FINAL JEE–MAIN EXAMINATION – FEBRUARY, 2021
Held On Thursday 26th February, 2021
TIME: 3:00 PM to 6:00 PM

SECTION-A

1. Which of the following forms of hydrogen emits low energy β^- particles?

(1) Deuterium ${}_1^2H$ (2) Tritium ${}_1^3H$

(3) Protium ${}_1^1H$ (4) Proton H^+

Official Ans. by NTA (2)

Sol. For tritium $({}_1^3H)$

No. of neutron (n) = 2

No. of proton (p) = 1

$$\frac{n}{p}=2$$

$\because \frac{n}{p}$ is high ,

tritium wil emit β particle.

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

Assertion A : In $T\ell I_3$, isomorphous to CsI_3, the metal is present in +1 oxidation state.

Reason R : $T\ell$ metal has fourteen f electrons in the electronic configuration.

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

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

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

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

(4) Both **A** and **R** are correct but **R** is NOT the correct explanation of **A**.

Official Ans. by NTA (4)

Sol. $T\ell I_3 \Rightarrow \left(T\ell^{\oplus} \& I_3^{\ominus}\right)$

$CsI_3 \Rightarrow \left(Cs^{\oplus} \& I_3^{\ominus}\right)$

[Both have same crystalline structure is called isomorphous]

$T\ell_{(81)}^{\oplus}$ = $[Xe_{54}]4f^{14}, 5d^{10}, 6s^2$

(It is correct due to present 14 f electrons in $T\ell^{\oplus}$ ion)

3. Match List-I with List-II

List-I	List-II
(a) Sucrose	(i) β-D-Galactose and β-D-Glucose
(b) Lactose	(ii) α-D-Glucose and β-D-Fructose
(c) Maltose	(iii) α-D-Glucose and α-D-Glucose

Choose the correct answer from the options given below :

Options :

(1) (a) → (i), (b) → (iii), (c) → (ii)

(2) (a) → (iii), (b) → (i), (c) → (iii)

(3) (a) → (ii), (b) → (i), (c) → (iii)

(4) (a) → (iii), (b) → (ii), (c) → (i)

Official Ans. by NTA (3)

Sol.

(1) Sucrose → α-D-Glucose and β-D-Fructose

(2) Lactose → β-D-Galactose and β-D-Glucose

(3) Maltose → α-D-Glucose and α-D-Glucose

a → II

b → I

c → III

4. A. Phenyl methanamine

B. N,N-Dimethylaniline

C. N-Methyl aniline

D. Benzenamine

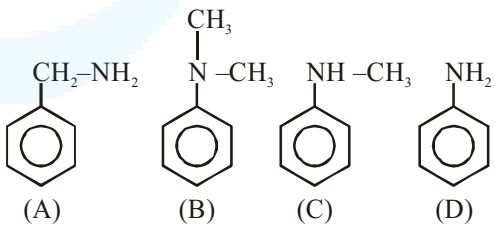
Choose the correct order of basic nature of the above amines.

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

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

Official Ans. by NTA (4)

Sol.



B.S. order (A) > (B) > (C) > (D)

5. The correct order of electron gain enthalpy is

(1) S > Se > Te > O (2) Te > Se > S > O

(3) O > S > Se > Te (4) S > O > Se > Te

Official Ans. by NTA (1)

Sol. correct order of electron gain enthalpy is :-

O < S > Se > Te

⇒ S > Se > Te > O

(Oxygen shows least electron gain enthalpy due to small size of atom)

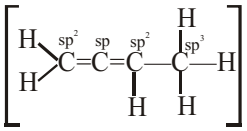
6. In $\overset{1}{CH_2}=\overset{2}{C}=\overset{3}{CH}-\overset{4}{CH_3}$ molecule, the hybridization of carbon 1,2,3 and 4 respectively are :

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

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

Official Ans. by NTA (3)

Sol. $[\overset{1}{CH_2}=\overset{2}{C}=\overset{3}{CH}-\overset{4}{CH_3}]$



7. Seliwanoff test and Xanthoproteic test are used for the identification of _____and _____ respectively

(1) Aldoses, ketoses (2) Proteins, ketoses

(3) Ketoses, proteins (4) Ketoses, aldoses

Official Ans. by NTA (3)

Sol. Seliwanoff test for ketose and Xenthoprotic test for proteins.

8. 2,4-DNP test can be used to identify :

(1) Amine (2) Aldehyde

(3) Ether (4) Halogens

Official Ans. by NTA (2)

Sol. 2,4-DNP test is useful for the identification of carbonyl compounds.

9. Ceric ammonium nitrate and $CHCl_3$ / alc. KOH are used for the identification of functional groups present in _____ and ___ respectively.

(1) Alcohol, phenol (2) Amine, alcohol

(3) Alcohol, amine (4) Amine, phenol

Official Ans. by NTA (3)

Sol. Ceric ammonium nitrate for alcohol and $CHCl_3$/ KOH is carbyl amine test for primary amines

10. Which pair of oxides is acidic in nature?

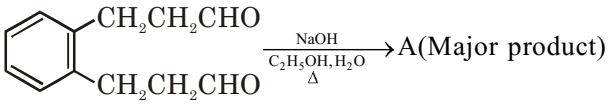
(1) B_2O_3, CaO (2) B_2O_3, SiO_2

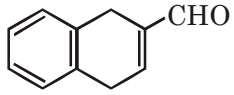
(3) N_2O, BaO (4) CaO, SiO_2

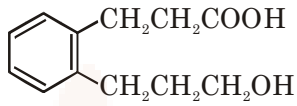
Official Ans. by NTA (2)

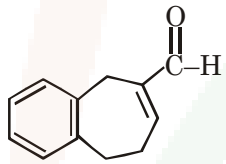
Sol.
- CaO, BaO = Basic Nature
- B_2O_3, SiO_2 = Acidic Nature
- N_2O = Neutral oxide

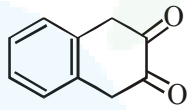
11. Identify A in the given chemical reaction,



(1) 

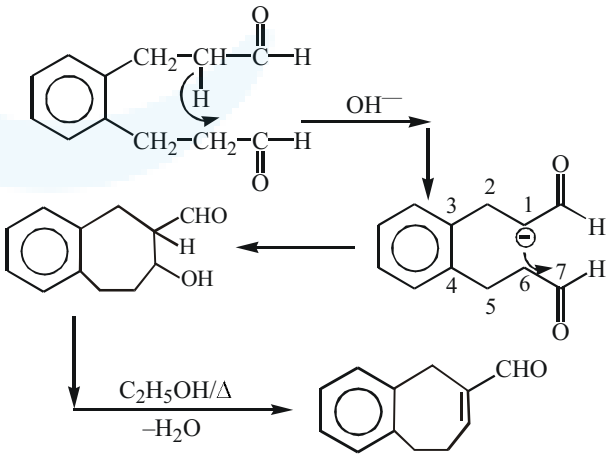
(2) 

(3) 

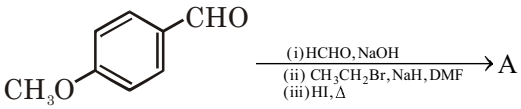
(4) 

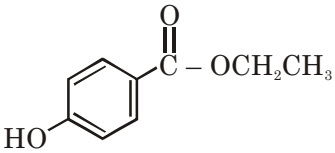
Official Ans. by NTA (3)

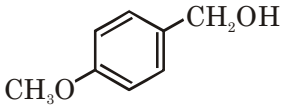
Sol.

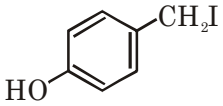


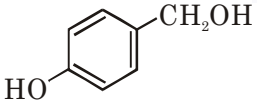
12. Identify A in the following chemical reaction



(1) 

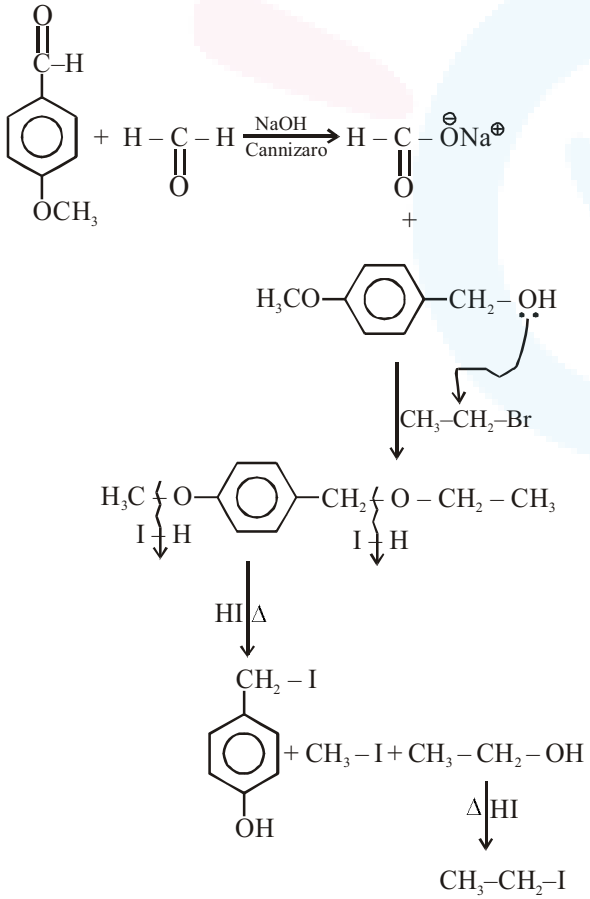
(2) 

(3) 

(4) 

Official Ans. by NTA (3)

Sol.



13. Calgon is used for water treatment. Which of the following statement is NOT true about Calgon?

(1) Calgon contains the 2nd most abundant element by weight in the Earth's crust.

(2) It is polymeric compound and is water soluble.

(3) It is also known as Graham's salt

(4) It does not remove Ca^{2+} ion by precipitation.

Official Ans. by NTA (1)

Sol. → 2nd most abundant element is "Si" and it is not present in calgon

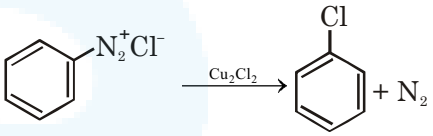
$Na_6P_6O_{18}$ = (Graham's salt) (Sodium hexametaphosphate)

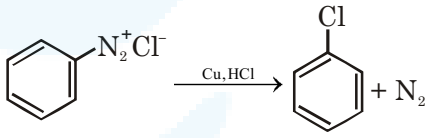
→ It exist in polymeric form as $(NaPO_3)_6$ and water soluble compound

→ It removes Ca^{2+} in soluble ion but not by precipitation

14. Match List-I with List-II

List-I

(a) 

(b) 

(c) $2CH_3CH_2Cl + 2Na \xrightarrow{Ether} C_2H_5–C_2H_5 + 2NaCl$

(d) $2C_6H_5Cl + 2Na \xrightarrow{Ether} C_6H_5–C_6H_5 + 2NaCl$

List-II

(i) Wurtz reaction

(ii) Sandmeyer reaction

(iii) Fittig reaction

(iv) Gatterman reaction

Choose the correct answer from the options given below :

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

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

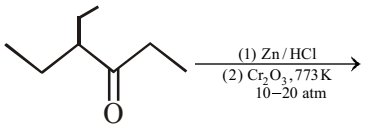
(3) (a) → (ii), (b) → (iv), (c) → (i), (d) → (iii)

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

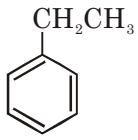
Official Ans. by NTA (3)

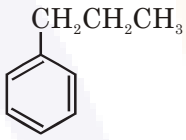
Sol. (a) → (ii) Sand Meyer reaction
(b) → (iv) Gatterman reaction
(c) → (i) Wurtz reaction
(d) → (iii) Fittig reaction
(a) → (ii),
(b) → (iv),
(c) → (i),
(d) → (iii)

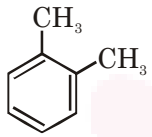
15.

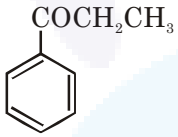


considering the above reaction, the major product among the following is :

(1) 

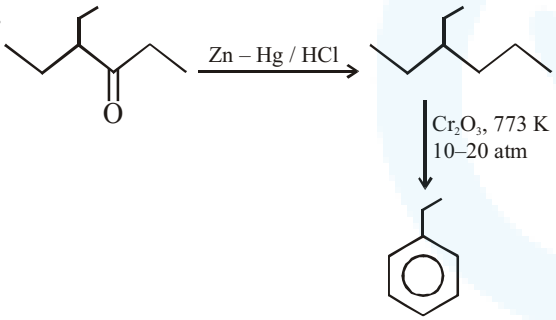
(2) 

(3) 

(4) 

Official Ans. by NTA (1)

Sol.



16. Match List-I with List-II.

	List-I (Molecule)		**List-II (Bond order)**
(a)	Ne_2	(i)	1
(b)	N_2	(ii)	2
(c)	F_2	(iii)	0
(d)	O_2	(iv)	3

Choose the correct answer from the options given below :
(1) (a)→(iii), (b)→(iv), (c)→(i), (d)→(ii)
(2) (a)→(i), (b)→(ii), (c)→(iii), (d)→(iv)
(3) (a)→(ii), (b)→(i), (c)→(iv), (d)→(iii)
(4) (a)→(iv), (b)→(iii), (c)→(ii), (d)→(i)

Official Ans by NTA (1)

Sol. (a) Ne_2 = Total $e^{\ominus}$ = 20

$$B.O. = \frac{10-10}{2} = 0$$

(b) N_2 = Total $e^{\ominus}$ = 14

$$B.O. = \frac{10-4}{2} = 3$$

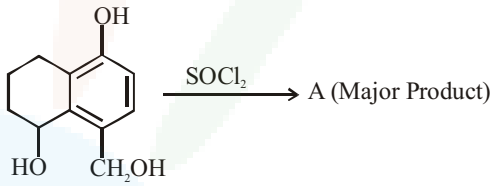
(c) F_2 = Total $e^{\ominus}$ = 18

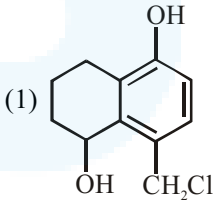
$$B.O. = \frac{10-8}{2} = 1$$

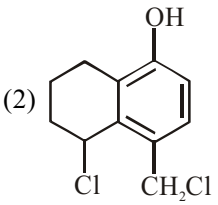
(d) O_2 = Total $e^{\ominus}$ = 16

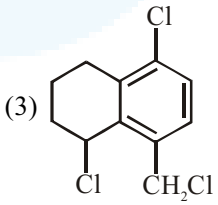
$$B.O. = \frac{10-6}{2} = 2$$

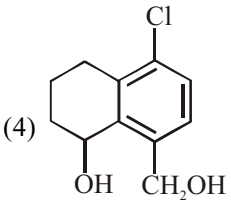
17. Identify A in the given reaction.



(1) 

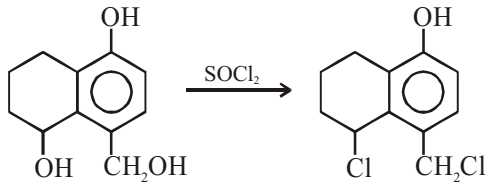
(2) 

(3) 

(4) 

Official Ans by NTA (2)

Sol.



18. Match List-I with List-II.

	List-I		List-II
(a)	Siderite	(i)	Cu
(b)	Calamine	(ii)	Ca
(c)	Malachite	(iii)	Fe
(d)	Cryolite	(iv)	Al
		(v)	Zn

Choose the correct answer from the options given below :
(1) (a)→(iii), (b)→(i), (c)→(v), (d)→(ii)
(2) (a)→(i), (b)→(ii), (c)→(v), (d)→(iii)
(3) (a)→(iii), (b)→(v), (c)→(i), (d)→(iv)
(4) (a)→(i), (b)→(ii), (c)→(iii), (d)→(iv)

Official Ans by NTA (3)

Sol. (a) Siderite = $FeCO_3$ = Fe-metal
(b) Calamine = $ZnCO_3$ = Zn-metal
(c) Malachite = $Cu(OH)_2.CuCO_3$ = Cu-metal
(d) Cryolite = $Na_3A\ell F_6$ = $A\ell$-metal

19. The nature of charge on resulting colloidal particles when $FeCl_3$ is added to excess of hot water is :
(1) Positive
(2) Sometimes positive and sometimes negative
(3) Neutral
(4) Negative

Official Ans by NTA (1)

Sol. If $FeCl_3$ is added to hot water, a positively charged sol, hydrated ferric oxide is formed due to adsorption of Fe^{3+} ions.

$Fe_2O_3.\ xH_2O/Fe^{3+}$

Positively charged.

20. Match List-I with List-II.

	List-I		List-II
(a)	Sodium Carbonate	(i)	Deacon
(b)	Titanium	(ii)	Castner-Kellner
(c)	Chlorine	(iii)	Van-Arkel
(d)	Sodium hydroxide	(iv)	Solvay

Choose the correct answer from the options given below :
(1) (a)→(iv), (b)→(iii), (c)→(i), (d)→(ii)
(2) (a)→(i), (b)→(iii), (c)→(iv), (d)→(ii)
(3) (a)→(iv), (b)→(i), (c)→(ii), (d)→(iii)
(4) (a)→(iii), (b)→(ii), (c)→(i), (d)→(iv)

Official Ans by NTA (1)

Sol. (a) Sodium carbonate is prepared by Solvay process
(b) Titanium is refined by Van-Arkel process
(c) Chlorine is prepared by Deacon process
(d) Sodium hydroxide is prepared by Castner-Kellner process

SECTION-II

1. The $NaNO_3$ weighed out to make 50 mL of an aqueous solution containing 70.0 mg Na^+ per mL is _____g. (Rounded off to the nearest integer)
[Given : Atomic weight in g mol^{-1} – Na : 23 ; N : 14 ; O : 16]

Official Ans by NTA (13)

Sol. Na^+ present in 50 ml

$$= \frac{70mg}{1ml} \times 50ml = 3500 \text{ mg} = 3.5 \text{ gm}$$

$$\text{moles of } Na^+ = \frac{3.5}{23} = \text{moles of } NaNO_3$$

$$\text{weight of } NaNO_3 = \frac{3.5}{23} \times 85 = 12.993gm$$

2. Emf of the following cell at 298 K in V is $x \times 10^{-2}$. $Zn|Zn^{2+}$ (0.1 M)$||Ag^+$ (0.01 M)| Ag
The value of x is _____. (Rounded off to the nearest integer)

[Given : $E^0_{Zn^{2+}/Zn} = -0.76V;\ E^0_{Ag^+/Ag} = +0.80V;\ \frac{2.303RT}{F} = 0.059$]

Official Ans by NTA (147)

Sol. $Zn_{(s)} \rightarrow Zn^{2+}_{(aq.)} + 2e^-$
$2Ag^+_{(aq.)} + 2e^- \rightarrow 2Ag_{(s)}$

$$Zn_{(s)} + 2Ag^+_{(aq.)} \rightarrow Zn^{2+}_{(aq.)} + 2Ag_{(s)}$$

$$E^0_{cell} = E^0_{Ag^+/Ag} - E^0_{Zn^{2+}/Zn}$$
$$= 0.80 - (-0.76)$$
$$= 1.56 \text{ V}$$

$$E_{cell} = 1.56 - \frac{0.059}{2}\log\frac{[Zn^{2+}]}{[Ag^+]^2}$$

$$= 1.56 - \frac{0.059}{2}\log\frac{0.1}{(0.01)^2}$$

$$= 1.56 - \frac{0.059}{2} \times 3$$
$$= 1.56 - 0.0885$$
$$= 1.4715$$
$$= 147.15 \times 10^{-2}$$

3. When 12.2 g of benzoic acid is dissolved in 100 g of water, the freezing point of solution was found to be –0.93°C ($K_f(H_2O)$ = 1.86K kg mol^{-1}). The number (n) of benzoic acid molecules associated (assuming 100% association) is ____.

Official Ans by NTA (2)

Sol. $\Delta T_f = i \times k_f \times m$

$$0 - (-0.93) = i \times 1.86 \times \frac{12.2}{122 \times 100} \times 1000$$

$$i = \frac{0.93}{1.86} = 0.5$$

$$i = 1 + \left(\frac{1}{n} - 1\right)\alpha$$

$$\frac{1}{2} = 1 + \left(\frac{1}{n} - 1\right) \times 1$$

n = 2

4. The average S–F bond energy in kJ mol^{-1} of SF_6 is _____.(Rounded off to the nearest integer)

[Given : The values of standard enthalpy of formation of $SF_6(g)$, S(g) and F(g) are –1100, 275 and 80 kJ mol^{-1} respectively.]

Official Ans by NTA (309)

Sol. $SF_6(g) \rightarrow S(g) + 6F(g)$

If $\in$ - bond enthalpy

$$\Delta_r H = 6 \times \in_{S-F}$$

$$= \Delta_f H(S,g) + 6 \times \Delta_f H(F,g) - \Delta_f H(SF_6,g)$$

= 275 + 6 × 80 – (–1100)

= 1855 kJ

$$\in_{S-F} = \frac{1855}{6} = 309.16 \text{ kJ/mol.}$$

5. A ball weighing 10 g is moving with a velocity of 90 ms^{-1}. If the uncertainty in its velocity is 5%, then the uncertainty in its position is_____$\times 10^{-33}$ m. (Rounded off to the nearest integer)

[Given : h = 6.63 × 10^{-34} Js]

Official Ans by NTA (1)

$$\Delta v = 90 \times \frac{5}{100}$$

= 4.5 m/s

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

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

$$= \frac{6.63 \times 10^{-34}}{4 \times 3.14 \times 0.01 \times 4.5}$$

= 1.17 × 10^{-33}

6. The number of octahedral voids per lattice site in a lattice is _____.(Rounded off to the nearest integer)

Official Ans by NTA (1)

Sol. If number of lattice points are N.

then effective octahedral voids = N

So, octahedral voids / lattice site = 1

7. In mildly alkaline medium, thiosulphate ion is oxidized by MnO_4^- to "A". The oxidation state of sulphur in "A" is _____.

Official Ans by NTA (6)

Sol. $MnO_4^- + S_2O_3^{2-} \rightarrow \overset{+4}{M}nO_2 + \underset{(A)}{SO_4^{2-}}$

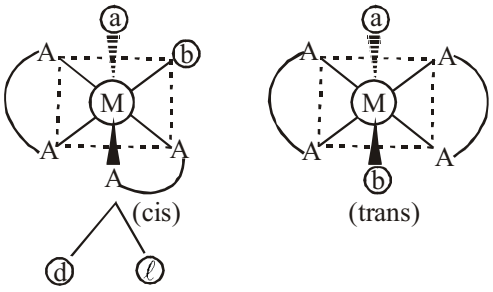
Oxidation state of 'S' in SO_4^{2-}

= + 6

8. The number of stereoisomers possible for $[Co(ox)_2(Br)(NH_3)]^{2-}$ is _____.[ox = oxalate]

Official Ans by NTA (3)

Sol. Total number of stereoisomers in $[Co(ox)_2Br(NH_3)]^{2\ominus}$ i.e. $\simeq [M(AA)_2ab]^{2-}$



→ cis is optically active isomers and trans is optically inactive isomer

→ Hence total isomers is = 3

9. If the activation energy of a reaction is 80.9 kJ mol^{-1}, the fraction of molecules at 700 K, having enough energy to react to form products is e^{-x}. The value of x is _____.
(Rounded off to the nearest integer)
[Use R = 8.31 J K^{-1} mol^{-1}]

Official Ans by NTA (14)

Sol. Fraction of molecules to have enough energy to react = $e^{-Ea/RT}$

So, $x = \frac{E_a}{RT}$

$= \frac{80.9 \times 10^3}{8.31 \times 700}$

$= 13.9$

10. The pH of ammonium phosphate solution, if pK_a of phosphoric acid and pk_b of ammonium hydroxide are 5.23 and 4.75 respectively, is _____.

Official Ans by NTA (7)

Sol. Since $(NH_4)_3PO_4$ is salt of weak acid (H_3PO_4) & weak base (NH_4OH).

$pH = 7 + \frac{1}{2}(pka - pkb)$

$= 7 + \frac{1}{2}(5.23 - 4.75)$

$= 7.24 \approx 7.$