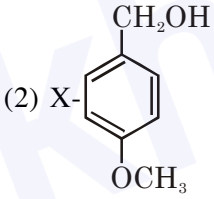
$n - 1 = 2$

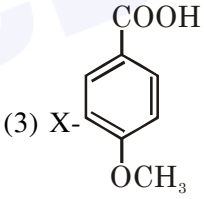
$n = 3$

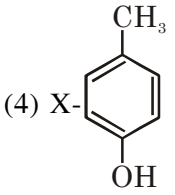
**15.** 

Considering the above chemical reaction, identify the product "X" :

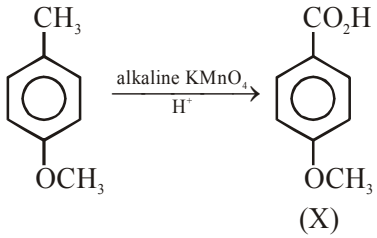
(1) 

(2) 

(3) 

(4) 

**Official Ans. by NTA (3)**

**Sol.** 

**16.** Match **List-I** with **List-II**

| **List-I** (process) | **List-II (catalyst)** |
|---|---|
| (a) Deacron's process | (i) ZSM-5 |
| (b) Contact process | (ii) $CuCl_2$ |
| (c) Cracking of hydrocarbons | (iii) Particles 'Ni' |
| (d) Hydrogenation of vegetable oils | (iv) $V_2O_5$ |

Choose the most appropriate answer from the options given below -

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

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

**Official Ans. by NTA (1)**

**Sol.** In manufacture of $H_2SO_4$ (contact process), $V_2O_5$ is used as a catalyst.

Ni catalysts enables the hydrogenation of fats.

$CuCl_2$ is used as catalyst in Deacon's process.

ZSM-5 used as catalyst in cracking of hydrocarbons.

**17.** Given below are two statements : One is labelled as Assertion A and the other labelled as reason R

**Assertion A :** During the boiling of water having temporary hardness, $Mg(HCO_3)_2$ is converted to $MgCO_3$.

**Reason R :** The solubility product of $Mg(OH)_2$ is greater than that of $MgCO_3$.

In the light of the above statements, choose the most appropriate answer from the options given below :

(1) Both A and R are true but R is not the correct explanation of A

(2) A is true but R is false

(3) Both A and R are true and R is the correct explanation of A

(4) A is false but R is true

**Official Ans. by NTA (4)**

**Sol.** For temporary hardness,

$Mg(HCO_3)_2 \xrightarrow{\text{heating}} Mg(OH)_2\downarrow + 2CO_2\uparrow$

Assertion is false.

$MgCO_3$ has high solubility product than $Mg(OH)_2$.

According to data of NCERT table 7.9 (Equilibrium chapter), the solubility product of magnesium carbonate is $3.5 \times 10^{-8}$ and solubility product of $Mg(OH)_2$ is $1.8 \times 10^{-11}$.

Hence Reason is incorrect.

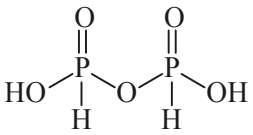
The question should be Bonus.

**18.** The number of ionisable hydrogens present in the product obtained from a reaction of phosphorus trichloride and phosphonic acid is:

(1) 3 (2) 0 (3) 2 (4) 1

**Official Ans. by NTA (3)**

**Sol.** $PCl_3 + H_3PO_3 \rightarrow H_4P_2O_5$



(Two ionisable H)

**19.** In a binary compound, atoms of element A form a hcp structure and those of element M occupy 2/3 of the tetrahedral voids of the hcp structure. The formula of the binary compound is :

(1) $M_2A_3$ (2) $M_4A_3$ (3) $M_4A$ (4) $MA_3$

**Official Ans. by NTA (2)**

**Sol.** $M_{12\times\frac{2}{3}}A_6$

$M_8A_6$

$M_4A_3$

**20.** The chemical that is added to reduce the melting point of the reaction mixture during the extraction of aluminium is :

(1) Cryolite (2) Bauxite

(3) Calamine (4) Kaolite

**Official Ans. by NTA (1)**

**Sol.** To reduce the melting point of reaction mixture, cryolite is added.

## SECTION-B

**1.** AX is a covalent diatomic molecule where A and X are second row elements of periodic table. Based on Molecular orbital theory, the bond order of AX is 2.5. The total number of electrons in AX is _____. (Round off to the Nearest Integer).

**Official Ans. by NTA (15)**

**Sol.** AX is a covalent diatomic molecule.

The molecule is NO.

Total no. of electrons is 15.

**2.** In order to prepare a buffer solution of pH 5.74, sodium acetate is added to acetic acid. If the concentration of acetic acid in the buffer is 1.0 M, the concentration of sodium acetate in the buffer is _____ M. (Round off to the Nearest Integer).

[Given : pKa (acetic acid) = 4.74]

**Official Ans. by NTA (10)**

**Sol.** $pH = pKa + \log \frac{[CB]}{[WA]}$

$5.74 = 4.74 + \log \frac{[CB]}{1}$

$\Rightarrow [CB] = 10\ M$

**3.** $2\ NO(g) + Cl_2(g) \rightleftharpoons 2\ NOCl(s)$

This reaction was studied at –10°C and the following data was obtained

| run | $[NO]_0$ | $[Cl_2]_0$ | $r_0$ |
|---|---|---|---|
| 1 | 0.10 | 0.10 | 0.18 |
| 2 | 0.10 | 0.20 | 0.35 |
| 3 | 0.20 | 0.20 | 1.40 |

$[NO]_0$ and $[Cl_2]_0$ are the initial concentrations and $r_0$ is the initial reaction rate.

The overall order of the reaction is _____. (Round off to the Nearest Integer).

**Official Ans. by NTA (3)**

**Sol.** $r = k[NO]^m [Cl_2]^n$

$= k(0.1)^m (0.1)^n$ .....(1)

$= k(0.1)^m (0.2)^n$ .....(2)

$= k(0.2)^m (0.2)^n$ .....(3)

$n = 1$

$m = 2$

$m + n = 3$

**4.** For the reaction

$C_2H_6 \rightarrow C_2H_4 + H_2$

the reaction enthalpy $\Delta_r H$ = _____ kJ $mol^{-1}$. (Round off to the Nearest Integer).

[Given : Bond enthalpies in kJ $mol^{-1}$ : C–C : 347, C=C : 611; C–H : 414, H–H : 436]

**Sol.** $\Delta_r H = [\in_{C-C} + 2\in_{C-H}] - [\in_{C=C} + \in_{H-H}]$

$= [347 + 2 \times 414] - [611 + 436]$

$= 128$

**5.** _____ grams of 3-Hydroxy propanal (MW=74) must be dehydrated to produce 7.8 g of acrolein (MW = 56) ($C_3H_4O$) if the percentage yield is 64. (Round off to the Nearest Integer).

[Given : Atomic masses : C : 12.0 u, H : 1.0 u, O : 16.0 u]

**Official Ans. by NTA (16)**

**Sol.** $(HO)H_2C-\overset{H_2}{\underset{}{C}}-CHO \xrightarrow[64\%]{\Delta} C_3H_4O + H_2O$

$\frac{x}{74}$ mol $\qquad \frac{x}{74} \times 0.64 = \frac{7.8}{56}$

$x = 16.10$

$\simeq 16.00$

**6.** A reaction of 0.1 mole of Benzylamine with bromomethane gave 23 g of Benzyl trimethyl ammonium bromide. The number of moles of bromomethane consumed in this reaction are $n \times 10^{-1}$, when n = _____. (Round off to the Nearest Integer).

(Given : Atomic masses : C : 12.0 u, H : 1.0 u, N : 14.0 u, Br : 80.0 u]

**Official Ans. by NTA (3)**

**Sol.** $Ph-CH_2-NH_2 \xrightarrow[-HBr]{CH_3-Br} Ph-CH_2-\ddot{N}H-CH_3$

$\downarrow -HBr \mid CH_3-Br$

$Ph-CH_2-\overset{\oplus}{N}(CH_3)_3 \xleftarrow[-HBr]{CH_3-Br} Ph-CH_2-\ddot{N}(CH_3)_2$

no of moles = 3

**7.** The total number of unpaired electrons present in the complex $K_3[Cr(oxalate)_3]$ is _____.

**Official Ans. by NTA (3)**

**Sol.** $K_3[Cr(oxalate)_3]$

Chromium is in +3 oxidation state.

Number of unpaired electrons in $Cr^{+3}$ will

**8.** 2 molal solution of a weak acid HA has a freezing point of 3.885°C. The degree of dissociation of this acid is _____ $\times 10^{-3}$. (Round off to the Nearest Integer).

[Given : Molal depression constant of water = 1.85 K kg $mol^{-1}$ Freezing point of pure water = 0°C]

**Official Ans. by NTA (50)**

**Sol.** $\Delta T_f = (1 + \alpha)\, K_f.m$

$\alpha = 0.05 = 50 \times 10^{-3}$

**9.** For the reaction

$2Fe^{3+}(aq) + 2I^-(aq) \rightarrow 2Fe^{2+}(aq) + I_2(s)$

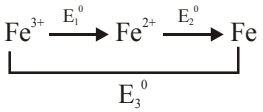
the magnitude of the standard molar free energy change, $\Delta_r G_m^\circ$ = – _____ kJ (Round off to the Nearest Integer).

$$\left[\begin{array}{l} E^o_{Fe^{2+}/Fe(s)} = -0.440 \text{ V}; \; E^o_{Fe^{3+}/Fe(s)} = -0.036 \text{ V} \\ E^o_{I_2/2I^-} = 0.539 \text{ V}; \qquad F = 96500 \text{ C} \end{array}\right]$$

**Official Ans. by NTA (46)**

**Official Ans. by [ ] (45)**

**Sol.**




$E_1^0 + 2E_2^0 = 3E_3^0$

$E_1^0 = 3E_3^0 - 2E_2^0$

$= 3\ (-0.036) - 2(-0.44)$

$= + 0.772$ V

$E^0_{cell} = E^0_{Fe^{3+}/Fe^{2+}} + E^0_{I^-/I_2} = 0.233$

$\Delta_r G^0 = -2 \times 96.5 \times 0.233 = -45$ kJ

**10.** Complete combustion of 3 g of ethane gives $x \times 10^{22}$ molecules of water. The value of x is _____. (Round off to the Nearest Integer).

[Use : $N_A = 6.023 \times 10^{23}$; Atomic masses in u : C : 12.0 ; O : 16.0 ; H : 1.0]

**Official Ans. by NTA (18)**

**Sol.** $C_2H_6 \rightarrow 3H_2O$

0.1 mol $\qquad 0.3 = 0.3 \times 6 \times 10^{23} = 18 \times 10^{22}$ mol

No. of molecules = $0.3 \times 6.023 \times 10^{23}$

$= 18.069 \times 10^{22}$