

JEE Main July 2021
Question Paper With Text Solution
25 July. | Shift-2

CHEMISTRY



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

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JEE MAIN JULY 2021 | 25TH JULY SHIFT-2**SECTION - A**

1. Match List I with List II : (Both having metallurgical terms)

List - I

- (a) Concentration of Ag ore
(b) Blast furnace
(c) Blister copper
(d) Froth floatation method

List - II

- (i) Reverberatory furnace
(ii) Pig iron
(iii) Leaching with dilute NaCN solution
(iv) Sulfide ores

Choose the correct answer from the options given below :

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

Ans. Official Answer NTA (3)

Sol. Reverberatory furnace → Blister copper

Blast furnace → Pig iron

Leaching with dilute NaCN solution → Concentration of Ag ore

Froth floatation method → Sulfide ores

2. Which one of the following metal complexes is most stable ?

- (1) $[\text{Co(en)}_3]\text{Cl}_2$ (2) $[\text{Co(en)}_2(\text{NH}_3)_2]\text{Cl}_2$
(3) $[\text{Co(en)}(\text{NH}_3)_4]\text{Cl}_2$ (4) $[\text{Co}(\text{NH}_3)_6]\text{Cl}_2$

Ans. Official Answer NTA (1)

Sol. → greater the chelation greater is the stability.

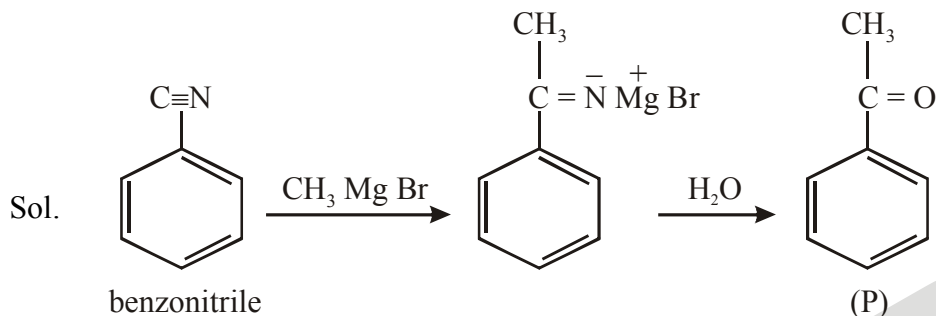
→ bidentate ligands are the chelating ligands

→ As the donor atom in NH_3 and en are same but en is a bidentate ligand.

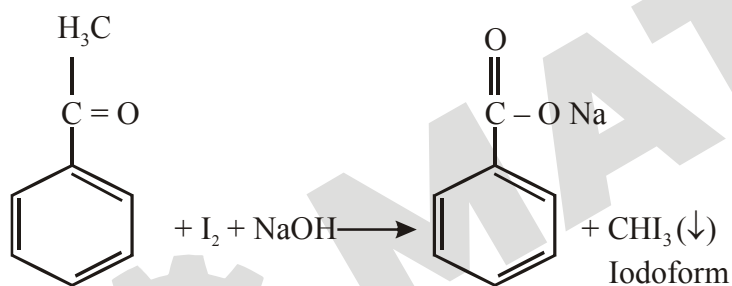
3. A reaction of benzonitrile with one equivalent CH_3MgBr followed by hydrolysis produces a yellow liquid "P". The compound "P" will give positive_____.

- (1) Schiff's test (2) Ninhydrin's test
(3) Tollen's test (4) Iodoform test

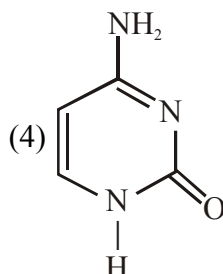
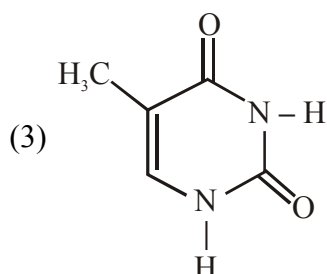
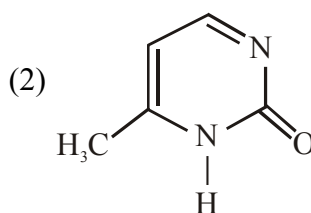
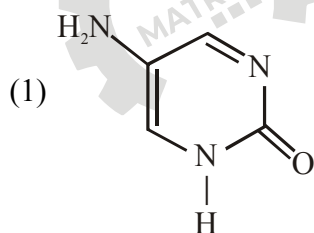
Ans. Official Answer NTA (4)



⇒ Compound P is a methyl ketone hence give iodo form test

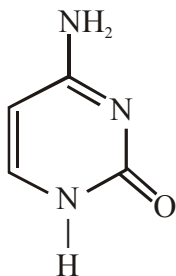


4. Which one of the following is correct structure for cytosine ?

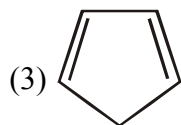
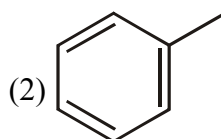


Ans. Official Answer NTA (4)

Sol. Structure of cytosine $\Rightarrow$

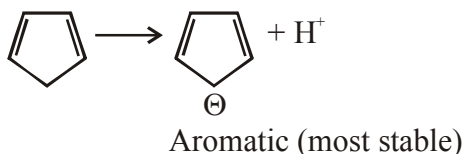
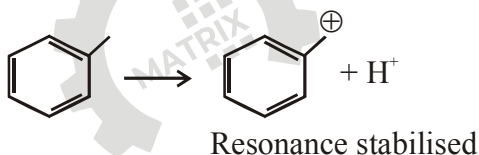
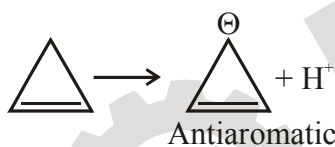


5. Which among the following is the strongest acid ?

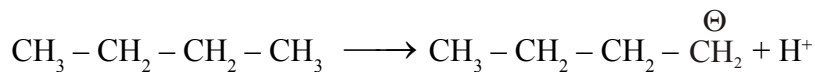
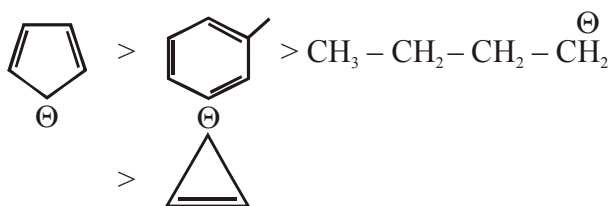


Ans. Official Answer NTA (3)

Sol. Acidic strength $\propto$ stability of conjugate base



Stability of conjugate base



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6. Given below are two statements :

Statement I : Chlorofluoro carbons breakdown by radiation in the visible energy region and release chlorine gas in the atmosphere which then reacts with stratospheric ozone.

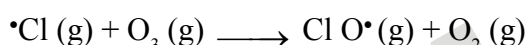
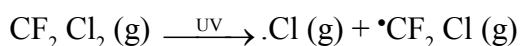
Statement II : Atmospheric ozone reacts with nitric oxide to give nitrogen and oxygen gases, which add to the atmosphere.

For the above statements choose the correct answer from the options given below :

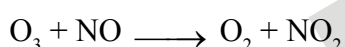
- (1) Both statement I and II are false
- (2) Statement I is incorrect but statement II is true
- (3) Both statement I and II are correct
- (4) Statement I is correct but statement II is false

Ans. Official Answer NTA (1)12

Sol. In stratosphere CFCs get broken down by powerful UV radiations, releasing chlorine free radical.



Atmospheric ozone reacts with nitric oxide to give nitrogen dioxide and oxygen



7. The ionic radii of F^- and O^{2-} respectively are 1.33 Å and 1.4 Å, while the covalent radius of N is 0.74 Å.

The correct statement for the ionic radius of N^{3-} from the following is :

- (1) It is smaller than O^{2-} and F^- , but bigger than of N
- (2) It is smaller than F^- and N
- (3) It is bigger than F^- and N, but smaller than of O^{2-}
- (4) It is bigger than O^{2-} and F^-

Ans. Official Answer NTA (4)

Sol. Order of atomic radius $\Rightarrow \text{F} < \text{O} < \text{N}$

Size of anion $\propto$ magnitude of -ve charge

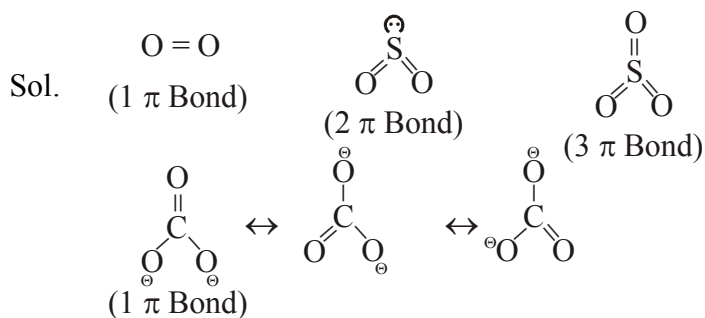
N^{3-} is bigger than F^- , O^{2-} , N

8. Identify the species having one π -bond and maximum number of canonical forms from the following :

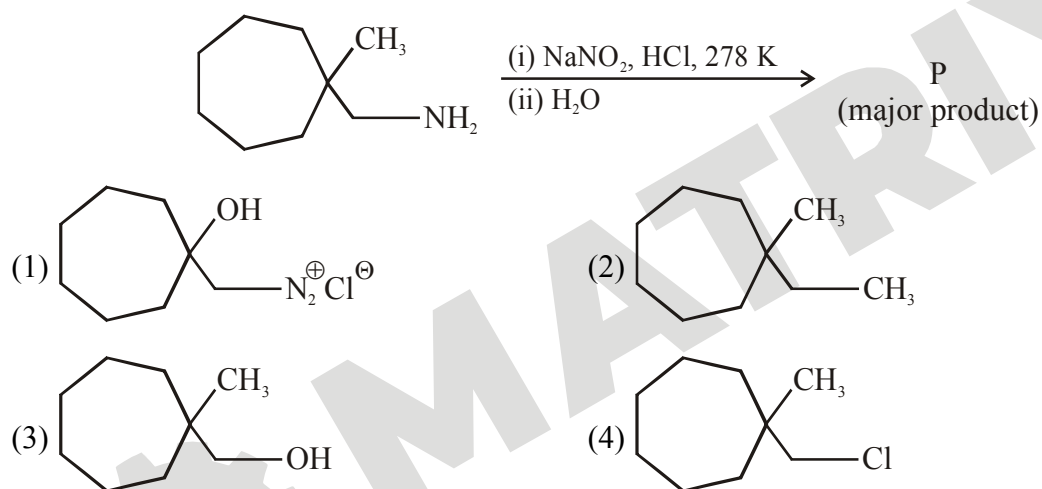
- | | |
|-------------------|------------------------|
| (1) O_2 | (2) SO_2 |
| (3) SO_3 | (4) CO_3^{2-} |



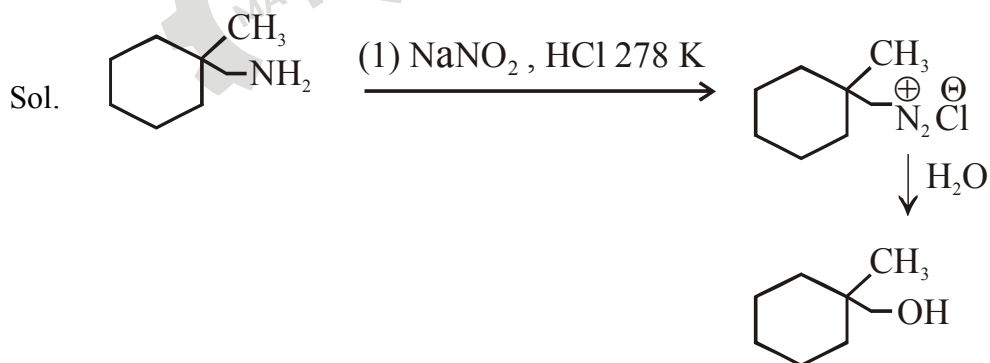
Ans. Official Answer NTA (4)



9. What is the major product "P" of the following reaction ?



Ans. Official Answer NTA (3)



10. Match List I with List II :

List - I
Example of Colloids

- (a) Cheese
- (b) Pumice stone
- (c) Hair cream
- (d) Cloud

List - II
Classification

- (i) dispersion of liquid in liquid
- (ii) dispersion of liquid in gas
- (iii) dispersion of gas in solid
- (iv) dispersion of liquid in solid

Choose the most appropriate answer from the options given below :

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

Ans. Official Answer NTA (1)

Sol.

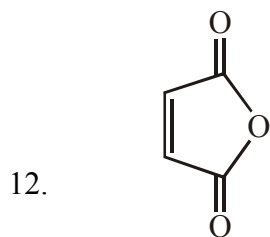
Dispersed Phase	Dispersion medium	Type of colloid	Example
Liquid	Solid	Gas	Cheese
Gas	Solid	Solid sol	Pumice Stone
Liquid	Liquid	Emulsion	Hair cream
Liquid	Gas	Aerosol	Cloud

11. Which one of the following metals forms interstitial hydride easily ?

- (1) Mn
- (2) Cr
- (3) Fe
- (4) Co

Ans. Official Answer NTA (2)

Sol. The metals like Cr absorb dihydrogen in almost stoichiometric quantities. This Phenomenon is known as occlusion and the compounds thus formed are known as interstitial hydrides or metallic hydrides.

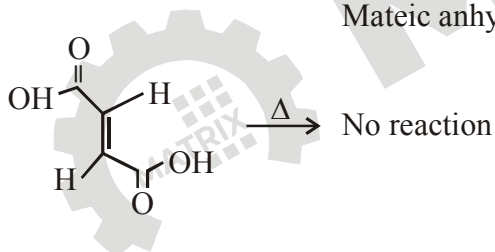
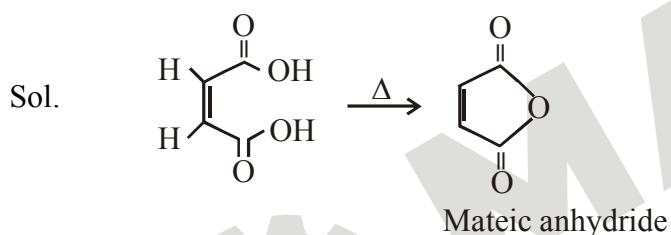


Maleic anhydride

Maleic anhydride can be prepared by :

- (1) Treating cis-but-2-enedioic acid with alcohol and acid.
- (2) Heating cis-but-2-enedioic acid
- (3) Heating trans-but-2-enedioic acid
- (4) Treating trans-but-2-enedioic acid with alcohol and acid

Ans. Official Answer NTA (2)



13. A biodegradable polyamide can be made from :

- (1) Glycine and aminocaproic acid
- (2) Hexamethylene diamine and adipic acid
- (3) Glycine and isoprene
- (4) Styrene and caproic acid

Ans. Official Answer NTA (1)

Sol. Nylon – 2 – nylon – 6 is a biodegradable polymer

Monomer units $\Rightarrow$ glycine + Aminocaproic acid

14. Match List I with List II :

List - I**Elements**

(a) Li

(b) Na

(c) K

(d) Cs

List - II**Properties**(i) Poor water solubility of I^- salt

(ii) Most abundant element in cell fluid

(iii) Bicarbonate salt used in fire extinguisher

(iv) Carbonate salt decomposes easily on heating

Choose the correct answer from the options given below :

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

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

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

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

Ans. Official Answer NTA (4)

Sol. (a) - (iv) : due to high polarization power Li_2CO_3 salt decomposes easily on heating.

(b) - (iii) : $NaHCO_3$ salt used in fire extinguisher.

(c) - (ii) : K is most abundant element in cell fluid.

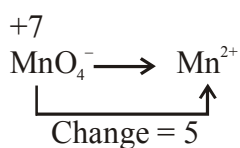
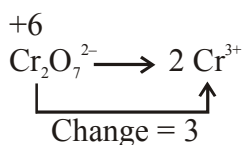
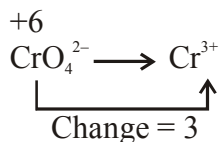
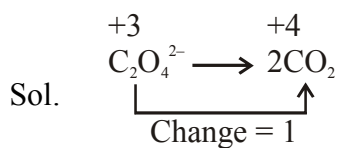
(d) - (i) : order of water solubility

$LiI > NaI > KI > RbI > CsI$

15. Identify the process in which change in the oxidation state is five :

(1) $C_2O_4^{2-} \rightarrow 2CO_2$ (2) $CrO_4^{2-} \rightarrow Cr^{3+}$ (3) $Cr_2O_7^{2-} \rightarrow 2Cr^{3+}$ (4) $MnO_4^- \rightarrow Mn^{2+}$

Ans. Official Answer NTA (4)



16. The spin only magnetic moments (in BM) for free Ti^{3+} , V^{2+} and Sc^{3+} ions respectively are
(At. No. Sc : 21; Ti : 22 ; V : 23)

- (1) 3.87, 1.73, 0
(2) 0, 3.87, 1.73
(3) 1.73, 0, 3.87
(4) 1.73, 3.87, 0

Ans. Official Answer NTA (4)



number of unpaired electrons = 1

$$u = \sqrt{n(n+2)} \text{ BM}$$

$$= \sqrt{1(1+2)} = 1.73$$



Unpaired electrons = 3

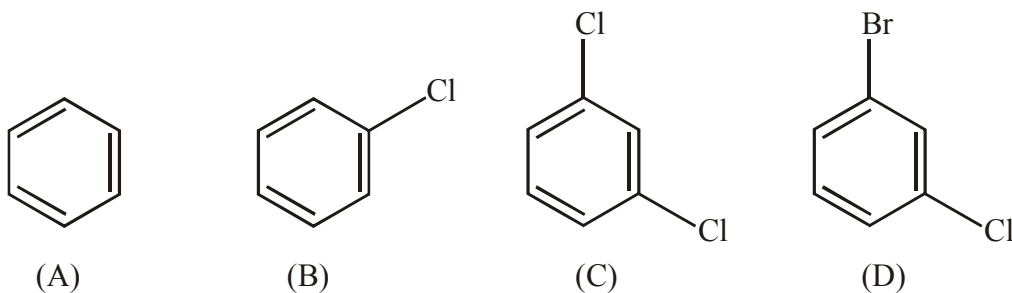
$$u = \sqrt{3(3+2)} = 3.87$$



unpaired electrons = 0

$$\mu = 0$$

17. The correct decreasing order of densities of the following compounds is :



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

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

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

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

Ans. Official Answer NTA (2)

Sol. $d = \frac{M}{V}$

→ As the molecular weight increases density increases.

→ As the molecular weight increases the interparticle force of attraction increases so volume decreases and density increases.

18. In the following the correct bond order sequence is :

(1) $O_2^+ > O_2^- > O_2^{2-} > O_2$

(2) $O_2 > O_2^- > O_2^{2-} > O_2^+$

(3) $O_2^+ > O_2 > O_2^- > O_2^{2-}$

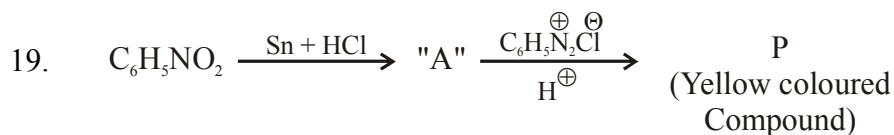
(4) $O_2^{2-} > O_2^+ > O_2^- > O_2$

Ans. Official Answer NTA (3)

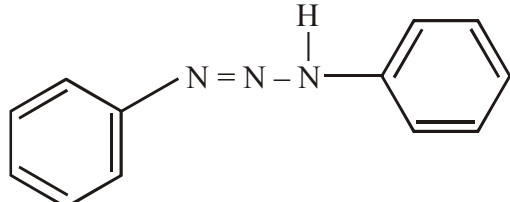
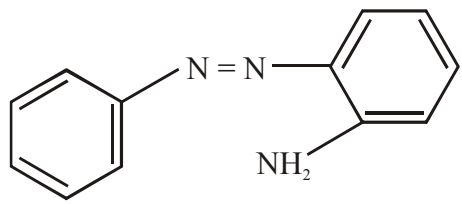
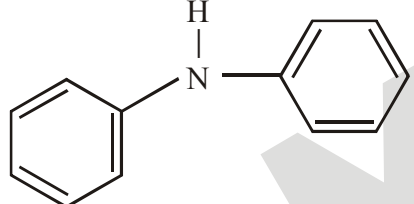
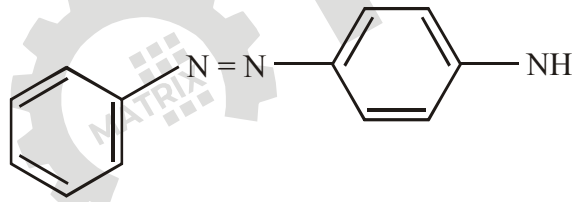
Sol.	Species	Electronic configuration	Bond order = $\frac{BE - ABE}{2}$
	O_2^+	$\sigma 2p^2, \pi 2p^2, \pi^* 2p^1$	$\frac{6-1}{2} = 2.5$
	O_2^-	$\sigma 2p^2, \pi 2p^2, \pi^* 2p^2, \pi^* 2p^1$	$\frac{6-3}{2} = 1.5$
	O_2^{2-}	$\sigma 2p^2, \pi 2p^2, \pi^* 2p^2, \pi^* 2p^2$	$\frac{6-4}{2} = 1$
	O_2	$\sigma 2p^2, \pi 2p^2, \pi^* 2p^1, \pi^* 2p^1$	$\frac{6-2}{2} = 2$

Order of bond order.

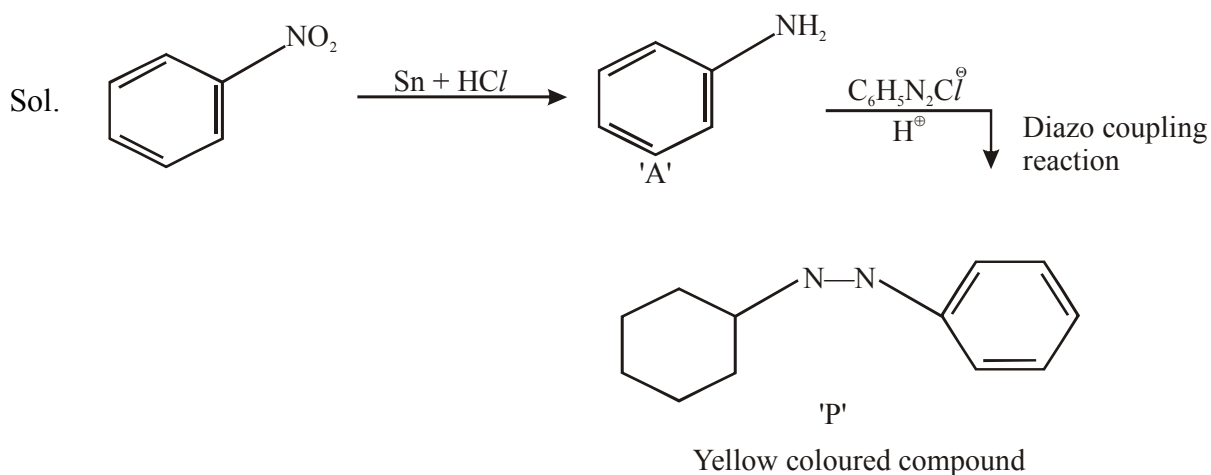
$O_2^+ > O_2 > O_2^- > O_2^{2-}$



Consider the above reaction, the Product "P" is :

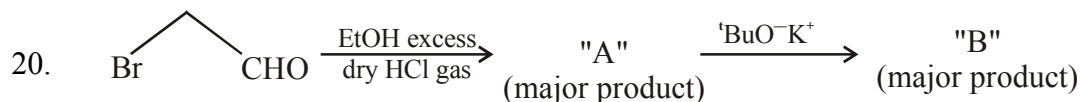
- (1) 
- (2) 
- (3) 
- (4) 

Ans. Official Answer NTA (4)



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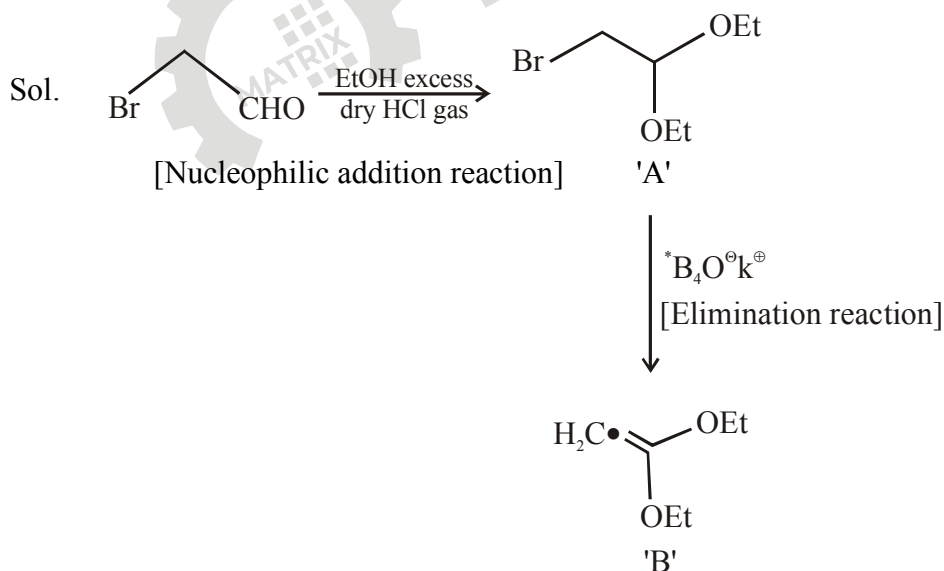


[where Et $\Rightarrow$ $-\text{C}_2\text{H}_5$ *Bu $\Rightarrow$ $(\text{CH}_3)_3\text{C}-$]

Consider the above reaction sequence, Product "A" and Product "B" formed respectively are :

- (1) $\text{Br}-\text{CH}_2-\text{CH}(\text{OEt})_2$, $\text{H}_2\text{C}=\text{C}(\text{OEt})_2$
(2) $\text{EtO}-\text{CH}_2-\text{CH}(\text{OEt})_2$, $\text{H}_2\text{C}=\text{C}(\text{OEt})_2$
(3) $\text{Br}-\text{CH}_2-\text{CH}(\text{OEt})_2$, $\text{"BuO"}-\text{CH}_2-\text{CH}(\text{OEt})_2$
(4) $\text{EtO}-\text{CH}_2-\text{CHO}$, $\text{EtO}-\text{CH}_2-\text{CH}(\text{OH})-\text{O"Bu"}$

Ans. Official Answer NTA (1)



SECTION - B

1. Assuming that Ba(OH)_2 is completely ionised in aqueous solution under the given conditions the concentration of H_3O^+ ions in 0.005 M aqueous solution of Ba(OH)_2 at 298 K is _____ $\times 10^{-12} \text{ mol L}^{-1}$.
(Nearest integer)

Ans. Official Answer NTA (1)



$$\begin{array}{ccc} 0.005 \text{ M} & \text{---} & \text{---} \\ \text{---} & 0.005 \text{ M} & 2 \times 0.005 \text{ M} \end{array}$$

$$[\text{H}_3\text{O}^+][\text{OH}^-] = K_w$$

$$[\text{H}_3\text{O}^+] = \frac{10^{-14}}{0.01} = 10^{-12} \text{ M}$$

2. A system does 200 J of work and at the same time absorbs 150 J of heat. The magnitude of the change in internal energy is _____ J. (Nearest integer)

Ans. Official Answer NTA (50)

Sol. $w = 200 \text{ J}$

$$q = 150 \text{ J}$$

$$\text{FLOT} \Rightarrow \Delta E = q + w$$

$$\Delta E = 150 \text{ J} - 200 \text{ J} = -50 \text{ J}$$

3. 0.8 g of an organic compound was analysed by Kjeldahl's method for the estimation of nitrogen. If the percentage of nitrogen in the compound was found to be 42%, then _____ ml of 1 M H_2SO_4 would have been neutralized by the ammonia evolved during the analysis.

Ans. Official Answer NTA (12)

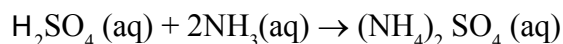
Sol. % of nitrogen = 42%

$$\text{mass of nitrogen} = \frac{42}{100} \times 0.8 \text{ g} = 0.336 \text{ g}$$

In kjeldahl's method all the nitrogen transfer from compound to ammonia.

$$\text{Moles of nitrogen} = \frac{0.336}{14} = 0.024 \text{ mol}$$

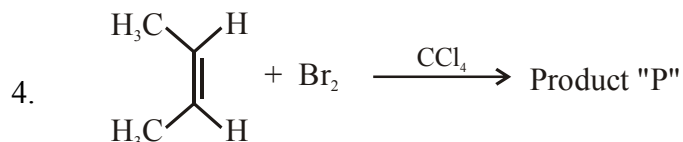
Moles of ammonia formed = 0.024 mol



moles of H_2SO_4 reacted = $\frac{1}{2} \times$ moles of NH_3 reacted

$$(1\text{M}) \times V = \frac{1}{2} \times 0.024$$

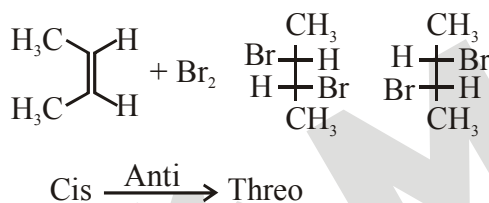
$$V = 0.012 \text{ L} = 12.00 \text{ ml}$$



Consider the above chemical reaction. The total number of stereoisomers possible for Product 'Y' is _____.

Ans. Official Answer NTA (2)

Sol. Addition of Br_2 is a stereospecific reaction and anti addition take place.



5. When 3.00 g of a substance 'X' is dissolved in 100 g of CCl_4 , it raises the boiling point by 0.60 K. The molar mass of the substance 'X' is _____ g mol^{-1} . (Nearest integer)

[Given K_b for CCl_4 is $5.0 \text{ K kg mol}^{-1}$]

Ans. Official Answer NTA (250)

Sol. $\Delta T_b = K_b m$

$$= K_b \times \left(\frac{\text{mass of solute}}{\text{M.M of solute} \times \text{mass of solvent}} \times 1000 \right)$$

$$0.60 = 5 \times \left(\frac{3 \times 1000}{\text{MM of solute} \times 100} \right)$$

$$\text{M.M. of solute} = 250$$

6. An accelerated electron has a speed of $5 \times 10^6 \text{ ms}^{-1}$ with an uncertainty of 0.02%. The uncertainty in finding its location while in motion is $x \times 10^{-9} \text{ m}$. The value of x is _____. (Nearest integer)

[Use mass of electron = $9.1 \times 10^{-31} \text{ kg}$, $h = 6.63 \times 10^{-34} \text{ Js}$, $\pi = 3.14$]

Ans. Official Answer NTA (58)

Sol. $\Delta v = 5 \times 10^6 \times \frac{0.02}{100} = 1000 \text{ m/s}$

$$\Delta x \cdot \Delta p = \frac{h}{4\pi}$$

$$\Delta x \cdot m \Delta v = \frac{h}{4\pi}$$

$$\Delta x = \frac{6.63 \times 10^{-34}}{4 \times 3.14 \times 9.1 \times 10^{-31} \times 1000} = 58 \times 10^{-9} \text{ m}$$

7. Number of electrons present in 4f orbital of Ho^{3+} ion is _____. (Given Atomic No. of Ho = 67)

Ans. Official Answer NTA (10)

Sol. ${}_{67}^{40} \Rightarrow [\text{Xe}]^{57} 4f^{10} 5d^1 6s^2$

$$\text{Ho}^{3+} \Rightarrow [\text{Xe}]^{57} 4f^{10}$$

8. For a chemical reaction $A \rightarrow B$, it was found that concentration of B is increased by 0.2 mol L^{-1} in 30 min. The average rate of the reaction is _____ $\times 10^{-1} \text{ mol L}^{-1} \text{ h}^{-1}$. (in nearest integer)

Ans. Official Answer NTA (4)

Sol. $A \rightarrow B$

$$\text{rate} = \frac{\Delta[B]}{\Delta t} \quad ; t = 30 \text{ min} = 0.5 \text{ h}$$

$$= \frac{0.2 \text{ mol L}^{-1}}{0.5 \text{ h}} = 4 \times 10^{-1} \text{ mol L}^{-1} \text{ h}^{-1}$$

9. An LPG cylinder contains gas at a pressure of 300 kPa at 27°C . The cylinder can withstand the pressure of $1.2 \times 10^6 \text{ Pa}$. The room in which the cylinder is kept catches fire. The minimum temperature at which the bursting of cylinder will take place is _____ $^\circ\text{C}$ (Nearest integer)

Ans. Official Answer NTA (927)

Sol. Volume of cylinder is constant

$$P \propto T$$

$$\frac{P_1}{P_2} = \frac{T_1}{T_2}$$

$$\frac{300 \times 10^3 \text{ Pa}}{1.2 \times 10^6 \text{ Pa}} = \frac{300 \text{ K}}{T_2}$$

$$T_2 = 1200 \text{ K} = 927^\circ \text{C}$$

10. The number of significant figures in 0.00340 is _____.

Ans. Official Answer NTA (3)

Sol. 0.00340 These three digits are significant

– All non - zero digits are significant

– For a value less than one all zeroes after a non-zero digit are significant.