JEE Main July 2021

Question Paper With Text Solution

20 July. | Shift-2

CHEMISTRY

MATRIX

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

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JEE MAIN JULY 2021 | 20TH JULY SHIFT-2

SECTION – A

1. Which one of the following gases is reported to retard photosynthesis ?

(1) CO_2

(2) CO

(3) NO_2

(4) CFCs

Ans. Official Answer NTA (3)

Sol. NO_2 damages the leaves of plants and retard the rate of photosynthesis.

2. Outermost electronic configuration of a group 13 element E, is $4s^2$, $4p^1$. The electronic configuration of an element of p-block period-five placed diagonally to element, E is :

(1) [Ar] $3d^{10}$ $4s^2$ $4p^2$

(2) [Kr] $4d^{10}$ $5s^2$ Sp^2

(3) [Xe] $5d^{10}$ $6s^2$ $6p^2$

(4) [Kr] $3d^{10}$ $4s^2$ $4P^2$

Ans. Official Answer NTA (2)

Sol. E is Galium (Ga)

p-block element placed diagonally to E in 5th period is Sn

Sn ≡ [Kr] $4d^{10}$ $5s^2$ $5p^2$

3. Which one of the following species doesn't have a magnetic moment of 1.73 BM, (spin only value) ?

(1) CuI

(2) $O_2^{\oplus}$

(3) $[Cu(NH_3)_4]Cl_2$

(4) $O_2^{\ominus}$

Ans. Official Answer NTA (1)

Sol. (1) $Cu^{\oplus} = 3d^{10}$ Magnetic moment = 0

(2) $O^{\oplus}_2 = \sigma_{1s}^2\ \sigma^*_{1s}{}^2\ \sigma_{2s}^2\ \sigma^*_{2s}{}^2\ \sigma_{2Pz}{}^2\ \pi_{2Px}{}^2\ \pi_{2Py}{}^2\ \pi^{*1}_{2Px}$

$\mu = \sqrt{1(1+2)}\ \sqrt{3}$ B.M.

(3) $[Cu(NH_3)_4]Cl_2$

$Cu^{2+} = 3d^9$

$\mu = \sqrt{1(1+2)}\ \sqrt{3}$ B.M.

(4) O^{Θ}_2

$\mu = \sqrt{1(1+2)}\ \sqrt{3}$ B.M.

4. Metallic sodium does not react normally with :

(1) tert-butyl alcohol

(2) But-2-yne

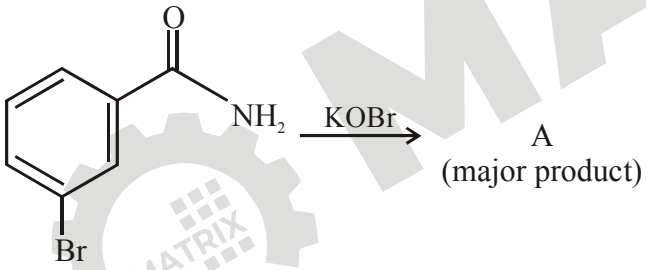
(3) Ethyne

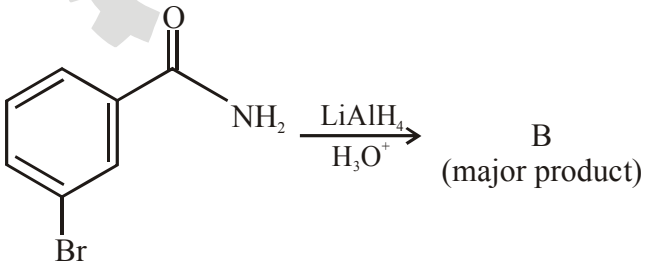
(4) gaseous ammonia

Ans. Official Answer NTA (2)

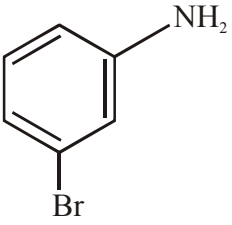
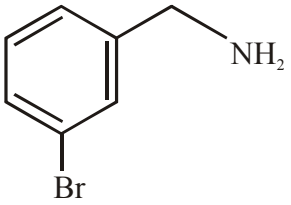
Sol. Metallic sodium reacts with compounds containing active hydrogen to release H_2 gas. As But-2-yne has no active hydrogen, hence it will not react with metallic sodium.

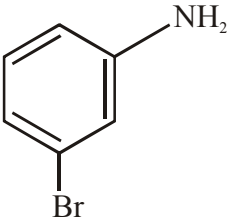
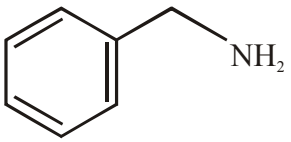
5.

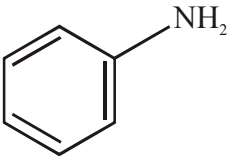
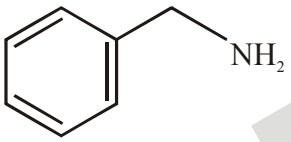


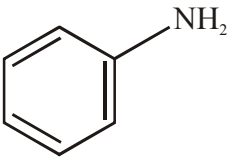
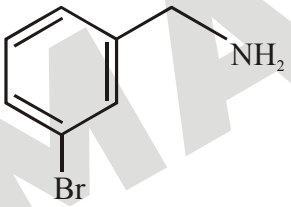


In the above reactions, product A and product B respectively are :

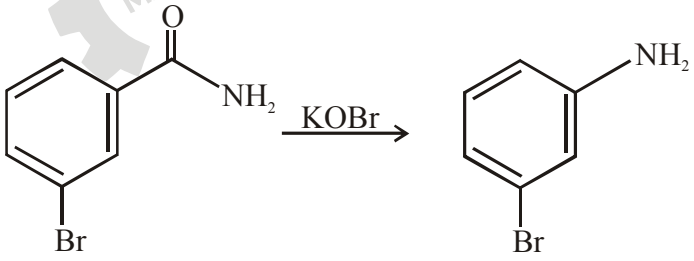
(1)  , 

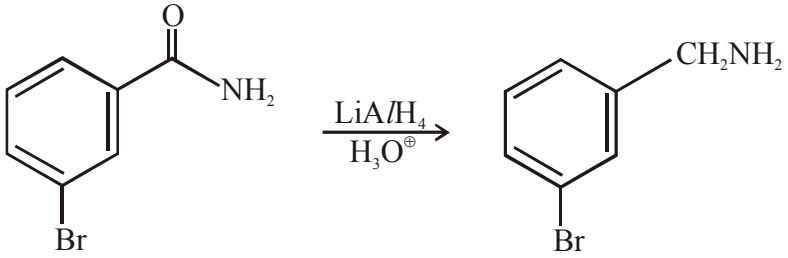
(2)  , 

(3)  , 

(4)  , 

Ans. Official Answer NTA (1)

Sol. 
(A)


(B)

6. A solution is 0.1 M in Cl^- and 0.001 M in CrO^{2-}_4. Solid $AgNO_3$ is gradually added to it. Assuming that the addition does not change in volume and $K_{sp}(AgCl) = 1.7 \times 10^{-10}\ M^2$ and $Ksp(Ag_2CrO_4) = 1.9 \times 10^{-12}\ M^3$. Select correct statement from the following :

(1) AgCl precipitates first because its K_{sp} is high.

(2) Ag_2CrO_4 precipitates first because the amount of Ag^+ needed is low.

(3) AgCl will precipitate first as the amount of Ag^+ needed to precipitate is low.

(4) Ag_2CrO_4 precipitates first as its K_{sp} is low.

Ans. Official Answer NTA (3)

Sol. For AgC*l*

$[Ag^+]\ [0.1] > 1.7 \times 10^{-10}$ for precipitation

$[Ag^+] > 1.7 \times 10^{-9}$

For Ag_2CrO_4

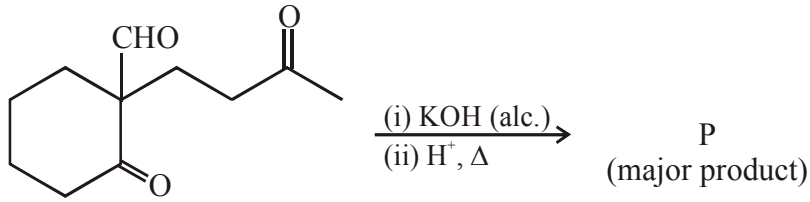
$[Ag^+]^2\ [0.001] > 1.9 \times 10^{-12}$

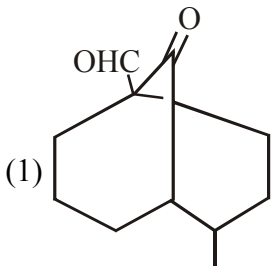
$[Ag^+]^2 > 1.9 \times 10^{-9}$

$[Ag^+] = \sqrt{19} \times 10^{-5}$

So AgC*l* will precipitate first as the amount of $Ag^{\oplus}$ needed to precipitate is low.

7. The major product (P) in the following reaction is :



(1)


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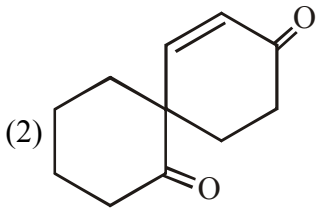

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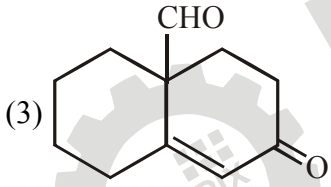

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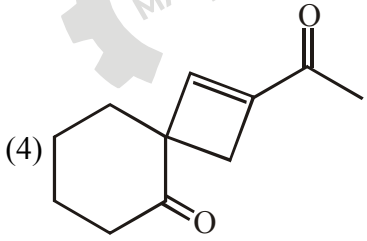
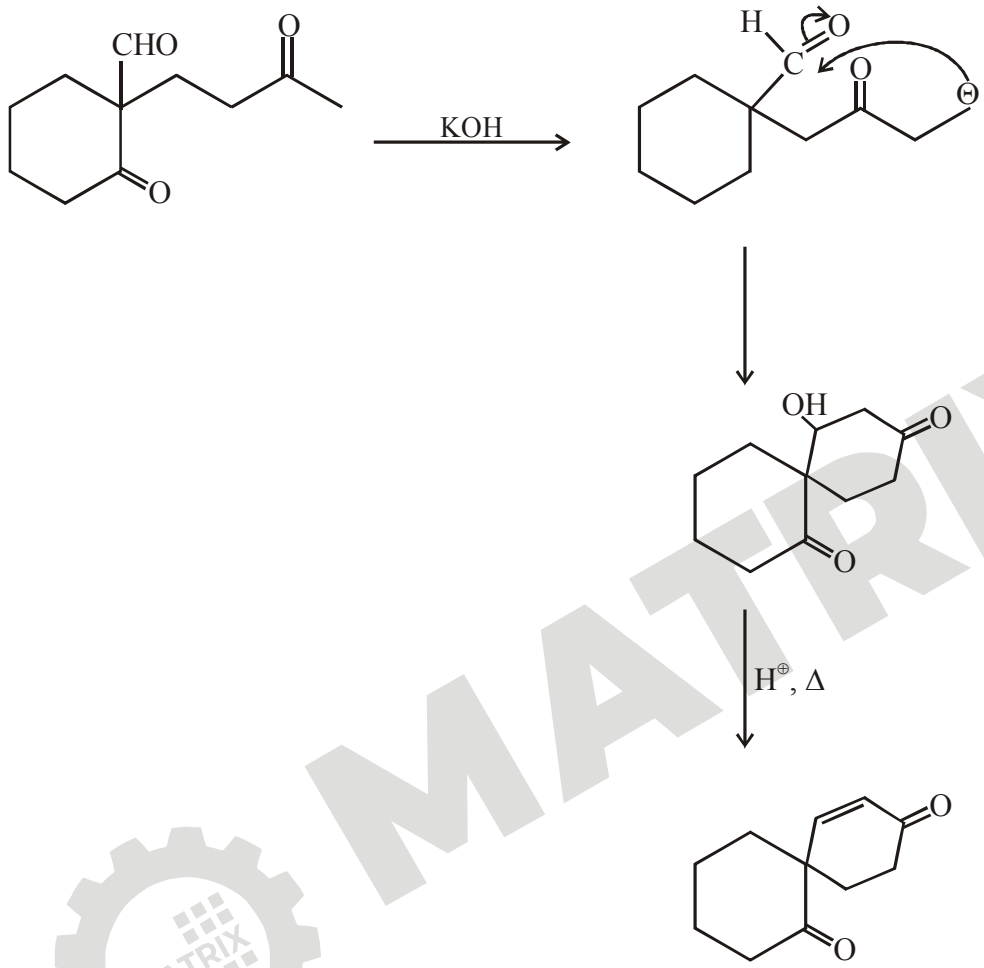


Ans. Official Answer NTA (2)

Sol.



8. Which one of the following statements is not true about enzymes ?

(1) Enzymes work as catalysts by lowering the activation energy of a biochemical reaction.

(2) Enzymes are non-specific for a reaction and substrate.

(3) The action of enzymes is temperature and pH specific.

(4) Almost all enzymes are proteins.

Ans. Official Answer NTA (2)

Sol. Enzymes are specific for a reaction and substrate

9. The hybridisations of the atomic orbitals of nitrogen in NO^-_2, NO^+_2 and NH^+_4 respectively are :

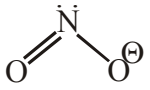
(1) sp^2, sp and sp^3

(2) sp, sp^2 and sp^3

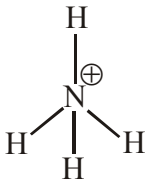
(3) sp^3, sp and sp^2

(4) sp^3, sp^2 and sp

Ans. Official Answer NTA (1)

Sol.  sp^2

 sp

 sp^3

10. Consider two chemical reactions (A) and (B) that take place during metallurgical process :

(A) $ZnCO_{3(s)} \xrightarrow{\Delta} ZnO_{(s)} + CO_{2(g)}$

(B) $2ZnS_{(s)} + 3O_{2(g)} \xrightarrow{\Delta} 2ZnO_{(s)} + 2SO_{2(g)}$

The correct option of names given to them respectively is:

(1) (A) is roasting and (B) is calcination

(2) (A) is calcination and (B) is roasting

(3) Both (A) and (B) are producing same product so both are roasting

(4) Both (A) and (B) are producing same product so both are calcination

Ans. Official Answer NTA (2)

Sol. (A) $ZnCO_3(s) \xrightarrow{\Delta} ZnO(s) + CO_2(g)$

It represents calcination which is heating of ore in absence of air

(B) $2ZnS(s) + 3O2(g) \xrightarrow{\Delta} 2ZnO(s) + 2SO2(g)$

It represents roasting which is heating of ore in presence of air.

11. Bakelite is a cross-linked polymer of formaldehyde and :

(1) Novolac

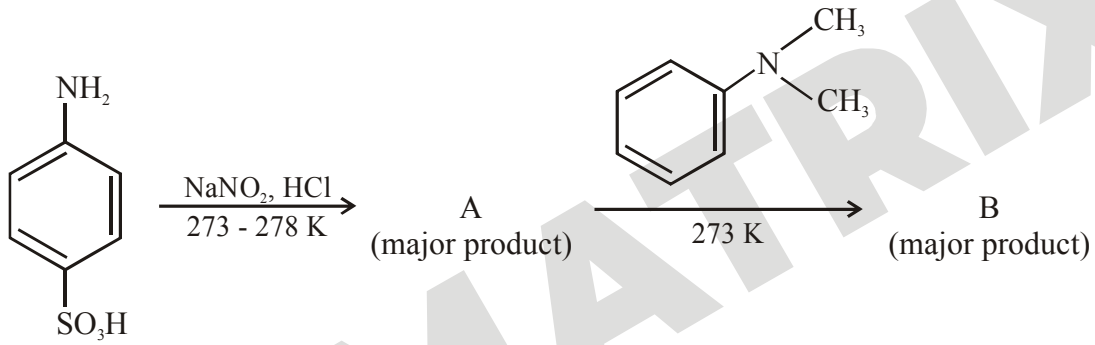
(2) Dacron

(3) Buna-S

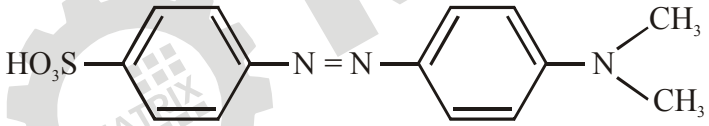
(4) PHBV

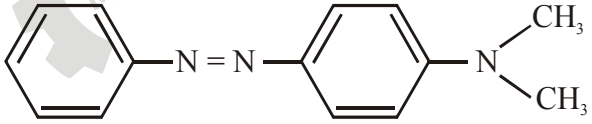
Ans. Official Answer NTA (1)

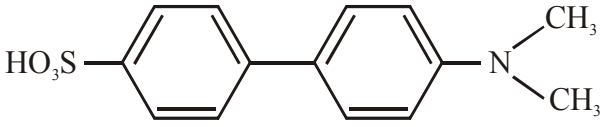
Sol. A linear product of phenol formaldehyde polymer is called Novolac. Novalac on heating with formaldehyde undergoes cross linking to form bakelite.

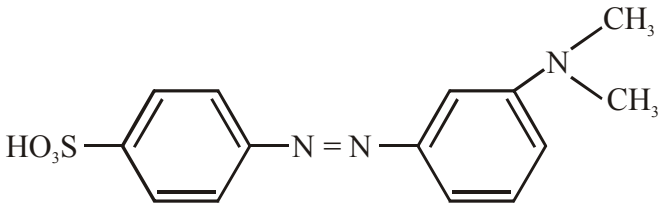
12. 

Consider the above reaction, compound B is :

(1) 

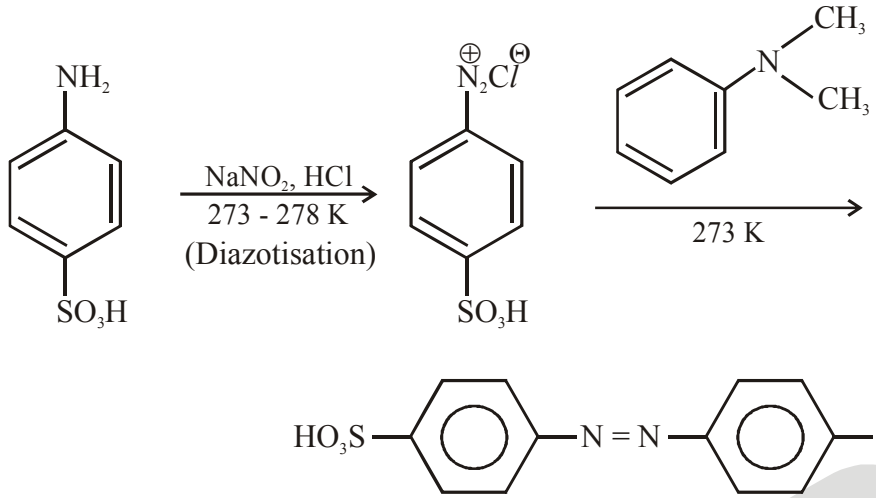
(2) 

(3) 

(4) 

Ans. Official Answer NTA (1)

Sol.



13. In Carius method, halogen containing organic compound is heated with fuming nitric acid in the presence of :

(1) $AgNO_3$

(2) $BaSO_4$

(3) $CuSO_4$

(4) HNO_3

Ans. Official Answer NTA (1)

Sol. In carius method, halogen containing organic compound is heated with fuming nitric acid in presence of $AgNO_3$

14. Benzene on nitration gives nitrobenzene in presence of HNO_3 and H_2SO_4 mixture, where :

(1) HNO_3 acts as a base and H_2SO_4 acts as an acid

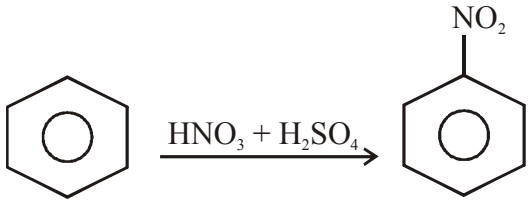
(2) both H_2SO_4 and HNO_3 act as an acids

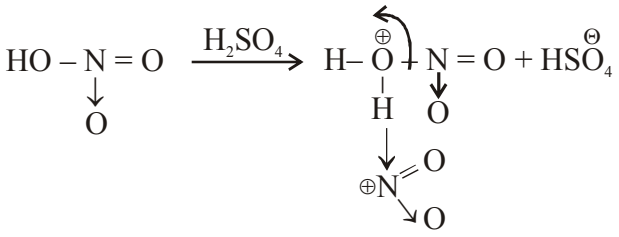
(3) HNO_3 acts as an acid and H_2SO_4 acts as a base

(4) both H_2SO_4 and HNO_3 act as a bases

Ans. Official Answer NTA (1)

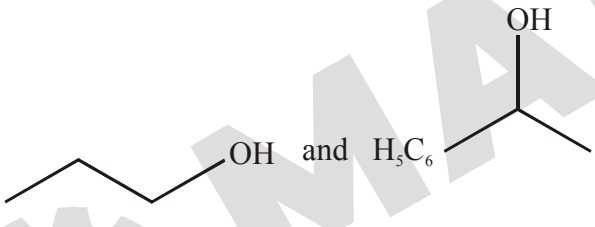
Sol.

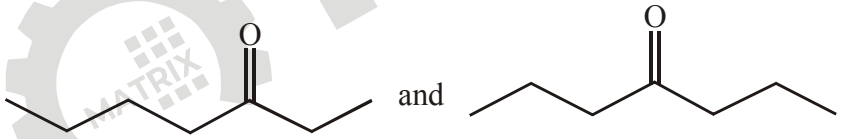




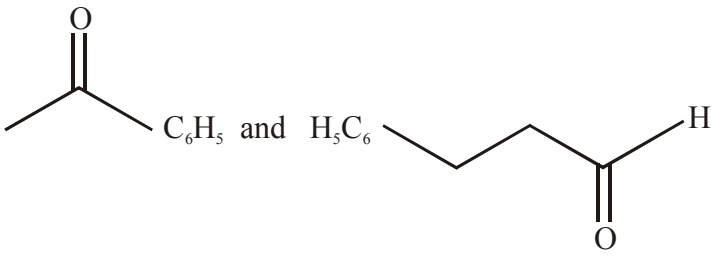
Hence H_2SO_4 act as acid and HNO_3 act as base

15. Which one of the following pairs of isomers is an example of metamerism ?

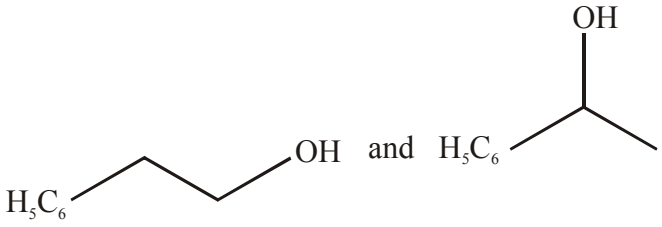
(1) 

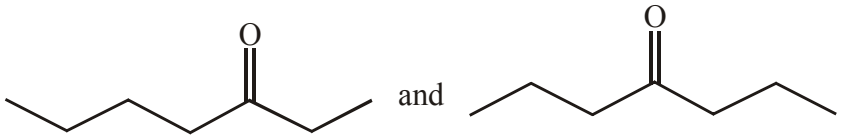
(2) 

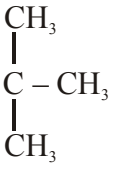
(3) $CH_3CH_2CH_2CH_2CH_3$ and $H_3C - \underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}} - CH_3$

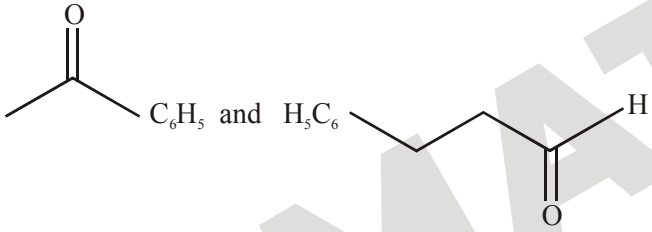
(4) 

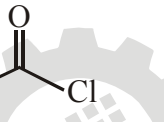
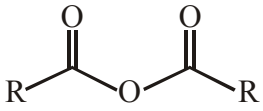
Ans. Official Answer NTA (2)

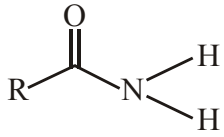
Sol. (1)  → Position Isomers

(2)  → Metamers

(3) $CH_3CH_2CH_2CH_2CH_3$ and  → Chain

(4)  →Different molecular formula hence not isomers

16. (A)  (B) 

(C)  (D) 

The correct order of their reactivity towards hydrolysis at room temperature is :

(1) (A) > (B) > (C) > (D)

(2) (D) > (A) > (B) > (C)

(3) (A) > (C) > (B) > (D)

(4) (D) > (B) > (A) > (C)

Ans. Official Answer NTA (1)

Sol. Hydrolysis of acid derivatives will take place via S_N2 or acyl substitution reaction.

Rate ∝ leaving group ability of leaving group

Order of leaving group ability → $Cl^- > \overset{\ominus}{O} - \overset{O}{\overset{\|}{C}} - R > \overset{\ominus}{O} - R > \overset{\ominus}{N}H_2$

17. Spin only magnetic moment of an octahedral complex of Fe^{2+} in tlie presence of a strong field Iigand in BM is :

(1) 0

(2) 2.82

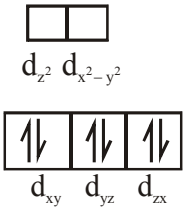
(3) 3.46

(4) 4.89

Ans. Official Answer NTA (1)

Sol. $Fe^{2+} \equiv 3d^6$

in preseuce of strong field ligand



$\mu = \sqrt{n(n+2)} = 0$

18. Cu^{2+} salt reacts with potassium iodide to give :

(1) $Cu(I_3)_2$

(2) Cu_2I_3

(3) CuI

(4) Cu_2I_2

Ans. Official Answer NTA (4)

Ans. Answer by Matrix (3, 4)

Sol. $Cu^{2+} + I^{\ominus} \longrightarrow Cu^{\oplus} + I_2$

$2\ CuSO_4 + 4KI \longrightarrow Cu_2I_2 + 2K_2SO_4 + I_2$

19. The single largest industrial application of dihydrogen is :

(1) In the synthesis of nitric acid

(2) Manufacture of metal hydrides

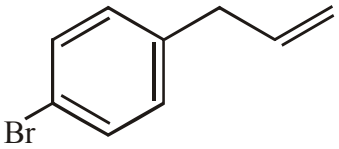
(3) In the synthesis of ammonia

(4) Rocket fuel in space research

Ans. Official Answer NTA (3)

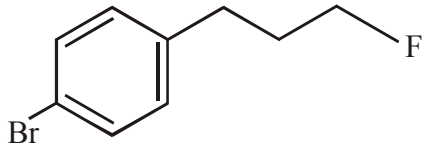
Sol. Dihydrogen is used in synthesis of NH_3 via Haber process.

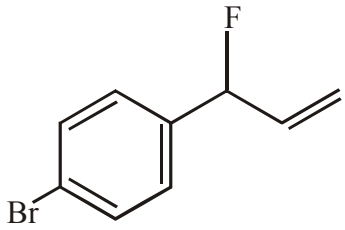
$N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

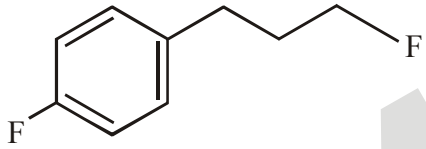
20. 

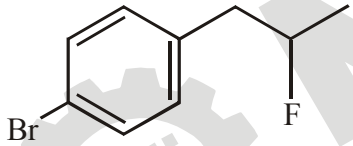
$\xrightarrow[\text{(ii) } CoF_2]{\text{(i) } (C_6H_5CO)_2O_2,\ HBr}$ P (major product)

Major product P of above reaction, is :

(1) 

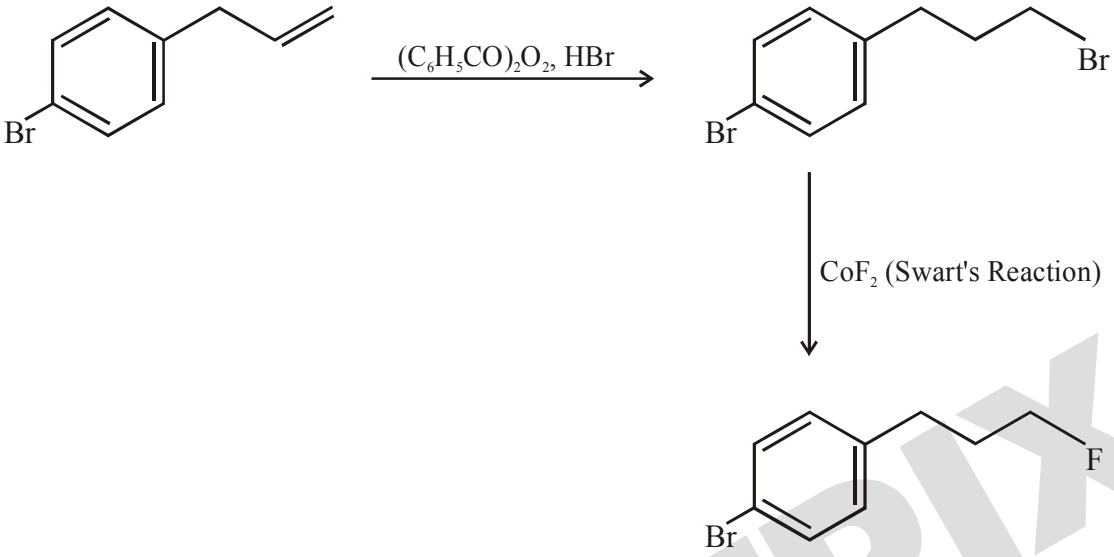
(2) 

(3) 

(4) 

Ans. Official Answer NTA (1)

Sol.



SECTION - B

1. 4 g equimolar mixture of NaOH and Na_2CO_3 contains x g of NaOH and y g of Na_2CO_3. The value of x is_____ g. (Nearest integer)

Ans. Official Answer NTA (1)

Sol. Let mass of NaOH = x gm

mass of $Na_2CO_3 = 4 - x$

$$\frac{x}{40} = \frac{4-x}{106}$$

$\Rightarrow 106x = 160 - 40x$

$\Rightarrow 146x = 160$

$$x = \frac{160}{146}\text{gm}$$

= 1.095 gm

2. When 0.15 g of an organic compound was analyzed using Carius method for estimation of bromine, 0.2397 g of AgBr was obtained. The percentage of bromine in the organic compound is_____. (Nearest integer)

[Atomic mass: Silver = 108; Bromine = 80]

Ans. Official Answer NTA (68)

Sol. Mass of Br $= \frac{0.2397}{188} \times 80\text{gm}$

$$\% \text{ of Br} = \frac{\frac{0.2397}{188} \times 80}{0.15} \times 100 = 68$$

3. An aqueous solution of $NiCl_2$ was heated with excess sodium cyanide in presence of strong oxidizing agent to form $[Ni(CN)_6]^{2-}$. The total change in number of unpaired electrons on metal centre is_____.

Ans. Official Answer NTA (2)

Sol. $NiCl_2$

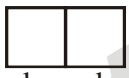
$Ni^{2+} = 3d^8 =$ 

number of unpaired $e^- = 2$

$[Ni(CN)_6]^{2-}$

$Ni^{4+} = 3d^6$

$CN^{\ominus}$ is a strong ligand hence



number of unpaired $e^- = 0$

Change in number of unpaired $e^- = 2 - 0 = 2$

4. 100 ml of 0.0018% (w/v) solution of Cl^- ion was the minimum concentration of Cl^- required to precipitate a negative sol in one hour. The coagulating value of Cl^- ion is_____.

(Nearest integer)

Ans. Official Answer NTA (1)

Ans. Answer by Matrix (Bonus)

Sol. Coagulating value $\Rightarrow$ It is the minimum concentration of electrolyte in milimoles required to cause coagulation of 1 litre solution.

5. $PCl_5(g) \rightarrow PCl_3(g) + Cl_2(g)$

In the above first order reaction the concentration of PCl_5 reduces from initial concentration 50 mol L^{-1} to 10 mol L^{-1} in 120 minutes at 300 K. The rate constant for the reaction at 300 K is $x \times 10^{-2}$ min^{-1}. The value of x is_____.

Ans. Official Answer NTA (1)

Sol. $K \times t = 2.303 \log \frac{C_o}{C_t}$

$$K = \frac{2.303}{120} \log \frac{50}{10}$$

$$K = \frac{2.303}{120} \times 0.6989 = 0.01341$$

$= 1.34 \times 10^{-2}\, min^{-1}$

6. The vapour pressures of A and B at 25°C are 90 mm Hg and 15 mm Hg respectively. If A and B are mixed such that the mole fraction of A in the mixture is 0.6, then the mole fraction of B in the vapour phase is $x \times 10^{-1}$. The value of x is_. (Nearest integer)

Ans. Official Answer NTA (1)

Sol. $P_T = P_A^o X_A + P_B^o X_B$
$= 90 \times 0.6 + 15 \times 0.4$
$= 60$

Mole fraction of B in vapour phase $= \frac{15 \times 0.4}{60} = 0.1 = 1 \times 10^{-1}$

7. Potassium chlorate is prepared by electrolysis of KC1 in basic solution as shown by following equation.

$6\, OH^- + C1^- \rightarrow ClO^-_3 + 3\, H_2O + 6\, e^-$

A current of xA has to be passed for 10 h to produce 10.0 g of potassium chlorate. The value of x is_____. (Nearest integer)

(Molar mass of $KCIO_3$ = 122.6 g mol^{-1}, F = 96500 C)

Ans. Official Answer NTA (1)

Sol. $6\overset{\ominus}{O}H + Cl^- \longrightarrow \overset{\ominus}{Cl}O_3 + 3H_2O + 6e^-$

Moles of $KClO_3 = \frac{10}{122.6}$

Moles of $e^- = \frac{10}{122.6} \times 6$

Charge $= \frac{10}{122.6} \times 6 \times 96500$

$\frac{10}{122.6} \times 6 \times 96500 = x \times 10 \times 3600$

$x = 1.311$ A

8. For a given chemical reaction A → B at 300 K the free energy change is –49.4 kJ mol^{-1} and the enthalpy of reaction is 51.4 kj mol^{-1}. The entropy change of the reaction is _____J K^{-1} mol^{-1}.

Ans. Official Answer NTA (336)

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

$-49.4 \times 10^3 = 51.4 \times 10^3 - 300\ \Delta S$

$300\ \Delta S = 51.4 \times 10^3 + 49.4 \times 10^3$

$\Delta S = \frac{(51.4 + 49.4)}{300} \times 10^3$

$= 336\ JK^{-1}\ mol^{-1}$

9. Diamond has a three dimensional structure of C atoms formed by covalent bonds. The structure of diamond has face centred cubic lattice where 50% of the tetrahedral voids are also occupied by carbon atoms. The number of carbon atoms present per unit cell of diamond is _____.

Ans. Official Answer NTA (8)

Sol. Number of carbon atoms present at lattice points of fcc $= 8 \times \frac{1}{8} + 6 \times \frac{1}{2} = 4$

Number of carbon atoms present in tetrahedral voids $= 8 \times \frac{1}{2} = 4$

Total number of carbon atoms present per unit cell of diamond = 4 + 4 = 8

10. The wavelength of electrons accelerated from rest through a potential difference of 40 kV is $x \times 10^{-12}$ m.

The value of x is_____. (Nearest integer)

Given : Mass of electron = 9.1×10^{-31} kg

Charge on an electron = 1.6×10^{-19} C

Planck's constant = 6.63×10^{-34} Js

Ans. Official Answer NTA (6)

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

$$\lambda = \frac{6.63\times10^{-34}}{\sqrt{2\times9.1\times10^{-31}\times1.6\times10^{-19}\times40\times10^{3}}}$$

$= 0.614 \times 10^{-11}$

$= 6.14 \times 10^{-12}$ m