

1. A sample of  $\text{NaClO}_3$  is converted by heat to  $\text{NaCl}$  with a loss of 0.16 g of oxygen. The residue is dissolved in water and precipitated as  $\text{AgCl}$ . The mass of  $\text{AgCl}$  (in g) obtained will be : (Given : Molar mass of  $\text{AgCl} = 143.5 \text{ g mol}^{-1}$ )

- A. 0.35
- B. 0.41
- C. 0.48
- D. 0.54

Answer ||| C

Solution |||  $2\text{NaClO}_3 \rightarrow 2\text{NaCl} + 3\text{O}_2$

Amount of  $\text{O}_2$  obtained is 0.16 g

Number of moles of  $\text{O}_2 = 0.16 \text{ g} / 32 \text{ g mol}^{-1} = 0.005 \text{ mol}$

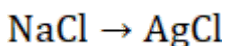
Now,

$$n_{\text{NaCl}}/2 = n_{\text{O}_2}/3$$

$$\Rightarrow n_{\text{NaCl}} = n_{\text{O}_2} \times 2/3$$

$$\Rightarrow n_{\text{NaCl}} = 0.005 \times 2/3 = 0.01/3$$

Here  $\text{NaCl}$  is converting to  $\text{AgCl}$



According to Law of Conservation of Mass, number of  $\text{NaCl}$  moles are equal to that of  $\text{AgCl}$

i.e.  $n_{\text{AgCl}} = 0.01/3$

Finally mass of  $\text{AgCl}$

$$= 0.01/3 \text{ mol} \times 143.5 \text{ g mol}^{-1}$$

$$= 0.48 \text{ g}$$

2. Which of the following arrangements shows the schematic alignment of magnetic moments of antiferromagnetic substance?

- A. 
- B. 
- C. 
- D. 

Answer ||| C

Solution ||| Ant-Ferromagnetic Substances possess zero net magnetic moments because of cancellation of the magnetic field.

Materials those have unpaired electrons are expected to possess para-magnetism or ferromagnetism.

So, the answer must be the one where the overall spin of total electrons is zero. This will ensure the overall

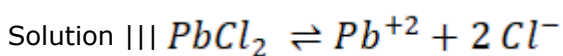
cancellation of the magnetic field.

In Option C, three electrons have one kind of spin and the other three have the opposite. So the overall magnetism is canceled.

3. The minimum volume of water required to dissolve 0.1 g lead(II) chloride to get a saturated solution ( $K_{sp}$  of  $PbCl_2 = 3.2 \times 10^{-8}$ ; atomic mass of Pb = 207u) is :

- A. 0.36 L
- B. 17.98 L
- C. 0.18 L
- D. 1.798 L

Answer ||| C



Solubility product ( $K_{sp}$ ) of  $PbCl_2 = 32 \times 10^{-9}$

$$K_{sp} = [Pb^{2+}] [Cl^{-}]^2$$

$$K_{sp} = (s)^1 (2s)^2$$

$$K_{sp} = 4s^3 = 32 \times 10^{-9}$$

$$s^3 = 8 \times 10^{-9}$$

$$s = 2 \times 10^{-3} \text{ mol/L}$$

So from here we can calculate volume of water

$$\text{Weight/ molecular weight} \times \text{volume (L)} = 2 \times 10^{-3}$$

$$\text{volume (L)} = \frac{0.1}{278 \times 2 \times 10^{-3}}$$

$$V = 0.18 \text{ L}$$

4. In which of the following reactions, an increase in the volume of the container will favor the formation of products?

- A.  $2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)$
- B.  $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$
- C.  $4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(l)$
- D.  $3O_2(g) \rightleftharpoons 2O_3(g)$

Answer ||| A

Solution ||| An increase in the volume of the container will decrease the partial pressure.

According to Le-Chatelier's principle, the reaction will proceed in such a way that it counteracts the change.

Thus, the reaction will try to increase the partial pressure. This will happen when the number of moles of

products (gaseous state) is produced more than that of reactant.

=>  $\Delta_{ng} > 0$  as  $\Delta_{ng} = \text{Number of moles of gases in Products} - \text{Number of moles of gases in reactants}$

Reaction	$\Delta_{ng}$	Effect of volume increase
$2\text{NO}_2(\text{g}) \rightleftharpoons 2\text{NO}(\text{g}) + \text{O}_2(\text{g})$	$\Delta_{ng} = 3 - 2 = 1$	Product formation would be favored
$\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$	$\Delta_{ng} = 2 - 2 = 0$	No Change in the reaction equilibrium
$4\text{NH}_3(\text{g}) + 5\text{O}_2(\text{g}) \rightleftharpoons 4\text{NO}(\text{g}) + 6\text{H}_2\text{O}(\text{l})$	$\Delta_{ng} = 4 - 9 = -5$	Reactant formation would be favored
$3\text{O}_2(\text{g}) \rightleftharpoons 2\text{O}_3(\text{g})$	$\Delta_{ng} = 2 - 3 = -1$	Reactant formation would be favored

Thus, the answer is  $2\text{NO}_2(\text{g}) \rightleftharpoons 2\text{NO}(\text{g}) + \text{O}_2(\text{g})$  as  $\Delta_{ng} > 0$

5. When an electric current is passed through acidified water, 112 mL of hydrogen gas at N.T.P. was collected at the cathode in 965 seconds. The current passed, in ampere, is :

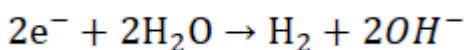
- A. 1.0
- B. 0.5
- C. 0.1
- D. 2.0

Answer ||| A

Solution ||| At NTP, weight of 22400 mL of  $\text{H}_2 = 2 \text{ g}$

$$\therefore \text{weight of 112 mL hydrogen at NTP} = \frac{2}{22400} \times 112 = 0.01 \text{ g}$$

Reaction at Cathode



$$2F = 1 \text{ mol}$$

i.e. 2 g hydrogen deposited by passing charge of  $2 \times 96500 \text{ C}$

$$\therefore 0.01 \text{ g of hydrogen will deposit by } 2 \times 96500 \text{ C} \times 0.01 \text{ g} / 2 \text{ g} = 965 \text{ C}$$

$\therefore$  the current passed in ampere can be calculated as follows:

$$Q = i \times t \rightarrow i = Q/t$$

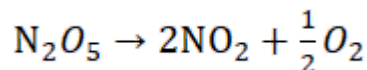
$$965 \text{ C} / 965 \text{ sec} = 1 \text{ A}$$

6.  $N_2O_5$  decomposes to  $NO_2$  and  $O_2$  and follows first order kinetics. After 50 minutes, the pressure inside the vessel increases from 50 mmHg to 87.5 mmHg. The pressure of the gaseous mixture after 100 minutes at constant temperature will be :

- A. 175.0 mmHg
- B. 116.25 mmHg
- C. 136.25 mmHg
- D. 106.25 mmHg

Answer ||| D

Solution |||



When t=0 minute	50	0	0
When t=50 minutes	$50-x_1$	$2x_1$	$x_1/2$
When t=100 minutes	$50-x_2$	$2x_2$	$x_2/2$

At t = 50 minutes, the total partial pressure is 87.5

Thus,  $50-x_1 + 2x_1 + x_1/2 = 87.5$

$$\Rightarrow 50 + 3x_1/2 = 87.5$$

$$\Rightarrow 3x_1/2 = 37.5$$

$$\Rightarrow x_1 = 25 \text{ mm of Hg}$$

50 minutes is the half-life time period for 100 minutes (2 half-life periods)

So  $x_2$  can be calculated as follows

$$50-x_2 = 12.5$$

$$\Rightarrow x_2 = 37.5$$

Total pressure at 100 minutes

$$= 50 - x_2 + 2x_2 + x_2/2$$

$$= 50 + 3/2 x_2$$

$$= 50 + 3/2 \times 37.5$$

$$= 50 + 56.25$$

$$= 106.25 \text{ mm of Hg}$$

7. For which of the following reactions,  $\Delta H$  is equal to  $\Delta U$  ?

- A.  $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
- B.  $2HI(g) \rightarrow H_2(g) + I_2(g)$
- C.  $2NO_2(g) \rightarrow N_2O_4(g)$
- D.  $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$

Answer ||| B

Solution ||| According to the thermodynamic relation

$\Delta H = \Delta U + \Delta n_g RT$ , where  $\Delta n_g = \text{products moles} - \text{reactants moles}$

For  $\Delta H = \Delta U$ ,  $\Delta n_g$  must be equal to 0

Reaction	$\Delta n_g$ Calculation
$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$	$\Delta n_g = 2 - 4 = -2$
$2HI(g) \rightarrow H_2(g) + I_2(g)$	$\Delta n_g = 2 - 2 = 0$
$2NO_2(g) \rightarrow N_2O_4(g)$	$\Delta n_g = 1 - 2 = -1$
$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$	$\Delta n_g = 2 - 3 = -1$

Hence answer is  $2HI(g) \rightarrow H_2(g) + I_2(g)$

8. Which of the following statements about colloids is False?

- A. Freezing point of colloidal solution is lower than true solution at same concentration of a solute.
- B. Colloidal particles can pass through ordinary filter paper.
- C. When silver nitrate solution is added to potassium iodide solution, a negatively charged colloidal solution is formed.
- D. When excess of electrolyte is added to colloidal solution, colloidal particle will be precipitated.

Answer ||| A

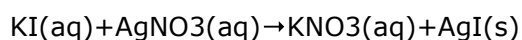
Solution ||| Colloidal Solution consists of colloidal particles which have the size larger than that of particles in true solution. Since the size is larger, thus the number of colloidal particles would be less than that of the number of particles in true solution

Thus, the value of colligative properties (osmotic pressure, lowering in vapour pressure, depression in freezing point, etc.) are of small order compared to the true solution of same concentration.

Thus, freezing point of a colloidal solution is always higher than the true solution at same concentration of a solute.

Colloidal particles can pass through ordinary filter paper because the pores of filter paper are larger than that of the colloidal solution.

When silver nitrate solution is added to potassium iodide solution, a negatively charged colloidal solution is formed.



When excess of electrolyte is added to colloidal solution, colloidal particle will be precipitated, this is because coagulation happens. When an electrolyte is added to the colloidal solution, opposite charges get

neutralize and thus coagulation happens.

9. Ejection of the photoelectron from metal in the photoelectric effect experiment can be stopped by applying 0.5 V when the radiation of 250 nm is used. The work function of the metal is :

- A. 4 eV
- B. 4.5 eV
- C. 5 eV
- D. 5.5 eV

Answer ||| B

Solution ||| Wavelength of radiation ( $\lambda$ ) = 250 nm or 2500 Å

Energy of radiation

$$E = hc/\lambda$$

$$\Rightarrow E = 12400/2500 = 4.96 \text{ eV}$$

Kinetic energy (K.E.) = stopping potential = 0.5 eV

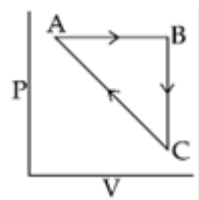
$$E = \text{work function } (W_0) + \text{K.E.}$$

$$W_0 = E - \text{Kinetic energy}$$

$$W_0 = 4.96 - 0.5$$

$$W_0 = 4.46 \approx 4.5 \text{ eV}$$

10. An ideal gas undergoes a cyclic process as shown in Figure.



$$\Delta U_{BC} = -5 \text{ kJ mol}^{-1}, q_{AB} = 2 \text{ kJ mol}^{-1}$$

$$W_{AB} = -5 \text{ kJ mol}^{-1}, W_{CA} = 3 \text{ kJ mol}^{-1}$$

Heat absorbed by the system during process CA is :

- A.  $-5 \text{ kJ mol}^{-1}$
- B.  $+5 \text{ kJ mol}^{-1}$
- C.  $18 \text{ kJ mol}^{-1}$
- D.  $-18 \text{ kJ mol}^{-1}$

Answer ||| B

Solution ||| In the above figure

A -to- B process is isobaric (constant pressure)

B -to- C process is isochoric (constant volume)

Given data-

$$\Delta U_{BC} = -5 \text{ kJ mol}^{-1}, q_{AB} = 2 \text{ kJ mol}^{-1}$$

$$W_{AB} = -5 \text{ kJ mol}^{-1}, W_{CA} = 3 \text{ kJ mol}^{-1}$$

So

$$\Delta U_{AB} = q + W$$

$$= 2 - 5 = -3 \text{ kJ mol}^{-1}$$

$$\Delta U_{ABC} = \Delta U_{AB} + \Delta U_{BC}$$

$$= -3 - 5 = -8 \text{ kJ mol}^{-1}$$

$$\Delta U_{CBA} = +8 \text{ kJ mol}^{-1}$$

$$= q + W$$

$$8 = q + 3$$

$$q = +5 \text{ kJ mol}^{-1}$$

11. For  $\text{Na}^+, \text{Mg}^{2+}, \text{F}^-$  and  $\text{O}^{2-}$ ; the correct order of increasing ionic radii is :

A.  $\text{O}^{2-} < \text{F}^- < \text{Na}^+ < \text{Mg}^{2+}$

B.  $\text{Na}^+ < \text{Mg}^{2+} < \text{F}^- < \text{O}^{2-}$

C.  $\text{Mg}^{2+} < \text{Na}^+ < \text{F}^- < \text{O}^{2-}$

D.  $\text{Mg}^{2+} < \text{O}^{2-} < \text{Na}^+ < \text{F}^-$

Answer ||| C

Solution ||| Higher the positive charge, smaller will be ionic radius because the force of attraction between the outer shell and the nucleus will increase.

And higher the negative charge, larger will be the ionic radius - in accordance with the above analogy. Hence, the correct increasing order is  $\text{Mg}^{2+} < \text{Na}^+ < \text{F}^- < \text{O}^{2-}$

12. In the molecular orbital diagram for the molecular ion,  $\text{N}_2^+$ , the number of electrons in the  $\sigma_{2p}$  molecular orbital is :

A. 0

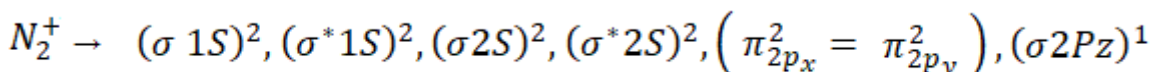
B. 1

C. 2

D. 3

Answer ||| B

Solution ||| Electrons in the molecular orbital energy level diagram can be filled like-



The number of electrons in  $(\sigma 2Pz)$  molecular orbital is 1.

13. Which of the following is a Lewis acid?

- A.  $\text{PH}_3$
- B.  $\text{B}(\text{CH}_3)_3$
- C.  $\text{NaH}$
- D.  $\text{NF}_3$

Answer ||| B

Solution ||| Lewis Acid accepts pairs of electrons whereas Lewis base donates pairs of electrons.

$\text{B}(\text{CH}_3)_3$  is a  $6 e^-$  species - which means that the central atom has an incomplete octet. It is an electron deficient molecule and thus can accept electrons. Hence, it is considered to be a Lewis Acid

In the case of  $\text{PH}_3$ , P has a lone pair and thus P can donate. Hence, it is considered to be Lewis base.

$\text{NaH}$ : Na can donate lone pair, thus acting as Lewis base.

$\text{NF}_3$  also has a lone pair thus it can donate lone pair. Hence it is also considered to be a Lewis base.

14. In graphite and diamond, the percentage of p-characters of the hybrid orbitals in hybridisation are respectively :

- A. 33 and 25
- B. 33 and 75
- C. 50 and 75
- D. 67 and 75

Answer ||| D

Solution ||| In graphite and diamond, the percentage of p-characters can be calculate as follows-

Graphite is  $sp^2$  hybridized So,

$$\% p = \frac{2}{3} \times 100 = 67\%$$

Diamond is  $sp^3$  hybridized So,

$$\% p = \frac{3}{4} \times 100 = 75\%$$

15. A white sodium salt dissolves readily in water to give a solution which is neutral to litmus. When silver nitrate solution is added to the aforementioned solution, a white precipitate is obtained which does not dissolve in dil. nitric acid. The anion is :

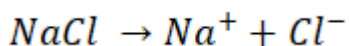
- A.  $\text{CO}_3^{2-}$
- B.  $\text{SO}_4^{2-}$



- C.  $\text{Cl}^-$
- D.  $\text{S}^{2-}$

Answer ||| C

Solution ||| When sodium salt ( $\text{NaCl}$ ) dissolves in water it gives a solution which is neutral to litmus.



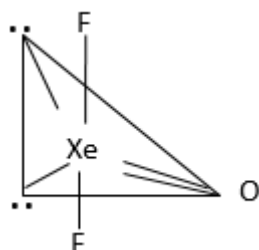
But when silver nitrate solution is added to the aforementioned solution, a white precipitate of  $\text{AgCl}$  is obtained which does not dissolve in dil. nitric acid. So the only anion is  $\text{Cl}^-$ .

16. Identify the pair in which the geometry of the species is T-shape and square pyramidal, respectively :

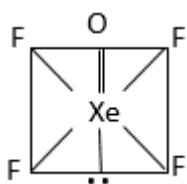
- A.  $\text{ClF}_3$  and  $\text{IO}_4^-$
- B.  $\text{ICl}_2$  and  $\text{ICl}_5$
- C.  $\text{XeOF}_2$  and  $\text{XeOF}_4$
- D.  $\text{IO}_3^-$  and  $\text{IO}_2\text{F}_2^-$

Answer ||| C

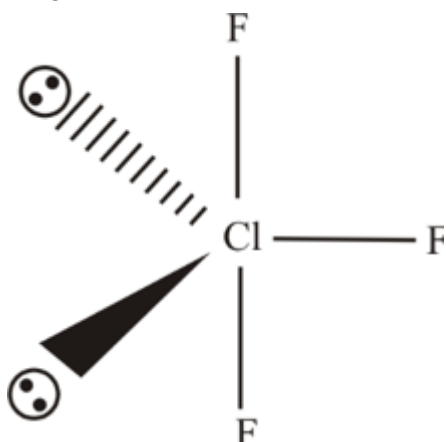
Solution ||| The geometry of the species  $\text{XeOF}_2$  is T-shape because we put more electronegative ligands (atoms) on axial position.



Square-pyramidal for  $\text{XeOF}_4$

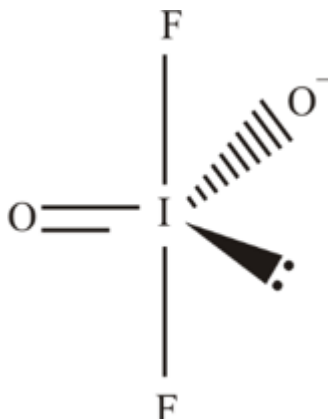


$\text{ClF}_3^-$  has T- shaped structure.



$\text{IO}_3^-$  has a pyramid-shaped structure.

$\text{IO}_2\text{F}_2^-$  has a see-saw structure.

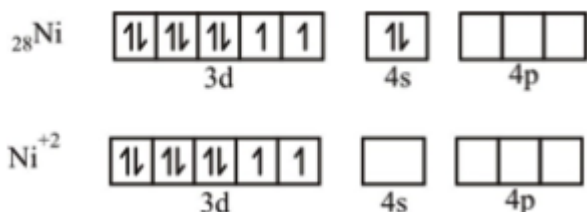


17. The correct combination is :

- A.  $[\text{Ni}(\text{CN})_4]^{2-}$ —tetrahedral ;  $[\text{Ni}(\text{CO})_4]$ —paramagnetic
- B.  $[\text{NiCl}_4]^{2-}$ —paramagnetic ;  $[\text{Ni}(\text{CO})_4]$ —tetrahedral
- C.  $[\text{NiCl}_4]^{2-}$ —square-planar ;  $[\text{Ni}(\text{CN})_4]^{2-}$ —paramagnetic
- D.  $[\text{NiCl}_4]^{2-}$ —diamagnetic ;  $[\text{Ni}(\text{CO})_4]$ —square-planar

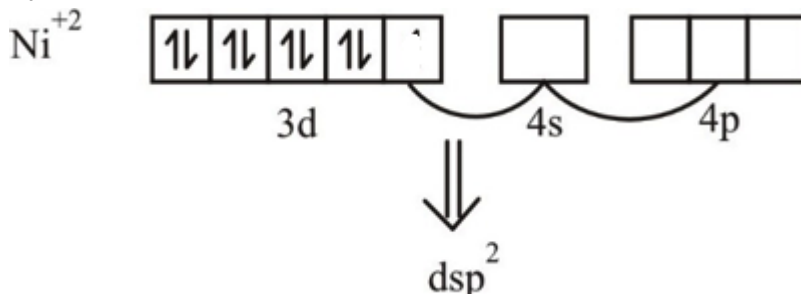
Answer ||| B

Solution ||| Ni has 28 atomic number, thus configuration is



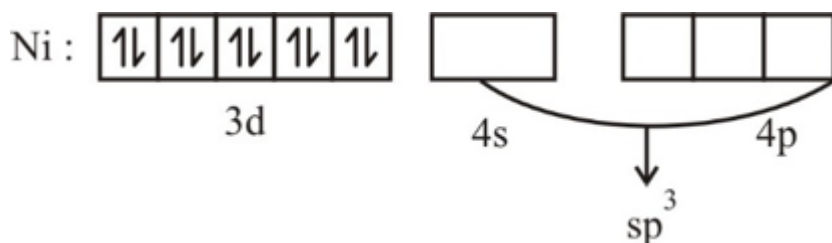
$[\text{Ni}(\text{CN})_4]^{2-}$  has  $\text{CN}^-$  as a strong field ligand.

Thus, the pairing will happen in 3d and one orbital from 3d, one from 4s and 2 from 4p will be available for hybridization.



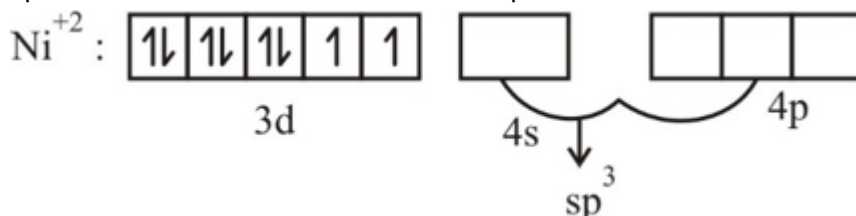
$\text{dsp}^2$  is square planar. And there are no unpaired electrons thus diamagnetic.

$[\text{Ni}(\text{CO})_4]$  has CO as a strong field ligand and Ni has 0 oxidation state.



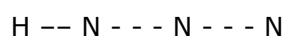
In case of  $[\text{NiCl}_4]^{2-}$   $\text{Cl}^-$  is weak field ligand

$sp^3$  is tetrahedral and there are no unpaired electrons thus diamagnetic.



$sp^3$  is tetrahedral and there are two unpaired electrons thus paramagnetic.

18.(I) (II)



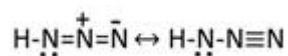
In hydrogen azide (above) the bond orders of bonds (I) and (II) are :

- A. (I) < 2, (II) > 2
- B. (I) > 2, (II) < 2
- C. (I) > 2, (II) > 2
- D. (I) < 2, (II) < 2

Answer ||| A

Solution ||| The bond order refers to the total number of chemical bonds between two atoms. It may or may not be an integer.

Hydrogen azide exists under resonance having the below two resonating structure (as shown below)

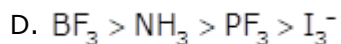
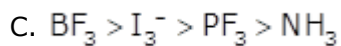


Now it can be easily seen that the total number of bonds in the second pair (of nitrogen) is always > 2, in both resonating structures.

In the case of the first pair (of nitrogen), the BO is less than 2.

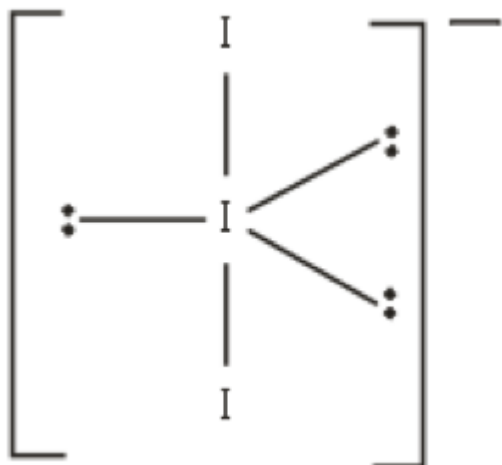
19. The decreasing order of bond angles in  $\text{BF}_3$ ,  $\text{NH}_3$ ,  $\text{PF}_3$  and  $\text{I}_3^-$  is :

- A.  $\text{I}_3^- > \text{NH}_3 > \text{PF}_3 > \text{BF}_3$
- B.  $\text{I}_3^- > \text{BF}_3 > \text{NH}_3 > \text{PF}_3$

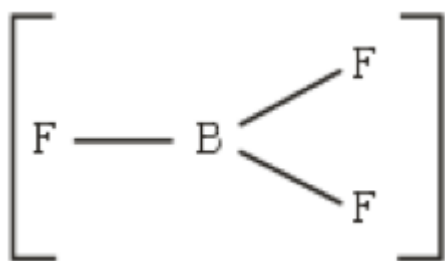


Answer ||| B

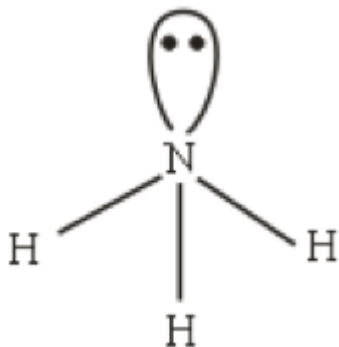
Solution |||  $\text{I}_3^-$  has linear geometry thus the angle is  $180^\circ$



$\text{BF}_3$  has trigonal planar geometry thus the angle is  $120^\circ$



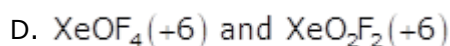
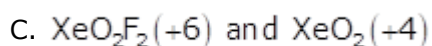
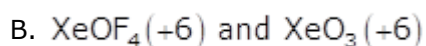
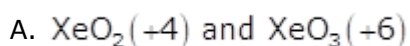
$\text{NH}_3$  has pyramidal geometry thus the angle is  $107^\circ$



$\text{PF}_3$  has pyramidal geometry. The angle  $\text{PF}_3 < \text{NH}_3$  due to presence of lone pair of electron on P atom

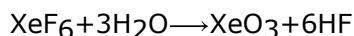
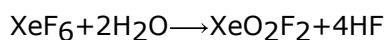
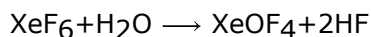
Hence, the correct order is  $\text{I}_3^- > \text{BF}_3 > \text{NH}_3 > \text{PF}_3$

20. Xenon hexafluoride on partial hydrolysis produces compounds 'X' and 'Y'. Compounds 'X' and 'Y' and the oxidation state of Xe are respectively :



Answer ||| D

Solution ||| The complete/ partial hydrolysis depends on the availability of water during hydrolysis. The reactions involved in the hydrolysis of  $\text{XeF}_6$  are:



The first two is partial hydrolysis and the last reaction is the complete hydrolysis.

Thus, Xenon hexafluoride on partial hydrolysis can produce  $\text{XeOF}_4$  and  $\text{XeO}_2\text{F}_2$  in both compounds the oxidation state is +6.

Oxygen ion has -2 charge and Fluorine has -1 charge.

**Oxidation state in the case of  $\text{XeOF}_4$  :**

Let Oxidation state be x,

$$\text{Thus, } x - 2 - 4 = 6$$

$$\Rightarrow x = + 6$$

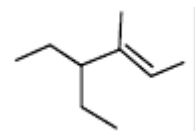
**Oxidation state in the case of  $\text{XeO}_2\text{F}_2$**

Let oxidation state be x,

$$\text{Thus, } x - 4 - 2 = 0$$

$$\Rightarrow x = 6$$

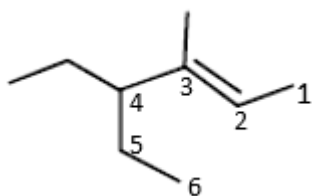
21. The IUPAC name of the following compound is :



- A. 4-methyl-3-ethylhex-4-ene
- B. 3-ethyl-4-methylhex-4-ene
- C. 4-ethyl-3-methylhex-2-ene
- D. 4, 4-diethyl-3-methylbut-2-ene

Answer ||| C

Solution ||| According to IUPAC nomenclature double bonds are given preference over single bonds. Hence, numbering starts from the carbon atom near to double bond



Once numbering done, the alphabetical order is followed for naming.

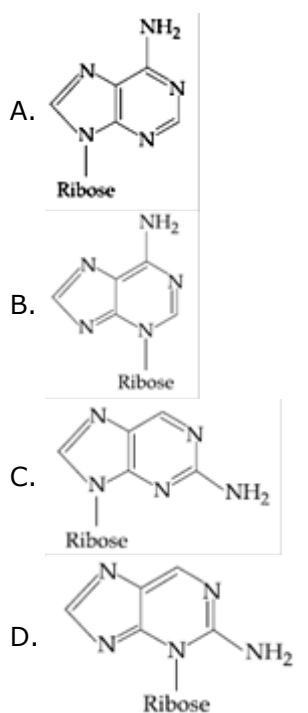
Ethyl comes first in alphabetical order which is at number 4. Thus 4 - ethyl

Next comes methyl which is at number 3. Thus 4- ethyl - 3 - methyl

The longest carbon chain has 6 carbon and double bond is at number 2. Thus hex-2-ene

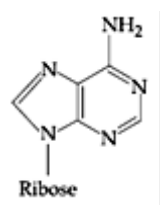
Hence overall IUPAC name is 4-ethyl-3-methyl hex-2-ene

22. Which of the following is the correct structure of Adenosine ?

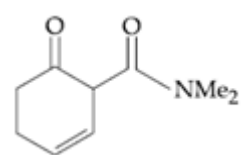


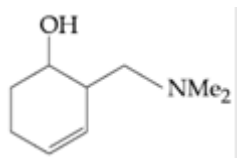
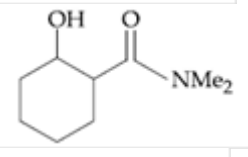
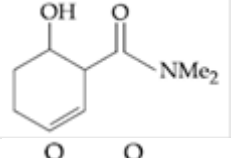
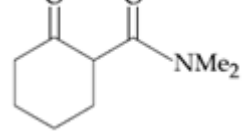
Answer ||| A

Solution ||| The correct structure of Adenosine



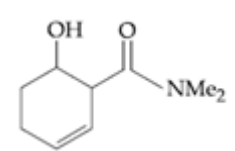
23. The main reduction product of the following compound with  $\text{NaBH}_4$  in methanol is :



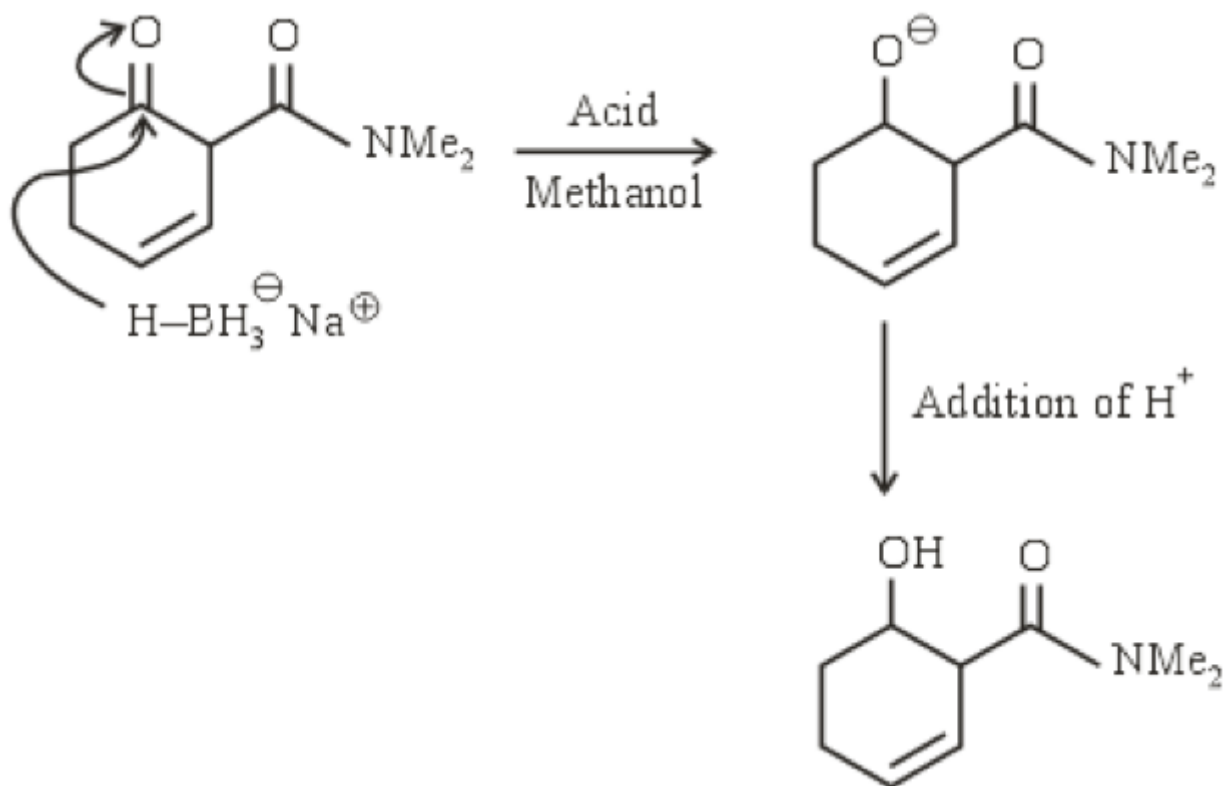
- A. 
- B. 
- C. 
- D. 

Answer ||| C

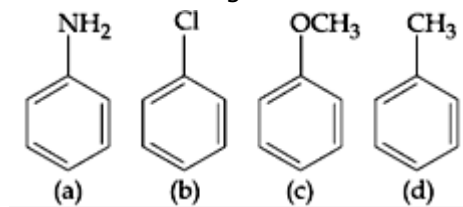
Solution ||| The main reduction product of the following compound with  $\text{NaBH}_4$  in methanol is



The reaction mechanism involved is:



24. The increasing order of nitration of the following compounds is :



- A. (b) < (a) < (c) < (d)
- B. (a) < (b) < (c) < (d)
- C. (b) < (a) < (d) < (c)
- D. (a) < (b) < (d) < (c)

Answer ||| D

Solution ||| Nitration is the addition of NO<sub>2</sub> to the compound.

The rate will depend on the availability of electron cloud on the compound.

More is the electron cloud, more will be the rate.

Thus, it can be said that the rate of the nitration is directly proportional to the Electron Donating Group in the compound.

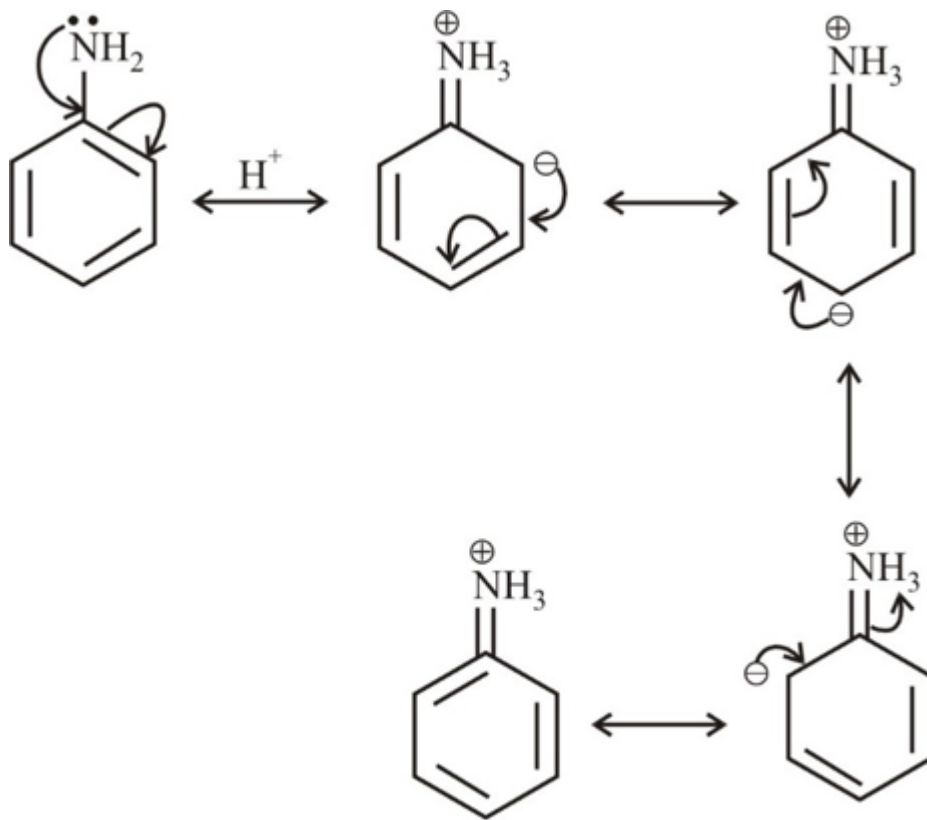
C will have the highest order because of the resonance effect. The resonance will increase the electron cloud on the ring and thus it will facilitate nitration.

In case of option d, hyperconjugation will increase the electron cloud. Hyperconjugation effect is less than that of resonance thus, this will come on 2nd with respect to nitration.

Third will be 'b', because of the inductive effect of Chlorine.

Option A will have the least reactivity because of the formation of anilinium ion in acidic medium. Anilium ion is formed as a result of resonance as shown below.





Anilinium

Once Anilium ion is formed, the electron cloud cannot be increased on the ring, thus nitration will be least.

Hence the order is (a) < (b) < (d) < (c)

25. The correct match between items of List-I and List-II is :

List - I

- (A) Coloured impurity
- (B) Mixture of o-nitrophenol and p-nitrophenol
- (C) Crude Naphtha
- (D) Mixture of glycerol and sugars reduced

List - II

- (P) Steam distillation
- (Q) Fractional distillation
- (R) Charcoal treatment
- (S) Distillation under pressure

- A. (A)-(R), (B)-(S), (C)-(P), (D)-(Q)
- B. (A)-(R), (B)-(P), (C)-(S), (D)-(Q)
- C. (A)-(R), (B)-(P), (C)-(Q), (D)-(S)
- D. (A)-(P), (B)-(S), (C)-(R), (D)-(Q)

Answer ||| C

Solution |||

Charcoal treatment removes coloured impurity by Chemical Adsorption

Activated charcoal when treated with oxygen, opens up millions of tiny pores between carbon atoms. This helps in Chemical adsorption and finally removal of coloured impurity.

Mixture of o-nitrophenol and p-nitrophenol can be separated by steam distillation

The o-nitrophenol has intra-molecular H-bonding thus it makes o-nitrophenol steam volatile. And, p-nitrophenol is not volatile. This change in the volatile property will help in separation using steam distillation

Crude Naphtha is a flammable liquid hydrocarbon mixture. It can be separated using fractional distillation as

Fractional distillation is based on the difference in boiling point

Mixture of glycerol and sugars reduced can be reduced by Distillation under pressure. Glycerol and sugars differ in boiling points, thus distillation under pressure can be used.

Thus, the correct match is

Colored impurity → Charcoal treatment

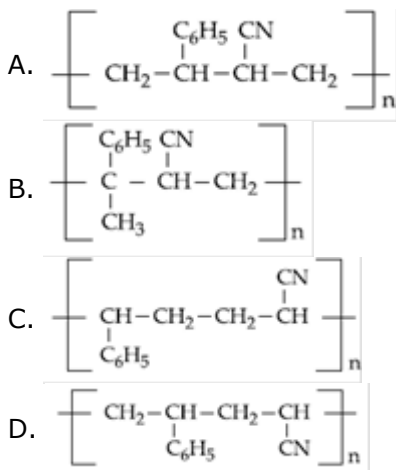
Mixture of o-nitrophenol and p-nitrophenol → Steam distillation

Crude Naphtha → Fractional distillation

Mixture of glycerol and sugars → Distillation under reduced pressure

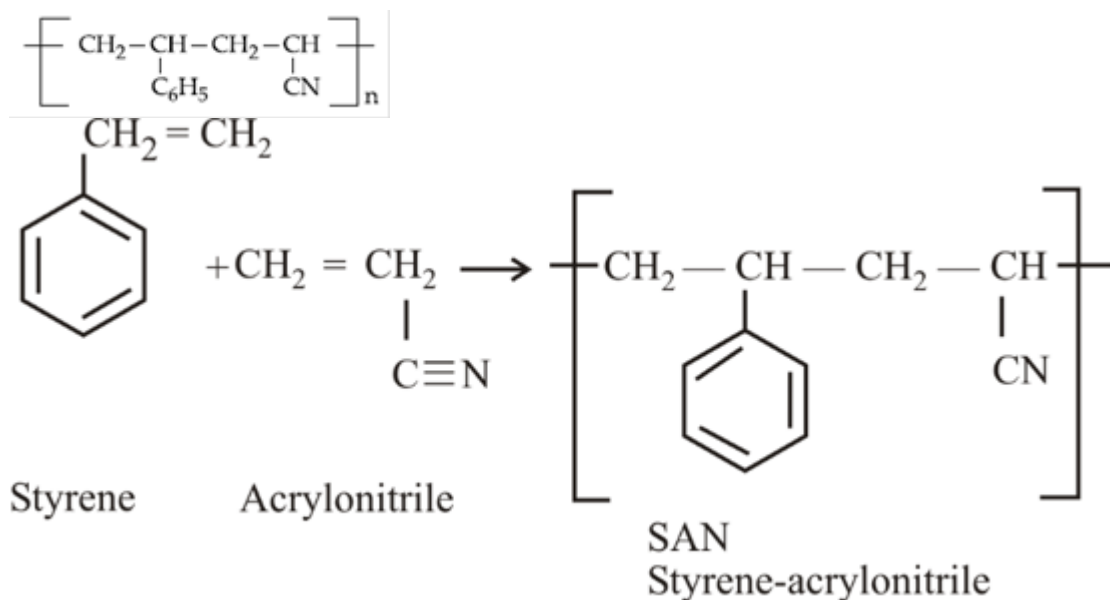
(A)-(R), (B)-(P), (C)-(Q), (D)-(S)

26. The copolymer formed by addition polymerization of styrene and acrylonitrile in the presence of peroxide is :

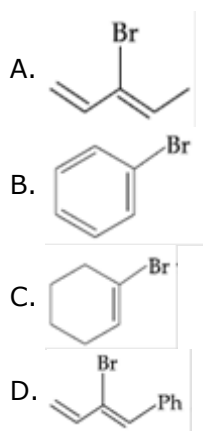


Answer ||| D

Solution ||| The copolymer formed by addition polymerization of styrene and acrylonitrile in the presence of peroxide is :



27. Which of the following will most readily give the dehydrohalogenation product?



Answer ||| D

Solution ||| De-hydro-halogenation proceeds by  $E_{1cb}$  mechanism.  $E_{1cb}$  mechanism involves the formation of an anion.

First, the base abstracts the most acidic proton

The removal of most acidic proton forms an anion.

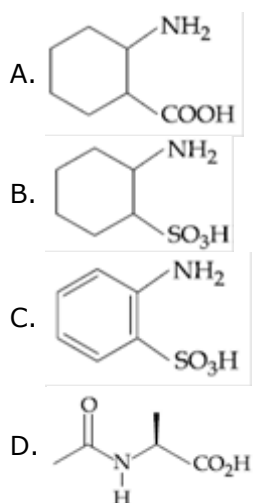
Thus, the more stable anion is formed, the more will be the rate of  $E_{1cb}$  thus dehydrohalogenation.

The stability of anion depends on the stability of the formed negative charge. If the negative charge is involved in resonance, it will be most stable.

The formation of anion and thus stability of anion should not break the already existing aromaticity of the compounds. If there is breakage of aromaticity due to the formation of anion, that process would not be favored.

will form the most stable carbanion and thus it will have maximum reactivity.

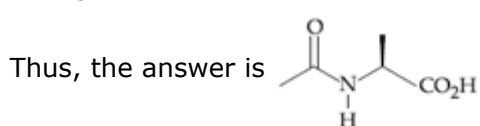
28. Which of the following will not exist in zwitter ionic form at pH=7 ?



Answer ||| D

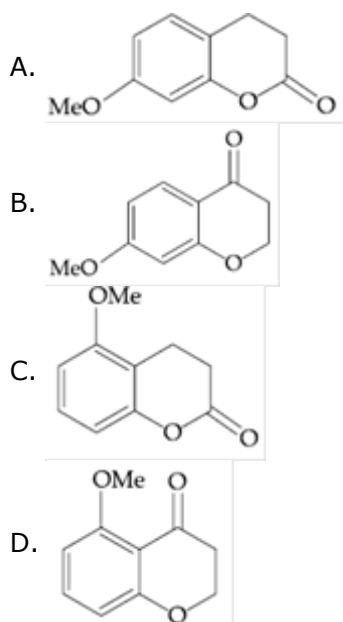
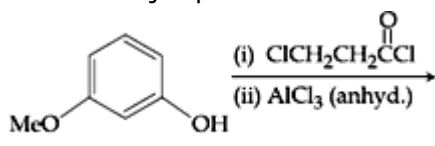
Solution ||| Zwitterion contains two or more functional groups. Out of these functional groups, one must have a positive charge and at least another must have a negative charge.

Nitrogen atom of amide is not basic so cannot exist as zwitter ionic form at neutral pH



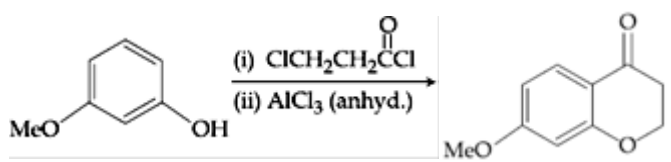
In all other cases, one functional can act as a negatively charged functional group and another as a positively charged functional group.

29. The major product of the following reaction is :

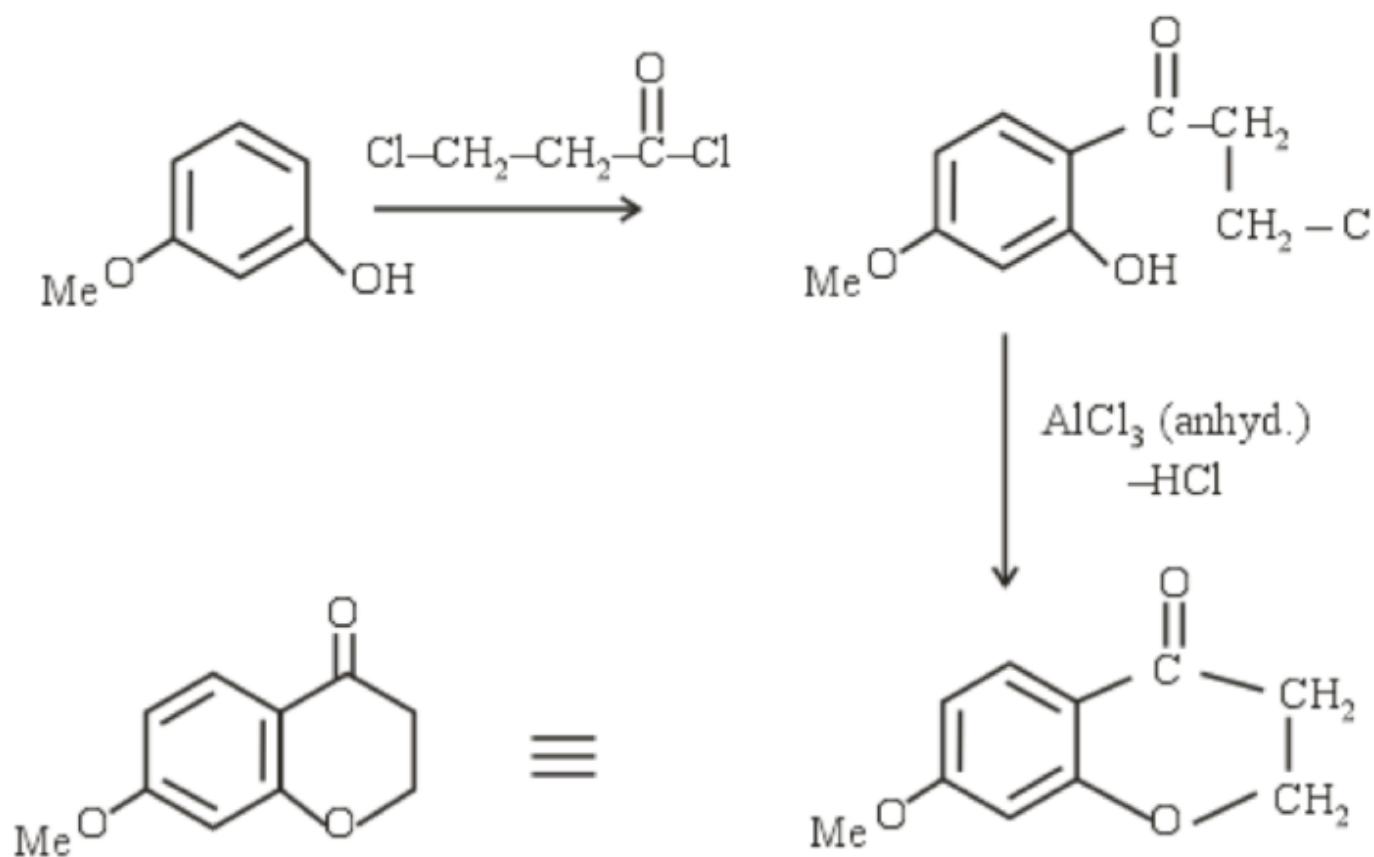


Answer ||| B

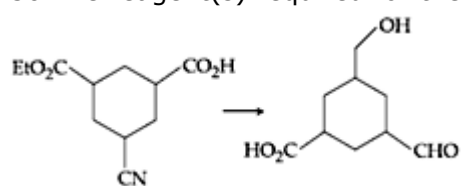
Solution ||| The reactant undergoes Friedel Craft acylation first followed by Intermolecular substitution.



The mechanism involved is as follows:



30. The reagent(s) required for the following conversion are :



- A. (i)  $\text{B}_2\text{H}_6$   
 (ii)  $\text{SnCl}_2 / \text{HCl}$   
 (iii)  $\text{H}_3\text{O}^+$
- B. (i)  $\text{B}_2\text{H}_6$   
 (ii)  $\text{H}_3\text{O}^+$

C. (i)  $B_2H_6$

(ii) DIBAL - H

(iii)  $H_3O^+$

D. (i)  $NaBH_4$

(ii) Raney Ni /  $H_2$

(iii)  $H_3O^+$

Answer ||| A

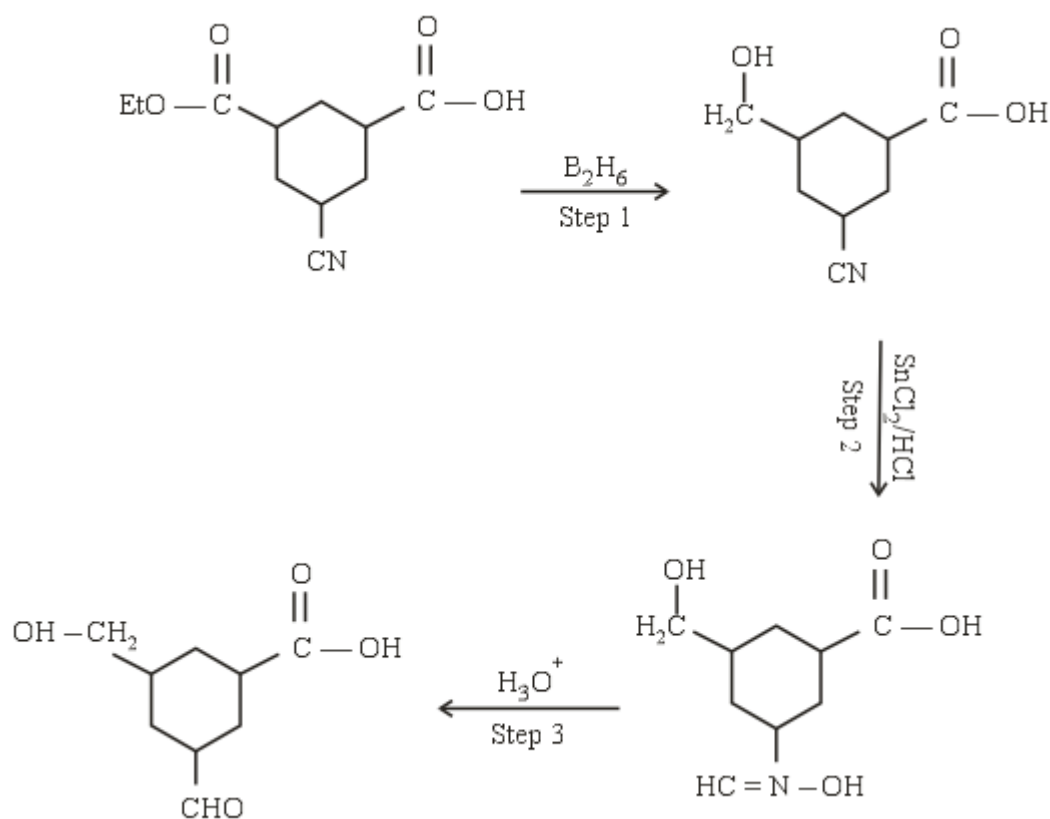
Solution ||| Multiple steps are involved in this reduction reaction.

Step 1:  $B_2H_6$  will reduce the  $-COOEt$  instead of  $-COOH$  because we have only one mole of  $B_2H_6$  and  $-OEt$  is a better leaving group than  $-OH$

Step 2:  $SnCl_2/HCl$  in presence of  $H^+$  will bring a partial reduction

Step 3: In the last step, hydrolysis will happen and the final product will be obtained.

The reaction mechanism is as follows;



Thus, reagents required for the conversion are (i)  $B_2H_6$  (ii)  $SnCl_2/HCl$  (iii)  $H_3O^+$