JEE Main March 2021

Question Paper With Text Solution

17 March. | Shift-2

CHEMISTRY

MATRIX

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

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JEE MAIN MARCH 2021 | 17TH MARCH SHIFT-2

SECTION – A

1. The correct pair(s) of the ambident nucloeophiles is (are) :

(A) AgCN/KCN (B) RCOOAg/RCOOK

(C) $AgNO_2/KNO_2$ (D) AgI/KI

(1) (B) and (C) only (2) (A) and (C) only

(3) (B) only (4) (A) only

Ans. Official Answer NTA (2)

Sol. The nucloeophile that can attack through two different site are known as ambident nucloeophile.

$NO_2^{\ominus} \Rightarrow :\ddot{\underset{\cdot\cdot}{\overline{O}}} - \ddot{N} = \ddot{O}:$ (Oxygen and nitrogen are two nucleophilic sites)

$\overset{\ominus}{C}N \Rightarrow \overline{\underset{\cdot}{C}} \equiv \ddot{N}$ (Carbon and nitrogen are two nucleophilic sites)

2. One of the by–product formed during the recovery of NH_3 from Solvay process is :

(1) $Ca(OH)_2$ (2) NH_4Cl (3) $CaCl_2$ (4) $NaHCO_3$

Ans. Official Answer NTA (3)

Sol. by product of Recovery of NH_3 from solvay process is $CaCl_2$.

3. For the coagulation of a negative sol, the species below, that has the highest flocculating power is :

(1) S_4^{2-} (2) Na^+ (3) PO_4^{3-} (4) Ba^{2+}

Ans. Official Answer NTA (4)

Sol. for the coagulation of a negative sol. flocculating power of cation $Ba^{+2} > Na^{+2}$

as charge ion increases, its flocculating power increases

4. $C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{Enzyme A}} C_6H_{12}O_6 + C_6H_{12}O_6$

Sucrose Glucose Fructose

$C_6H_{12}O_6 \xrightarrow{\text{Enzyme B}} 2C_2H_5OH + 2CO_2$

Glucose

In the above reactions, the enzyme A and enzyme B respectively are :

(1) Invertase and Amylase

(2) Zymase and Invertase

(3) Invertase and Zymase

(4) Amylase and Invertase

Ans. Official Answer NTA (3)

Sol. $C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{invertase}} C_6H_{12}O_6 + C_6H_{12}O_6$

Sucrose Glucose Fructose

$C_6H_{12}O_6 \xrightarrow{\text{Zymase}} 2C_2H_5OH + 2CO_2$

Glucose

Enzyme A = invertase

Enzyme B = Zymase

5. Match List – I with List – II.

List – I	List – II
Chemical Compound	Used as
(a) Sucralose	(i) Synthetic detergent
(b) Glyceryl ester of stearic acid	(ii) Artificial sweetener
(c) Sodium benzoate	(iii) Antiseptic
(d) Bithionol	(iv) Food preservative

Choose the correct match :

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

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

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

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

Ans. Official Answer NTA (4)

Sol. Sucralose is an Artifical sweetener
Glyceryl ester of stearic acid is a Synthetic detergent
Sodium benzoate is a food preservative
Bithionol is an Antiseptic

6. The set that represents the pair of neutral oxides of nitrogen is :

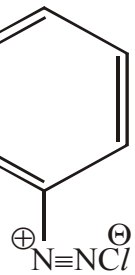
(1) NO and N_2O (2) N_2O and N_2O_3

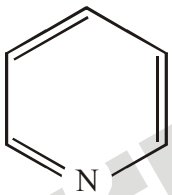
(3) NO and NO_2 (4) N_2O and NO_2

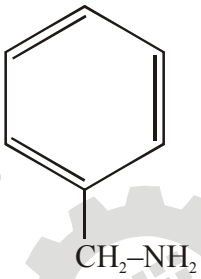
Ans. Official Answer NTA (1)

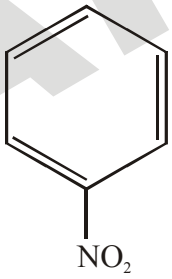
Sol. Neutral oxides of nitrogen : N_2O and NO.

7. Nitrogen can be estimated by Kjeldahl's method for which of the following compound ?

(1) 

(2) 

(3) 

(4) 

Ans. Official Answer NTA (3)

Sol. Kjeldahl method is not applicable to compounds containing nitrogen in nitro and azo groups and nitrogen present in ring (like pyridine, quinoline, iso quinoline.) as nitrogen of these compounds does not convert to ammonium sulfate under the condition of this method.

8. Which of the following statement(s) is (are) incorrect reason for eutrophication ?

(A) excess usage of fertilisers

(B) excess usage of detergents

(C) dense plant population in water bodies

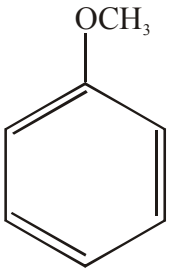
(D) lack of nutrients in water bodies that prevent plant growth

(1) (B) and (D) only (2) (D) only

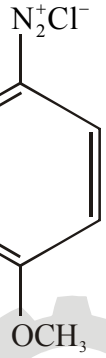
(3) (A) only (4) (C) only

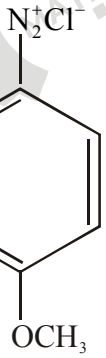
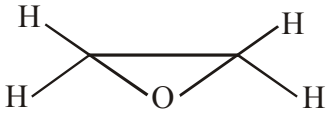
Ans. Official Answer NTA (2)

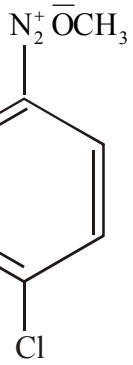
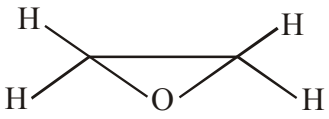
Sol. The process in which nutrient enriched water bodies support a dense plant population, which kills animal life by depriving it of oxygen and results in subsequent loss of biodiversity is known as Eutrophication.

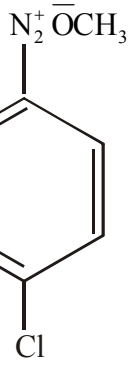
9. $C_7H_7N_2OCl + C_2H_5OH \longrightarrow$  $+ N_2 + \text{"X"} + \text{"Y"}$

In the above reaction, the structural formula of (A), "X" and "Y" respectively are :

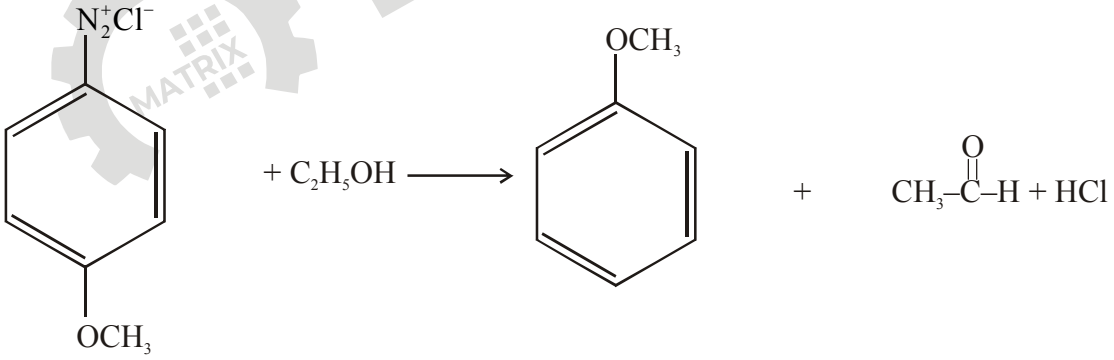
(1)  , $CH_3-\overset{\overset{O}{\|}}{C}-H$, HCl

(2)  ,  , H_2O

(3)  ,  , HCl

(4)  , $CH_3–\overset{O}{\overset{\|}{C}}–H$, H_2O

Ans. Official Answer NTA (1)

Sol. 

10. Match List – I with List – II :

List – I	List – II
(a) Haematite	(i) $Al_2O_3 \cdot xH_2O$
(b) Bauxite	(ii) Fe_2O_3
(c) Magnetite	(iii) $CuCO_3 \cdot Cu(OH)_2$

(d) Malachite (iv) Fe_3O_4

Choose the correct answer from the options given below :

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

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

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

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

Ans. Official Answer NTA (1)

Sol. Haematite Fe_2O_3

Bauxite $Al_2O_3 \cdot xH_2O$

Magnetite Fe_3O_4

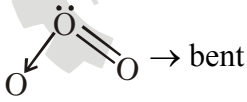
Malachite $CuCO_3 \cdot Cu(OH)_2$

11. Amongst the following, the linear species is :

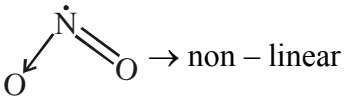
(1) Cl_2O (2) O_3 (3) NO_2 (4) N_3^-

Ans. Official Answer NTA (4)

Sol. (1)  → bent shape

(2)  → bent

(3) $NO_2 \Rightarrow SP^2$

 → non – linear

$\Rightarrow \theta = 132^\circ$

12. The set of elements that differ in mutual relationship from those of the other sets is :

(1) Li – Na (2) B – Si (3) Li – Mg (4) Be – Al

Ans. Official Answer NTA (1)

Sol. B–Si, Li – Mg, Be – Al → diagonal relation Li – Na → No diagonal relation.

13. The functional groups that are responsible for the ion–exchange property of cation and anion exchange resins, repectively, are :

(1) – NH_2 and –SO_3H (2) – NH_2 and – COOH

(3) – SO_3H and – COOH (4) – SO_3H and – NH_2

Ans. Official Answer NTA (4)

Sol. Cation exchange :

$R - SO_3H + M^{2+} \rightarrow (RSO_3H)_2\ M + 2H^+$

Anion exchange :

$R–NH_2 \xrightarrow{H_2O} R - \overset{+}{N}H_3\overset{-}{O}H \xrightarrow{Cl^-} R - \overset{+}{N}H_3Cl^- + OH^-$

14. Given below are two statements :

Statement I : 2–methylbutane on oxidation with $KMnO_4$ gives 2–methylbutan–2–ol.

Statement II : n–alkanes can be easily oxidised to corresponding alcohols with $KMnO_4$.

Choose the correct option :

(1) Statement I is correct but statement II is incorrect

(2) Both statement I and statement II are incorrect

(3) Statement I is incorrect but statement II is correct

(4) Both statement I and statement II are correct

Ans. Official Answer NTA (1)

Sol. Ordinarily alkanes resist oxidation but alkanes having tertiary hydrogen atom can be oxidized to corresponding alcohols by potassium permanganate.

15. Match list – I with List – II :

List – I	List – II
(a) $[Co(NH_3)_6][Cr(CN)_6]$	(i) Linkage isomerism
(b) $[Co(NH_3)_3\ (NO_2)_3]$	(ii) Solvate isomerism
(c) $[Cr(H_2O)_6]\ Cl_3$	(iii) Co–ordination isomerism
(d) cis–$[CrCl_2(ox)_2]^{3-}$	(iv) Optical isomerism

Choose the correct answer from the options given below :

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

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

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

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

Ans. Official Answer NTA (1)

Sol.

$[Co(NH_3)_6][Cr(CN)_6]$	Co–ordination isomerism
$[Co(NH_3)_3\ (NO_2)_3]$	Linkage isomerism
$[Cr(H_2O)_6]\ Cl_3$	Solvate isomerism
cis–$[CrCl_2(ox)_2]^{3-}$	Optical isomerism

16. Primary, secondary and tertiary amines can be separated using :

(1) Benzene sulphonic acid

(2) Chloroform and KOH

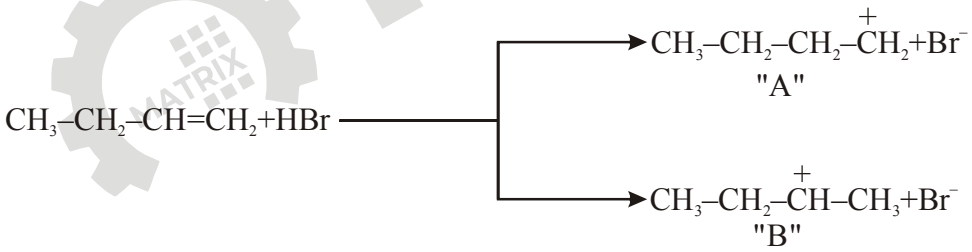
(3) Acetyl amide

(4) para–Toluene sulphonyl chloride

Ans. Official Answer NTA (4)

Sol. Primary, secondary and tertiary amine can be separated by Hinsberg reagent.

17. Choose the correct statement regarding the formation of carbocations A and B give.



(1) Carbocation B is more stable and formed relatively at faster rate

(2) Carbocation A is more stable and formed relatively at faster rate

(3) Carbocation A is more stable and formed relatively at slow rate

(4) Carbocation B is more stable and formed relatively at slow rate

Ans. Official Answer NTA (1)

Sol. $CH_3-CH_2-\overset{\oplus}{C}H-CH_3$ has more hyperconjugating structure than $CH_3-CH_2-CH_2-\overset{\oplus}{C}H_2$ hence 'B' is more stable than 'A' and formed relatively at faster rate.

18. The common positive oxidation states for an element with atomic number 24, are:

(1) +2 to +6 (2) +1 and +3

(3) +1 and +3 to +6 (4) +1 to +6

Ans. Official Answer NTA (1)

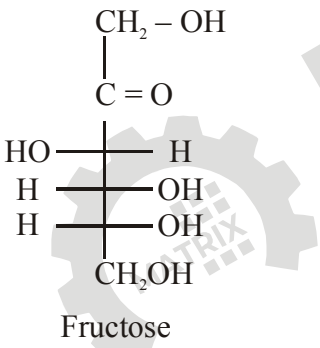
Sol. Atomic number = 24 (Cr)
Common oxidation state of Cr
= +2 to +6

19. Fructose is an example of :

(1) Aldohexose (2) Heptose (3) Ketohexose (4) Pyranose

Ans. Official Answer NTA (3)

Sol.



Fructose

20. During which of the following processes, does entropy decrease ?

(A) Freezing of water to ice at 0ºC (B) Freezing of water to ice at –10ºC

(C) $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ (D) Adsorption of CO(g) on lead surface.

(E) Dissolution of NaCl in water

Choose the correct answer from the options given below :

(1) (A), (B), (C) and (D) only (2) (A), (C) and (E) only

(3) (A) and (E) only (4) (B) and (C) only

Ans. Official Answer NTA (1)

Sol. (A) $H_2O(\ell) \xrightarrow{0^\circ C} H_2O(s)$ ΔS = –Ve (randomness ↓)

(B) $H_2O(\ell) \xrightarrow{-10^\circ C} H_2O(s)$ ΔS = –Ve (randomness ↓)
(C) $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ moles of gas decrease, entropy decreases
(D) Adsorption of CO(g) on lead surface $\Rightarrow \Delta S$ = –Ve
(E) $NaCl(s) + H_2O(\ell) \rightarrow Na+(aq)^+ Cl^-(aq)$ S ↑.

Section B

1. The reaction $2A + B_2 \rightarrow 2AB$ is an elementary reaction.

For a certain quantity of reactants, if the volume of the reaction vessel is reduced by a factor of 3, the rate of the reaction increases by a factor of _____. (Round off to the Nearest).

Ans. Official Answer NTA (27)

Sol. $2A + B_2 \rightarrow 2AB$ (elementary Reaction)
$r = K[A]^2[B]^1$

volume is reduced by factor of 3 then [A] or [B_2] is increased by factor of 3

$r_1 = K[A]^2 3[B]^2$

$r_2 = K[3A]^2[3B]^1$

$r_2 = 27r_1$

2. A 1 molal $K_4Fe(CN)_6$ solution has a degree of dissociation of 0.4. Its boiling point is equal to that of another solution which contains 18.1 weight percent of a non electrolytic solute A. The molar mass of A is _____ u.(Round off to the Nearest).

Ans. Official Answer NTA (85)

Sol. (i) If boiling point is same for both solutions then
$i_1m_1 = i_2m_2$
for $K_4[Fe(CN)_6]$

$i = 1 + \alpha(5 - 1)$

$1 + 4\alpha$

$i_1 = 1 + 4\alpha = 2.6$ $\quad m_1 = 1$

(ii) non – electrolyte solute (i = 1)

$$\%\frac{w}{w}=18.1$$

$$m_2=\frac{\frac{18.1}{M}\times 1000}{100-18.1}$$

$$i_1m_1=i_2m_2$$

$$1\times 2.6=1\times\frac{18.1\times 1000}{M(81.9)}$$

$$M=\frac{18100}{81.9\times 2.6}=85$$

3. KBr is doped with 10^{-5} mole percent of $SrBr_2$. The number of cationic vacancies in 1g of KBr crystal is _____10^{14}. (Round off to the Nearest).

Ans. Official Answer NTA (5)

Sol. in 1 mole KBr $\Rightarrow \frac{10^{-5}}{100}=10^{-7}$ mole of $SrBr_2$

no. of Sr^{2+} added = No. of cationic vacancies created

10^{-7} mole Sr^{2+} are present in 1 mole KBr crystal

119 gm KBr contains 10^{-7} mole cationic vacancies

$\Rightarrow$ 1 gm KBr contains $\frac{10^{-7}}{119}\times 6.022\times 10^{23}$

$= 5.06\times 10^{14}$ cationic vacancies

4. On complete reaction of $FeCl_3$ with oxalic acid in aqueous solution containing KOH, resulted in the formation of product A. The secondary valency of Fe in the product A is _____.(Round off to the Nearest).

Ans. Official Answer NTA (6)

Sol. $FeCl_3 + H_2C_2O_4 + KOH \rightarrow K_3[Fe(C_2O_4)_3]$

$C_2O_4^{-2}$ is a bidentate legand

Secondary valency = coordination Number = 6

5. The number of chlorine atoms in 20 mL of chlorine gas at STP is _____ 10^{21}. (Round off to the Nearest Integer).

[Assume chlorine is an ideal gas at STP

$R = 0.083$ L bar mol^{-1} K^{-1}, $N_A = 6.023 \times 10^{23}$]

Ans. Official Answer NTA (1)

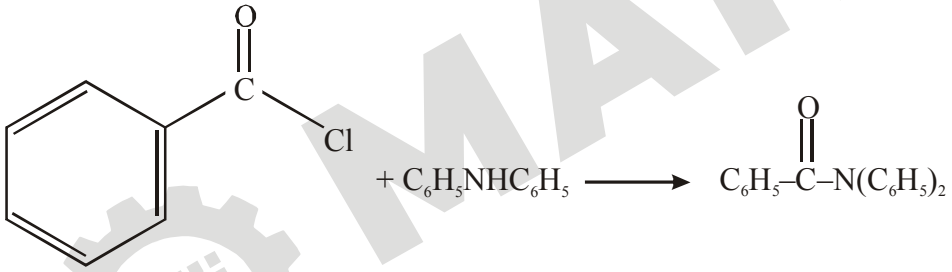
Sol. no of moles of Cl_2 at S.T.P in 20ml = $\frac{20\times10^{-3}}{22.4}$

no of moles of Cl – atom = $\frac{40\times10^{-3}}{22.4}$

no of Cl–atom = $\frac{40\times10^{-3}\times6.023\times10^{23}}{22.4}$

$= 10.755 \times 10^{20}$

$= 1.07 \times 10^{21}$

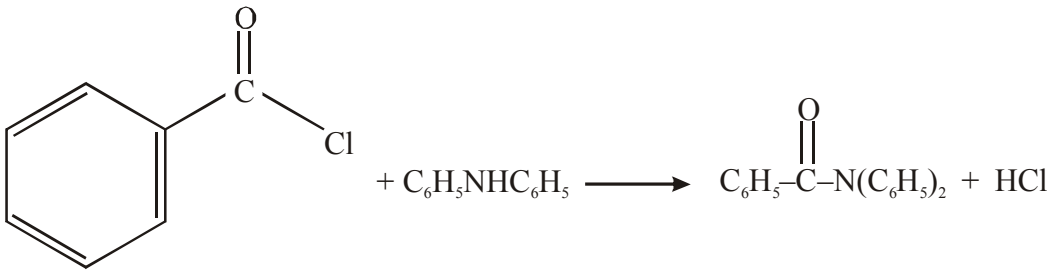
6. 

0.140 g 0.388 g 0.210 g

Consider the above reaction. The percentage yield of amide product is _____. (Round off to the Nearest Integer.)

(Given : Atomic mass : C : 12.0 u, H : 1.0 u, N : 14.0 u, O : 16.0 u, Cl : 35.5 u)

Ans. Official Answer NTA (77)

Sol. 

mass	0.140	0.388	0.210

moles $\frac{0.140}{140.5} \Rightarrow$ L.R $\frac{0.388}{169}$ $\frac{0.210}{273}$ (experimental)

$\frac{.140}{140.5}$ (theoritical)

$$\%\text{yield} = \frac{\frac{0.210}{273}}{\frac{0.140}{140.5}} \times 100$$

= 77.19 %

7. The total number of C–C sigma bond /s in mesityl oxide ($C_6H_{10}O$) is _____(Round off to the Nearest Integer).

Ans. Official Answer NTA (5)

Sol. Mesityl oxide ($C_6H_{10}O$) $\Rightarrow$ $H_3C \overset{\sigma}{-} \underset{\sigma|}{\underset{CH_3}{C}} \overset{\sigma}{=} CH \overset{\sigma}{-} \underset{||}{\underset{O}{C}} \overset{\sigma}{-} CH_3$

no of C–C bond = 5

8. Consider the reaction $N_2O_4(g) \rightleftharpoons 2NO_2(g)$. The temperature at which K_C = 20.4 and K_p = 600.1, is _____ K. (Round off to the Nearest Integer).

[Assume all gases are ideal and R = 0.0831 L bar K^{-1} mol^{-1}]

Official Answer NTA (354)

Sol. $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

$\Delta n_g = 1$

$K_p = K_c (RT)^1$

600.1 = 20.4 (.0831 × T)

T = 353.99

9. A KCl solution of conductivity 0.14 Sm^{-1} shows a resistance of 4.19 Ω in a conductivity cell. If the same cell is filled with an HCl solution, the resistance drops to 1.03 Ω. The conductivity of the HCl solution is _____ × 10^{-2} Sm^{-1}. (Round off to the Nearest Integer).

Ans. Official Answer NTA (57)

Sol. $K = \frac{1}{R}\frac{l}{A}$

$\frac{l}{A} = KR$

$K_1R_1 = K_2 R_2$

$0.14 \times 4.19 = 1.03 \times K_2$

$K_2 = .5695$

$= 56.95 \times 10^{-2}$

10. In the ground state of atomic Fe(Z = 26), the spin–only magnetic moment is _____ $\times 10^{-1}$ BM.

(Roound off the Nearest Integer).

[Given : $\sqrt{3} = 1.73, \sqrt{2} = 1.41$]

Ans. Official Answer NTA (49)

Sol. Fe(Z=26) $\Rightarrow$ [Ar] $4S^2 3d^6$

no of unpaired e^- = 4

$\mu = \sqrt{(4)(6)} = 4.89$

$\mu = 48.9 \times 10^{-1}$