

JEE Main March 2021
Question Paper With Text Solution
16 March. | Shift-1

CHEMISTRY



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

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JEE MAIN MARCH 2021 | 16TH MARCH SHIFT-1**SECTION - A**

1. Given below are two statements :

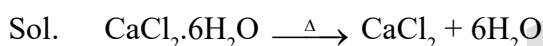
Statement I : Both $\text{CaCl}_2 \cdot 6\text{H}_2\text{O}$ and $\text{MgCl}_2 \cdot 8\text{H}_2\text{O}$ undergo dehydration on heating.

Statement II : BeO is amphoteric whereas the oxides of other elements in the same group are acidic.

In the light of the above statements, choose the correct answer from the options given below :

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

Ans. Official Answer NTA (4)



On heating $\text{MgCl}_2 \cdot 8\text{H}_2\text{O}$, hydrolysis takes place hence complete dehydration is not achieved. BeO is amphoteric and oxides of other elements in the same group are basic in nature.

2. Match List – I with List – II :

List – I

List – II

Name of oxo acid

Oxidation state of 'P'

(a) Hypophosphorous acid

(i) +5

(b) Orthophosphoric acid

(ii) +4

(c) Hypophosphoric acid

(iii) +3

(d) Orthophosphorous acid

(iv) +2

(v) +1

Choose the correct answer from the options given below :

(1) (a)–(iv), (b)–(v), (c)–(ii), (d)–(iii)



(2) (a)–(v), (b)–(iv), (c)–(ii), (d)–(iii)

(3) (a)–(v), (b)–(i), (c)–(ii), (d)–(iii)

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

Ans. Official Answer NTA (3)

Sol.	Name of Acid	Formula	O.S. of P
	Hypophosphorous acid	H_3PO_2	+1
	Orthophosphoric acid	H_3PO_4	+5
	Hypophosphoric acid	$\text{H}_4\text{P}_2\text{O}_6$	+4
	Orthophosphorous acid	H_3PO_3	+3

3. The functions of antihistamine are :

(1) Antacid and antiallergic

(2) Analgesic and antacid

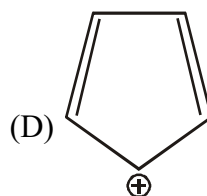
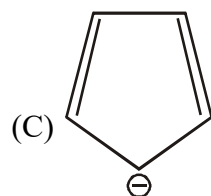
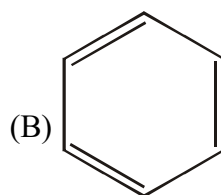
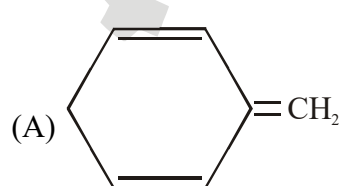
(3) Antiallergic and Analgesic

(4) Antiallergic and antidepressant

Ans. Official Answer NTA (1)

Sol. Antacid and antiallergic

4. Among the following, the aromatic compounds are :



Choose the correct answer from the following options :

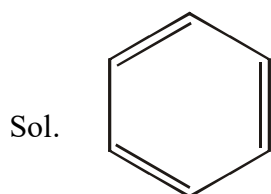
(1) (A) and (B) only

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

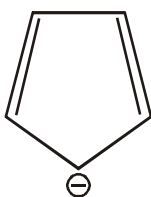
(2) (B) and (C) only

(4) (B), (C) and (D) only

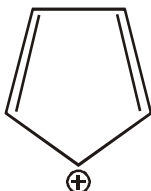
Ans. Official Answer NTA (3)


 $6\pi e^-$

Aromatic


 $6\pi e^-$

Aromatic


 $4\pi e^-$

Antiaromatic



Not complete delocalisation, (non aromatic)

5. Given below are two statement : one is labelled as Assertion A and the other is labelled as Reason R :

Assertion A : Size of Bk^{3+} ion is less than Np^{3+} ion.

Reason R : The above is a consequence of the lanthanoid contraction.

In the light of the above statements, choose the correct answer from the options give below:

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

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

(3) A is false but R is true

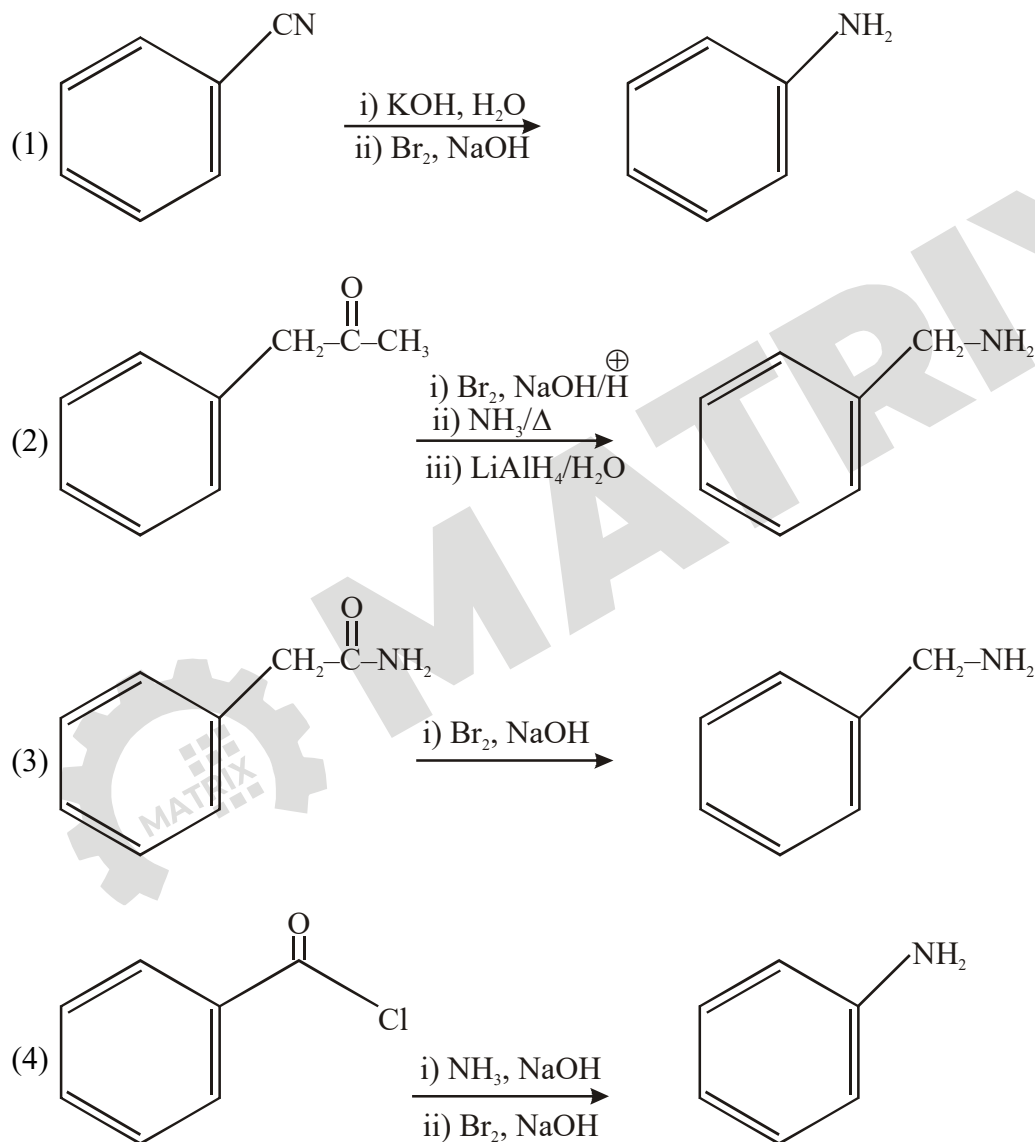
(4) A is true but R is false

Ans. Official Answer NTA (1)

Ans. **Official Answer By Matrix (4)**

Sol. Size of Bk^{+3} ion is less than Np^{3+} ion is due to Actinoid contraction

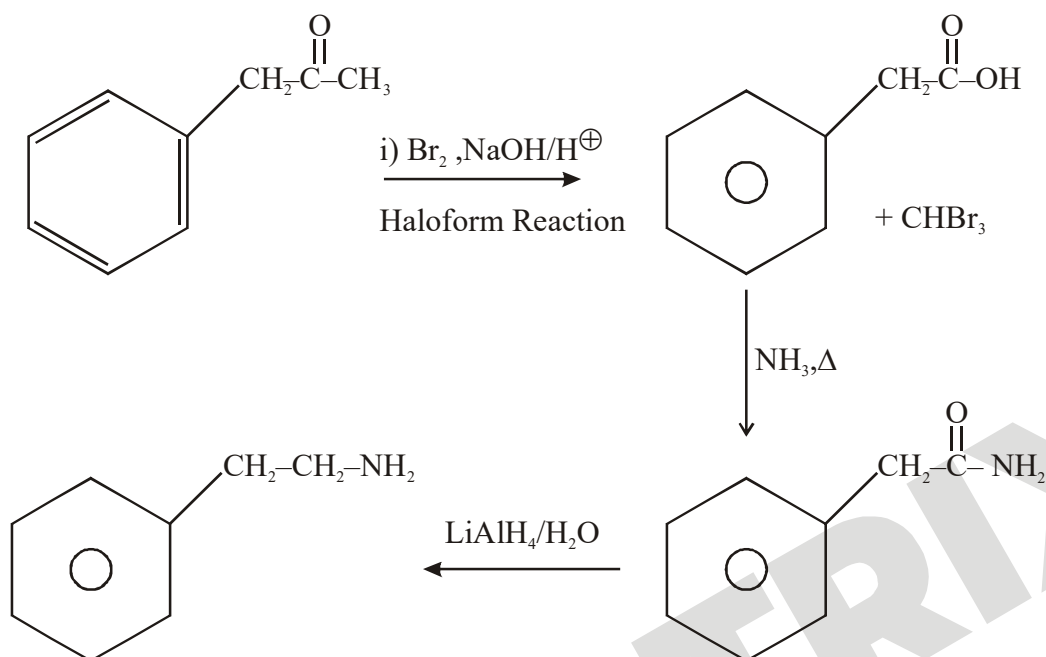
6. Which of the following reaction DOES NOT involve Hofmann bromamide degradation ?



Ans. Official Answer NTA (2)



Sol.



7. Match List – I with List – II :

List – I

Industrial process

- (a) Haber's process
- (b) Ostwald's process
- (c) Contact process
- (d) Hall–Heroult process

List – II

Application

- (i) HNO_3 synthesis
- (ii) Aluminium extraction
- (iii) NH_3 synthesis
- (iv) H_2SO_4 synthesis

Choose the correct answer from the options given below :

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

Ans. Official Answer NTA (2)

Sol. Haber's process \rightarrow NH_3 synthesis

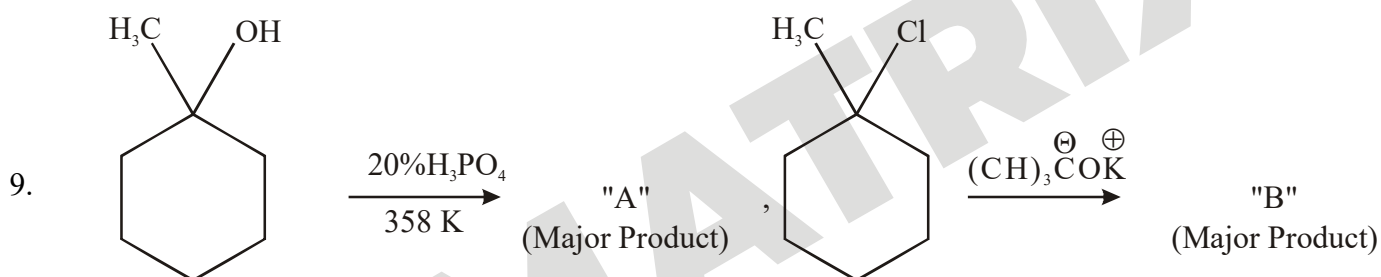
Ostwald's process	→	HNO ₃ synthesis
Contact process	→	H ₂ SO ₄ synthesis
Hall–Heroult process	→	Aluminium extraction

8. A group 15 element, which is a metal and forms a hydride with strongest reducing power among group 15 hydrides. The element is :

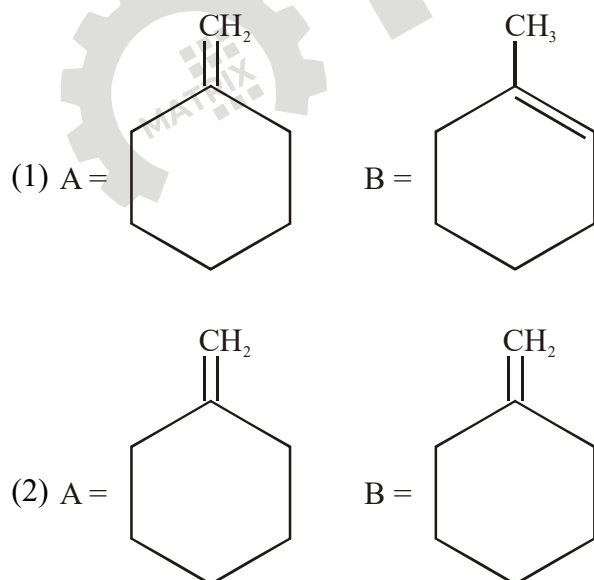
(1) Sb (2) P (3) Bi (4) As

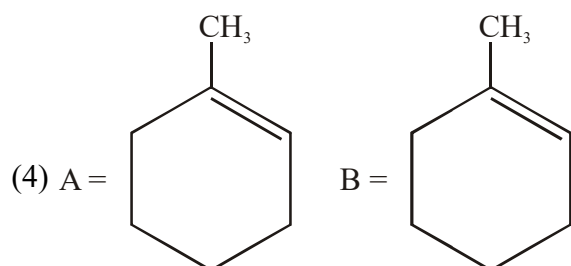
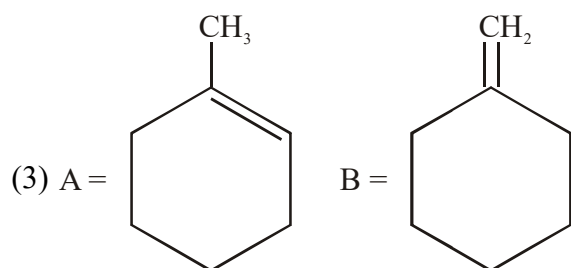
Ans. Official Answer NTA (3)

Sol. Bi is metal and BiH₃ is strongest reducing agent among hydrides of elements of 15th group.

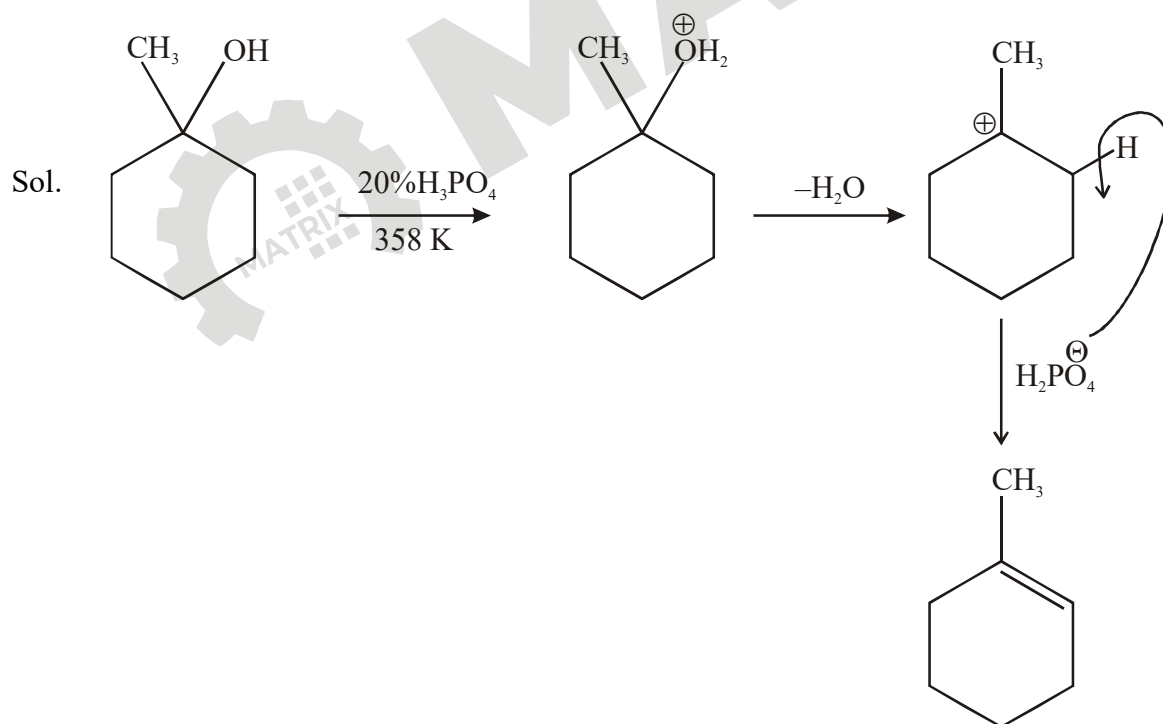


The product "A" and "B" formed in above reactions are :

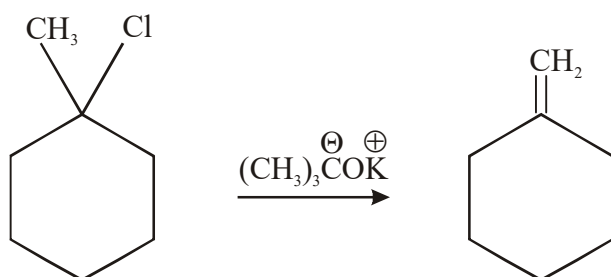




Ans. Official Answer NTA (3)



Alcohols give E1 elimination with Conc. H_2SO_4 and H_3SO_4 on heating



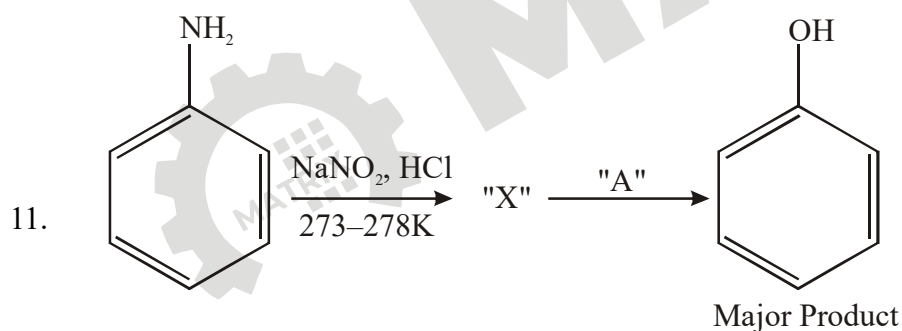
t.BuO^\ominus is bulky base and will form Hofmann alkene via elimination

10. In Chromatography Technique, the purification of compound is independent of :

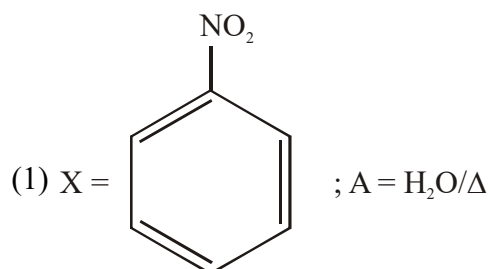
- (1) Length of the column or TLC plate
- (2) Mobility or flow of solvent system
- (3) Solubility of the compound
- (4) Physical state of the pure compound

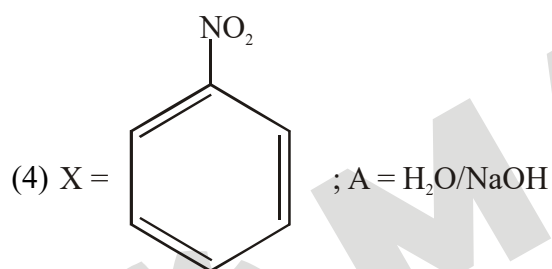
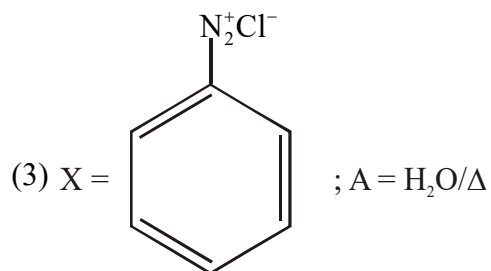
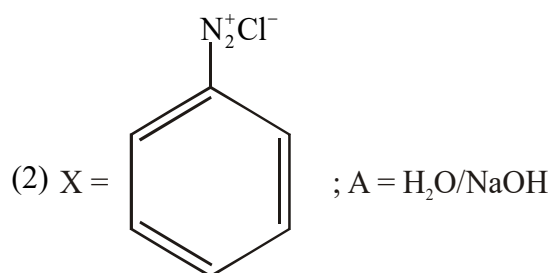
Ans. Official Answer NTA (4)

Sol. In Chromatography Technique Purification is independent of physical state of the pure compound.

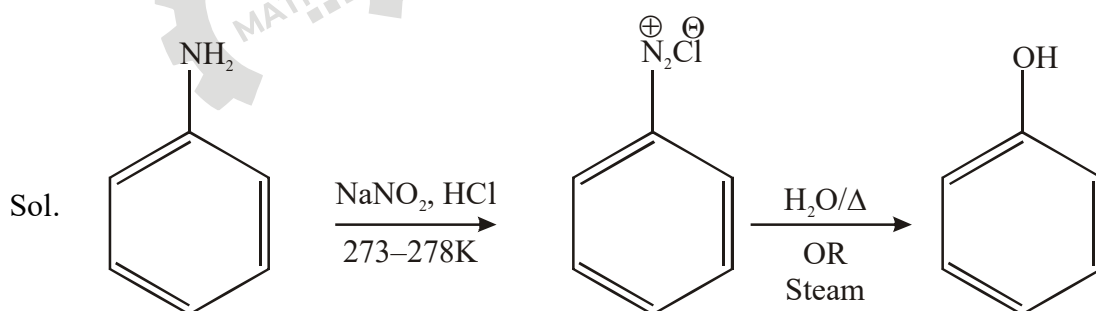


In the above chemical reaction, intermediate "X" and reagent/condition "A" are :





Ans. Official Answer NTA (3)



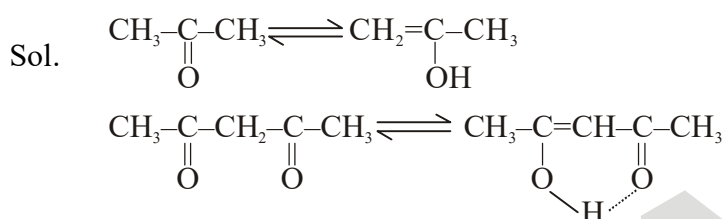
12. Assertion A : Enol form of acetone [CH₃COCH₃] exists in <0.1% quantity. However, the enol form of acetyl acetone [CH₃COCH₂OCCH₃] exists in approximately 15% quantity.

Reason R : Enol form of acetyl acetone is stabilized by intramolecular hydrogen bonding, which is not possible in enol form of acetone.

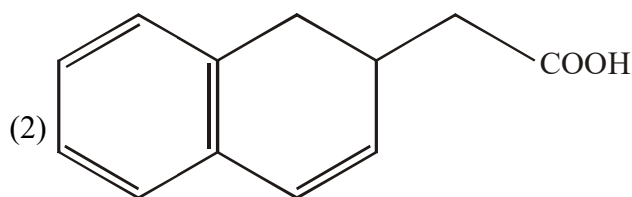
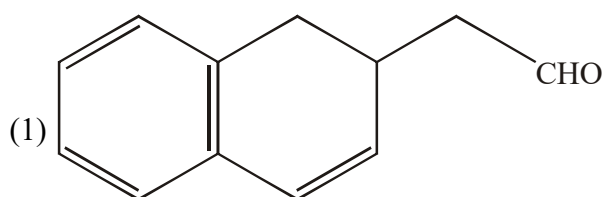
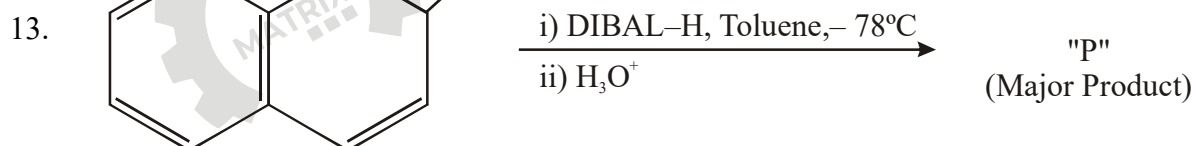
Choose the correct statement :

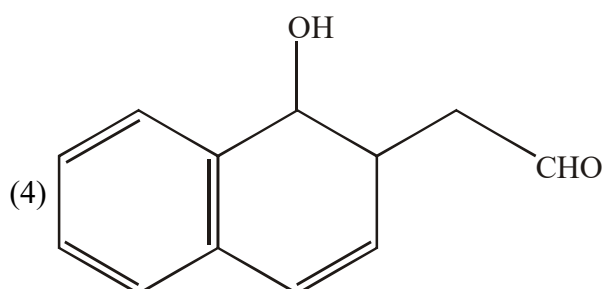
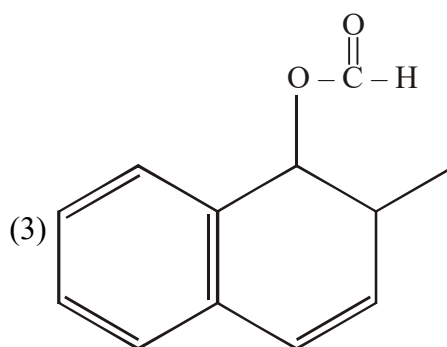
- (1) Both A and R are true but R is not the correct explanation of A
- (2) A is true but R is false
- (3) Both A and R are true R is the correct explanation of A
- (4) A is false but R is true

Ans. Official Answer NTA (3)

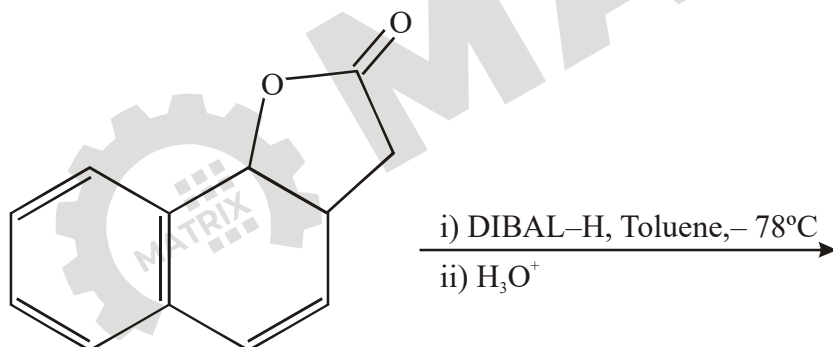


enol content in acetylacetone is more than acetone due to intramolecular hydrogen bonding.

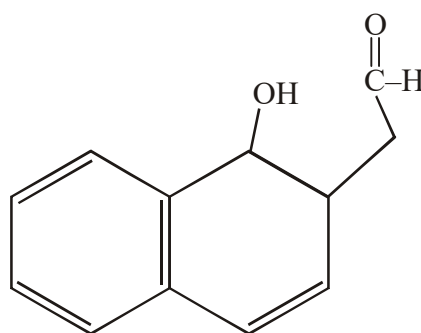




Ans. Official Answer NTA (4)



Sol.



14. Given below are two statements :

Statement I : The E° value for $\text{Ce}^{4+}/\text{Ce}^{3+}$ is $+1.74\text{ V}$.

Statement II : Ce is more stable in Ce^{4+} state than Ce^{3+} state.

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

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

Ans. Official Answer NTA (1)

Sol. $E^{\circ}_{\text{Ce}^{4+}/\text{Ce}^{3+}} = 1.74$

For lanthanides, +3 oxidation state is most stable.

15. Which of the following is Lindlar catalyst ?

- (1) Cold dilute solution of KMnO_4
- (2) Sodium and Liquid NH_3
- (3) Partially deactivated palladised charcoal
- (4) Zinc chloride and HCl

Ans. Official Answer NTA (3)

Sol. Partially deactivated palladised charcoal ($\text{Pd}-\text{CaCO}_3$) is Lindlar catalyst.

16. Given below are two statements : one is labelled as Assertion A and other is labelled as

Reason R :

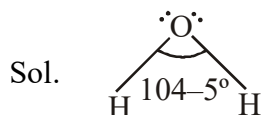
Assertion A : The $\text{H}-\text{O}-\text{H}$ bond angle in water molecule is 104.5° .

Reason R : The lone pair – lone pair repulsion of electrons is higher than the bond pair – bond pair repulsion.

In the light of the above statements, choose the correct 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) Both A and R are true, and R is the correct explanation of A
- (4) A is false but R is true

Ans. Official Answer NTA (3)



lone pair–lone pair repulsion is more than bond pair–bond pair repulsion hence value of H–O–H angle decreases from its ideal value of $109^{\circ}28'$.

17. The type of pollution that gets increased during the day time and in the presence of O_3 is :

- (1) Oxidising smog
- (2) Reducing smog
- (3) Global warming
- (4) Acid rain

Ans. Official Answer NTA (1)

Sol. Oxidising smog is increased during day time in presence of O_3 .

18. The process that involves the removal of sulphur from the ores is :

- (1) Roasting (2) Leaching (3) Smelting (4) Refining

Ans. Official Answer NTA (1)

Sol. During Roasting metal sulphide is converted to metal oxide and sulphur is removed in the form of SO_2

19. Which among the following pairs of Vitamins is stored in our body relatively for longer duration ?

- (1) Vitamin A and Vitamin D
- (2) Thiamine and vitamin A
- (3) Thiamine and Ascorbic acid
- (4) Ascorbic acid and Vitamin D

Ans. Official Answer NTA (1)

Sol. Vitamin A and Vitamin D is stored in our body relatively for longer duration.

20. Given below are two statements :

Statement I : H_2O_2 can act as both oxidising and reducing agent in basic medium.

Statement II : In the hydrogen economy, the energy is transmitted in the form of dihydrogen.

In the light of the above statements, choose the correct answer from the options given below :

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

Ans. Official Answer NTA (3)

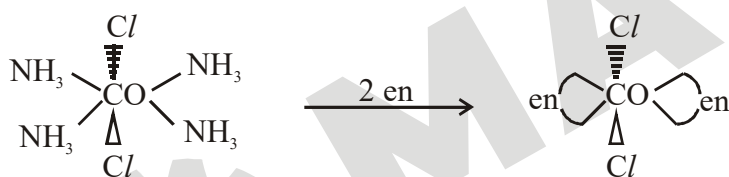
Sol. H_2O_2 can act as both oxidising and reducing agent in acidic as well as basic medium.
 In the hydrogen economy, energy is transmitted in the form of dihydrogen.

Section –'B'

1. The equivalents of ethylene diamine required to replace the neutral ligands from the coordination sphere of the trans-complex of $\text{CoCl}_3 \cdot 4\text{NH}_3$ is _____. (Round off to the Nearest Integer).

Ans. Official Answer NTA (2)

Sol. $\text{CoCl}_3 \cdot 4\text{NH}_3 \equiv [\text{Co}(\text{NH}_3)_4\text{Cl}_2] \text{Cl}$



Ethylenediamine is a bidentate ligands and both of its donor atoms will always be cis to each other. Hence trans Cl ligands can not be replaced by en.

2. A 6.50 molal solution of KOH (aq.) has a density of 1.89 g cm^{-3} . The molarity of the solution is _____ mol dm^{-3} . (Round off to the Nearest Integer).

[Atomic masses : K : 39.0 u ; O : 16.0 u ; H : 1.0 u]

Ans. Official Answer NTA (9)

Sol. 1000 gm solvent contains \rightarrow 6.5 mole KOH

$$\begin{aligned} \text{mass of KOH} &= 6.5 \times 56 \\ &= 364 \text{ gm KOH} \end{aligned}$$

mass of solution = 1364 gm

$$\text{volume of solution} = \frac{1364}{1.89} \text{ mL}$$

$$\text{Molarity} = \frac{6.5}{\frac{1364}{1.89}} \times 1000 = 9\text{M}$$

3. When light of wavelength 248 nm falls on a metal of threshold energy 3.0 eV, the de-Broglie wavelength of emitted electrons is _____ Å. (Round off to the Nearest Integer).

[Use : $\sqrt{3} = 1.73$, $h = 6.63 \times 10^{-34}$ Js

$m_e = 9.1 \times 10^{-31}$ kg ; $c = 3.0 \times 10^8$ ms⁻¹ ; $1\text{eV} = 1.6 \times 10^{-19}\text{J}$]

Ans. Official Answer NTA (9)

Sol. Energy of light = $\frac{hc}{\lambda}$

$$= \frac{1240}{248}$$

$$= 5\text{eV}$$

work function = 3eV

$E_{\text{light}} = \phi + KE_{\text{max}}$

$5 = 3 + KE_{\text{max}}$

$KE_{\text{max}} = 2\text{eV}$

$$\lambda_{\text{de-broglie}} = \frac{h}{\sqrt{2m(KE)_{\text{max}}}}$$

$$= \frac{6.62 \times 10^{-34}}{\sqrt{2 \times 9.1 \times 10^{-31} \times 2 \times 1.6 \times 10^{-19}}}$$

$$= 9 \times 10^{-10}$$

$$= 9\text{Å}$$

4. For the reaction $A(g) \rightleftharpoons B(g)$ at 495 K, $\Delta_r G^\circ = -9.478$ kJ mol⁻¹.

If we start the reaction in a closed container at 495 K with 22 millimoles of A, the amount of B in the equilibrium mixture is _____ millimoles. (Round off to the Nearest Integer).

[$R = 8.314$ J mol⁻¹ K⁻¹ ; $\ln 10 = 2.303$]

Ans. Official Answer NTA (20)

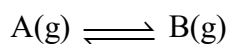
Sol. $A(g) \rightleftharpoons B(g)$ $\Delta_r G^\circ = -9.478$ kJ mole⁻¹

$\Delta_r G^\circ = -RT \ln k_{\text{eq}}$

$-9.478 \times 10^3 = -2.303 \times 8.314 \times 495 \log k_{\text{eq}}$

$$\log K_{eq} = 1$$

$$K_{eq} = 10$$



$$t = 0 \quad 22$$

$$t = t_{eq} \quad 22 - x \quad x$$

$$K_{eq} = \frac{x}{22 - x} = 10$$

$$x = 20$$

5. The decomposition of formic acid on gold surface follows first order kinetics. If the rate constant at 300 K is $1.0 \times 10^{-3} \text{ s}^{-1}$ and the activation energy $E_a = 11.488 \text{ kJ mol}^{-1}$, the rate constant at 200 K is _____ $\times 10^{-5} \text{ s}^{-1}$. (Round off to the Nearest Integer).

(Given : $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$)

Ans. Official Answer NTA (10)

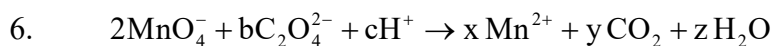
Sol. $\ln \frac{K_2}{K_1} = \frac{E_a}{R} \left(\frac{1}{T_1} - \frac{1}{T_2} \right)$

$$\ln \frac{K_{200}}{K_{300}} = \frac{11.488 \times 10^3}{8.314} \left(\frac{1}{300} - \frac{1}{200} \right)$$

$$\ln \frac{K_{200}}{K_{300}} = -2.303$$

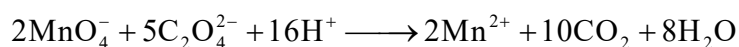
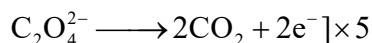
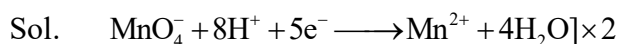
$$\frac{K_{300}}{K_{200}} = 10$$

$$\Rightarrow K_{200} = \frac{10^{-3}}{10} = 10^{-4}$$



If the above equation is balanced with integer coefficients, the value of c is _____ (Round off to the Nearest Integer).

Ans. Official Answer NTA (16)



7. A certain element crystallises in a bcc lattice of unit cell edge length 27 Å. If the same element under the same conditions crystallises in the fcc lattice, the edge length of the unit cell in Å will be _____.
(Round off to the Nearest Integer).

[Assume each lattice point has a single atom]

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

Ans. Official Answer NTA (33)

Sol. In bcc lattice

$$\sqrt{3}a = 4r$$

$$r = \frac{\sqrt{3} \times 27}{4} \text{ Å}$$

In fcc lattice

$$\sqrt{2}a = 4r$$

$$\sqrt{2}a = \frac{4 \times \sqrt{3} \times 27}{4}$$

$$a = \frac{\sqrt{3}}{\sqrt{2}} \times 27 = \frac{1.73}{1.41} \times 27 = 33.12$$

8. AB_2 is 10% dissociated in water to A^{2+} and B^- . The boiling point of a 10.0 molal aqueous solution of AB_2 is _____ °C. (Round off to the Nearest Integer).

[Given : Molal elevation constant of water $K_b = 0.5 \text{ K kg mol}^{-1}$ boiling point of pure water = 100° C]

Ans. Official Answer NTA (106)

Sol. $AB_2 \rightleftharpoons A^{2+} + 2B^-$

$$\Delta T_b = iK_b m$$

$$i = 1 + 0.1(3 - 1)$$

$$i = 1.2$$

$$\Delta T_b = 1.2 \times 0.5 \times 10$$

$$= 6$$

$$\Delta T_b = (T_{B.P.})_{\text{solution}} - (T_{B.P.})_{\text{solvent}}$$

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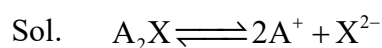
Website : www.matrixedu.in ; Email : smd@matrixacademy.co.in

$$6 = (T_{\text{B.P.}})_{\text{solution}} - 100$$

$$(T_{\text{B.P.}})_{\text{solution}} = 106$$

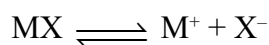
9. Two salts A_2X , MX have the same value of solubility product of 4.0×10^{-12} . The ratio of their molar solubilities i.e. $\frac{S(A_2X)}{S(MX)} = \underline{\hspace{2cm}}$. (Round off to the Nearest Integer).

Ans. Official Answer NTA (50)



$$2S_1 \quad S_1$$

$$K_{\text{sp}} = 4S_1^3 \quad 4S_1^3 = 4 \times 10^{-12} \quad S_1 = 10^{-4}$$



$$K_{\text{sp}} = S_2^2$$

$$S_2^2 = 4 \times 10^{-12}$$

$$S_2 = 2 \times 10^{-6}$$

$$\frac{S_1}{S_2} = \frac{10^{-4}}{2 \times 10^{-6}} = 50$$

10. Complete combustion of 750 g of an organic compound provides 420 g of CO_2 and 210 g of H_2O . The percentage composition of carbon and hydrogen in organic compound is 15.3 and $\underline{\hspace{2cm}}$ respectively. (Round off to the Nearest Integer).

Ans. Official Answer NTA (3)

Sol. mass of C in $\text{CO}_2 = \frac{420}{44} \times 12 \text{ gm}$

$$\text{mass of H in } \text{H}_2\text{O} = \frac{210}{18} \times 2 \text{ gm}$$

$$\% \text{ of C in organic compound} = \frac{420}{44} \times 12 = \frac{\frac{420}{44} \times 12}{750} \times 100 = 15.27$$

$$\% \text{ of H in organic compound} = \frac{\frac{210}{18} \times 2}{750} \times 100 = 3.11$$

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