FINAL JEE–MAIN EXAMINATION – AUGUST, 2021

(Held On Wednesday 01st September, 2021) TIME : 3 : 00 PM to 6 : 00 PM

CHEMISTRY — TEST PAPER WITH SOLUTION

SECTION-A

1. Water sample is called cleanest on the basis of which one of the BOD values given below

(1) 11 ppm (2) 15 ppm

(3) 3 ppm (4) 21 ppm

Official Ans. by NTA (3)

Sol. Clean water could have BOD value of less than 5 ppm whereas highly polluted water could have a BOD value of 17 ppm or more.

2. Calamine and Malachite, respectively, are the ores of :

(1) Nickel and Aluminium

(2) Zinc and Copper

(3) Copper and Iron

(4) Aluminium and Zinc

Official Ans. by NTA (2)

Sol. Calamine $\Rightarrow ZnCO_3$

Malachite $\Rightarrow Cu(OH)_2{\cdot}CuCO_3$

3. Experimentally reducing a functional group **cannot** be done by which one of the following reagents ?

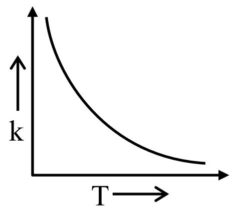
(1) $Pt\text{-}C/H_2$ (2) Na/H_2

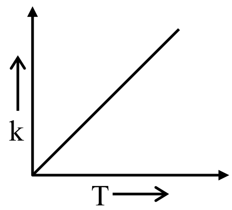
(3) $Pd\text{-}C/H_2$ (4) Zn/H_2O

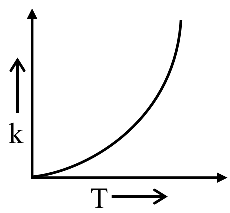
Official Ans. by NTA (2)

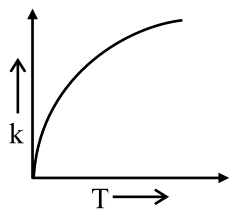
Sol. Solution NaH_2 is not reducing agent

4. Which one of the following given graphs represents the variation of rate constant (k) with temperature (T) for an endothermic reaction ?

(1) 

(2) 

(3) 

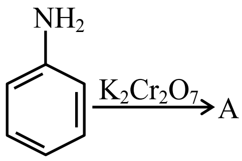
(4) 

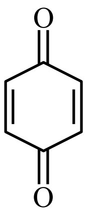
Official Ans. by NTA (3)

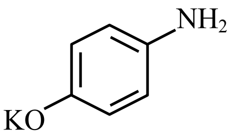
Sol. By observation we get this plot during measurable temperatures

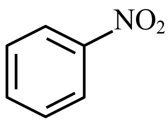
Ans. 3rd Option.

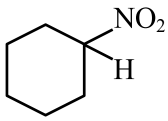
5. Identify A in the following reaction.



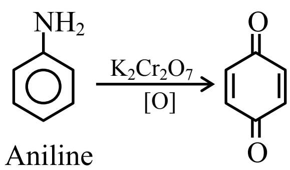
(1) 

(2) 

(3) 

(4) 

Official Ans. by NTA (1)

Sol. 

Aniline [A]

6. In the following sequence of reactions a compound **A**, (molecular formula $C_6H_{12}O_2$) with a straight chain structure gives a C_4 carboxylic acid. **A** is :

$$\mathbf{A} \xrightarrow[H_3O^+]{LiAlH_4} \mathbf{B} \xrightarrow{\text{Oxidation}} C_4 - \text{carboxylic acid}$$

(1) $CH_3 - CH_2 - COO - CH_2 - CH_2 - CH_3$

(2) $CH_3\text{–}CH_2\text{–}\underset{}{\overset{OH}{\overset{|}{C}H}}\text{–}CH_2\text{–}O\text{–}CH{=}CH_2$

(3) $CH_3 - CH_2 - CH_2 - COO - CH_2 - CH_3$

(4) $CH_3 - CH_2 - CH_2 - O - CH = CH - CH_2 - OH$

Official Ans. by NTA (3)

Sol.

$CH_3-CH_2-CH_2-\underset{\underset{O}{\|}}{C}-O-CH_2-CH_3$ (A) $[C_6H_{12}O_2]$

$\downarrow$ (1) $LiAlH_4$ (2) H_3O^+

$CH_3-CH_2-CH_2-CH_2-OH + CH_3-CH_2-$

(B)

$\downarrow$ [O]

$CH_3-CH_2-CH_2-\underset{\underset{O}{\|}}{C}-OH$ [C_4 carboxylic acid]

7. Match **List – I** with **List - II**.

List -I (Colloid Preparation Method)		List -II (Chemical Reaction)	
(a)	Hydrolysis	(i)	$2AuCl_3 + 3HCHO + 3H_2O \rightarrow 2Au(sol) + 3HCOOH + 6HCl$
(b)	Reduction	(ii)	$As_2O_3 + 3H_2S \rightarrow As_2S_3(sol) + 3H_2O$
(c)	Oxidation	(iii)	$SO_2 + 2H_2S \rightarrow 3S(sol) + 2H_2O$
(d)	Double Decomposition	(iv)	$FeCl_3 + 3H_2O \rightarrow Fe(OH)_3(sol) + 3HCl$

Choose the most appropriate answer from the options given below.

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

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

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

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

Official Ans. by NTA (2)

Sol. According to type of reactions for preparation, colloids have been classified

8. The Crystal Field Stabilization Energy (CFSE) and magnetic moment (spin-only) of an octahedral aqua complex of a metal ion (M^{z+}) are $-0.8\ \Delta_0$ and 3.87 BM, respectively. Identify (M^{Z+}) :

(1) V^{3+} (2) Cr^{3+}

(3) Mn^{4+} (4) Co^{2+}

Official Ans. by NTA (4)

Sol. $V^{3+} \Rightarrow \boxed{\ }\boxed{\ }_{e_g}$ $= 2 \times 0.4\ \Delta_0$

$\boxed{1}\boxed{1}\boxed{\ }_{t_{2g}}$ $= -0.8\ \Delta_0$

$= 2$ unpaired e^-

$\mu = 2.89$ Bm

Co^{2+} ➡ $\boxed{1}\boxed{1}_{e_g}$ $[2 \times 0.6\ \Delta_0 - 5 \times 0.4\ \Delta_0]$

$= -0.8\ \Delta_0$

$\boxed{1\!\downarrow}\boxed{1\!\downarrow}\boxed{1}_{t_{2g}}$ 3 unpaired $e^- \Rightarrow \mu = 3.87$ BM

hence d^7 configuration is of Co^{2+} Ans.

9. Monomer units of Dacron polymer are :

(1) ethylene glycol and phthalic acid

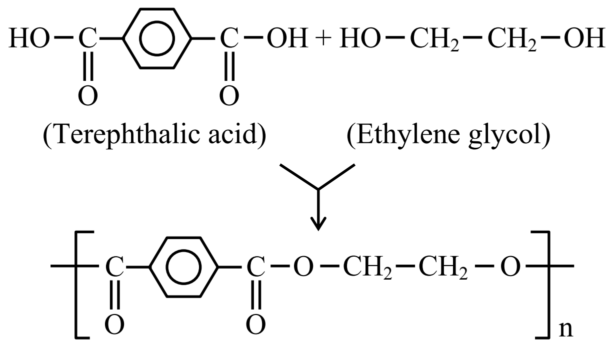
(2) ethylene glycol and terephthalic acid

(3) glycerol and terephthalic acid

(4) glycerol and phthalic acid

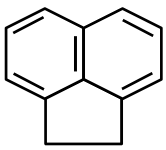
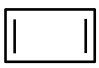
Official Ans. by NTA (2)

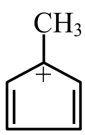
Sol.

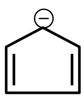


Dacron

10. Which one of the following compounds is aromatic in nature ?

(1)  (2) 

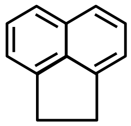
(3) 

(4) 

Official Ans. by NTA (4)

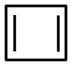
Allen Ans. (1,4)

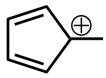
Sol. (1) (Acenaphthene)



$\rightarrow$ 10 πe^- in cyclic conjugation

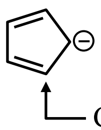
$\rightarrow$ $\boxed{\text{Aromatic}}$

(2)  $\rightarrow$ $4\pi e^-$ in ring conjugation $\Rightarrow$ Anti Aromatic

(3)  $CH_3 \Rightarrow$ $4\pi e^-$ in ring conjugation $\Rightarrow$

Antiaromatic

(4)

 $\Rightarrow$ $6\pi e^-$ in ring conjugation $\Rightarrow$ $\boxed{\text{Aromatic}}$

Cyclopentadienyl anion

11. In the given chemical reaction, colors of the Fe^{2+} and Fe^{3+} ions, are respectively :

$5Fe^{2+} + MnO_4^- + 8H^+ \rightarrow Mn^{2+} + 4H_2O + 5Fe^{3+}$

(1) Yellow, Orange (2) Yellow, Green

(3) Green, Orange (4) Green, Yellow

Official Ans. by NTA (4)

Sol. Colour of Fe^{2+} is observed green and Fe^{3+} is yellow

12. The stereoisomers that are formed by electrophilic addition of bromine to trans-but-2-ene is/are :

(1) 2 enantiomers and 2 mesomers

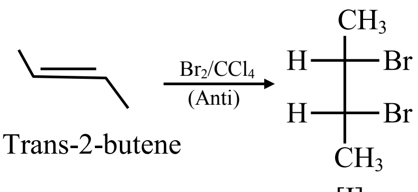
(2) 2 identical mesomers

(3) 2 enantiomers

(4) 1 racemic and 2 enantiomers

Official Ans. by NTA (2)

Sol.



Trans-2-butene

[I]

meso product

13. Hydrogen peroxide reacts with iodine in basic medium to give :

(1) IO_4^- (2) IO^- (3) I^- (4) IO_3^-

Official Ans. by NTA (3)

Sol. $I_2 + H_2O_2 + 2OH^- \longrightarrow 2I^- + 2H_2O + O_2$

14. In the following sequence of reactions,

$C_3H_6 \xrightarrow{H^+/H_2O} \mathbf{A} \xrightarrow[\text{dil KOH}]{\text{KIO}} \mathbf{B} + \mathbf{C}$

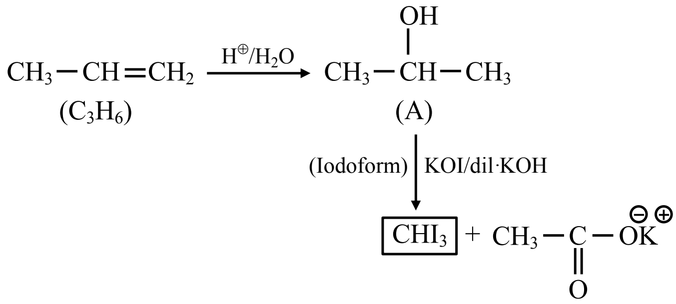
The compounds **B** and **C** respectively are :

(1) CI_3COOK, HCOOH (2) CI_3COOK, CH_3I

(3) CH_3I, HCOOK (4) CHI_3, CH_3COOK

Official Ans. by NTA (4)

Sol.



(B) (C)

15. Given below are **two** statements :

Statement I : The nucleophilic addition of sodium hydrogen sulphite to an aldehyde or a ketone involves proton transfer to form a stable ion.

Statement II : The nucleophilic addition of hydrogen cyanide to an aldehyde or a ketone yields amine as final product.

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

(1) Both **Statement I** and **Statement II** are true.

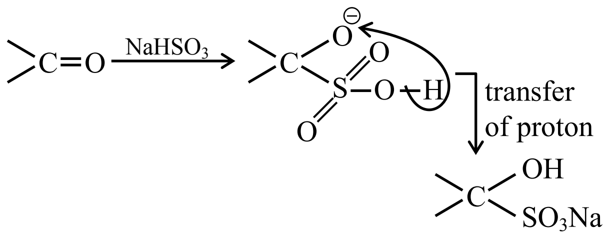
(2) **Statement I** is true but **Statement II** is false.

(3) **Statement I** is false but **Statement II** is true.

(4) Both **Statement I** and **Statement II** are false.

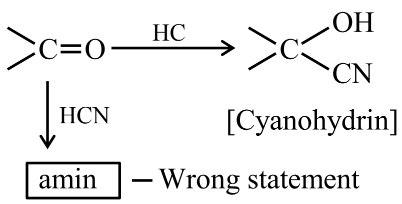
Official Ans. by NTA (2)

Sol. **Statement I :** Correct



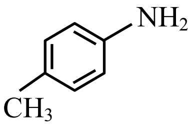
(White crystalline soluble ppt)

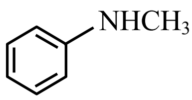
Statement II :



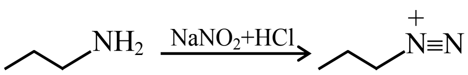
(Amine not formed)

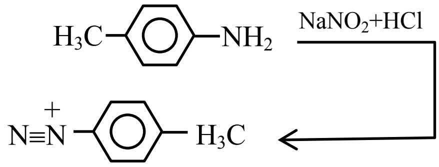
16. Which one of the following gives the most stable Diazonium salt ?

(1) $CH_3-CH_2-CH_2-NH_2$ (2) 

(3) $CH_3-\underset{H}{\overset{CH_3}{C}}-NH_2$ (4) 

Official Ans. by NTA (2)

Sol. (1) 

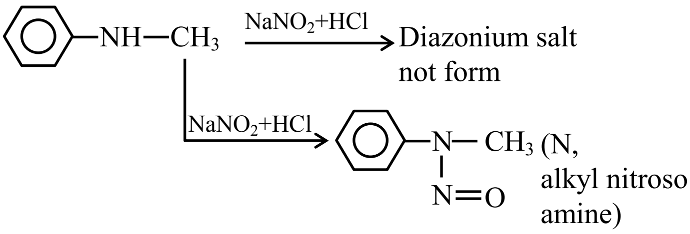
(2) 

(Most stable) +H-effect

(3)

$CH_3-\underset{CH_3}{CH}-NH_2 \xrightarrow{NaNO_2+HCl} H_3C-\underset{CH_3}{CH}-\overset{+}{N}\equiv N$

(4)



17. The potassium ferrocyanide solution gives a Prussian blue colour, when added to :

(1) $CoCl_3$ (2) $FeCl_2$

(3) $CoCl_2$ (4) $FeCl_3$

Official Ans. by NTA (4)

Sol. $FeCl_3 + K_4[Fe(CN)_6] \rightarrow Fe_4[Fe(CN)_6]_3$

Prussian blue

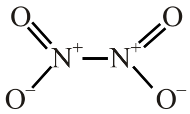
18. The oxide **without** nitrogen-nitrogen bond is :

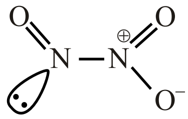
(1) N_2O (2) N_2O_4

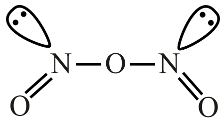
(3) N_2O_3 (4) N_2O_5

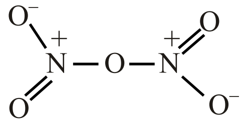
Official Ans. by NTA (4)

Sol. (1) $N\equiv N^+-O^-$

(2) 

(3)  unsymmetrical

 symmetrical

(4) 

19. Number of paramagnetic oxides among the following given oxides is __________.

Li_2O, CaO, Na_2O_2, KO_2, MgO and K_2O

(1) 1 (2) 2

(3) 3 (4) 0

Official Ans. by NTA (1)

Sol. $Li_2O \Rightarrow 2Li^+ \quad O^{2-}$ $\qquad MgO \Rightarrow Mg^{2+} \quad O^{2-}$

$CaO \Rightarrow Ca^{2+} \quad O^{2-}$ $\qquad K_2O \Rightarrow 2K^+ \quad O^{2-}$

$Na_2O_2 \Rightarrow 2Na^+ \quad O_2^{2-}$

$KO_2 \Rightarrow K^+ \quad O_2^-$

$O_2^- \Rightarrow$ Complete octet, diamagnetic

$O^{2-} \Rightarrow \sigma_{1s}^2\ \sigma_{1s}^{*2}\ \sigma_{2s}^2\ \sigma_{2s}^{*2}\ \sigma_{2px}^2\ \pi_{2py}^2 \simeq \pi_{2pz}^2\ \pi_{2py}^{*2} \simeq \pi_{2pz}^{*2}$ (dia)

$O_2^- \Rightarrow \sigma_{1s}^2\ \sigma_{1s}^{*2}\ \sigma_{2s}^2\ \sigma_{2s}^{*2}\ \sigma_{2px}^2\ \pi_{2py}^2 \simeq \pi_{2pz}^2\ \pi_{2py}^{*2} \simeq \pi_{2pz}^{*1}$ (para)

20. Identify the element for which electronic configuration in +3 oxidation state is $[Ar]3d^5$:

(1) Ru (2) Mn

(3) Co (4) Fe

Official Ans. by NTA (4)

Sol. Fe^{3+} $[Ar]\ 3d^5$

SECTION-B

1. An empty LPG cylinder weighs 14.8 kg. When full, it weighs 29.0 kg and shows a pressure of 3.47 atm. In the course of use at ambient temperature, the mass of the cylinder is reduced to 23.0 kg. The final pressure inside of the cylinder is ______atm. (Nearest integer)

(Assume LPG of be an ideal gas)

Official Ans. by NTA (2)

Sol. Initial mass of gas = 29 – 14.8 = 14.2 Kg

mass of gas used = 29 – 23 = 6 Kg

gas left = 14.2 – 6 = 8.2 Kg

(1) $3.47 \times V = \left(\frac{14.2 \times 10^3}{M}\right) \times R \times T$

(2) $p \times V = \left(\frac{8.2 \times 10^3}{M}\right) \times R \times T$

Divide :

$\frac{(1)}{(2)} \Rightarrow \frac{3.47}{P} = \frac{14.2}{8.2}$

P = 2.003

2. The molar solubility of $Zn(OH)_2$ in 0.1 M NaOH solution is $x \times 10^{-18}$ M. The value of x is _____(Nearest integer)

(Given : The solubility product of $Zn(OH)_2$ is 2×10^{-20})

Official Ans. by NTA (2)

Sol. $Zn(OH)_2\,(s) \rightleftharpoons Zn^{+2}\,(aq) + 2OH^-\,(aq)$

$\qquad\qquad\qquad\quad S \qquad\qquad (0.1 + 2s) \simeq 0.1$

$K_{sp} = S(0.1)^2$

$2 \times 10^{-20} = s \times 10^{-2} \Rightarrow s = 2 \times 10^{-18}$

$= x \times 10^{-18}$

x = 2

3. For the reaction $2NO_2(g) \rightleftharpoons N_2O_4(g)$, when $\Delta S = -176.0\ JK^{-1}$ and $\Delta H = -57.8\ kJ\ mol^{-1}$, the magnitude of ΔG at 298 K for the reaction is_____ kJ mol^{-1}. (Nearest integer)

Official Ans. by NTA (5)

Sol. $\Delta G = \Delta H - T\Delta S$

$\Delta G = 57.8 - \frac{298(-176)}{1000}$

$\Delta G = -5.352$ kJ/mole

|Nearest integer value| = 5

4. The sum of oxidation states of two silver ions in $[Ag(NH_3)_2]\ [Ag(CN)_2]$ complex is _______.

Official Ans. by NTA (2)

Sol. $[Ag(NH_3)_2]^+\ [Ag(CN)_2]^-$

+1 $\qquad\qquad$ +1

5. The number of atoms in 8 g of sodium is $x \times 10^{23}$. The value of x is________.(Nearest integer)

[Given : $N_A = 6.02 \times 10^{23}\ mol^{-1}$

Atomic mass of Na = 23.0 u]

Official Ans. by NTA (2)

Sol. No. of atoms $= \frac{8}{23} \times 6.02 \times 10^{23} = 2.09 \times 10^{23}$

$\simeq 2 \times 10^{23}$

$= x \times 10^{23}$

x = 2

6. If 80 g of copper sulphate $CuSO_4{\cdot}5H_2O$ is dissolved in deionised water to make 5 L of solution. The concentration of the copper sulphate solution is $x \times 10^{-3}\ mol\ L^{-1}$. The value of x is _________.

[Atomic masses Cu : 63.54 u, S : 32 u, O : 16 u, H : 1 u]

Official Ans. by NTA (64)

Sol. Moles of $CuSO_4{\cdot}5H_2O = \frac{80}{249.54}$

Molarity $= \frac{\frac{80}{249.54}}{5} = 64.117 \times 10^{-3}$

Nearest integer, x = 64

7. A 50 watt bulb emits monochromatic red light of wavelength of 795 nm. The number of photons emitted per second by the bulb is $x \times 10^{20}$. The value of x is __________.

[Given : $h = 6.63 \times 10^{-34}$ Js and $c = 3.0 \times 10^{8}\ ms^{-1}$]

Official Ans. by NTA (2)

Sol. Total energy per sec. = 50 J

$$50 = \frac{n \times 6.63 \times 10^{-34} \times 3 \times 10^{8}}{795 \times 10^{-9}}$$

$n = 1998.49 \times 10^{17}$ [n = no. of photons per second]

$= 1.998 \times 10^{20}$

$\simeq 2 \times 10^{20}$

$= x \times 10^{20}$

$x = 2$

8. The spin-only magnetic moment value of B_2^+ species is ________$\times 10^{-2}$ BM. (Nearest integer)

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

Official Ans. by NTA (173)

Sol. $B_2^+ \Rightarrow \sigma_{1s}^2\ \sigma_{1s}^{*2}\ \sigma_{2s}^2\ \sigma_{2s}^{*2}\ \pi_{2py}^1 \simeq \pi_{2pz}^0$

$\Rightarrow 9e^-$

$\mu = \sqrt{1(1+2)} = \sqrt{3}$ BM

$= 1.73$ BM

$= 1.73 \times 10^{-2}$ BM

9. If the conductivity of mercury at 0°C is 1.07×10^6 S m^{-1} and the resistance of a cell containing mercury is 0.243 Ω, then the cell constant of the cell is $x \times 10^4$ m^{-1}. The value of x is _______.(Nearest integer)

Official Ans. by NTA (26)

Sol. $k = 1.07 \times 10^6$ Sm^{-1}, $R = 0.243\ \Omega$

$$G = \frac{1}{R} = \frac{1}{0.243}\Omega^{-1}$$

$k = G \times G^*$

$$G^* = \frac{k}{G} = \frac{1.07 \times 10^6}{\frac{1}{0.243}} \simeq 26 \times 10^4 \text{ m}^{-1}$$

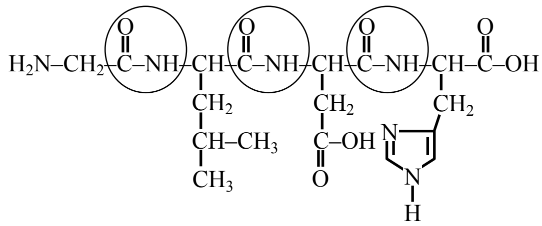
10. A peptide synthesized by the reactions of one molecule each of Glycine, Leucine, Aspartic acid and Histidine will have ________ peptide linkages.

Official Ans. by NTA (3)

Sol. $\boxed{\text{Glycine — leucine — Aspartic acid — Histidine}}$

peptide link   peptide link   peptide link

Total (3) peptide linkages are present



3 peptide linkage

Ans. (3)