

JEE Main March 2021
Question Paper With Text Solution
18 March. | Shift-1

CHEMISTRY



JEE Main & Advanced | XI-XII Foundation | VI-X Pre-Foundation

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JEE MAIN MARCH 2021 | 18TH MARCH SHIFT-1

SECTION - A

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

(1) 0

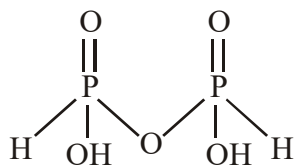
(2) 1

(3) 2

(4) 3

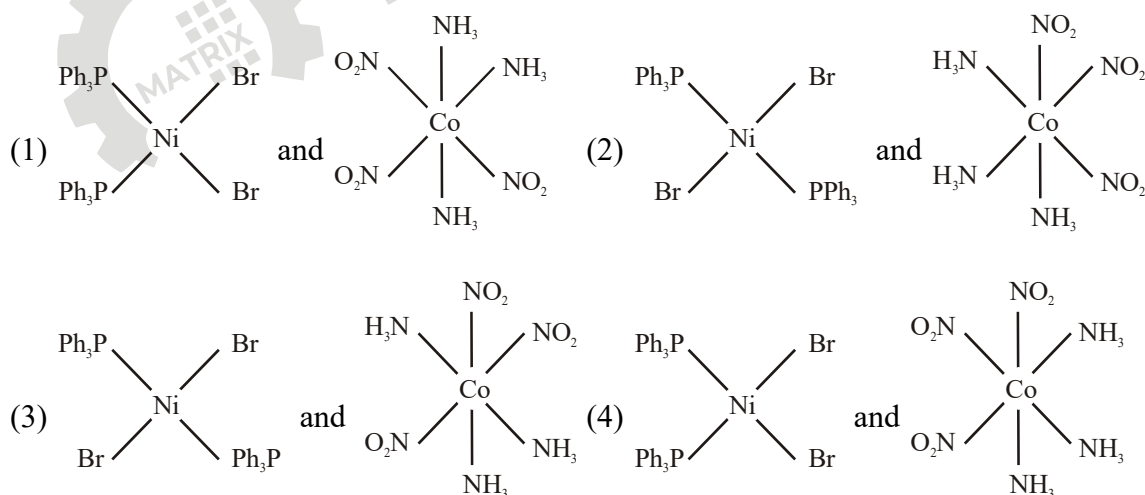
Ans. Official Answer NTA (3)

Sol. $\text{PCl}_3 + \text{H}_3\text{PO}_3 \rightarrow \text{H}_4\text{P}_2\text{O}_5 + \text{HCl}$
(Pyrophosphorus acid)



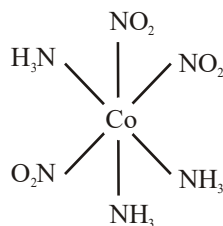
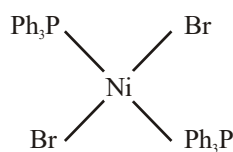
The number of ionisable hydrogens present = 2

2. The correct structures of trans-[NiBr₂(PPh₃)₂] and meridional-[Co(NH₃)₃(NO₂)₃], respectively, are :



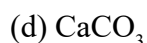
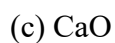
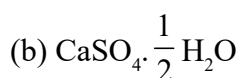
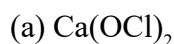
Ans. Official Answer NTA (3)

Sol. Trans-[NiBr ₂ (PPh ₃) ₂]	Meridional - [Co(NH ₃) ₃ (NO ₂) ₃]
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3. Match List-I with List-II :

List-I



List-II

(i) Antacid

(ii) Cement

(iii) Bleach

(iv) Plaster of Paris

Choose the most appropriate answer from the options given below :

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

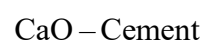
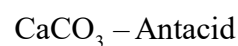
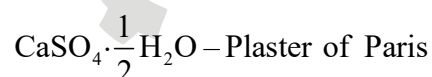
(2) a - i, b - iv, c - iii, d - ii

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

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

Ans. Official Answer NTA (1)

Sol. $\text{Ca}(\text{OCl})_2$ – Bleaching powder



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

(1) 2s

(2) 3p

(3) 3s

(4) 2p

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Ans. Official Answer NTA (3)

Sol. No angular nodes $\Rightarrow l = 0 \Rightarrow s$ orbital

two radial Nodes $\Rightarrow n - l - 1 = 2$

$$n - 0 - 1 = 2$$

$$n = 3$$

5. Match List-I with List-II :

List-I

List-II

(Class of Drug)

(Example)

(a) Antacid

(i) Novestrol

(b) Artificial Sweetener

(ii) Cimetidine

(c) Antifertility

(iii) Valium

(d) Tranquilizers

(iv) Alitame

Choose the most appropriate match :

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

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

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

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

Ans. Official Answer NTA (1)

Sol. Antacid — Cimetidine

Artificial Sweetener — Alitame

Antifertility — Novestrol

Tranquilizers — Valium

6. Match List-I with List-II :

List-I

List-II

(Process)

(Catalyst)

(a) Deacon'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 :

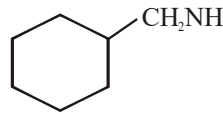
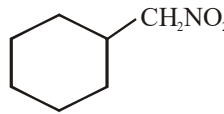
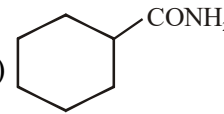
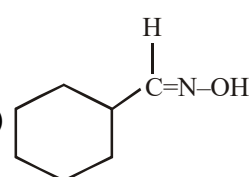
- (1) a - ii, b - iv, c - i, d - iii
 (2) a - i, b - iii, c - ii, d - iv
 (3) a - iv, b - ii, c - i, d - iii
 (4) a - iii, b - i, c - iv, d - ii

Ans. Official Answer NTA (1)

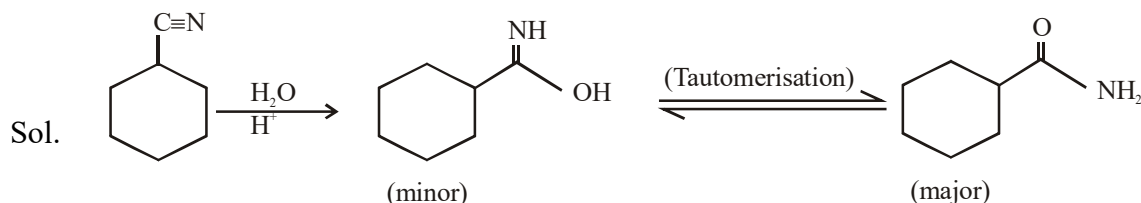
Sol.	Deacon's process	—	CuCl_2
	Contact process	—	V_2O_5
	Cracking of hydrocarbons	—	ZSM-5
	Hydrogenation of vegetable oils	—	particles 'Ni'



Consider the above chemical reaction and identify product "A" :

- (1)  (2)  (3)  (4) 

Ans. Official Answer NTA (3)



8. The statements 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 and B only
- (2) B, C, D only
- (3) A, B, C only
- (4) A, B, D only

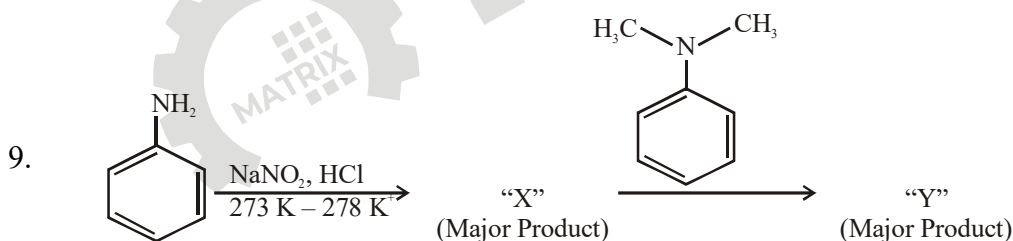
Ans. Official Answer NTA (3)

Sol. Methane leads to both global warming and photochemical smog – True

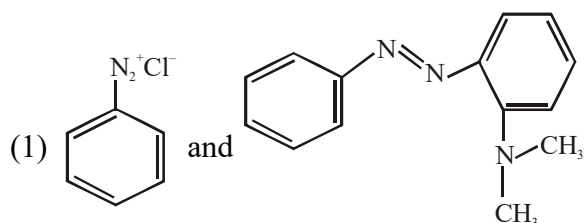
Methane is generated from paddy fields – True

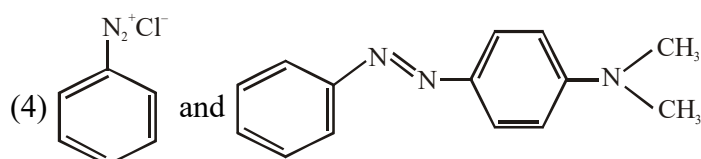
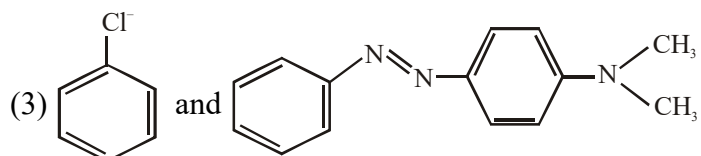
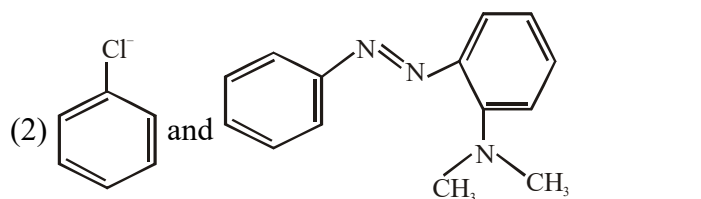
Methane is a stronger global warming gas than CO_2 – True

Methane is a part of reducing smog. – False

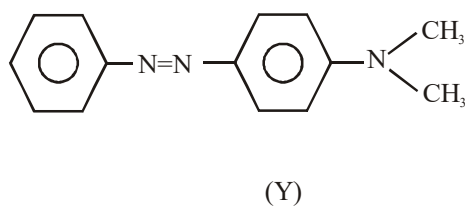
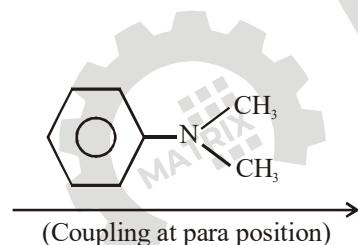
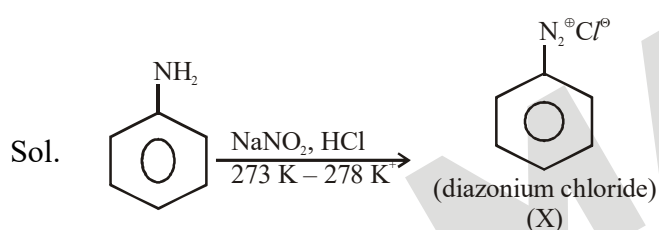


Considering the above reaction, X and Y respectively are :





Ans. Official Answer NTA (4)



10. In a binary compound, atoms of element A form a hcp structure and those of element M occupy $\frac{2}{3}$ of the tetrahedral voids of the hcp structure. The formula of the binary compound is :

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

Ans. Official Answer NTA (3)

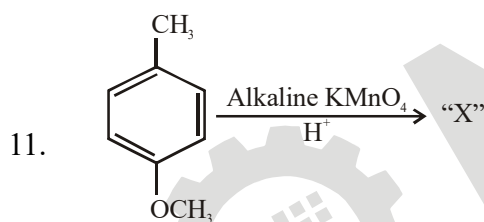
Sol. In hcp structure :

Number of effective A atoms in unit cell = 6

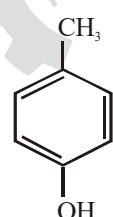
Number of effective M atoms in unit cell = $12 \times \frac{2}{3} = 8$

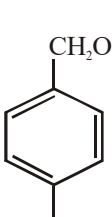
$\Rightarrow M_8A_6$

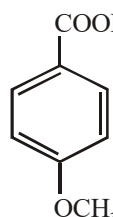
$\Rightarrow M_4A_3$

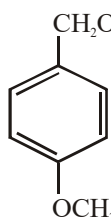


Considering the above chemical reaction, identify the product "X" :

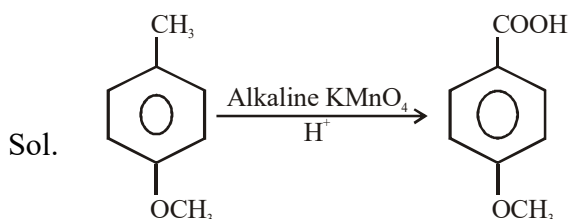
- (1) x - 

(2) x - 

(3) x - 

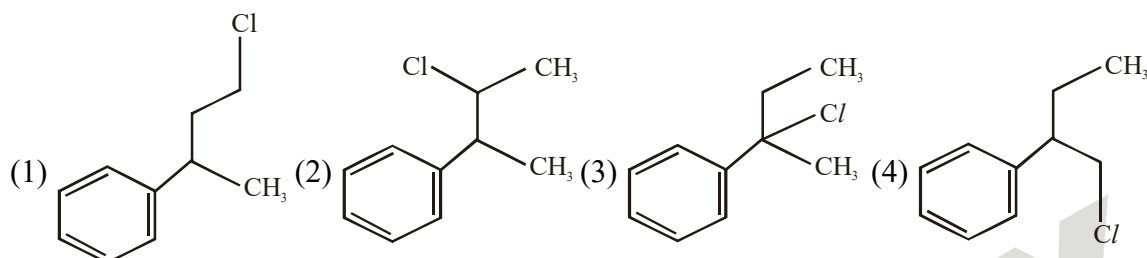
(4) x - 

Ans. Official Answer NTA (3)

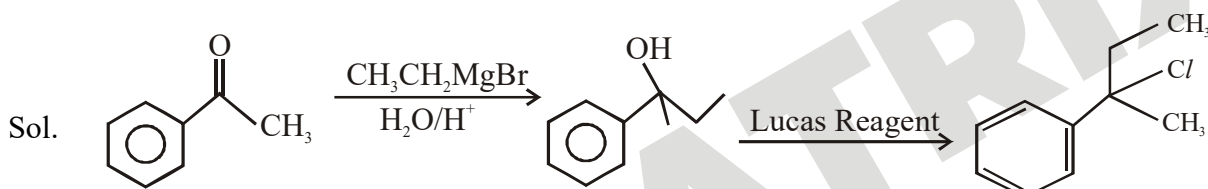


12. Reaction of Grignard reagent, $\text{C}_2\text{H}_5\text{MgBr}$ with $\text{C}_6\text{H}_5\text{CHO}$ followed by hydrolysis gives compound "A" which reacts instantly with Lucas reagent to give compound B, $\text{C}_{10}\text{H}_{13}\text{Cl}$.

The compound B is :



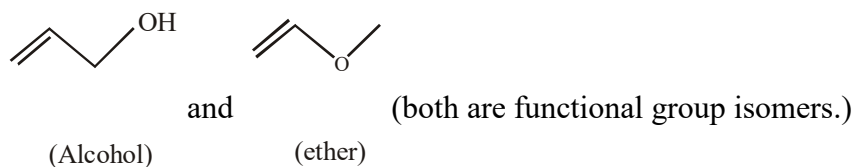
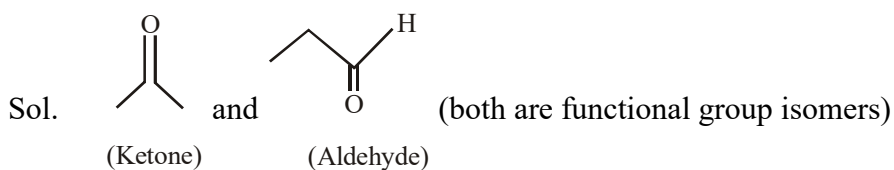
Ans. Official Answer NTA (3)



13. Compound with molecular formula $\text{C}_3\text{H}_6\text{O}$ can show :

- (1) Metamerism
- (2) Both positional isomerism and metamerism
- (3) Positional isomerism
- (4) Functional group isomerism

Ans. Official Answer NTA (4)



14. A non-reducing sugar "A" hydrolyses to give two reducing mono saccharides. Sugar A is :

- (1) Fructose
- (2) Galactose
- (3) Glucose
- (4) Sucrose

Ans. Official Answer NTA (4)

Sol. Sucrose is non-reducing sugar which gives fructose and glucose upon hydrolysis. Both, fructose and glucose are reducing mono saccharides.

15. The ionic radius of Na^+ ion is $1.02 \text{ \AA}$. The ionic radii (in $\text{\AA}$) of Mg^{2+} and Al^{3+} , respectively, are :

- (1) 0.72 and 0.54
- (2) 1.05 and 0.99
- (3) 0.68 and 0.72
- (4) 0.85 and 0.99

Ans. Official Answer NTA (1)

Sol. Order of Ionic radius $\text{Na}^+ > \text{Mg}^{2+} > \text{Al}^{3+}$

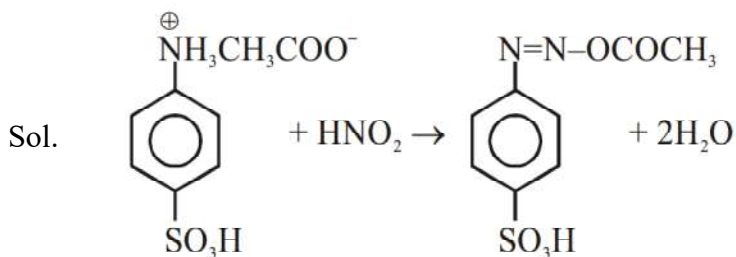
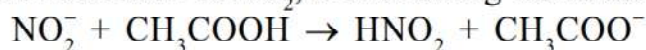
For Isoelectronic species Ionic radius $\propto \frac{1}{Z}$

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

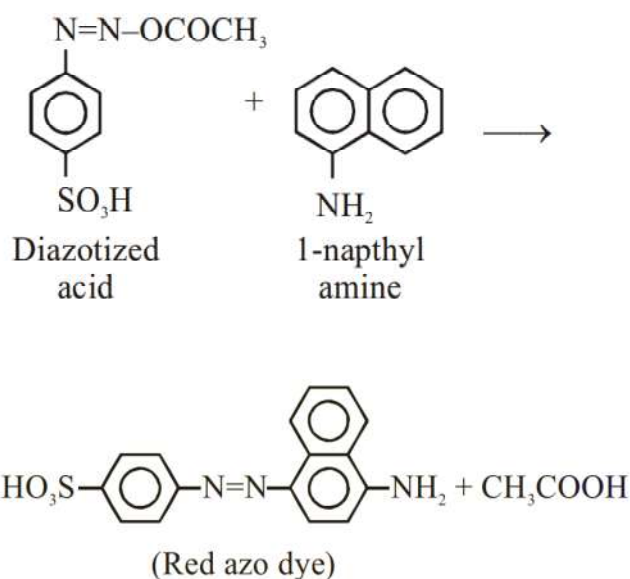
- (1) N_2O
- (2) NO
- (3) NO_3^-
- (4) NO_2^-

Ans. Official Answer NTA (4)

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



(Sulphanilic acid solution)



17. Given below are two Statements : One is labelled as Assertion A and the other is labelled as :

Reason R :

Assertion A : During the boiling of water having temporary hardness, $\text{Mg}(\text{HCO}_3)_2$ is converted to MgCO_3 .

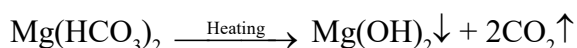
Reason R : The solubility product of $\text{Mg}(\text{OH})_2$ is greater than that of MgCO_3 .

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

- (1) A is true but R is false
- (2) Both A and R are true and R is the correct explanation of A
- (3) A is false but R is true
- (4) Both A and R are true but R is NOT the correct explanation of A

Ans. Official Answer NTA (3)

Sol. Temporary Hardness :



It is because of high solubility product of $\text{Mg}(\text{OH})_2$ as compared to that of MgCO_3 , that $\text{Mg}(\text{OH})_2$ is precipitated.

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18. Match List-I with List-II :

List-I

- (a) Chlorophyll
- (b) Vitamin - B₁₂
- (c) Anticancer drug
- (d) Grubbs catalyst

List - II

- (i) Ruthenium
- (ii) Platinum
- (iii) Cobalt
- (iv) Magnesium

Choose the most appropriate answer from the options given below :

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

Ans. Official Answer NTA (2)

Sol. Chlorophyll	→	Magnesium
Vitamin - B ₁₂	→	Cobalt
Anticancer drug	→	Platinum
Grubbs catalyst	→	Ruthenium

19. Match List-I with List-II :

List-I

(Chemicals)

- (a) Alcoholic potassium hydroxide
- (b) Pd/BaSO₄
- (c) BHC (Benzene hexachloride)
- (d) Polyacetylene

List - II

(Use/Preparation/Constituent)

- (i) Electrodes in batteries
- (ii) Obtained by addition reaction
- (iii) Used for β -elimination reaction
- (iv) Lindlar's Catalyst

Choose the most appropriate match :

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

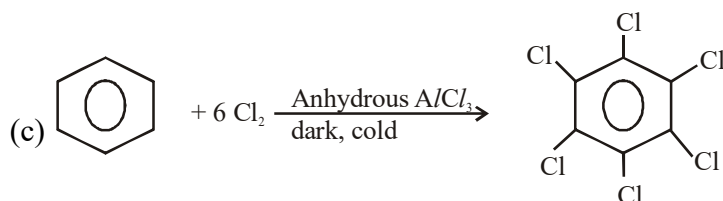
(3) a - ii, b - i, c - iv, d - iii

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

Ans. Official Answer NTA (1)

Sol. (a) Alcoholic KOH is used for 1,2-Elimination or β -elimination reactions to produce corresponding alkenes.

(b) Pd/BaSO_4 is known as lindlar's catalyst.



(d) Polyacetylene is used as electrodes in batteries.

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

(1) Calamine

(2) Cryolite

(3) Kaolite

(4) Bauxite

Ans. Official Answer NTA (2)

Sol. Molten cryolite is mixed with bauxite to reduce the melting point of reaction mixture during the extraction of aluminium.

Section-B

1. 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 : PK_a (acetic acid) = 4.74]

Ans. Official Answer NTA (10)

Sol. $\text{CH}_3\text{COOH} \rightleftharpoons \text{CH}_3\text{COO}^- + \text{H}^+$

For Buffer solution (weak acid & conjugate base)

$$\text{pH} = \text{pK}_a + \log \frac{[\text{CH}_3\text{COO}^-]}{[\text{CH}_3\text{COOH}]}$$

$$5.74 = 4.74 + \log \frac{[\text{CH}_3\text{COO}^-]}{1}$$

$$\log[\text{CH}_3\text{COO}^-] = 1$$

$$[\text{CH}_3\text{COO}^-] = 10 \text{ M}$$



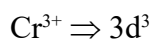
2. The total number of unpaired electrons present in the complex $K_3[Cr(oxalate)_3]$ is ———

Ans. Official Answer NTA (3)

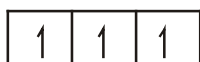
Sol. In compound $K_3[Cr(Ox)_3]$,

$$\text{Oxidation number of Cr, } 3(+1) + X + 3(-2) = 0$$

$$X = +3$$



d_{z^2} $d_{x^2-y^2}$

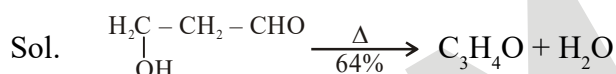


d_{xy} d_{yz} d_{zx}

Hence, Total number of unpaired electron = 3

3. ——— 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]

Ans. Official Answer NTA (16)



$$n_{C_3H_4O} = n_{3\text{-Hydroxy propanal}} \times \frac{64}{100}$$

$$\frac{7.8}{56} = \frac{w}{74} \times \frac{64}{100}$$

$$w = 16.1$$

$$w \approx 16 \text{ gm}$$

4. 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 = $1.85 \text{ K kg mol}^{-1}$

Freezing point of pure water = 0°C]

Ans. Official Answer NTA (50)



1

$1 - \alpha$ α α

$$i = \frac{1 + \alpha}{1} = 1 + \alpha$$

$$\Delta T_f = i K_f m$$

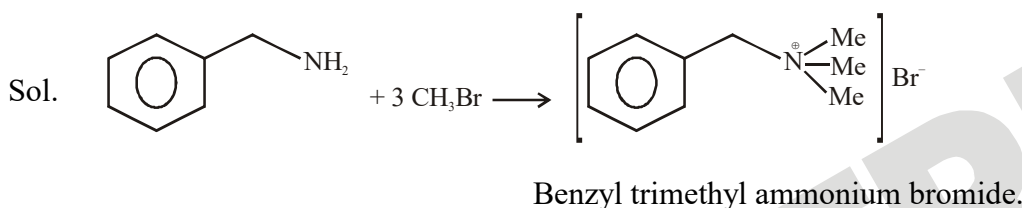
$$3.885 = (1 + \alpha)(1.85)^2$$

$$1 + \alpha = 1.05$$

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

5. 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 : 14.0u, Br : 80.0 u]

Ans. Official Answer NTA (3)



$\therefore$ 1 mole of Benzyl amine consumes 3 moles of CH_3Br

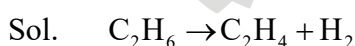
$\therefore$ 0.1 mole of Benzyl amine will consume $= 3 \times 0.1$

$$= 3 \times 10^{-1}$$

$$n = 3$$

6. For the reaction
 $\text{C}_2\text{H}_6 \rightarrow \text{C}_2\text{H}_4 + \text{H}_2$
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]

Ans. Official Answer NTA (128)



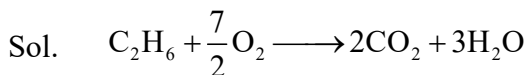
$$\Delta_r H = [\epsilon_{\text{C-C}} + 6\epsilon_{\text{C-H}}] - [\epsilon_{\text{C=C}} + 4\epsilon_{\text{C-H}}] - [\epsilon_{\text{H-H}}]$$

$$\begin{aligned} \Delta_r H &= \epsilon_{\text{C-C}} - \epsilon_{\text{C=C}} + 2\epsilon_{\text{C-H}} - \epsilon_{\text{H-H}} \\ &= 347 - 611 + 2 \times 414 - 436 \\ &= 128 \text{ KJ mol}^{-1} \end{aligned}$$

7. 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]

Ans. Official Answer NTA (18)



$$n_{H_2O} = 3 \times n_{C_2H_6}$$

$$n_{H_2O} = 3 \times \frac{3}{30} = 0.3 \text{ moles}$$

$$\begin{aligned} \text{Number of molecules} &= 0.3 \times N_A \\ &= 0.3 \times 6 \times 10^{23} \\ &= 1.8 \times 10^{23} \\ &= 18 \times 10^{22} \end{aligned}$$

8. 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).

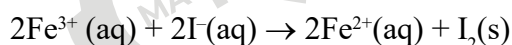
Ans. Official Answer NTA (15)

Sol. Compound AX has possible electrons according MOT = 13 or 15

AX is diatomic molecule, so possible molecule for 2nd period elements (diatomic) is NO

Number of electrons is No = 15

9. For the reaction



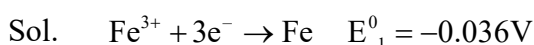
The magnitude of the standard molar free energy change, $\Delta_r G_m^\circ = -$ _____ kJ.

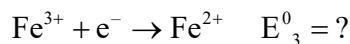
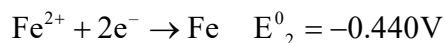
(Round off to the Nearest Integer).

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

Ans. Official Answer NTA (46)

Ans. Official Answer By Matrix (45)





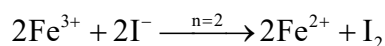
equation 3 = equation 1 – equation 2

$$E_3^0 = \frac{n_1 E_1^0 - n_2 E_2^0}{n_1 - n_2}$$

$$E_3^0 = \frac{(-0.036 \times 3) - (-0.44 \times 2)}{3 - 2}$$

$$E_3^0 = 0.772\text{V}$$

Given Reaction :



$$E_{\text{cell}}^0 = E_{\text{Fe}^{3+}/\text{Fe}^{2+}}^0 - E_{\text{I}_2/\text{I}^{-}}^0$$

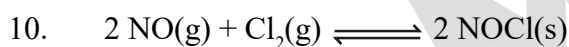
$$= 0.772 - 0.539$$

$$= 0.233\text{V}$$

$$\Delta G^0 = -nF E_{\text{cell}}^0$$

$$= -2 \times 96500 \times 0.233$$

$$= -44.969 \text{ KJ}$$



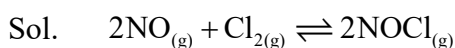
This reaction was studied at -10°C and the following data was obtained

run	$[\text{NO}]_0$	$[\text{Cl}_2]_0$	r_0
1	0.10	0.10	0.18
2	0.10	0.20	0.35
3	0.20	0.20	1.40

$[\text{NO}]_0$ and $[\text{Cl}_2]_0$ are the initial concentrations and r_0 is the initial reaction rate.

The overall order of the reaction is _____.

Ans. Official Answer NTA (3)



$$r = K[\text{NO}]^m[\text{Cl}_2]^n$$

$$r_1 = K[0.1]^m[0.1]^n$$

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$$r_2 = K[0.1]^m[0.2]^n$$

$$r_3 = K[0.2]^m[0.2]^n$$

$$\frac{r_2}{r_1} = 2^n = \frac{0.35}{0.18} \approx 2$$

$$2^n = 2$$

$$n = 1$$

$$\frac{r_3}{r_2} = 2^m = \frac{1.4}{0.35}$$

$$2^m = 4$$

$$m = 2$$

$$\text{overall order} = m + n = 2 + 1 = 3$$