FINAL JEE–MAIN EXAMINATION – MARCH, 2021

(Held On Wednesday 17th March, 2021) TIME : 3 : 00 PM to 6 : 00 PM

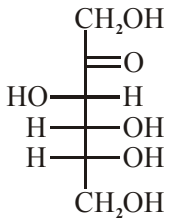
CHEMISTRY

TEST PAPER WITH ANSWER & SOLUTION

SECTION-A

1. Fructose is an example of :-
(1) Pyranose
(2) Ketohexose
(3) Aldohexose
(4) Heptose
Official Ans. by NTA (2)

Sol. Fructose is a ketohexose.



2. The set of elements that differ in mutual relationship from those of the other sets is :
(1) Li – Mg (2) B – Si
(3) Be – Al (4) Li – Na
Official Ans. by NTA (4)

Sol. Li–Mg, B–Si, Be–Al show diagonal relationship but Li and Na do not show diagonal relationship as both belongs to same group and not placed diagonally.

3. The functional groups that are responsible for the ion-exchange property of cation and anion exchange resins, respectively, are :
(1) $-SO_3H$ and $-NH_2$
(2) $-SO_3H$ and $-COOH$
(3) $-NH_2$ and $-COOH$
(4) $-NH_2$ and $-SO_3H$
Official Ans. by NTA (1)

Sol. Cation exchanger contains $-SO_3H$ or $-COOH$ groups while anion exchanger contains basic groups like $-NH_2$.

4. Match List-I and List-II :

	List-I		List-II
(a)	Haematite	(i)	$Al_2O_3.xH_2O$
(b)	Bauxite	(ii)	Fe_2O_3
(c)	Magnetite	(iii)	$CuCO_3.Cu(OH)_2$
(d)	Malachite	(iv)	Fe_3O_4

Choose the correct answer from the options given below :
(1) (a)-(ii), (b)-(iii), (c)-(i), (d)-(iv)
(2) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)
(3) (a)-(i), (b)-(iii), (c)-(ii), (d)-(iv)
(4) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)
Official Ans. by NTA (4)

Sol.

	Ore	Formula
(a)	Haematite	Fe_2O_3
(b)	Bauxite	$Al_2O_3.xH_2O$
(c)	Magnetite	Fe_3O_4
(d)	Malachite	$CuCO_3.Cu(OH)_2$

5. The correct pair(s) of the ambident nucleophiles is (are) :
(A) AgCN/KCN
(B) RCOOAg/RCOOK
(C) $AgNO_2/KNO_2$
(D) AgI/KI
(1) (B) and (C) only
(2) (A) only
(3) (A) and (C) only
(4) (B) only
Official Ans. by NTA (3)

Sol. Ambident nucleophile
(A) KCN & AgCN
(C) $AgNO_2$ & KNO_2

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) N_2O and NO_2 (4) NO and NO_2
Official Ans. by NTA (1)

Sol. N_2O and NO are neutral oxides of nitrogen NO_2 and N_2O_3 are acidic oxides.

7. 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)
Official Ans. by NTA (1)

Sol.

	Complex	Type of Isomerism
(a)	$[Co(NH_3)_6]\ [Cr(CN)_6]$	Co-ordination isomerism
(b)	$[Co(NH_3)_3\ (NO_2)_3]$	Linkage isomerism
(c)	$[Cr(H_2O)_6]Cl_3$	Solvate isomerism
(d)	*cis*-$[CrCl_2(ox)_2]^{3-}$	Optical isomerism

8. Primary, secondary and tertiary amines can be separated using :-
(1) Para-Toluene sulphonyl chloride
(2) Chloroform and KOH
(3) Benzene sulphonic acid
(4) Acetyl amide
Official Ans. by NTA (1)

Sol. Primary amines react with Para Toluene sulfonyl chloride to form a precipitate that is soluble in NaOH.
Secondary amines reacts with para toluene sulfonyl chloride to give a precipitate that is insoluble in NaOH.
Tertiary amines do not react with para toluen.

9. The common positive oxidation states for an element with atomic number 24, are :
(1) +2 to +6 (2) +1 and +3 to +6
(3) +1 and +3 (4) +1 to +6
Official Ans. by NTA (1)

Sol. Cr(Z=24)
[Ar] $4s^1 3d^5$ Cr shows common oxidation states starting from +2 to +6.

10. Match List-I with List-II :

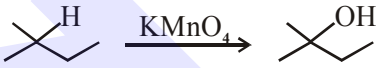
List-I Chemical Compound		List-II Used as	
(a)	Sucralose	(i)	Synthetic detergent
(b)	Glyceryl ester of stearic acid	(ii)	Artificial sweetener
(c)	Sodium benzoate	(iii)	Antiseptic
(d)	Bithionol	(iv)	Food preservative

Choose the correct match :
(1) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)
(2) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)
(3) (a)-(iii), (b)-(ii), (c)-(iv), (d)-(i)
(4) (a)-(i), (b)-(ii), (c)-(iv), (d)-(iii)
Official Ans. by NTA (2)

Sol. Artificial sweetner : Sucralose
Antiseptic : Bithional
Preservative : Sodium Benzoate
Glyceryl ester of stearic acid : Sodium steasate

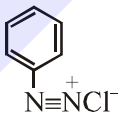
11. Given below are two statements :
Statement-I : 2-methylbutane on oxidation with $KMnO_4$ gives 2-methylbutan-2-ol.
Statement-II : n-alkanes can be easily oxidised to corresponding alcohol with $KMnO_4$.
Choose the correct option :
(1) Both statement I and statement II are correct
(2) Both statement I and statement II are incorrect
(3) Statement I is correct but Statement II is incorrect
(4) Statement I is incorrect but Statement II is correct
Official Ans. by NTA (3)

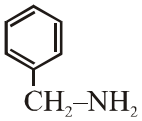
Sol. Alkane are very less reactive, tertiary hydrogen can oxidise to alcohal with $KMnO_4$.



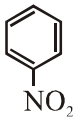
2-methyl-butane

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

(1) 

(2) 

(3) 

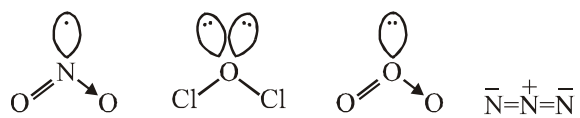
(4) 

Official Ans. by NTA (2)

Sol. Kjeldahl method is not applicable to compounds containing nitrogen in nitrogroup, Azo groups and nitrogen present in the ring (e.g Pyridine) as nitrogen of these compounds does not change to Ammonium sulphate under these conditions.

13. Amongst the following, the linear species is :
(1) NO_2 (2) Cl_2O
(3) O_3 (4) N_3^-
Official Ans. by NTA (4)

Sol.



14. $C_{12}H_{22}O_{11}+H_2O \xrightarrow{\text{Enzyme A}} \underset{\text{Glucose}}{C_6H_{12}O_6}+\underset{\text{Fructose}}{C_6H_{12}O_6}$
(Sucrose)

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

In the above reactions, the enzyme A and enzyme B respectively are :-
(1) Amylase and Invertase
(2) Invertase and Amylase
(3) Invertase and Zymase
(4) Zymase and Invertase

Official Ans. by NTA (3)

Sol. Informative

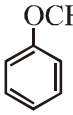
OR

$C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{Invertase}} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$

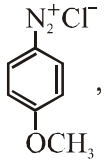
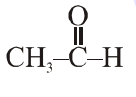
$C_6H_{12}O_6 \xrightarrow{\text{Zymase}} 2C_6H_5OH + 2CO_2$

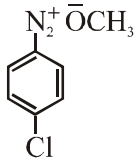
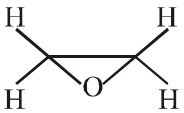
15. One of the by-products formed during the recovery of NH_3 from Solvay process is :
(1) $Ca(OH)_2$ (2) $NaHCO_3$
(3) $CaCl_2$ (4) NH_4Cl

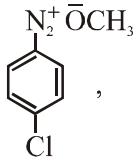
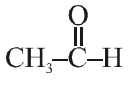
Official Ans. by NTA (3)

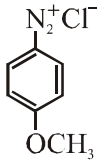
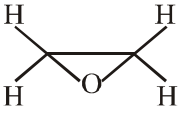
16. $\underset{(A)}{C_7H_7N_2OCl}+C_2H_5OH \rightarrow$  $+ N_2+\text{"X"}+\text{"Y"}$

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

(1)  ,  , HCl

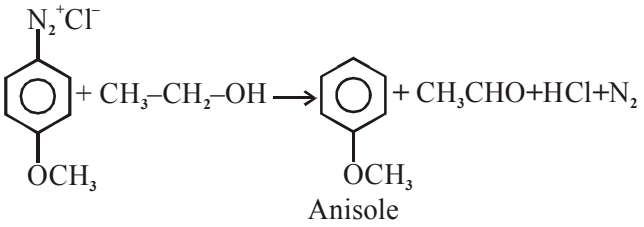
(2)  ,  , HCl

(3)  ,  , H_2O

(4)  ,  , H_2O

Official Ans. by NTA (1)

Sol.


Anisole

17. For the coagulation of a negative sol, the species below, that has the highest flocculating power is :
(1) SO_4^{2-} (2) Ba^{2+} (3) Na^+ (4) PO_4^{3-}

Official Ans. by NTA (2)

Sol. To coagulate negative sol, cation with higher charge has higher coagulation value.

18. 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

Choose the most appropriate answer from the options given below :
(1) (A) only (2) (C) only
(3) (B) and (D) only (4) (D) only

Official Ans. by NTA (4)

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.

19. Choose the correct statement regarding the formation of carbocations A and B given :

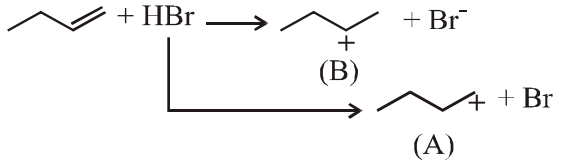
$CH_3-CH_2-CH=CH_2+HBr \rightarrow \underset{\text{"A"}}{CH_3-CH_2-CH_2-\overset{+}{C}H_2}+Br^-$

$CH_3-CH_2-CH=CH_2+HBr \rightarrow \underset{\text{"B"}}{CH_3-CH_2-\overset{+}{C}H-CH_3}+Br^-$

(1) Carbocation B is more stable and formed relatively at faster rate
(2) Carbocation A is more stable and formed relatively at slow rate
(3) Carbocation B is more stable and formed relatively at slow rate
(4) Carbocation A is more stable and formed relatively at faster rate

Official Ans. by NTA (1)

Sol.



This is more stable due to secondary cation formation and formed with faster rate due to low activation energy.

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

(A) Freezing of water to ice at 0°C
(B) Freezing of water to ice at –10°C
(C) $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
(D) Adsorption of CO(g) and lead surface
(E) Dissolution of NaCl in water

Official Ans. by NTA (1)

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

Sol. (A) Water $\xrightarrow{0°C}$ ice; ΔS = –ve

(B) Water $\xrightarrow{-10°C}$ ice; ΔS = –ve
(C) $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$; ΔS = –ve
(D) Adsorption; ΔS = –ve
(E) $NaCl(s) \rightarrow Na^+(aq) + Cl^-(aq)$; ΔS = +ve

SECTION-B

1. A KCl solution of conductivity 0.14 S m^{-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} S m^{-1}. (Round off to the Nearest Integer).

Official Ans. by NTA (57)

Sol. $\kappa = \frac{1}{R} \cdot G^*$

For same conductivity cell, G* is constant and hence κ.R. = constant.

$\therefore \quad 0.14 \times 4.19 = \kappa \times 1.03$

or, κ of HCl solution = $\frac{0.14 \times 4.19}{1.03}$

$= 0.5695 \ Sm^{-1}$

$= 56.95 \times 10^{-2} \ Sm^{-1} \approx 57 \times 10^{-2} \ Sm^{-1}$

2. 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 Integer).

Official Ans. by NTA (6)

Sol. $Fe^{3+} + 3K^+ + 3C_2O_4^{2-} \rightarrow \underset{(A)}{K_3[Fe(C_2O_4)_3]}$

Secondary valency of Fe in 'A' is 6.

3. 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 Integer).

Official Ans. by NTA (27)

Sol. Reaction : $2A + B_2 \longrightarrow 2AB$

As the reaction is elementary, the rate of reaction is

$r = K \ . \ [A]^2 \ [B_2]$

on reducing the volume by a factor of 3, the concentrations of A and B_2 will become 3 times and hence, the rate becomes $3^2 \times 3 = 27$ times of initial rate.

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

Official Ans. by NTA (5)

Sol. Mesityle oxide

$H_3C \overset{\sigma}{-} \underset{\underset{CH_3}{|\sigma}}{C} \overset{\sigma}{=} CH \overset{\sigma}{-} \underset{\underset{O}{||}}{C} \overset{\sigma}{-} CH_3$

$\therefore \quad C \overset{\sigma}{-} C = 5$

5. 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 Integer).

[Density of water = 1.0 g cm^{-3}]

Official Ans. by NTA (85)

Sol. $K_4\,Fe(CN)_6 \rightleftharpoons 4K^+ + Fe(CN)_6^{4-}$

Initial conc. 1 m 0 0

Final conc. (1 – 0.4)m 4×0.4 0.4m

= 0.6 m = 1.6 m

Effective molality = 0.6 + 1.6 + 0.4 = 2.6m

For same boiling point, the molality of another solution should also be 2.6 m.

Now, 18.1 weight percent solution means 18.1 gm solute is present in 100 gm solution and hence, (100 – 18.1 =) 81.9 gm water.

Now, $2.6 = \dfrac{18.1/M}{81.9/1000}$

$\therefore$ Molar mass of solute, M = 85

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

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

Official Ans. by NTA (49)

Sol. Fe $\rightarrow$ [Ar] $4s^2 3d^6$ $\boxed{\uparrow\downarrow}\boxed{1}\boxed{1}\boxed{1}\boxed{1}$

Number of unpaired $e^- = 4$

$\mu = \sqrt{4(4+2)}$ B.M.

$\mu = \sqrt{24}$ B.M.

$\mu = 4.89$ B.M.

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

Nearest integer value will be 49.

7. 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}, $N_A = 6.023 \times 10^{23}$]

Official Ans. by NTA (1)

Sol. PV = nRT

$1.0 \times \dfrac{20}{1000} = \dfrac{N}{6.023\times10^{23}} \times 0.083 \times 273$

$\therefore$ Number of Cl_2 molecules, $N = 5.3 \times 10^{20}$

Hence, Number of Cl-atoms = 1.06×10^{21}

$\approx 1 \times 10^{21}$

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

[Atomic Mass : K : 39.1 u, Br : 79.9 u,

$N_A = 6.023 \times 10^{23}$]

Official Ans. by NTA (5)

Sol. 1 mole KBr (= 119 gm) have $\dfrac{10^{-5}}{100}$ moles $SrBr_2$

and hence, 10^{-7} moles cation vacancy (as 1 Sr^{2+} will result 1 cation vacancy)

$\therefore$ Required number of cation vacancies

$= \dfrac{10^{-7}\times6.023\times10^{23}}{119} = 5.06\times10^{14} \simeq 5\times10^{14}$

9. 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 Ans. by NTA (354)

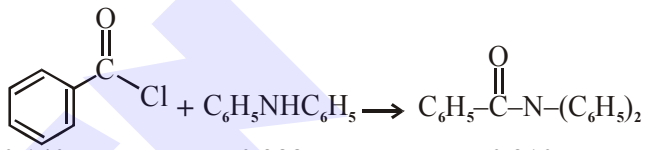
Sol. $N_2O_4(g) \rightleftharpoons 2NO_2(g)$; $\Delta n_g = 2 - 1 = 1$

Now, $K_p = K_c \,.\, (RT)^{\Delta ng}$

or, $600.1 = 20.4 \times (0.0831 \times T)^1$

$\therefore$ T = 353.99 K = 354K

10.



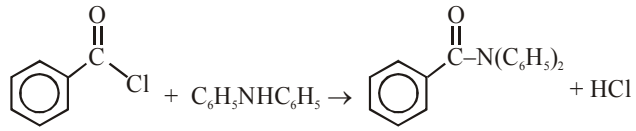
0.140g 0.388g 0.210g

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 : 1.0u, N : 14.0 u, O : 16.0 u, Cl : 35.5 u)

Official Ans. by NTA (77)

Sol.



1 mole = 140.5 gm 1 mole = 169 gm 1 mole = 273 gm

$\therefore$ 0.140 gm $\dfrac{169}{140.5}\times0.140$

L.R. = 0.168 gm < 0.388 gm

excess

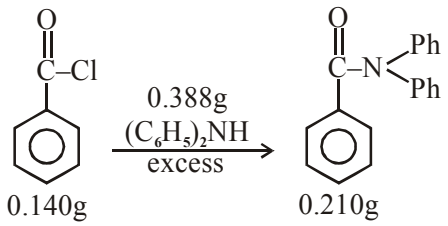
$\therefore$ Theoretical amount of given product formed

$= \dfrac{273}{140.5}\times0.140 = 0.272$gm

But its actual amount formed is 0.210 gm. Hence, the percentage yield of product.

$= \dfrac{0.210}{0.272}\times100 = 77.20 \approx 77$

OR



Mole of Ph – CoCl = $\frac{0.140}{140} = 10^{-3}$mol

Mole of $Ph–\overset{\overset{O}{\|}}{C}–N(Ph)_2$, that should be obtained by mol-mol analysis = 10^{-3} mol.

Theoritical mass of product = $10^{-3} \times 273 = 273 \times 10^{-3}$g

Observed mass of product = 210×10^{-3}g

%yield of product = $\frac{210\times10^{-3}}{273\times10^{-3}}\times100 = 76.9\% = 77$