JEE Main 2021 August 26, Shift 2 (Chemistry)

Q. 1. After hydrolysis of PCl_5, how many non-ionisable hydrogen ions are present.

(A) 2

(B) 0

(C) 1

(D) 3

Answer: (B)

Sol: $PCl_5 \longrightarrow^{H_2O} POCl_3 \longrightarrow^{H_2O} H_3PO_4$

The final product will be H_3PO_4 because the oxidation state will remain unchanged in the above sequence of reactions. The final product (H_3PO_4) has 3 P-OH bonds and no P-H bond. The hydrogen atoms in O-H bonds are ionisable in Ortho phosphoric acid. The P-H bonds are non-ionisable. Hence, the number of non-ionisable bonds in H_3PO_4 is zero.

Q. 2. In which case a negatively charged colloidal solution is obtained.

(A) KI added to $AgNO_3$

(B) $AgNO_3$added toKI

(C) $FeCl_3$ is added to freshly precipitated $Fe(OH)_3$

(D) $Al_2O_3xH_2O$

Answer : (B)

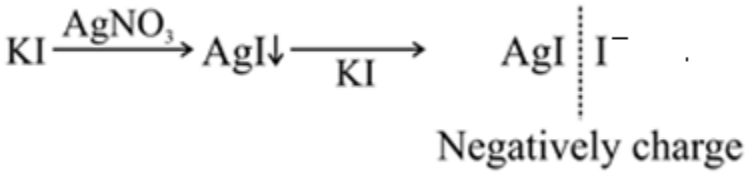
Sol: (A)When KI is added to $AgNO_3$

$$AgNO_3 \xrightarrow{KI} AgI\downarrow \xrightarrow[AgNO_3]{} AgI \mid Ag^+$$

Positively charge

Silver cation is adsorbed on the surface of AgI. Hence, this will result in formation of positively charged colloid.

(B) When $AgNO_3$ is added to KI



Iodine anion is adsorbed on the surface of AgI. Hence, this will result in formation of negatively charged colloid.

Options C and D will form positively charged colloids.

Q. 3. Bond order and magnetic nature of O_2^- is:

(A) 1.5, paramagnetic

(B) 2.0, diamagnetic

(C) 1.5, diamagnetic

(D) 2.5, paramagnetic

Answer: (A)

Sol: O_2^- (Total electron $= 17$){ $Bond\ order\ = 1.5, Paramagnetic$ }

$\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2Pz^2\ \ , \pi 2Px^2 = \pi 2P_y^1, \pi^* 2P_x^2 = \pi^* 2P_y^1, \sigma^* 2P_z^0$

No. of unpaired electron $= 1$

so it is paramagnetic

Bond order $= \frac{n_b - n_a}{2} = \frac{10-7}{2} = 1.5$

Q. 4. Which of the following complexes do not show geometrical isomerism.

(A) $[Pt(en)_2Cl_2]$

(B) $[Pt(NH_3)_4\ Cl_2]$

(C) $[Co(CN)_5H_2O]$

(D) $[Co(NH_3)_3(NO_2)_3]$

Answer: (C)

Sol: $[Co(CN)_5H_2O]$ does not show geometrical isomerism due to similar relative arrangement of ligands around the central atom. In $[Ma_5b]$type of complex, no geometrical isomerism is possible.

Q. 5. Statement-1: $BaCO_3$ is highly stable and insoluble in water.

Statement-2: Stability of carbonates increases with increase in cationic size.

(A) Statement$-$ 1 is true & Statement$-$ 2 is false

(B) Statement$-$ 1 is false & Statement$-$ 2 is true

(C) Both Statement$-$ 1 & Statement-2 are true

(D) Both Statement-1 & Statement-2 are false.

Answer: (C)

Sol: $BeCO_3 \quad MgCO_3 \quad CaCO_3 \quad SrCO_3 \quad BaCO_3 \longrightarrow$

(i) Stability of group-2 metal carbonates increases as we move down the group because large cations are stabilised by large cations and vice-versa. Carbonate being a larger cation is stabilised by larger cations.

(ii) Solubility in water decreases as we move down the group in case of group- 2 metal carbonates because of decrease in hydration energy of cations.

Q. 6. Identify the correct order of CFSE (crystal field splitting energy) of following compound

(i) $[Co(H_2O)_6]^{3+}$

(ii) $[CoF_6]^{3-}$

(iii) $[Co(en)_3]^{3+}$

(iv) $[Co(NH_3)_6]^{3+}$

(A) $(ii) < (i) < (iv) < (iii)$

(B) $(i) < (ii) < (iii) < (iv)$

(C) $(iv) < (iii) < (ii) < (i)$

(D) $(ii) < (i) < (iii) < (iv)$

Answer: (A)

Sol: CFSE depends on the strength of ligand. Stronger is ligand, greater will be splitting energy.

Order of Strength of ligand ⇒ $F^- < H_2O < NH_3 < en$

Q. 7. 100 ml solution of Na_3PO_4 contains 2.35 $gram$ of Na^+ion, then molarity of solution is $[X] \times 10^{-2}$, then x is ....."

Answer: 34

Solution: No. of mole of $Na^+ion = \frac{2.35}{23}$

So no. of mole of $Na_3PO_4 = \frac{2.35}{3\times23} = 0.034$

Molarity $= \frac{0.034}{100} \times 1000 = 0.34 = 34 \times 10^{-2}$

Q. 8. Statement−1: D_2O is used as a moderator in nuclear reactors and in exchange reactions for the study of reaction mechanisms.

Statement-2: Bond energy of $O - H$ is smaller than bond energy of $O - D$

(A) Statement $-$ 1 : is true & Statement $-$ 2 is false

(B) Statement $-$ 1 is false & Statement $-$ 2 is true

(C) Both Statement−1 & Statement−2 are true

(D) Both Statement $-$ 1 & Statement $-$ 2 are false

Answer: (C)

Solution: Statement−1: D_2O is used as a moderator in nuclear reactor and in exchange reactions for the study of reaction mechanisms

Statement−2 : Bond energy of $O - H <$ Bond energy of $O - D$. Deuterium forms a stronger bond as compared to hydrogen.

Q. 9. Identify the correct set of chalcogen family member

(A) S, Se, Te

(B) S, Se, Pm

(C) O, As, Bi

(D) Se, Te, Pm

Answer: (A)

Sol. Oxygen family is also called as chalcogen family O, S, Se, Te, Po are chalcogen family member

Q. 10. In London force interaction energy is proportional to r^x [where r is distance between two interacting

particles] then x is

(A) -6

(B) -3

(C) 3

(D) 6

Answer: (A)

Sol. In London force, interaction energy is inversely proportional to the sixth power of the distance between two interacting particles $\left(\frac{1}{r^6}\right)$

Q. 11. What is the cell potential for following cell

$Zn\ (s)|Zn^{2+}(0.04\ M)\ \|\ Cu^{2+}(0.02\ M)|Cu\ (s)$

Given $E^0\ Zn^{2+}|\ Zn = -0.76\ V$ & $E^0\ cu^{2+}|\ \ Cu = 0.34\ V$

[Report your answer to nearest integer]

Answer: 1

Sol. Cell reaction

$$\underset{0.02\ M}{Cu^{2+}(aq)} + Zn \rightleftharpoons Cu\ (s) + \underset{0.04\ M}{Zn^{2+}(aq)}$$

$E^0_{cell} = E^0_{Cu^{2+}|Cu} - E^0_{Zn^{2+}|Zn}$

$= 0.34 - (-0.75) = 1.1V$

$E_{cell} = E^0\ cell\ - \frac{0.059}{2} log\ \frac{[Zn^{2+}]}{[Cu^{2+}]}$

$= 1.1 - \frac{0.059}{2} log\ \left(\frac{0.04}{0.02}\right)$

$= 1.1 - 0.03 log\ 2 = 1.1 - 0.03 \times 0.30$

$= 1.0915 = 1.09V$

Q. 12. Statement-1: Sphalerite is ore of Zn while Galena is ore of Pb.

Statement-2: Two sulphide ore can be separated by using depressant and froth floatation processes.

(A) Statement$-$ 1 is true and Statement-2 is false

(B) Statement$-$ 1 is false and Statement$-$ 2 is true

(C) Both Statement-1 and Statement-2 are true

(D) Both Statement$-$ 1 and Statement-2 are false

Answer: (A)

Sol.

Sphalerite = ZnS

Galena = PbS

It is possible to separate two sulphide ores by adjusting the proportion of oil to water or by using ' depressants'. For example, in case of an ore containing ZnS and PbS, the depressant used is $NaCN$. It selectively prevents ZnS from coming to the froth but allows PbS to come with the froth.

Q. 13. 1 mole of He and 2 mole of CO_2 gas are taken in a container of volume $4 \times 10^{-3} m^3\ at\ 400K$ temperature, then pressure of gaseous mixture (in pascal)

$\left[Given\ R = 8.314 \frac{J}{K \times mole} \right]$

(A) 24.846×10^5

(B) 12.423×10^5

(C) 49.692×10^5

(D) 74.538×10^5

Answer: (A)

Sol. $n_{Total} = n_{H_e} + n_{CO_2} = 3$

$P_{Total} \times V_{Totals} = n_{Total} \times RT$

$P_{Total} = \frac{3 \times 0.082 \times 400}{4}$

$= 24.6\ atm$

$= 24.6 \times 1.01 \times 10^5\ pascal$

$= 24.846 \times 10^5\ pascal$

Q. 14. Which of the following is a strong oxidising agent.

(A) O_3

(B) H_2O_2

(C) SO_2

(D) $KMnO_4$

Answer: (*A*)

Sol.

Higher the reduction potential of a specie, higher will be its oxidising power.

$$E^0_{O_3/O_2} = 2.07V$$

$E^0_{H_2O_2/H_2O} = 1.78V$

$E^\circ_{MnO_4^-;/Mn^{2+}} = 1.51V$

Q. 15. For reaction $A + B \rightleftharpoons C + D, K_C = 100$ if equal concentration of A, B, C & $D = 1\ M$ is taken initially, then concentration of D at equilibrium is:

[Report your answer to the nearest integer].

Answer: 2

Sol.

	A	+	B	⇌	C	+	D	Kc = 100
Initially	1		1		1		1	
At. eq.	(1 - x)		(1 - x)		(1 + x)		(1 + x)	

$K_c = \left[\frac{1+x}{1-x}\right]^2 = 100$

$= \frac{1+x}{1-x} = 10$

$= 1 + x = 10 - 10x$

$11x = 9$

$x = \left[\frac{9}{11}\right]$

$[D] = \left[1 + \frac{9}{11}\right] = \left[\frac{20}{11}\right] = 1.8$

Q. 16. 83 $gram$ of ethylene glycol is added in 625 $gram$ of water, find ΔT_f of solution (Given $K_f(H_2O) = 1.86 \frac{K \cdot Kg}{Mole}$] (Report your answer nearest integer)

Answer: 4

Sol. $\Delta T_f = iK_f \times m$

For ethylene glycol, i=1

Molality,m= $\frac{Number\ of\ moles\ of\ solute}{Weight\ of\ solvent\ in\ kg}$

$\Delta T_f = 1 \times 1.86 \times \frac{83 \times 1000}{62 \times 625}$

$\Delta T_f = 3.98 \approx 4$

Q. 17. Formation constant of $[Cu(NH_3)]]^{2+}$ $is\ K_f = 4 \times 10^{11}$ them dissociation constant of $[Cu(NH_3)4]^{2+}$ is $Kdiss = [X] \times 10^{-13}$ then value of $X\ is\ '$ ……..

Answer: 25

Sol. $Cu^{2+} + 4NH_3 \rightleftharpoons [Cu(NH_3)_4]^{2+}$ $K_f = 4 \times 10^{11}$

$[Cu(NH_3)_4]^{2+} \rightleftharpoons Cu^{2+} + 4NH_3$ $K_{diss} = \frac{1}{K_f} = 25 \times 10^{-13}$

Thus, X = 25

Q. 18. Total number of isomers of 1,2 -Dimethyl cyclopropane?

(A) 2

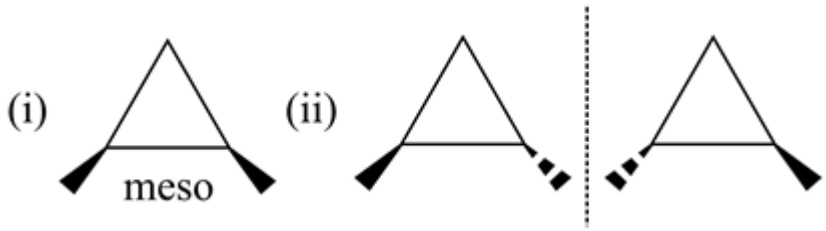
(B) 0

(C) 3

(D) 4

Answer: (C)

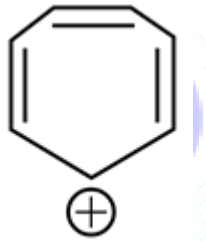
Sol.



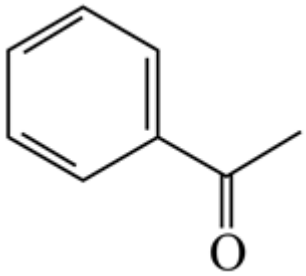
Meso is optically inactive whereas enantiomeric pairs are optically active. Therefore, total number of isomers are 3

Q. 19. Which of the following is not aromatic?

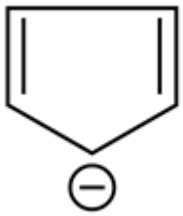
(A)



(B)



(C)



(D)

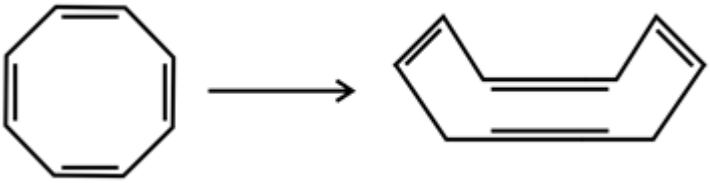
Answer: (D)

Compound given in option (A) is tropylium which is highly stable due to aromaticity.

Compound given in option (B) contains a benzene ring due to which the overall compound is aromatic.

Compound given in option (C) contains delocalised negative charge which is counted as two electrons. Total number of electrons in conjugation is equal to 6. Thus this compound is also aromatic.

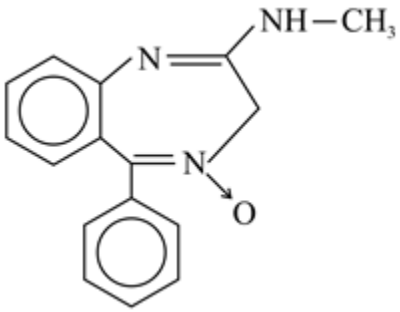
Compound given in option (D) exists as non-planar tub-shaped so it is non-aromatic.



.

It exists as non-planar tub-shaped so it is non aromatic.

Q. 20. Structure of "Chlordiazepoxide" is-



(A) Analgesic

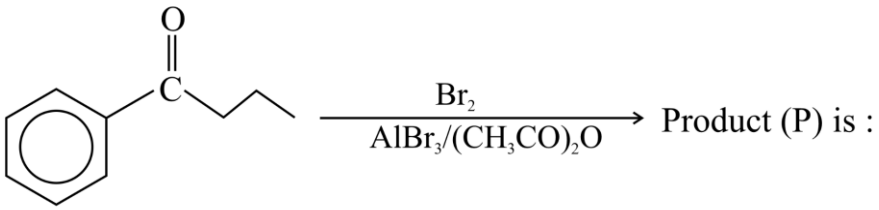
(B) Antibiotic

(C) Antacid

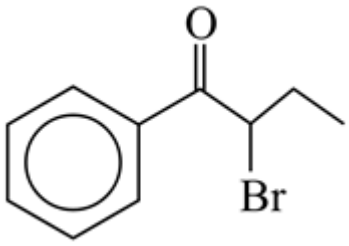
(D) Tranquiliser

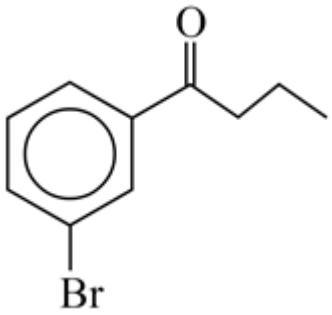
Answer: (D)

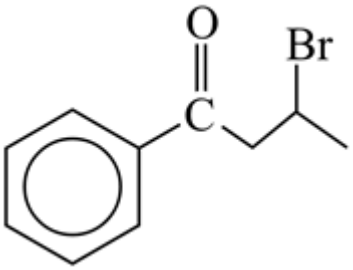
Sol.Chlordiazepoxide is used to treat the withdrawal symptoms of acute alcoholism, to treat preoperative anxiety, and to treat anxiety over a short term period. Thus, by definition it is a tranquiliser (substance used to reduce fear, tension, anxiety).

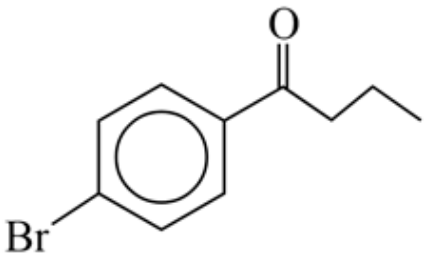
Q. 21. 

Product (P) is :

(A) 

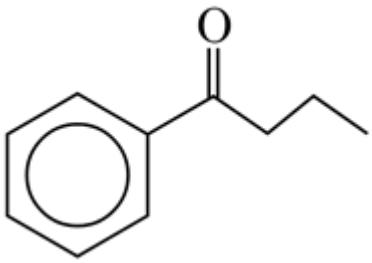
(B) 

(C) 

(D) 

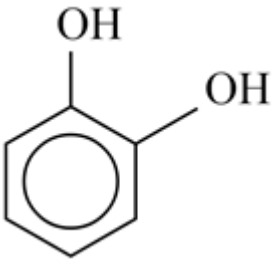
Answer: (B)

Sol: Bromine in the presence of aluminium bromide gives an electrophilic substitution reaction with benzene ring.

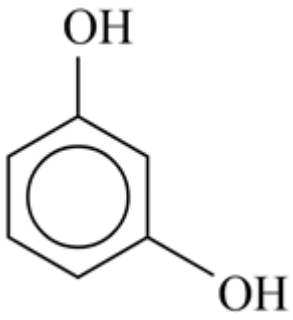
The given molecule 

contain a meta directing group. Hence, the electrophile bromine substituted at the meta position.

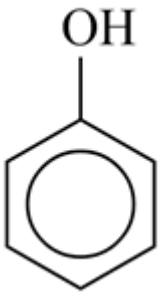
Q. 22. Which of the following phenol does not give colour with phthalic anhydride:

(A) 

(B)

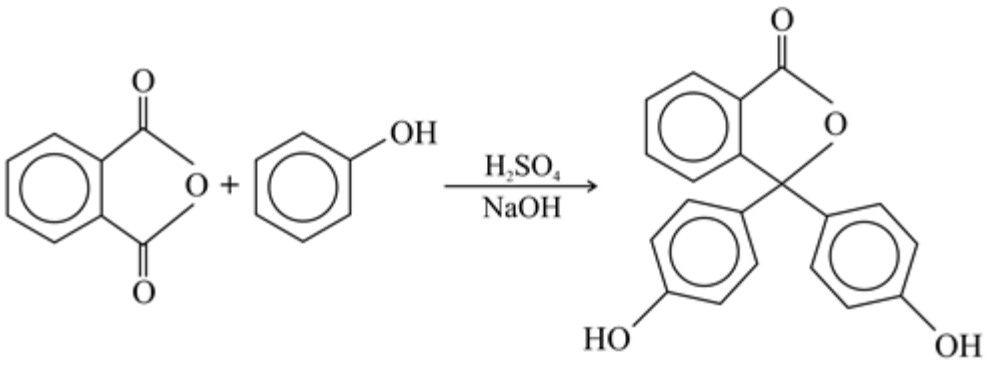


(C)



(D)

Answer: (B)



Pink colour
(derivative of phenolphthalein)

Sol.

In the electrophilic substitution reactions, phenol gives ortho and para substituted product, in which para is the major product.The electrophilic substitution reaction of phthalic anhydride with phenol taking place at para position of the phenol. All the given molecules have para positions free except in p-cresol. In p-cresol the para position is blocked by the methyl group, hence, it does not give the colour with phthalic anhydride.

Q. 23. Which statement is incorrect regarding photochemical smog.

(A) Photochemical smog occurs in warm, dry and sunny climates.

(B) The main component of photochemical smog results from the action of sunlight on unsaturated hydrocarbons.

(C) It has a high concentration of oxidising agents.

(D) It occurs by reaction of sunlight to saturated hydrocarbons.

Answer: (D)

Sol. Photochemical smog is composed of primary and secondary pollutants.

Primary pollutants, which include nitrogen oxides and volatile organic compounds, are introduced into the atmosphere via vehicular emissions and industrial processes.

Secondary pollutants, like ozone, result from the reaction of primary pollutants with ultraviolet light.

Photochemical smog is most common in sunny and dry cities, like Los Angeles.

Q. 24. Statement−1: Sucrose in non-reducing sugar.

Statement−2: Sucrose is formed by $\alpha - D$ Glucose and $\alpha - D$ Fructose

(A) Statement− 1 is True, Statement− 2 is True; Statement− 2 is a correct explanation for Statement−1.

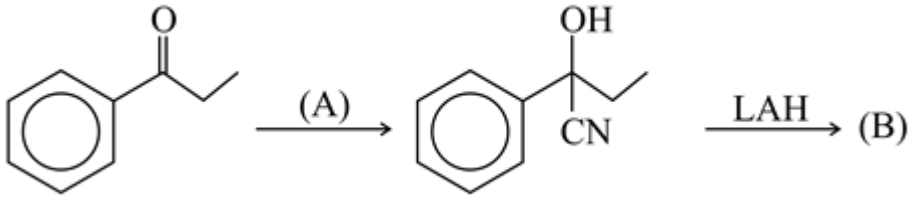
(B) Statement− 1 is False, Statement− 2 is True; Statement− 2 is NOT a correct explanation for Statement−1.

(C) Statement −1 is True, Statement − 2 is False.

(D) Statement −1 is False, Statement − 2 is False.

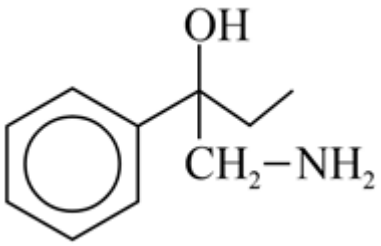
Answer. (C)

Sol. Sucrose is formed by $\alpha - D$ Glucose and $\beta - D$ Fructose. The glycosidic bond in sucrose is formed between the reducing ends of both glucose and fructose. This linkage inhibits further bonding to other saccharide units, and prevents sucrose from spontaneously reacting with cellular and circulatory macromolecules in the manner that glucose and other reducing sugars do. Since sucrose contains no anomeric hydroxyl groups, it is classified as a non-reducing sugar.

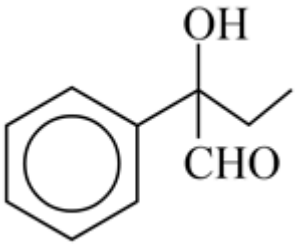


Q. 25.

Identify (A) and (B) respectively.

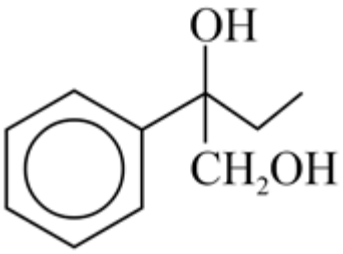


(A) $KCN/H_3O^{\oplus}$

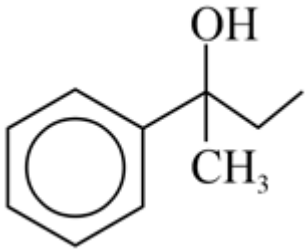


(B) $NaCN/H_2O$

(C) HCN,

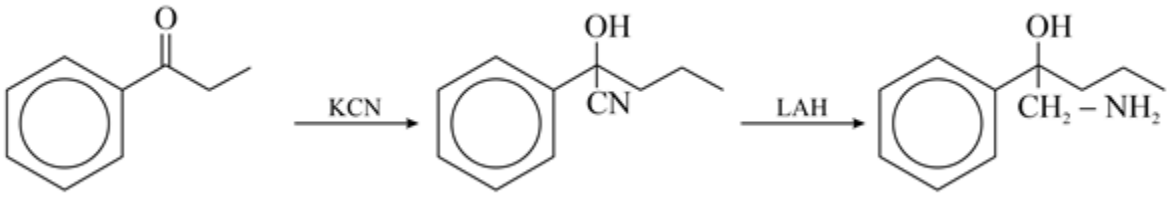


(D) $KCN/H_3O^{\oplus}$,

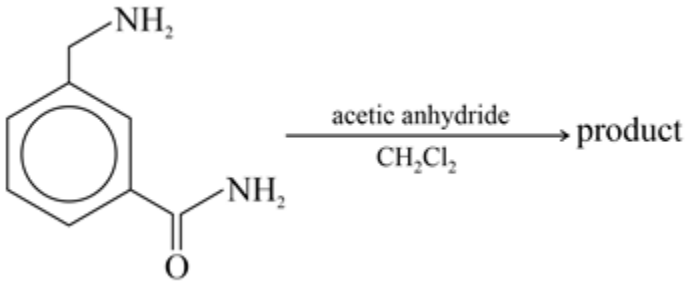


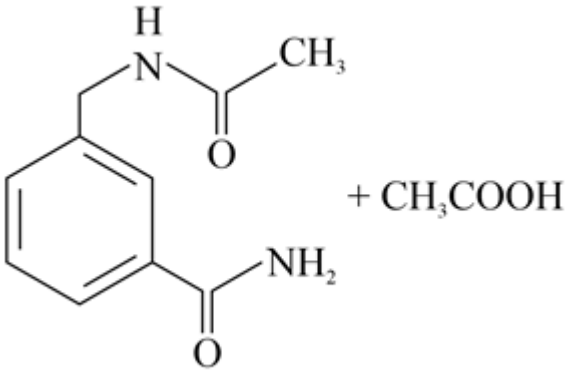
Answer: (A)

Sol.

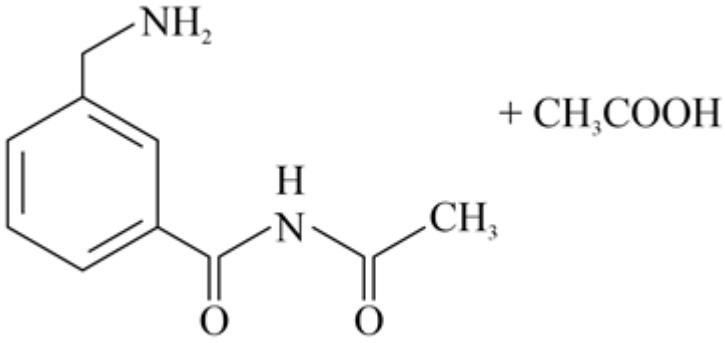


Q. 26. In the reaction shown below, the major product formed is:

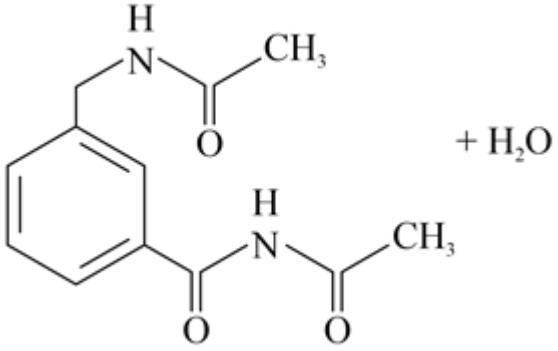



H
N
CH3
O
+ CH3COOH
NH2
O

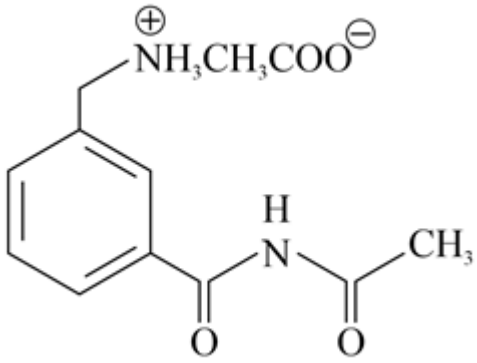
(A)


NH2
+ CH3COOH
H
N
CH3
O
O

(B)


H
N
CH3
O
+ H2O
H
N
CH3
O
O

(C)

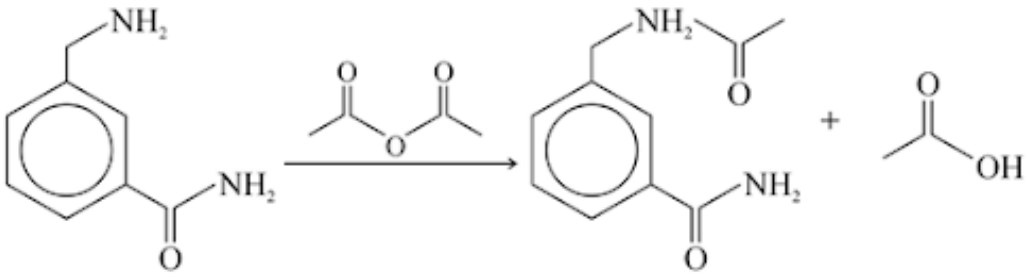


(D)

Answer: (A)

Solution:

The resulting amide will fail to react further. Had it been possible, imied formation would have occurred at both the sites.



since $-CH_2-NH_2$ is more basic.