JEE Main 2021 August 27, Shift 1 (Chemistry)

Q. 1. How many electrons are there in f subshell of $Np(Z = 93)$ in ground state configuration.

Ans: 18

Sol. $_{93}Np = [\ _{86}Rn]5f^4 6d^1 7s^2$

Total no. of electron in f subshell $= 14$ in $4\,f$ and 4 in $5f$ subshell.
$Total\ number\ of\ f\ subshell\ electrons = 18$

Neptunium lies in the 5f series (Actinide series in the Modern Periodic Table).

Q. 2. Nature of V_2O_3 and CrO is :

(A) acidic, acidic

(B) acidic, Basic

(C) Basic, acidic

(D) Basic, Basic

Ans: (D)

Sol.

Oxide Nature

$(i)\ V_2O_3$ Basic

$(ii)\ CrO$ Basic

The oxides of V and Cr in the lower oxidation state have basic nature due to lower polarising power of the metal cations.

Q. 3. In van der waal equation for a real gas $\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$ Unit of vander waal constant a is :

(A) $atm \times \frac{Lit^2}{mole^2}$

(B) $atm \times \frac{mole^2}{Lit^2}$

(C) $atm \times \frac{Lit}{mole}$

(D) $atm \times \frac{mole}{Lit}$

Ans: (A)

$P + \frac{an}{V^2}^2$ has a unit of atm.

Hence, unit of $\frac{an}{V^2}^2 = atm$

Hence, unit of a=$atm \times \frac{mole^2}{Lit^2}$

Q. 4. In $BF_3, BCl_3, BBr_3 \& BI_3$ which one shows strongest back bonding.

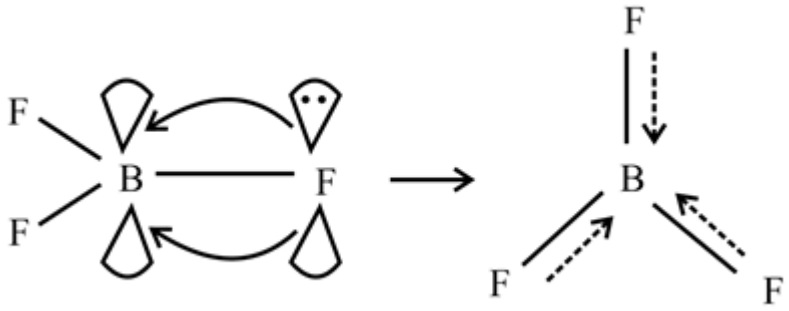
(A) BF_3

(B) BCl_3

(C) BBr_3

(D) BI_3

Ans: (A)



Sol.

Strongest back bonding is observed in BF_3.

Overlapping for back bonding:

$BF_3(2p-2p)$,$BCl_3(2p-3p), BBr_3(2p-4p), BI_3\ (2p-5p)$

So the extent of back bonding is maximum in (2p -2p) or BF_3because the size and energy of the orbitals is most suited for perfect overlapping.

Q. 5.

Column I Compound	Column II No. of lone pair on central atom
$(i)\ XeO_2F_2$	$(a)\ 0$
$(ii)\ XeO_3F_2$	$(b)\ 1$
$(iii)\ XeF_2$	$(c)\ 2$
$(iv)\ XeF_4$	$(d)\ 3$

(A) $(i)\ -(b); (ii)-(a); (iii)-(d); (iv)-(c)$

(B) $(i)\ -(a);\ (ii)\ -(b);\ (iii)\ -(d); (iv)-(c)$

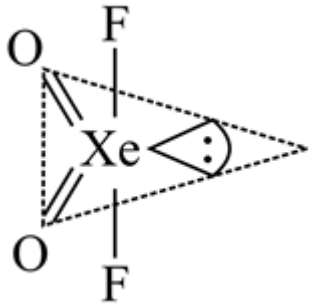
(C) $(i)\ -(a);\ (ii)\ -(b);\ (iii)\ -(c);\ (iv)\ -(d)$

(D) $(i)\ -(b);\ (ii)\ -(a);\ (iii)\ -(c);\ (iv)\ -(d)$

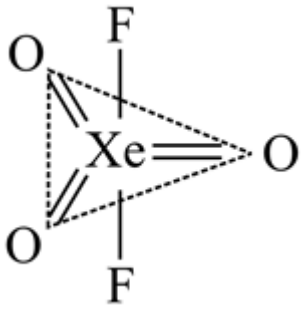
Ans: (A)

Xenon has 8 electrons in the valence shell. Oxygen and Fluorine require 2 and 1 electrons respectively to complete the octet. Based on this information, the number of lone pairs in various molecules are given below:

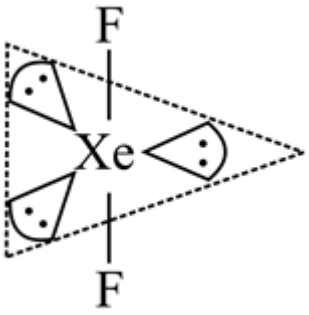
Sol. No. of lp



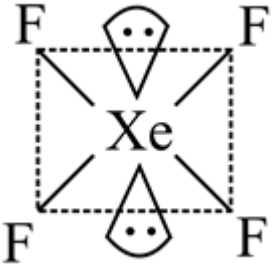
$(i)\ XeO_2F_2$ 1



$(ii)\ XeO_3F_2$ 0



(iii) XeF_2 3



(iv) XeF_4 2

Q. 6. Solution of sucrose in $1kg$ water of concentration of $0.75\ mole$ freezes up to $-4°C$ then amount of ice (in gram) separated out is [given $k_f(H_2O) = 1.86K \cdot kg/mol$]

[Report your answer to nearest integer]

Ans: 651

Sol. On freezing, moles of sucrose do not change.

But the solvent freezes upon cooling. Hence, Ice will be separated from solution upon freezing.

$\Delta T_f = i \times kf \times m$

$4 = 1 \times 1.86\left[\frac{0.75}{w_{H_2O}} \times 1000\right] = 348.75gram$

Amount of ice separated $= 1000 - 348.75 = 651.25$g

Q. 7. For reaction $3A \longrightarrow 2B$

Rate of formation of $B = 2.67\ \frac{mole}{Lit\ sec.}$

Then rate of disappearance of A is :

[Report your answer to nearest integer]

Ans: 4

Sol. $3A \longrightarrow 2B$

$rate\ of\ the\ reaction\ = -\frac{1}{3}\frac{d}{dt}[A] = \frac{1}{2}\frac{d}{dt}[B]$

$= -\frac{d}{dt}[A] = \frac{3}{2}\left[\frac{d}{dt}[B]\right] = \frac{3}{2} \times 2.67 = 4.005\,\frac{mole}{Lit\ sec.}$

Q. 8. For compound $H_2S_xO_6$[$where\ X = 3\ to\ 5$]

Oxidation state of sulphur in compound is:

(A) 5,0

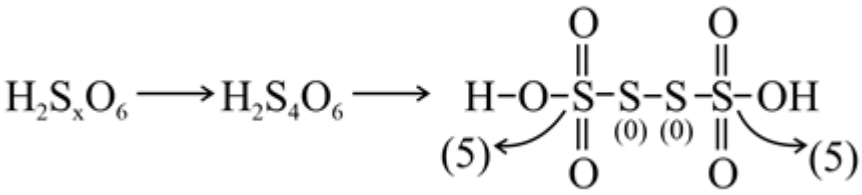
(B) 5,3

(C) only 6

(D) only 5

Ans: (A)

Sol. Structure of polythionic acid is given below



Oxidation states arise when there is electronegativity difference. The oxidation states of middle sulphur atoms are equal to zero because they are connected to other sulphur atoms only. The terminal sulphur oxidation states can be calculated using the concept, sum of the oxidation states of the atoms in a neutral molecule is equal to zero.

Q. 9. Which method of purification is used for purification of low melting point metal.

(A) Zone refining

(B) Liquification

(C) Crystallization

(D) Fractional distillation

Ans: (B)

Sol. Liquation is a metallurgical method for separating metals from an ore or alloy. The material must be heated until one of the metals starts to melt and drain away from the other and can be collected. This process is used for the purification of Sn and Zn and for removing Pb from $Zn - Ag$ alloy.

The principle of zone refining is that the impurities in an ingot or ore of metal are more soluble in the melt state when compared to the corresponding solid state of the impurities.

Q. 10. $200ml, 0.2MHCl$ is mixed with $400ml, 0.1M\ NaOH$ solution then find change in temperature.

given (i) Heat of neutralization of $1\ mole$ of HCl and $1\ mole$ of $NaOH = 57.1kJ/mol$

(ii) Specific heat of water $= 4.18\frac{J}{gram\times\ ^\circ C}$

Ans: 1

Sol.

	$HCl + NaOH$	$\rightarrow$	$NaCl$	$+ H_2O$
Initial millimoles	40	40	0	0
Final millimoles	0	0	40	40

Given that, for one mole of water formation, heat of neutralisation is $57.1kJ$. Now for 40 millimoles of water formation, the heat of neutralisation is

$\Delta H = [-57.1 \times 40 \times 10^{-3} \times 10^3]J = 2284J$

$q = m \cdot s \cdot \Delta T$

$2284 = 600 \times 4.18 \times \Delta T$

$\Delta T = 0.91 \approx 1$

Q. 11.

Column-I	ColumnII
(i) Paramagnetic	$(a)\ MnO$
(ii) Diamagnetic	$(b)\ Fe_3O_4$
(iii) Ferromagnetic	$(c)\ O_2$

(iv) Antiferromagnetic $(d)\ NaCl$

Identify correct matching:

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

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

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

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

Ans: (A)

Solution: Paramagnetism is a form of magnetism whereby some materials are weakly attracted by an externally applied magnetic field. Those substances which contain unpaired electrons exhibit this paramagnetism. Among the given molecules, oxygen molecules contain unpaired electrons according to molecular orbital theory. Ferromagnetic materials are weakly attracted by an externally applied magnetic field. Fe_3O_4 is an example of ferromagnetic material. Diamagnetism is a form of magnetism whereby some materials are weakly repelled by an externally applied magnetic field. Those substances which contain all paired electrons are diamagnetic.Sodium chloride is the example of it. In antiferromagnetic materials, which include certain metals and alloys in addition to some ionic solids, the magnetism from magnetic atoms or ions oriented in one direction is canceled out by the set of magnetic atoms or ions that are aligned in the reverse direction. MnO is an example of antiferromagnetic material.

Q. 12. Number of water of crystallization in gypsum, plaster of paris (POP) and dead burnt plaster are respectively:

(A) 2,0.5,0

(B) 0,0.5,2

(C) 2,0,0.5

(D) 0.2,2,0

Ans: (A)

Sol. $Gypsum = CaSO_4 \cdot 2H_2O$

Plaster of paris $(POP) = CaSO_4 \cdot \frac{1}{2}H_2O$

Dead burnt of plaster $= CaSO_4$

Q. 13. When $FeCl_3$ react with $K_4[Fe(CN)_6]$ a blue coloured colloidal solution is obtained. The product can be :

(A) $KFe[Fe(CN)_6]$

(B) $Fe_4[Fe(CN)_6]_3$

(C) $Fe_3[Fe(CN)_6]_2$

(D) $Fe[Fe(CN)_6]$

Ans: (B)

$$FeCl_3 + K_4[Fe(CN)_6] \longrightarrow \underset{\text{Blue colour}}{Fe_4[Fe(CN)_6]_3}$$

Sol.

Q. 14. Deuterium is different from hydrogen in which property

(A) It react more than hydrogen

(B) It react less than hydrogen

(C) It emits β^- particles

(D) Its reactivity is almost equal to hydrogen

Ans: (B)

Reactivity of Deuterium is less than hydrogen due to high bond dissociation energy of D_2

D_2 $Bond\ dissociation\ energy$: $443.35\ kJ/mol$

$H_2\ Bond\ dissociation\ energy$: $435.88\ kJ/mol$

Q. 15. Which one of the following solutions shows a higher Tyndall effect?

(A) Lyophilic colloidal solution

(B) Lyophobic colloidal solution

(C) True solution

(D) Suspension

Ans: (B)

Solution:

The Tyndall effect is the phenomenon in which the particles in a colloid scatter the beams of light that are directed at them. This effect is exhibited by all colloidal solutions and some very fine suspensions.

Lyophilic colloids do not show Tyndall effect. There is almost no difference in the refractive indices of dispersion medium and dispersed phase in the lyophilic sols. Lyophobic sols show the Tyndall effect readily. Tyndall effect is also not shown by true solutions because the solute particles are of smaller than the wavelength of visible light. Suspensions may scatter light, but if the number of suspended particles is sufficiently large, the suspension may simply be opaque and the light scattering will not occur.

Q. 16. $1\ mole$ of an octahedral complex of formula $MCl_3.2L$ on reaction with excess $AgNO_3$ gives precipitate of

$1\ mole\ AgCl$, then denticity of ligand (L) in complex is

Ans: 2

Solution: As $1\ mole$ complex give $1\ mole\ mole\ AgCl$ precipitate.

So only one Cl ion is in the ionisation sphere.

$$\underset{1\text{ mole}}{[ML_2Cl_2]Cl} \xrightarrow[\text{Excess}]{AgNO_3} \underset{1\text{ mole}}{AgCl\downarrow}$$

As complex is octahedral so denticity of Ligand (L) is $= 2$.

Q. 17. $10ml$ of $KMnO_4$ solution react completely with $10ml, 0.1MFeSO_4$ solution, then strength of $KMnO_4$

solution in gram/Lit is .....

[Report your answer in nearest integer]

Ans: 3

Solution: $MnO_4^- + Fe^{2+} \longrightarrow Mn^{2+} + Fe^{3+}$

$$vf = 5vf = 1$$

$$Mili\ equ.of\ MnO_4^- = mili\ equ.of\ Fe^{2+}$$

$$5[M \times 10] = 1[0.1 \times 10]$$

$$M = \left[\frac{0.1}{5}\right] = 0.02 \frac{mole}{Lit}$$

Strength of $KMnO_4 = 0.02 \times 158 \frac{gram}{Lit} = 3.16 g/L$

Q. 18. In $100ml, 0.1 MAgNO_3$ solution ammonia is passed. At equilibrium, $5 \times 10^{-6} MAg^{+} ion$ are reaming, then the number of millimoles of NH_3 added initially are:

$$[\, Given\ K_i [Ag(NH_3)_2]^{+} = 1.8 \times 10^7$$

[Report your answer to nearest integer]

Ans: 53

Solution:

$$Ag^{+} + 2NH_3 \rightleftharpoons [Ag(NH_3)_2]^{\oplus} \quad K_f = 1.8 \times 10^7$$

millimole	10	a	0
At equilibrium	5×10^{-6}	$(a - 20)$	10

$$K_i = \frac{10}{5 \times 10^{-6} \times [NH_3]^2} = 1.8 \times 10^7$$

$$[NH_3] = \frac{1}{3} \frac{mole}{lit}$$

$$\Rightarrow millimole\ of\ NH_3 = \frac{1}{3} \times 100 = 33.3$$

So $[a - 20] = 33.3$

$$a = 53.3\ millimole$$

Q. 19. S_1: Ethyl phenyl ether can be synthesised by Williamson's ether synthesis.

S_2: When bromobenzene reacts with sodium ethoxide, ethyl phenyl ether is formed.

(A) Both S_1 and S_2 are correct.

(B) S_1 is correct and S_2 is incorrect.

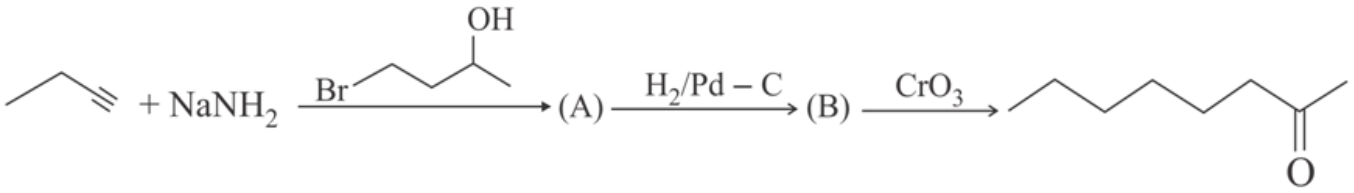
(C) S_1 is incorrect and S_2 is correct.

(D) Both S_1 and S_2 are incorrect.

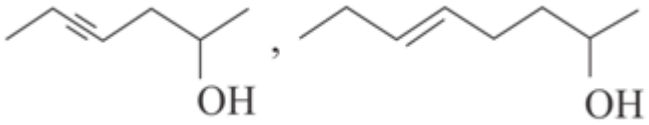
Ans: (B)

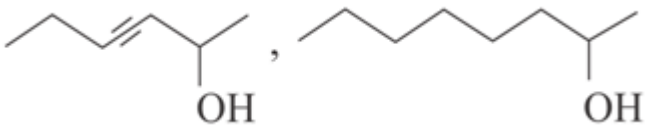
Solution: Due to double bond character in $C - Br$ bond in bromobenzene, reaction with sodium ethoxide is not possible.

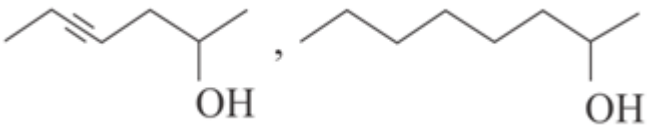
Q. 20.

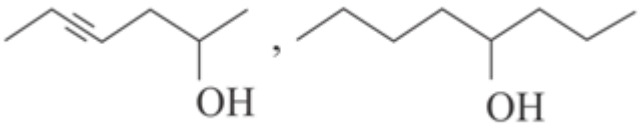


A and B respectively are:

(A)


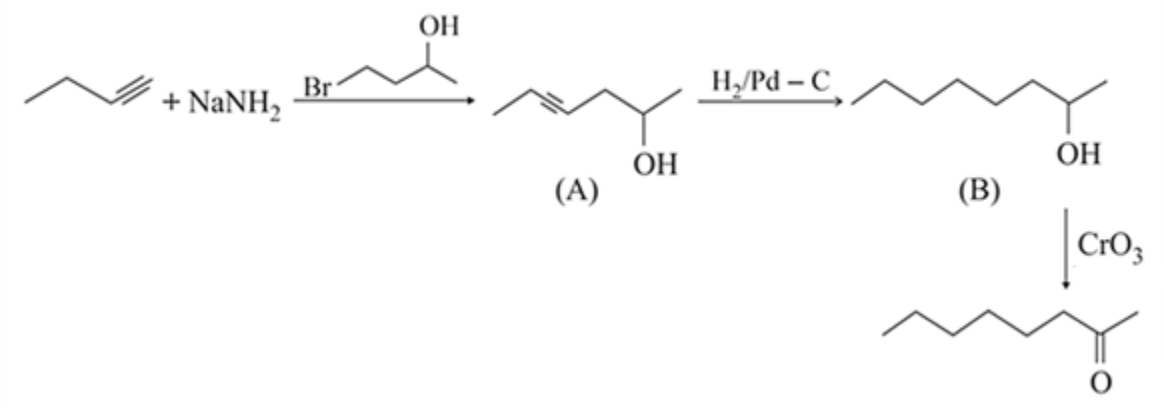
(B)


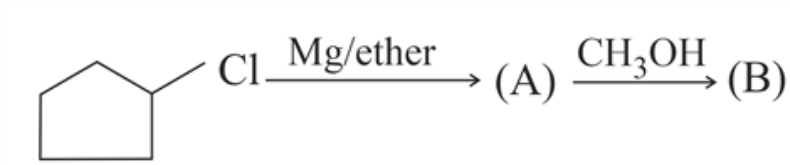
(C)


(D)


Ans: (C)

Solution:



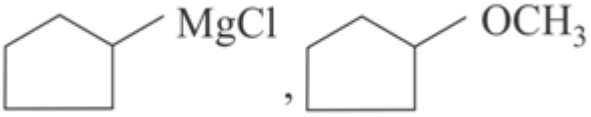


Q. 21.

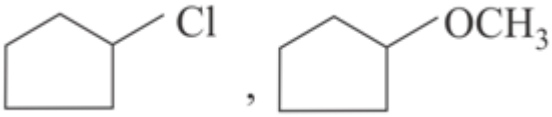
A and *B* respectively are:

(A)

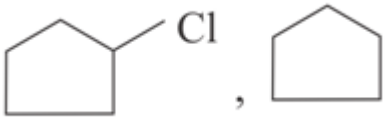
(B)



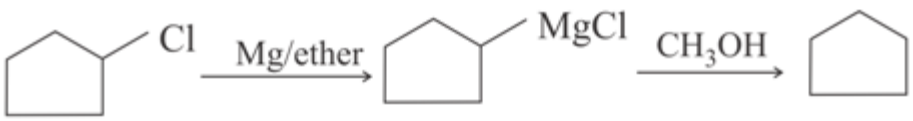
(C)



(D)

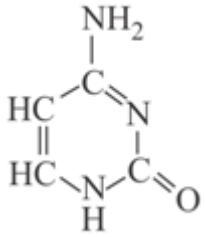


Ans: (A)

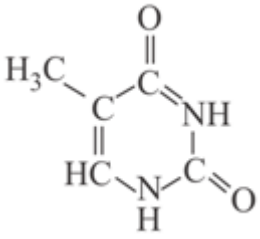


Solution:

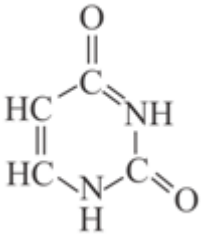
Q. 22. In which form uracil is present in DNA.



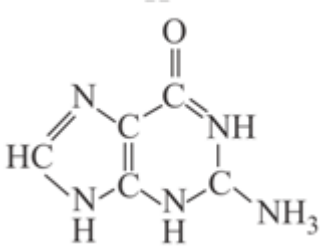
(A)



(B)

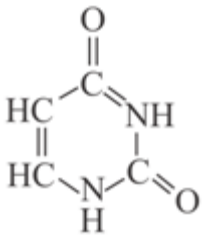


(C)



(D)

Ans: (C)



Solution:

Q. 23. $CF_2Cl_2 \longrightarrow^{UV} radical.$

Radical formed in reaction will be :

(A) $\dot{C}FCl_2$

(B) $\dot{F}$

(C) $\dot{C}F_2Cl$

(D) $\dot{C}Cl_2$

Ans: (C)

Solution: $CF_2Cl_2(g) \longrightarrow^{UV} \dot{C}l(g) + \dot{C}F_2Cl(g)$

Q. 24. 0.2 gm of an organic compound when analysed using Carius method gives 0.188 gm of $AgBr$. Find the percentage of bromine in the compound?

(A) 10%

(B) 20%

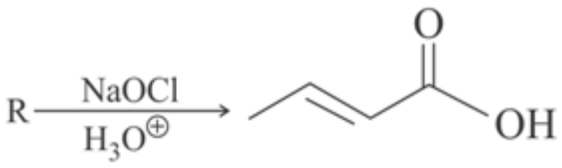
(C) 40%

(D) 80%

Ans: (C)

Solution: $= \frac{Atomic\ mass\ of\ X}{Molecular\ mass\ of\ AgX} \times \frac{wt.of\ AgX}{wt.of\ organic\ halides}$

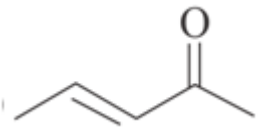
$$= \frac{80}{188} \times \frac{0.188}{0.2} \times 100 = 40\%$$



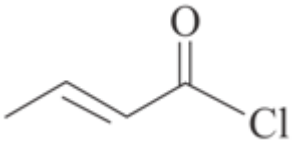
Q. 25.

Reactant is:

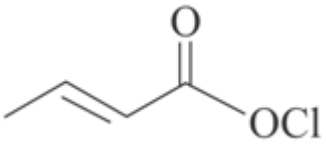
(A)



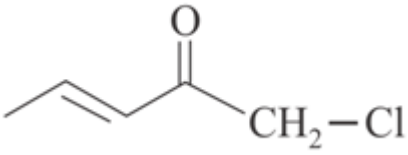
(B)



(C)

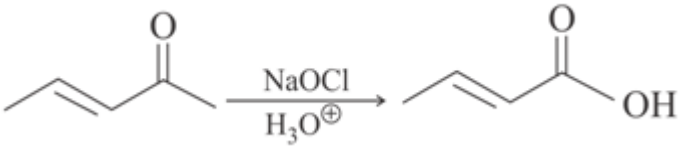


(D)



Ans: (A)

Solution:



It is a haloform reaction.

Q. 26. Which of the following statements is incorrect for primary amines.

(A) Primary amines are less basic than secondary amines.

(B) Primary amines can be prepared by Gabriel phthalimide synthesis.

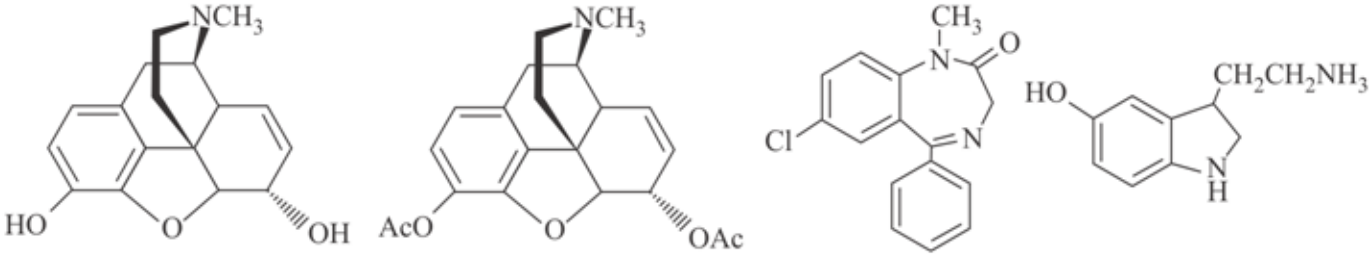
(C) Intermolecular association is more in primary amines than in secondary amines.

(D) Primary amines on reaction with nitrous acid give yellow oily liquid.

Ans: (D)

Solution: Primary amines on reaction with nitrous acid give alcohol.

Q. 27.



(a) (b) (c) (d)

(A) (a), (b) & (d) are Narcotic analgesic

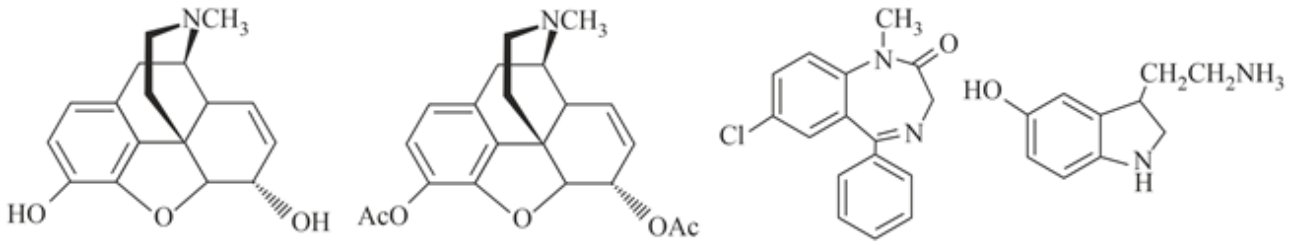
(B) (b) & (c) are Narcotic analgesic

(C) (c) & (d) are tranquilizers

(D) (a), (b) & (c) are tranquilizers

Ans: (C)

Solution:



Morphine Heroin Valium Serotonin

Morphine & Heroin are Narcotic analgesic while Valium and Serotonin are tranquilizers.