JEE Main February 2021

Question Paper With Text Solution

24 Feb. | Shift-1

CHEMISTRY

MATRIX

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

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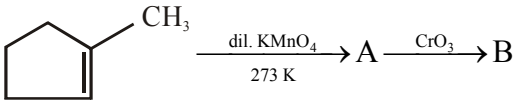
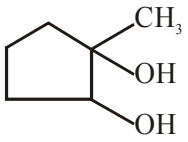
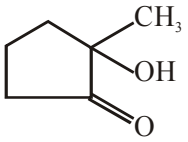
JEE MAIN FEB. 2021 | 24TH FEB SHIFT-1

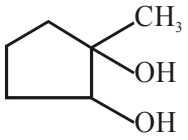
SECTION – A

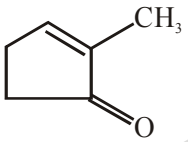
1. Identify products A and B.



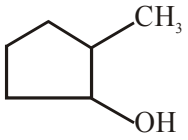
(1) A : 

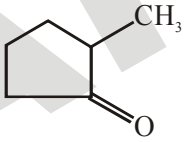
B : 

(2) A : 

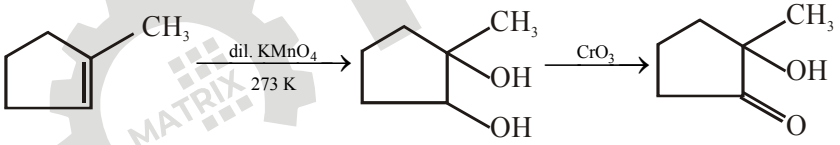
B : 

(3) A : $OHC - CH_2CH_2CH_2 - \overset{\overset{O}{\|}}{C} - CH_3$ B : $HOOC - CH_2CH_2CH_2 - \overset{\overset{O}{\|}}{C} - CH_3$

(4) A : 

B : 

Ans. Offical Answer NTA (1)

Sol. 

(A) (B)

2. Al_2O_3 was leached with alkali to get X. The solution of X on passing of gas Y, forms Z.

X, Y and Z respectively are :

(1) X = $Al(OH)_3$, Y = CO_2, Z = Al_2O_3

(2) X = $Na[Al(OH)_4]$, Y = SO_2, Z = Al_2O_3

(3) X = $Al(OH)_3$, Y = SO_2, Z = $Al_2O_3.xH_2O$

(4) X = $Na[Al(OH)_4]$, Y = CO_2, Z = $Al_2O_3.xH_2O$

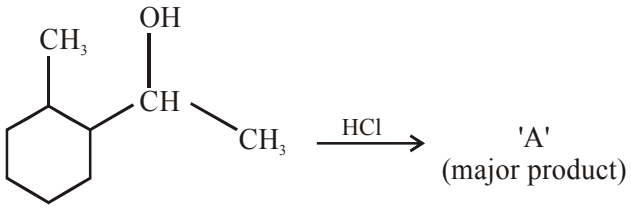
Ans. Offical Answer NTA (4)

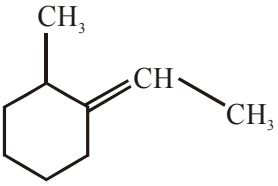
Sol. $Al_2O_3 + NaOH \longrightarrow \underset{\text{'x'}}{Na[Al(OH)_4]}$

$Na[Al(OH)_4], + CO_2 \longrightarrow Al_2O_3 . xH_2O$

X Z

3. What is the final product (major) 'A' in the given reaction ?



(1)


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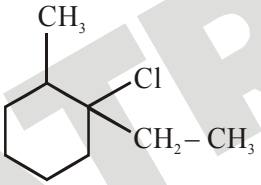

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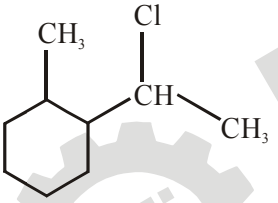

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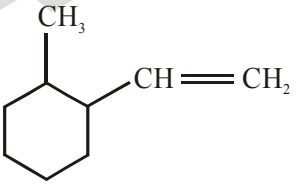
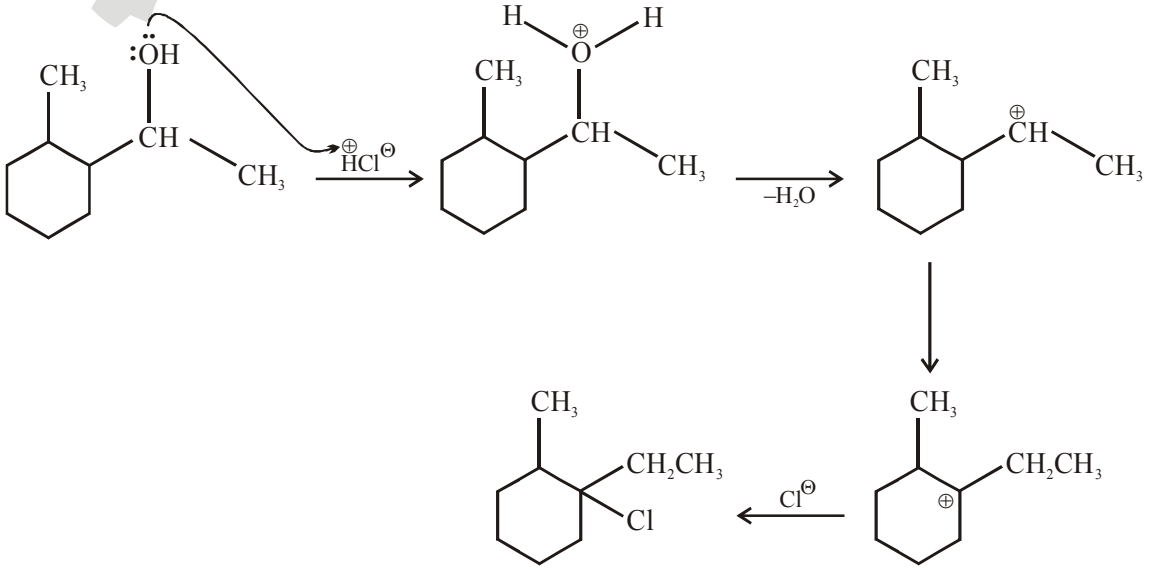


Ans. Offical Answer NTA (2)

Sol.


4. Out of the following, which type of interaction is responsible for the stabilisation of α-helix structure of proteins ?

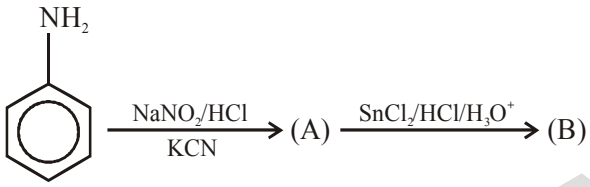
(1) Ionic bonding (2) vander Waals forces

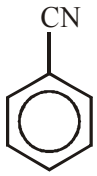
(3) Hydrogen bonding (4) Covalent bonding

Ans. Offical Answer NTA (3)

Sol. α-helix structure of protein is due to H-bondng between $-\overset{\overset{O}{\|}}{C}-$ and – NH – group of peptide bond.

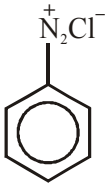
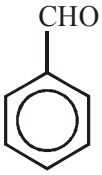
5. 'A' and 'B' in the following reactions are :



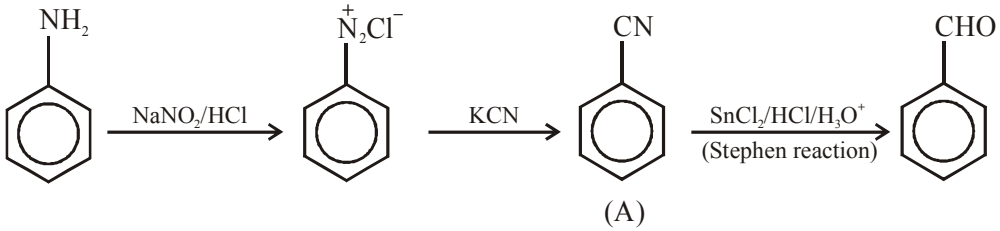
(1) (A) :  (B) : 

(2) (A) :  (B) : 

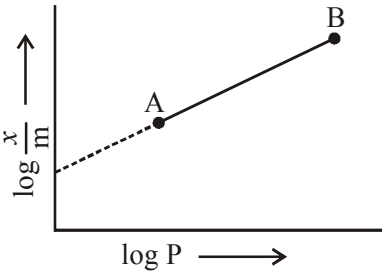
(3) (A) :  (B) : 

(4) (A) :  (B) : 

Ans. Offical Answer NTA (1)

Sol. 

6. In Freundlich adsorption isotherm, slope of AB line is :



(1) log n with (n > 1)

(2) $\frac{1}{n}$ with $\left(\frac{1}{n} = 0 \text{ to } 1\right)$

(3) n with (n, 0.1 to 0.5)

(4) $\log \frac{1}{n}$ with (n < 1)

Ans. Offical Answer NTA (2)

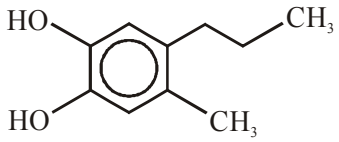
Sol. According to freundlich

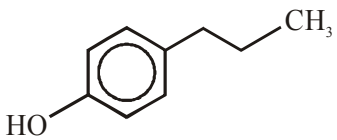
$$\frac{x}{m} = k(p)^{1/n}$$

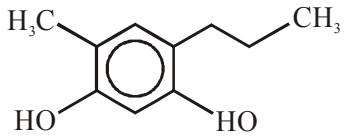
$$\log \frac{x}{m} = \log k + \frac{1}{n} \log p$$

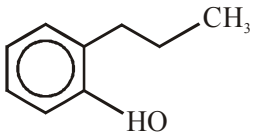
Hence slope is $\frac{1}{n}$ with $\left(\frac{1}{n} = 0 \text{ to } 1\right)$

7. Which of the following compound gives pink colour on reaction with phthalic anhydride in conc. H_2SO_4 followed by treatment with NaOH ?

(1) 

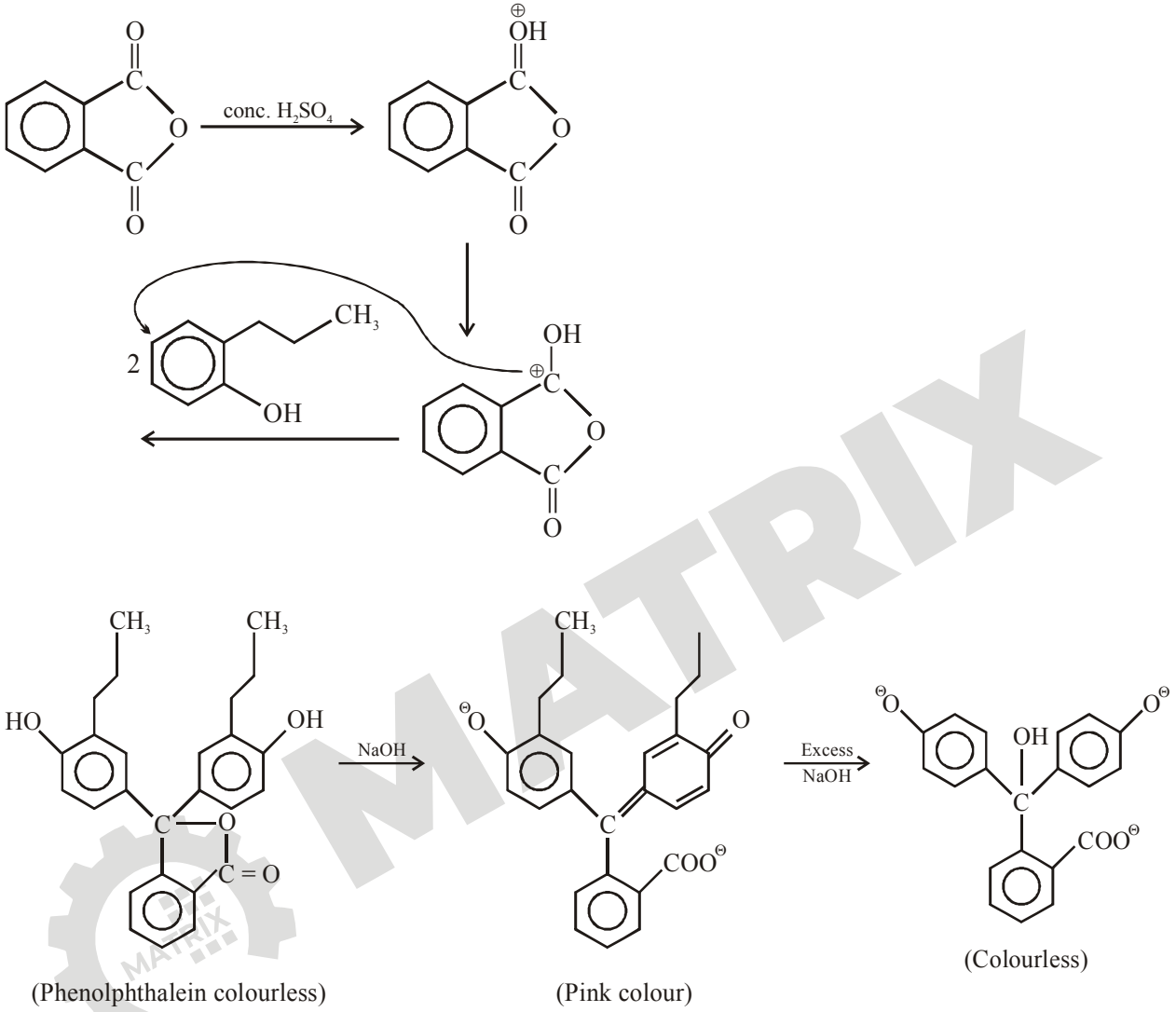
(2) 

(3) 

(4) 

Ans. Offical Answer NTA (4)

Sol.



8. Which of the following reagent is used for the following reaction ?

$CH_3CH_2CH_3 \xrightarrow{?} CH_3CH_2CHO$

(1) Copper at high temperature and pressure (2) Manganese acetate

(3) Molybdenum oxide (4) Potassium permanganate

Ans. Offical Answer NTA (3)

Sol. $CH_3CH_2CH_3 \xrightarrow{Mo_2O_3} CH_3CH_2CHO$

9. The gas released during anaerobic degradation of vegetation may lead to :

(1) Ozone hole (2) Global warming and cancer

(3) Acid rain (4) Corrosion of metals

Ans. Offical Answer NTA (2)

Sol. During anaerobic degradation of vegetation, methane is produced which is a greehouse gas and can lead to global warming.

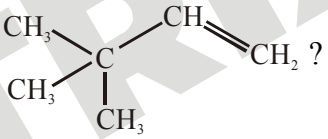
10. The major components in "Gun Metal" are :

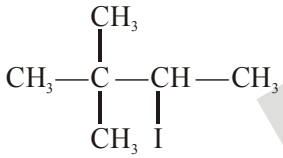
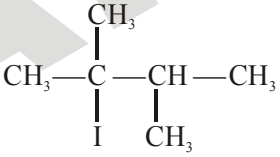
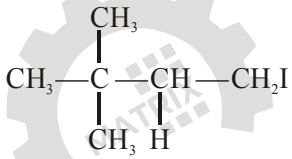
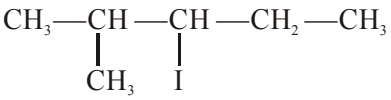
(1) Cu, Zn and Ni
(2) Cu, Sn and Zn
(3) Al, Cu, Mg and Mn
(4) Cu, Ni and Fe

Ans. Offical Answer NTA (2)

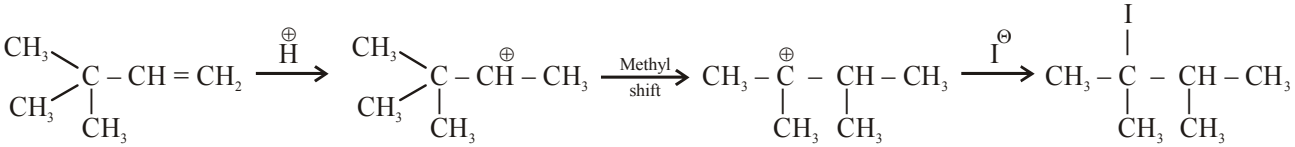
Sol. Composition of Gun Metal is

88% Cu + 10% Sn + 2% Zn

11. What is the major product formed by HI on reaction with  ?

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

Ans. Offical Answer NTA (2)

Sol. 

12. Match List I with List II.

List I (Monomer Unit)	**List II (Polymer)**
(a) Caprolactum	(i) Natural rubber
(b) 2-Chloro-l,3-butadiene	(ii) Buna-N
(c) Isoprene	(iii) Nylon 6
(d) Acrylonitrile	(iv) Neoprene

Choose the correct answer from the options given below :

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

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

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

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

Ans. Offical Answer NTA (3)

Sol.

Polymer	Monomer unit
Nylon 6	Caprolactum
Buna-N	Acrylonitrile
Natural rubber	Isoprene

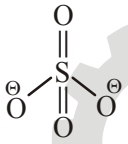
13. Which of the following are isostructural pairs ?

(A) SO_4^{2-} and CrO_4^{2-} (B) $SiCl_4$ and $TiCl_4$ (C) NH_3 and NO_3^- (D) BCl_3 and $BrCl_3$

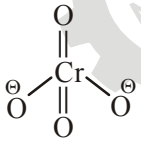
(1) A and B only (2) C and D only (3) A and C only (4) B and C only

Ans. Offical Answer NTA (1)

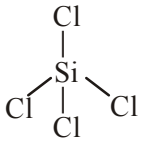
Sol.



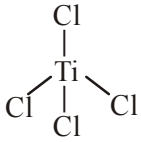
Tetrahedral



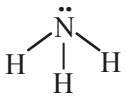
Tetrahedral



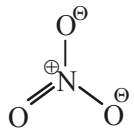
Tetrahedral



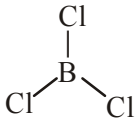
Tetrahedral



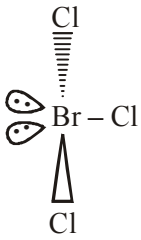
Pyramidal



Trigonal planar



Trigonal planar



T-Shape

14. (A) $HOCl + H_2O_2 \rightarrow H_3O^+ + Cl^- + O_2$

(B) $I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H_2O + O_2$

Choose the correct option.

(1) H_2O_2 acts as reducing agent in equations (A) and (B).

(2) H_2O_2 acts as oxidising agent in equations (A) and (B).

(3) H_2O_2 acts as oxidizing and reducing agent respectively in equations (A) and (B).

(4) H_2O_2 acts as reducing and oxidising agent respectively in equations (A) and (B).

Ans. Offical Answer NTA (1)

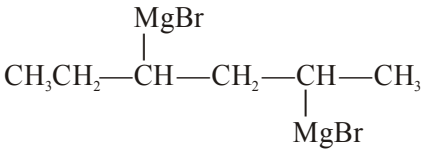
Sol. $\underset{\text{Oxidising Agent}}{HOCl} + \underset{\text{Reducing Agent}}{H_2O_2} \longrightarrow H_3O^{\oplus} + Cl^{\ominus} + O_2$

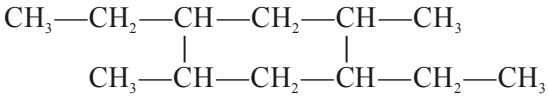
$\underset{\text{Oxidising Agent}}{I_2} + \underset{\text{Reducing Agent}}{H_2O_2} + 2OH^{\ominus} \longrightarrow 2I^{\ominus} + 2H_2O + O_2$

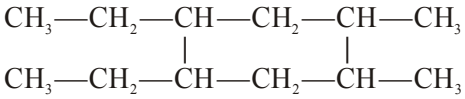
In both the reactions H_2O_2 is oxidised to O_2 hence it acts as reducing agent.

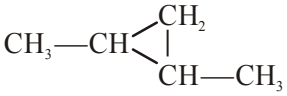
15. The product formed in the first step of the reaction of

$CH_3—CH_2—\underset{\displaystyle Br}{\underset{|}{CH}}—CH_2—\underset{\displaystyle Br}{\underset{|}{CH}}—CH_3$ with excess $Mg/Et_2O (Et = C_2H_5)$ is :

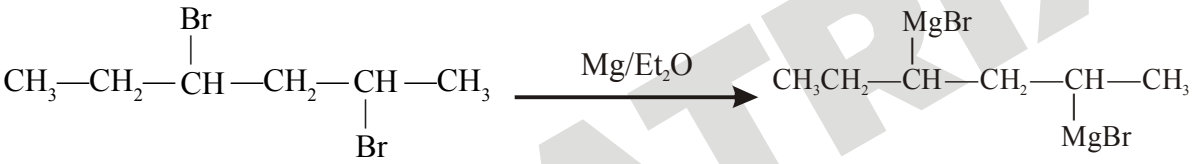
(1) 

(2) 

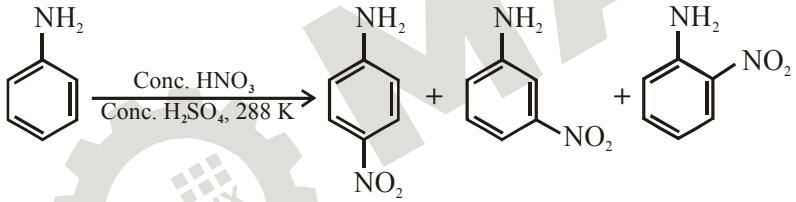
(3) 

(4) 

Ans. Offical Answer NTA (1)

Sol. 

16. In the following reaction the reason why meta-nitro product also formed is :



[A] 51% [B] 47% [C] 2%

(1) NH_2 group is highly meta-directive

(2) low temperature

(3) $-NO_2$ substitution always takes place at meta-position

(4) Formation of anilinium ion

Ans. Offical Answer NTA (4)

Sol. In presence of acid, NH_2 is protonated and becomes $\overset{\oplus}{N}H_3$ (anilinium ion) which is meta directing in nature hence meta nitro product is formed.

17. Which of the following ore is concentrated using group 1 cyanide salt ?

(1) Malachite (2) Sphalerite (3) Calamine (4) Siderite

Ans. Offical Answer NTA (2)

Sol. (1) Malachite :- $CuCO_3 . (Cu(OH)_2$

(2) Sphalerite :- ZnS

(3) Calamine :- $ZnCO_3$

(4) Siderite :- $FeCO_3$

Sphalerite can bc dissolved in Ist group cyanide salt i.e. NaCN, KCN

$$ZnS + 4NaCN \longrightarrow \underbrace{Na_2[Zn(CN)_4] + Na_2S}_{\text{Soluble in water}}$$

18. The electrode potential of M^{2+}/M of 3d-series elements shows positive value for :

(1) Fe (2) Zn (3) Co (4) Cu

Ans. Offical Answer NTA (4)

Sol. $E^\circ_{Cu^{2+}/Cu} = 0.34$

$E^\circ_{Zn^{2+}/Zn} = -0.76$

$E^\circ_{Co^{2+}/Co} = -0.28$

$E^\circ_{Fe^{2+}/Fe} = -0.44$

19. Consider the elements Mg, Al, S, P and Si, the correct increasing order of their first ionization enthalpy is :

(1) Al < Mg < Si < S < P (2) Mg < Al < Si < S < P

(3) Al < Mg < S < Si < P (4) Mg < Al < Si < P < S

Ans. Offical Answer NTA (1)

Sol. Correct order of first ionization enthalpy is

Al < Mg < Si < S < P

20. Given below are two statements :

Statement I : Colourless cupric metaborate is reduced to cuprous metaborate in a luminous flame.

Statement II : Cuprous metaborate is obtained by heating boric anhydride and copper sulphate in a non-luminous flame.

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

(1) Statement I is false but Statement II is true

(2) Statement I is true but Statement II is false

(3) Both Statement I and Statement II are true

(4) Both Statement I and Statement II are false

Ans. Offical Answer NTA (4)

Sol. $CuSO_4 \xrightarrow[\text{Non luminous flame}]{\Delta, B_2O_3} \underset{\text{Cupric metaborate}}{\underset{\text{Blue}}{Cu(BO_2)_2}} \xrightarrow[\text{luminous flame}]{C, \Delta} \underset{\text{Red}}{Cu + CO + B_2O_3}$

SECTION – B

1. For the reaction $A_{(g)} \rightarrow B_{(g)}$, the value of the equilibrium constant at 300 K and 1 atm is equal to 100.0. The value of $\Delta_r G°$ for the reaction at 300 K and 1 atm in J mol^{-1} is $-xR$, where x is _____ .

(Rounded off to the nearest integer)

[R = 8.31 J mol^{-1} K^{-1} and ln 10 = 2.3)

Ans. Offical Answer NTA (1380)

Sol. $\Delta G° = -RT \ln(K_{eq})$

$-xR = -R \times 300 \ln(100)$

$x = 300 \times 2 \times 2.3$

$x = 600 \times 2.3$

$= 1380$

2. At 1990 K and 1 atm pressure, there are equal number of Cl_2 molecules and Cl atoms in the reaction mixture. The value of K_p for the reaction $Cl_{2(g)} \rightleftharpoons 2Cl_{(g)}$ under the above conditions is $x \times 10^{-1}$. The value of x is _____ . (Rounded off to the nearest integer)

Ans. Offical Answer NTA (5)

Sol. $Cl_2 \rightleftharpoons 2Cl$
(g) (g)

$\because$ Number of Cl atoms and Cl_2 molecules is same hence

$P_{Cl} = P_{Cl_2}$

$P_{Cl} = P_{Cl_2} = 1$

$P_{Cl} = \frac{1}{2}$

$$K_p = \frac{(P_{Cl})^2}{P_{Cl_2}} = \frac{\left(\frac{1}{2}\right)^2}{\frac{1}{2}} = \frac{1}{2} = 5 \times 10^{-1}$$

x = 5

3. A proton and a Li^{3+} nucleus are accelerated by the same potential. If $\lambda_{Li^{3+}}$ and λ_p denote the de Broglie wavelengths of Li^{3+} and proton respectively, then the value of $\frac{\lambda_{Li^{3+}}}{\lambda_P}$ is $x \times 10^{-1}$.

The value of x is _____ . (Rounded off to the nearest integer)

[Mass of Li^{3+} = 8.3 mass of proton]

Ans. Offical Answer NTA (2)

Sol. $\lambda = \frac{h}{\sqrt{2mk.E.}}$

$\lambda = \frac{h}{\sqrt{2mqv}}$

$$\frac{\lambda_{Li^{3+}}}{\lambda_{proton}} = \sqrt{\frac{m_{proton}\, q_{proton}}{m_{Li^{3+}} \times q_{Li^{3+}}}}$$

$$\frac{\lambda_{Li^{3+}}}{\lambda_p} = \sqrt{\frac{1}{8.3 \times 3}}$$

$$\frac{\lambda_{Li^{3+}}}{\lambda_p} = \sqrt{\frac{1}{8.3 \times 3}} = \sqrt{\frac{1}{24.9}}$$

4. The coordination number of an atom in a body-centered cubic structure is _____ .

[Assume that the lattice is made up of atoms.]

Ans. Offical Answer NTA (8)

Sol. Coordination number of an atom in BCC structure is 8

5. When 9.45 g of $ClCH_2COOH$ is added to 500 mL of water, its freezing point drops by 0.5ºC. The dissociation constant of $ClCH_2COOH$ is $x \times 10^{-3}$. The value of x is _____ .

(Rounded off to the nearest integer)

[$K_{f(H_2O)} = 1.86$ K kg mol^{-1}]

Ans. Offiwcal Answer NTA (35)

Answer by Matrix is (36)

Sol. $\Delta T_f = i\, k_f m$

$$0.5 = i \times 1.86 \times \frac{\frac{9.45}{94.5}}{500} \times 1000$$

$$i = \frac{5}{2 \times 1.86}$$

$$\frac{5}{2 \times 1.86} = 1 + \alpha\ (n-1)$$

$$\frac{2.5}{1.86} = 1 + \alpha$$

$$\alpha = \frac{2.5}{1.86} - 1$$

$$\alpha = 0.344$$

$$k_a = \frac{C\alpha^2}{1-\alpha} = \frac{(0.2) \times (0.344)^2}{1 - 0.344} = 36.07 \times 10^{-3}$$

6. Gaseous cyclobutene isomerizes to butadiene in a first order process which has a 'k' value of 3.3×10^{-4} s^{-1} at 153ºC. The time in minutes it takes for the isomerization to proceed 40% to completion at this temperature is _____ . (Rounded off to the nearest integer)

Ans. Offical Answer NTA (26)

Sol. $$kt = 2.303 \log \frac{C_0}{C_t}$$

$$3.3 \times 10^{-4} \times t = 2.303 \log \frac{100}{60}$$

$$t = \frac{2.303}{3.3 \times 10^{-4}} \log \frac{5}{3}$$

$$t = \frac{2.303\times10^{4}}{3.3\times60}\times0.22$$

= 25.58 minutes

7. The stepwise formation of $[Cu(NH_3)_4]^{2+}$ is given below :

$Cu^{2+} + NH_3 \overset{K_1}{\rightleftharpoons} [Cu(NH_3)]^{2+}$

$[Cu(NH_3)]^{2+} + NH_3 \overset{K_2}{\rightleftharpoons} [Cu(NH_3)_2]^{2+}$

$[Cu(NH_3)_2]^{2+} + NH_3 \overset{K_3}{\rightleftharpoons} [Cu(NH_3)_3]^{2+}$

$[Cu(NH_3)_3]^{2+} + NH_3 \overset{K_4}{\rightleftharpoons} [Cu(NH_3)_4]^{2+}$

The value of stability constants K_1, K_2, K_3 and K_4 are 10^4, 1.58×10^3, 5×10^2 and 10^2 respectively. The overall equilibrium constants for dissociation of $[Cu(NH_3)_4]^{2+}$ is $x \times 10^{-12}$. The value of x is _____ . (Rounded off to the nearest integer)

Ans. Offical Answer NTA (1)

Sol. Overall equilibrium constant for the formation of $[Co(NH_3)_4]^{2+} = k_1 \times k_2 \times k_3 \times k_4$

$= 10^4 \times 1.58 \times 10^3 \times 5 \times 10^2 \times 10^2$

$= 5 \times 1.58 \times 10^{11}$

overall equilibrium constant for dissociation of $[Co(NH_3)_4]^{2+} = \frac{1}{5\times1.58\times10^{11}} = 1.26\times10^{-12}$

8. Number of amphoteric compounds among the following is..... .

(1) BeO (2) BaO (3) $Be(OH)_2$ (4) $Sr(OH)_2$

Ans. Offical Answer NTA (2)

Sol. BeO $\rightarrow$ Amphoteric

BaO $\rightarrow$ Basic

$Be(OH)_2$ $\rightarrow$ Amphoteric

$Sr(OH)_2$ $\rightarrow$ Basic

9. 4.5 g of compound A (MW = 90) was used to make 250 mL of its aqueous solution. The molarity of the solution in M is $x \times 10^{-1}$. The value of x is _____. (Rounded off to the nearest integer)

Ans. Offical Answer NTA (2)

Sol. $$\text{Molarity} = \frac{\frac{4.5}{90}}{250} \times 1000$$

$$= \frac{1}{20} \times 4 = \frac{1}{5} = 2 \times 10^{-1}$$

Hence x = 2

10. The reaction of sulphur in alkaline medium is given below :

$$S_{g(s)} + a\ OH^-_{(aq)} \longrightarrow b\ S^{2-}_{(aq)} + c\ S_2O_3^{2-}{}_{(aq)} + d\ H_2O_{(l)}$$

The values of 'a' is _____. (Integer answer)

Ans. Offical Answer NTA (12)

Sol. $$\underset{(s)}{S_8} + aOH^{\Theta}(aq.) \longrightarrow b\ S^{2-}(aq.) + c\ S_2O_3^{2-}(aq) + d\ H_2O(\ell)$$

$$\underset{16}{S_8} + \underset{16}{S_8} + OH^{\Theta} \longrightarrow 8S^{2-} + 4S_2O_3^{2-} + H_2O$$

$$24OH^{\Theta} + 2S_8 \longrightarrow 8S^{2-} + 4S_2O_3^{2-} + 12H_2O$$

$$12OH^{\Theta} + S_8 \longrightarrow 4S^{2-} + 2S_2O_3^{2-} + 6H_2O$$

Hence a = 12