JEE Main July 2021

Question Paper With Text Solution

20 July. | Shift-1

CHEMISTRY

MATRIX

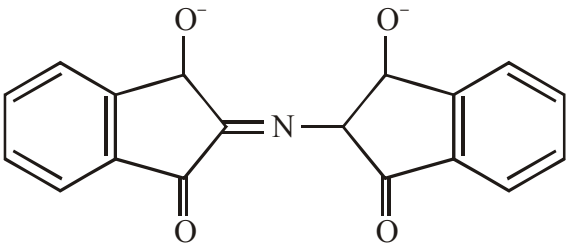
JEE Main & Advanced | XI-XII Foundation| VI-X Pre-Foundation

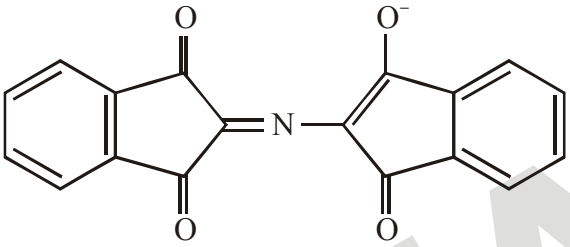
Office : Piprali Road, Sikar (Raj.) | Ph. 01572-241911
Website : www.matrixedu.in ; Email : smd@matrixacademy.co.in

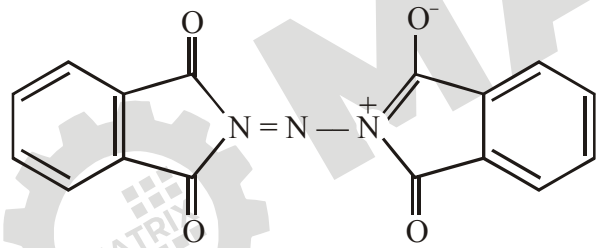
JEE MAIN JULY 2021 | 20TH JULY SHIFT-1

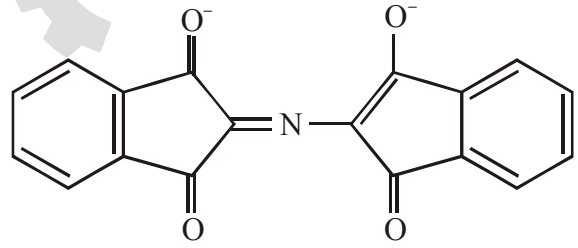
SECTION – A

1. The correct structure of Rhumann's Purple, the compound formed in the reaction of ninhydrin with proteins is :

(1) 

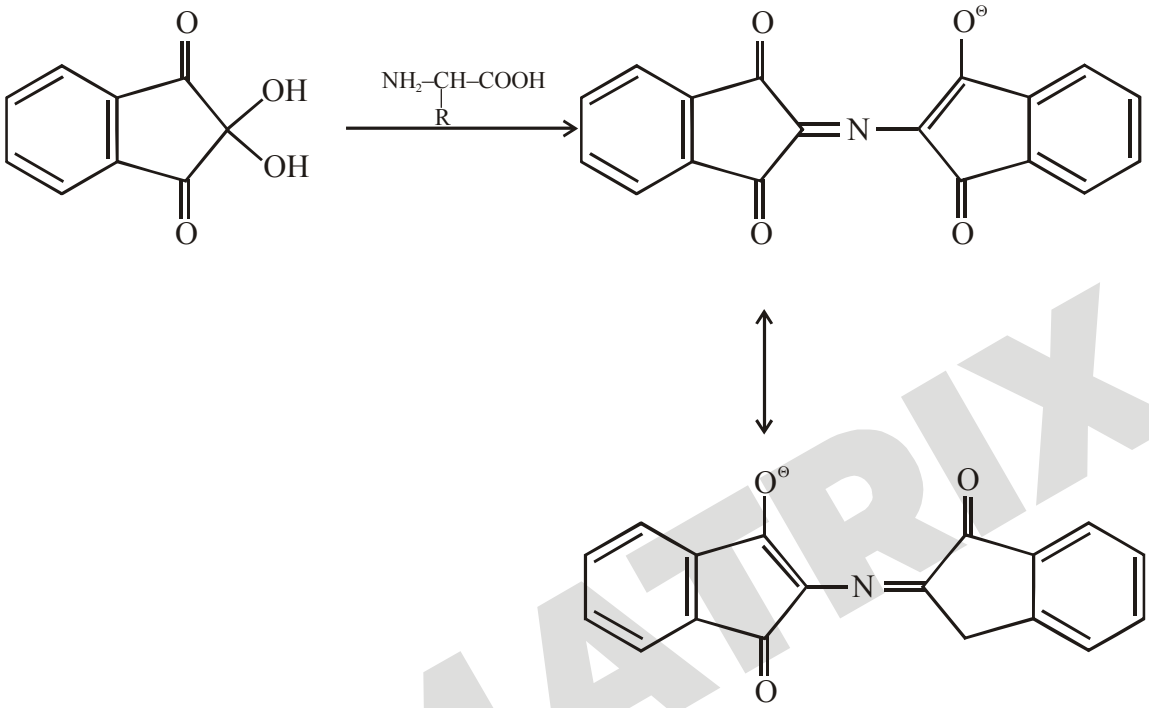
(2) 

(3) 

(4) 

Ans. Official Answer NTA (2)

Sol. Ninhydrin is used to detect primary amines, secondary amines and NH_3.



Ninhydrin, on reaction with amines produces a deep blue or purple color complex which is known as Rhumann's purple

2. According to the valence bond theory the hybridization of central metal atom is dsp^2 for which one of the following compounds ?

(1) $K_2\left[Ni(CN)_4\right]$

(2) $Na_2\left[NiCl_4\right]$

(3) $NiCl_2.6H_2O$

(4) $\left[Ni(CO)_4\right]$

Ans. Official Answer NTA (1)

Sol. (1) $K_2\left[Ni(CN)_4\right]$

$Ni^{2+} \equiv 3d^8$

$CN^{\ominus}$ is a strong ligand hence hybridisation is dsp^2.

(2) $Na_2[NiCl_4]$

$Ni^{2+} \equiv 3d^8$

$Cl^{\ominus}$ is a weak ligand hence hybridisation is sp^3.

(3) $NiCl_2.6H_2O$

$[Ni(H_2O)_6]Cl_2$

$Ni^{2+} \equiv 3d^8$

H_2O is a weak ligand hence hybridisation is sp^3d^2.

(4) $[Ni(CO)_4]$

$Ni \equiv 3d^8 4s^2$

CO is strong ligand but even after pairing d orbital is not vacant hence hybridisation is sp^3.

3. In the given reaction 3-Bromo-2,2-dimethyl butane $\xrightarrow{C_2H_5OH}$ (Major $\overset{'A'}{Pr}$oduct) Product A is :

(1) 2-Ethoxy-2,3-dimethyl butane.

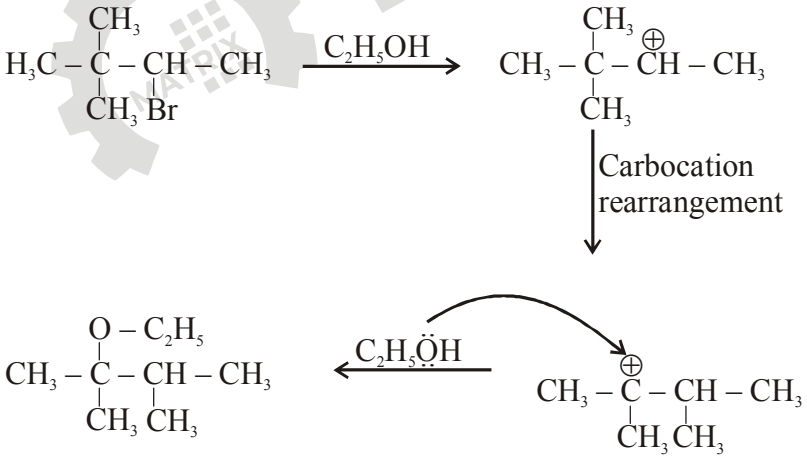
(2) 2-Ethoxy-3 3-dimethyl butane.

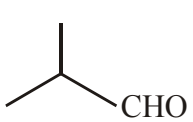
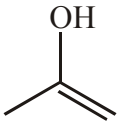
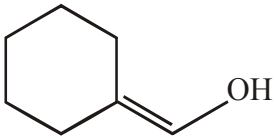
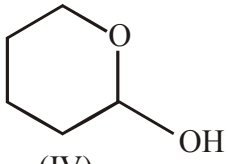
(3) 2- Hydroxy-3,3- dimethyl butane.

(4) l-Ethoxy-3,3-dimethyl butane.

Ans. Official Answer NTA (1)

Sol.



4. 
(I)

(II)

(III)

(IV)

Which among the above compound/s does/do not form Silver mirror when treated with Tollen's reagent?

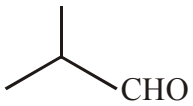
(1) (I), (III) and (IV) only

(2) (II) and (IV) only

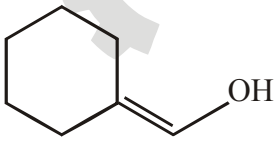
(3) Only (IV)

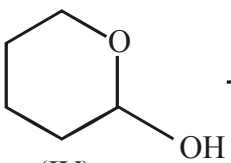
(4) Only (II)

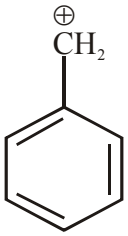
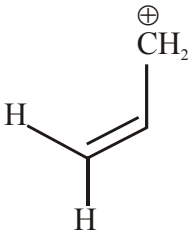
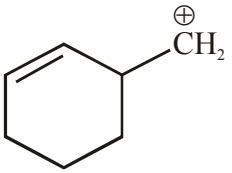
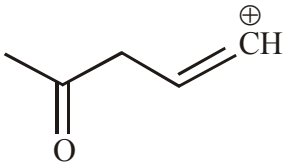
Ans. Official Answer NTA (4)

Sol. 
(I) ⟶ Positive Tollen's Test as it is a aldehyde


(II) ⟶ Negative Tollen's Test because it will tautomerise and will form ketone.


(III) ⟶ Positive Tollen's Test because it will tautomerise and will form aldehyde.


(IV) ⟶ It is a cyclic hemiacetal and it will give +ve Tollen's Test.

5.    

(A) (B) (C) (D)

Among the given species the Resonance stabilised carbocations are :

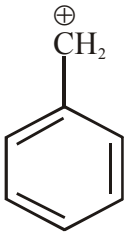
(1) (A), (B) and (C) only

(2) (C) and (D) only

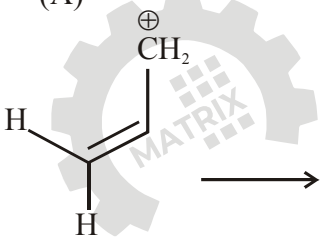
(3) (A), (B) and (D) only

(4) (A) and (B) only

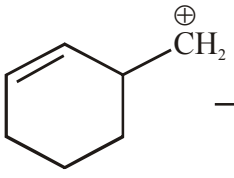
Ans. Official Answer NTA (4)

Sol.  ⟶ Resonance stabilised

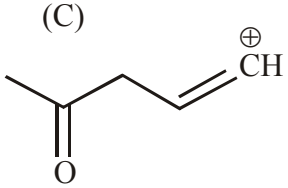
(A)

 ⟶ Resonance stabilised

(B)

 ⟶ No resonance as vacant p-orbital and π bond are not in conjugation.

(C)

 ⟶ No resonance

(D)

6. Chemical nature of the nitrogen oxide compound obtained from a reaction of concentrated nitric acid and P_4O_{10} (in 4 : 1 ratio) is :

(1) amphoteric

(2) neutral

(3) basic

(4) acidic

Ans. Official Answer NTA (4)

Sol. $P_4O_{10} + 4HNO_3 \longrightarrow 2N_2O_5 + 4HPO_3$

N_2O_5 is Acidic in nature

7. The correct order of intensity of colors of the compounds is :

(1) $[NiCl_4]^{2-} > [Ni(H_2O)_6]^{2+} > [Ni(CN)_4]^{2-}$

(2) $[NiCl_4]^{2-} > [Ni(CN)_4]^{2-} > [Ni(H_2O)_6]^{2+}$

(3) $[Ni(CN)_4]^{2} > [NiCl_4]^{2-} > [Ni(H_2O)_6]^{2+}$

(4) $[Ni(H_2O)_6]^{2+} > [NiCl_4]^{2-} > [Ni(CN)_4]^{2-}$

Ans. Official Answer NTA (1)

Sol. Generally tetrahedral complexes are more intense in color in comparison to octahedral complexes.

	$[NiCl_4]^{2-}$		$[Ni(H_2O)_6]^{2+}$		$[Ni(N)_4]^{2-}$
	I		II		III
Order of splitting energy	Δ_t	<	Δ_0	<	Δ_{sp}
Order of absorbed energy	I	<	II	<	III
Order of intensity of color	I	<	II	<	III

8. An inorganic Compound 'X' on treatment with concentrated H_2SO_4 produces brown fumes and gives dark brown ring with $FeSO_4$ in presence of concentrated H_2SO_4. Also Compound 'X' gives precipitate 'Y, when its solution in dilute HC1 is treated with H_2S gas. The precipitate 'Y on treatment with concentrated HNO_3 followed by excess of NH_4OH further gives deep blue coloured solution, Compound 'X' is:

(1) $Pb(NO_2)_2$

(2) $Cu(NO_3)_2$

(3) $Pb(NO_3)_2$

(4) $Co(NO_3)_2$

Ans. Official Answer NTA (2)

Sol. $\underset{(X)}{Cu(NO_3)_2} \xrightarrow{\text{Conc. } H_2SO_4} \underset{\text{Brown fumes}}{Cu^{+2} + NO_2\uparrow}$

$NO_3^{\ominus} + FeSO_4 + H_2SO_4 \longrightarrow Fe_2(SO_4)_3 + NO$

$FeSO_4(aq) + NO \longrightarrow [Fe(H_2O)_5\ NO]SO_4 \rightarrow$ Dark brown ring

$Cu^{+2} + H_2S/H^{\oplus} \longrightarrow \underset{\text{Black PPT (Y)}}{CuS\downarrow}$

$CuS \xrightarrow[(2)\text{ Excess } NH_4OH]{(1)\ HNO_3} \underset{\text{Deep blue colour}}{[Cu(NH_3)_4]^{2+}}$

9. Orion fibres are made up of :

(1) Polyesters

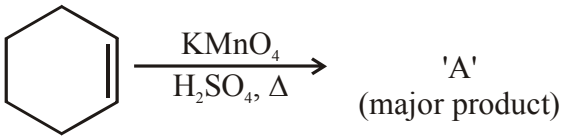
(2) Cellulose

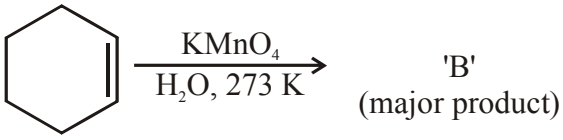
(3) Polyacrylonitrile

(4) Poly amide

Ans. Official Answer NTA (3)

Sol. Orion fibres are made from polymerized acrylonitrile

10. 



For above chemical reactions, identify the correct statement from the following.

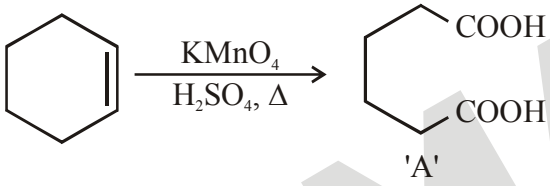
(1) Compound 'A' is dicarboxylic acid and compound 'B' is diol.

(2) Compound 'A' is diol and compound 'B' is dicarboxylic acid.

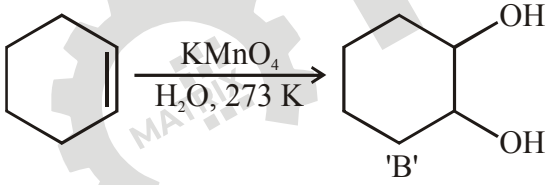
(3) Both compound 'A' and compound 'B' are diols,

(4) Both compound 'A' and compound 'B' are dicarboxylic acids.

Ans. Official Answer NTA (1)

Sol. 

$KMnO_4/H_2SO_4$, Δ is a oxidising agent.



$KMnO_4$, H_2O|273 K is Bayer's Reagent.

11. The set in which compounds have different nature is :

(1) $B(OH)_3$ and $Al(OH)_3$

(2) NaOH and $Ca(OH)_2$

(3) $Be(OH)_2$ and $Al(OH)_3$

(4) $B(OH)_3$ and H_3PO_3

Ans. Official Answer NTA (1)

Sol. $B(OH)_3 \rightarrow$ Boric acid and it is acidic in nature

$Al(OH)_3 \rightarrow$ Amphoteric

$NaOH \rightarrow$ Basic

$Ca(OH)_2 \rightarrow$ Basic

$Be(OH)_2 \rightarrow$ Amphoteric

$Al(OH)_3 \rightarrow$ Amphoteric

$H_3PO_3 \rightarrow$ Acidic

12. The species given below that does NOT show disproportionation reaction is :

(1) BrO_3^-

(2) BrO_4^-

(3) BrO_2^-

(4) BrO^-

Ans. Official Answer NTA (2)

Sol. $BrO^{\ominus}_4$ can not show dispropotionation because Br is present in its highest oxidation state in it.

13. Identify the incorrect statement from the following :

(1) Glycogen is called as animal starch

(2) Amylose is a branched chain polymer of glucose

(3) β-Glycosidic linkage makes cellulose polymer

(4) Starch is a polymer of α-D glucose

Ans. Official Answer NTA (2)

Sol. → Glycogen is an animal food storage called animal starch.

→ Amylose is a straight chain polymer of α-D-glucose

→ Monomer unit of cellulose is β-D-glucose and linkage is β-Glycosidic linkage.

→ Monomer unit of starch is α-D-glucose

14. The metal that can be purified economically by fractional distillation method is :

(1) Cu

(2) Fe

(3) Zn

(4) Ni

Ans. Official Answer NTA (3)

Sol. Boiling point of Zn is relatively low hence it can be purified by fractional distillation.

15. The conditions given below are in the context of observing Tyndall effect in colloidal solutions :

(A) The diameter of the colloidal particles is comparable to the wavelength of light used.

(B) The diameter of the colloidal particles is much smaller than the wavelength of light used.

(C) The diameter of the colloidal particles is much larger than the wavelength of light used.

(D) The refractive indices of the dispersed phase and the dispersion medium are comparable.

(E) The dispersed phase has a very different refractive index from the dispersion medium.

Choose the most appropriate conditions from the options given below.

(1) (C) and (D) only

(2) (A) and (D) only

(3) (B) and (E) only

(4) (A) and (E) only

Ans. Official Answer NTA (4)

Sol. A colloidal solution will show Tyndall effect when

(a) Diameter of the colloidal particles should be comparable to the wavelenth of light used.

(b) Difference between refractive index of dispersion medium and dispersed phase should be high.

16. Green Chemistry in day-to-day life is in the use of :

(1) Tetrachloroethene for laundry

(2) Liquified CO_2 for dry cleaning of clothes

(3) Chlorine for bleaching of paper

(4) Large amount of water alone for washing clothes

Ans. Official Answer NTA (2)

Sol. Nowadays H_2O_2 with a suitable catalyst is used to bleach the paper instead of chlorine

Tetra chlroroethene ($Cl_2C = CCl_2$) was earlier used as solvent for dry cleaning. The compound contaminates the ground water and is also a suspected carcinogen. The process using this compound is now being replaced by a process, where liquefied carbondioxide, with a suitable detergent is used. Replacement of halogenated solvent by liquid CO_2 will result in less harm to ground water.

These days hydrogen peroxide (H_2O_2) is used for the purpose of bleaching clothes in the process of laundary, which gives better results and makes use of lesser amount of water.

17. Given below are two statements. One is labelled as Assertion A and the other is labelled as Reason R

Assertion A : Sharp glass edge becomes smooth on heating it upto its melting point.

Reason R : The viscosity of glass decreases on melting. 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 but R is NOT the correct explanation of A.

(3) A is false but R is true.

(4) Both A and R are true and R is the correct explanation of A.

Ans. Official Answer NTA (2)

Sol. On heating viscosity of glass decreases but it does not have any relation with smoothing.

18. Given below are two statements : One is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : The dihedral angles in H_2O_2 in gaseous phase is 90.2° and in solid phase is 111.5°.

Reason R : The change in dihedral angle in solid and gaseous phase is due to the difference in the intermolecular forces. Choose the most appropriate answer from the options given below for A and R.

(1) A is not correct but R is correct.

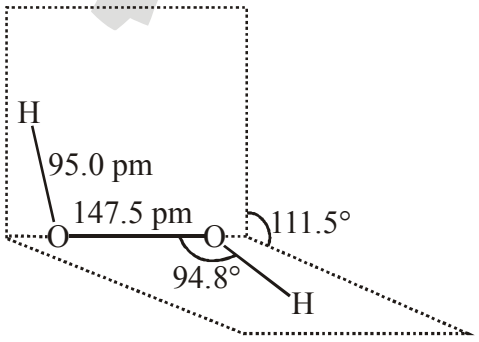
(2) Both A and R are correct and R is the correct explanation of A.

(3) A is correct but R is not correct.

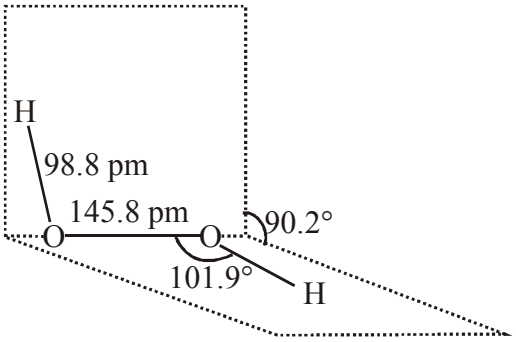
(4) Both A and R are correct but R is not the correct explanation of A

Ans. Official Answer NTA (1)

Sol.



Gas Phase



Solid phase

Due to greater intermolecular forces in solid phase, the bond angle found to be less in solid phase than gas phase.

19. A s-block element (M) reacts with oxygen to form an oxide of the formula MO_2. The oxide is pale yellow in colour and paramagnetic. The element (M) is :

(1) Ca

(2) Mg

(3) Na

(4) K

Ans. Official Answer NTA (4)

Sol. Li forms Li_2O on reaction with O_2 which is diamagnetic

Na forms Na_2O_2 on reaction with O_2 which is diamagnetic

K forms KO_2 on reaction with O_2 which is paramagnetic

20. Compound A is converted to B on reaction with $CHC1_3$ and KOH. The compound B is toxic and can be decomposed by C. A, B and C respectively are :

(1) primary amine, nitrile compound, Conc. HC1

(2) secondary amine, nitrile compound, Conc. NaOH

(3) secondary amine, isonitrile compound, Conc. NaOH

(4) primary amine, isonitrile compound, Conc. HC1

Ans. Official Answer NTA (4)

Ans. Answer By Matrix (1)

Sol. $R–NH_2 + CHCl_3 + KOH \rightarrow R–NC \xrightarrow{\text{Conc. HCl}} RNH_2 + HCOOH$

(A) (B)

toxic

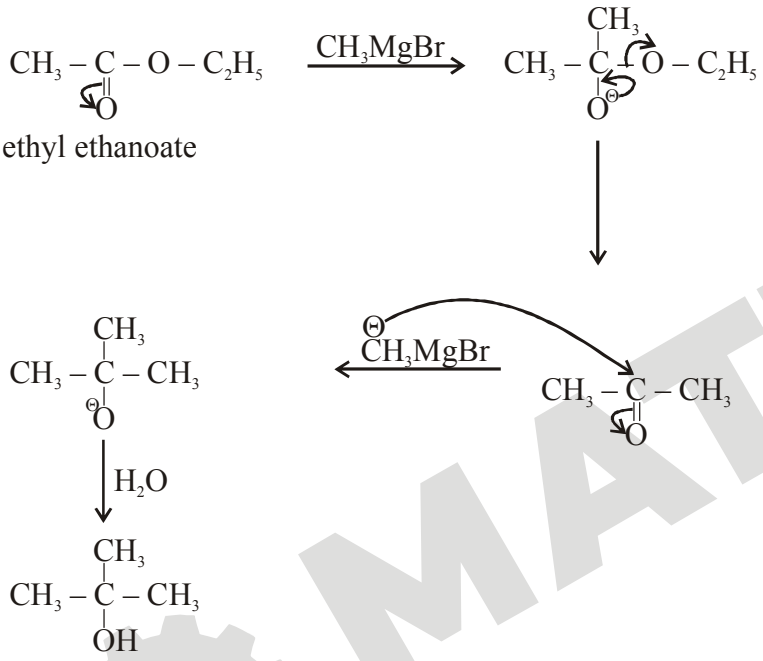
B is isocyanide or isonitrile which is toxic in nature and can be decomposed by Conc-HCl

SECTION - B

1. To synthesise 1.0 mole of 2-methylpropan-2-ol from Ethylethanoate_____equivalents of CH_3MgBr reagent will be required. (Integer value)

Ans. Official Answer NTA (2)

Sol.



2 equivalents of CH_3MgBr reagent will be required.

2. The inactivation rate of a viral preparation is proportional to the amount of virus. In the first minute after preparation, 10% of the virus is inactivated. The rate constant for viral inactivation is_____ $\times 10^{-3}$ min^{-1}. (Nearest integer)

[Use : In 10 = 2.303 ; $\log_{10} 3 = 0.477$;

property of logarithm : log x^y — y log x]

Ans. Official Answer NTA (106)

Sol. It is a first order process hence

$Kxt = 2.303 \log \frac{C_O}{C_t}$

$Kx1 = 2.303 \log \frac{100}{90}$

$K = 2.303 [\log 10 - \log 9]$

$K = 2.303 [1 - 0.477 \times 2]$

$K = 2.303 \times 0.046$

$K = 0.10593 \text{ min}^{-1}$

$K = 105.93 \times 10^{-3} \text{ min}^{-1}$

3. An average person needs about 10000 kJ energy per day. The amount of glucose (molar mass = 180.0 g mol^{-1}) needed to meet this energy requirement is _____g. (Nearest integer)

(Use : $\Delta_C H$(glucose) = -2700 kJ mol^{-1})

Ans. Official Answer NTA (667)

Sol. Moles of glucose required for 1000 kJ energy = $\frac{1}{2700} \times 1000$

$= \frac{100}{27}$

mass of glucose = $= \frac{100}{27} \times 180$

$= \frac{100 \times 20}{3} \text{gm}$

= 666.67 gm

4. At 20°C, the vapour pressure of benzene is 70 torr and that of methyl benzene is 20 torr. The mole fraction of benzene in the vapor phase at 20°C above an equimolar mixture of benzene and methyl benzene is_____ -10^{-2}. (Nearest integer)

Ans. Official Answer NTA (78)

Sol. $P_T = P°_{benzene}\ X_{benzene} + P°_{methylbenzene}\ X_{methylbenzene}$

$= 70\times\frac{1}{2}+20+\frac{1}{2}$

$= 45$ torr

mole traction of benzene in vapour phase $= \frac{70\times\frac{1}{2}}{45}$

$= \frac{7}{9}$

$= 0.7777$

$= 77.77 \times 10^{-2}$

5. The number of lone pairs of electrons on the central I atom in I^-_3 is_____.

Ans. Official Answer NTA (3)

Sol. 

6. 250 mL of 0.5 M NaOH was added to 500 mL of 1 M HCL The number of unreacted HCl molecules in the solution after complete reaction is_____ $\times 10^{21}$. (Nearest integer) ($N_A = 6.022 \times 10^{23}$)

Ans. Official Answer NTA (226)

Sol. $NaOH + HCl \rightarrow NaCl + H_2O$

$250 \times 0.5 \quad 500 \times 1$

$0 \quad 375 \quad 125$

moles of HCl unreacted = 0.375

Number of molecules = $0.375 \times 6.022 \times 10^{23}$

of HCl unreacted $= 2.258 \times 10^{23}$

$= 225.8 \times 10^{21}$

7. The Azimuthal quantum number for the valence electrons of Ga^{+} ion is_____.

(Atomic number of Ga = 31)

Ans. Official Answer NTA (0)

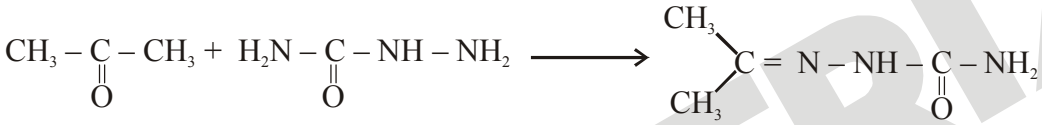
Sol. $Ga^{\oplus} = 1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^2\,3d^{10}\,4p^0$

Valence electron is in 4s

hence value of *l* for s-orbital is 0.

8. The number of nitrogen atoms in a semicarbazone molecule of acetone is .

Ans. Official Answer NTA (3)

Sol. 

Semicarbazone

9. The spin-only magnetic moment value for the complex $[Co(CN)_6]^4$ is_____BM.

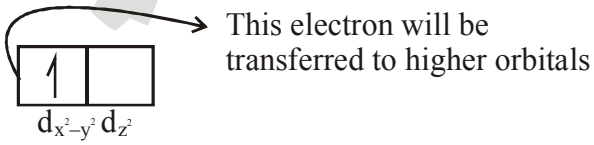
[At. no. of Co = 27]

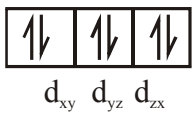
Ans. Official Answer NTA (2)

Sol. $[Co(CN)_6]^{4-}$

$Co^{2+} = 3d^7$

As CN^{Θ} is a strong ligand





$\mu = \sqrt{n(n+2)}$

$= \sqrt{l(l+2)} = \sqrt{3} = 1.732$ B.M.

10. $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

In an equilibrium mixture, the partial pressures are

P_{SO_3} = 43 kPa ; P_{O_2} = 530 Pa and P_{SO_2} =45kPa. The equilibrium constant K_p =_____ $\times 10^{-2}$.

(Nearest integer)

Ans. Official Answer NTA (172)

Ans. Answer Matrix By (0)

Sol. $$K_p = \frac{\left(P_{SO_3}\right)^2}{\left(P_{SO_2}\right)^2 P_{O_2}} = = \frac{(43\times10^3)^2}{(45\times10^3)^2\times530}$$

$= 0.0017228$

$= 0.172 \times 10^{-2}$