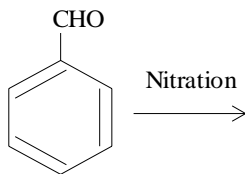


65. The nitration of benzaldehyde will yield which of the following?



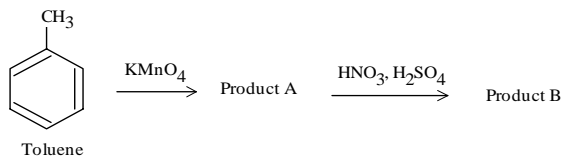
Benzaldehyde

- o-Nitrobenzaldehyde
- p-Nitrobenzaldehyde
- m-Nitrobenzaldehyde
- o-Nitrobenzaldehyde and p-Nitrobenzaldehyde

66. Which of the following should be used as starting material to get p-Bromonitrobenzene as the final product?

- Nitrobenzene
- Bromobenzene
- Cyclohexane
- m-Bromonitrobenzene

67. What would be the product A and Product B of the following reaction?



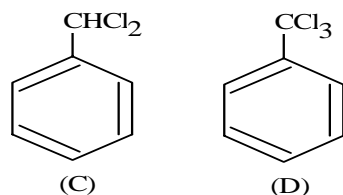
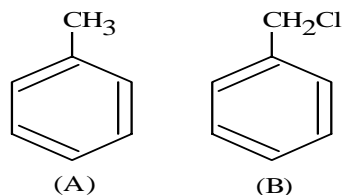
- Benzaldehyde, o-Nitrobenzoic acid
- Acetophenone, o-Nitrobenzaldehyde
- Benzoic acid, m-Nitrobenzoic acid
- Benzaldehyde, m-Nitrobenzoic acid

68. A nitration of toluene would yield which of the following?

- m-Nitrotoluene
- o-Nitrotoluene
- p-Nitrotoluene

- I only
- I and II only
- II and III only
- All

69. Please arrange the following compounds in order reducing the reactivity of the benzene ring. (Most activating molecule first, least activating molecule last).



- D > B > C > A
- A > B > C > D
- B > A > D > C
- C > D > A > B

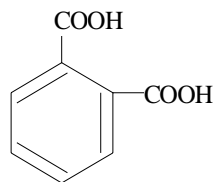
70. All of the following are electron-releasing groups EXCEPT:

- NH₂
- OCH₃
- CN
- NHCOCH₃

71. Which of the following compounds has the most reactivity?

- Toluene
- Ethylbenzene
- n-Propylbenzene
- Isobutylbenzene

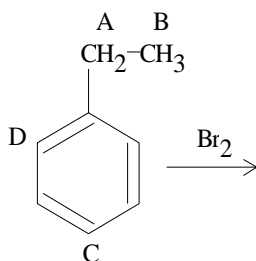
72. An unknown aromatic compound with formula (C_8H_{10}) yields phthalic acid upon oxidation in the presence of hot $KMnO_4$. What would be the name of the unknown compound?



Phthalic acid

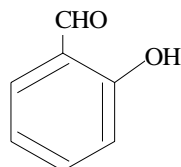
- Ethylbenzene
- o-Xylene
- o-Chlorotoluene
- 1-Ethyl-2-methylbenzene

73. The bromination of the following compound yields bromo-phenylethane derivative. The most active hydrogen where the bromination will take place should be:



- A
- B
- C
- D

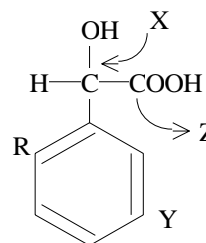
74. What is the other name of the following compound?



o-Hydroxybenzaldehyde

- Propanal
- Benzaldehyde
- Salicylaldehyde
- Phenylacetaldehyde

75. Which of the following is a chiral carbon in mandelic acid?



Mandelic acid

- R
- Z
- X
- Y

76. Which of the following tests is used to differentiate acetaldehyde from acetophenone?

- Clemmensen reduction
- Wolff-Kishner reduction
- Tollens' reaction
- Cyanohydrin formation

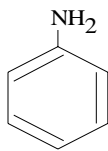
77. An Iodoform test is used to identify whether or not a ketone is a methyl ketone. The test is considered positive if yellow crystals of iodoform form. Which of the following compounds is the responsible for causing these yellow precipitates?

- CH_3COONa
- $NaOH$
- CHI_3
- CH_3COCl_3

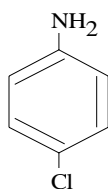
78. Which of the following would be the strongest acid?

- CH_3COOH
- $HCOOH$
- Cl_3CCOOH
- $BrCH_2COOH$

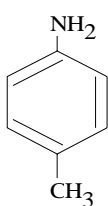
79. Arrange the basicity of the following compounds in decreasing order. (Most basic first, least basic last).



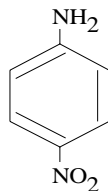
A (Aniline)



B (p-Chloroaniline)



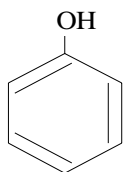
(C) p-Toluidine



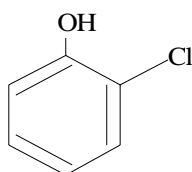
(D) p-Nitroaniline

- $C > A > B > D$
- $D > B > C > A$
- $B > D > A > C$
- $A > B > C > D$

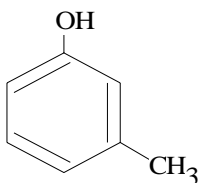
80. Which of the following phenols should be the most acidic in nature?



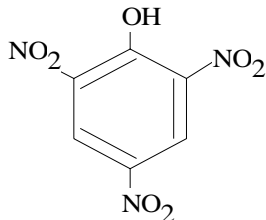
(X) Phenol



(Y) o-Chlorophenol



(Z) m-Cresol



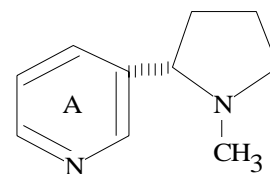
(Q) Picric acid

- Phenol
- o-Chlorophenol
- m-Cresol
- Picric acid

81. Ortho-nitrophenol has a much lower boiling point and much lower solubility in water than its para and meta isomers. Which of the following bondings may be responsible for this?

- Intermolecular hydrogen bonding
- Hydrogen bonding
- Intramolecular hydrogen bonding
- Van der Waals force

82. What is the name of the aromatic heterocycle compound denoted by "A" in the following structure?



Nicotine

- Pyrrole
- Pyrrolidine
- Furan
- Pyridine

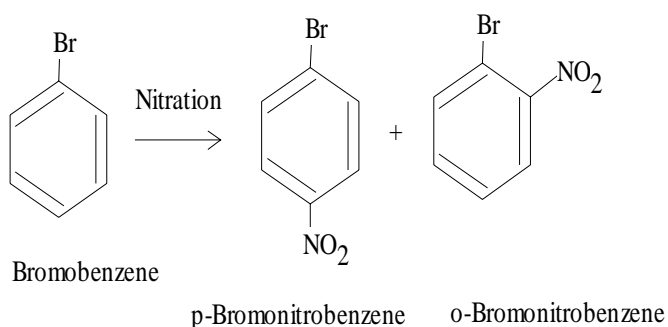
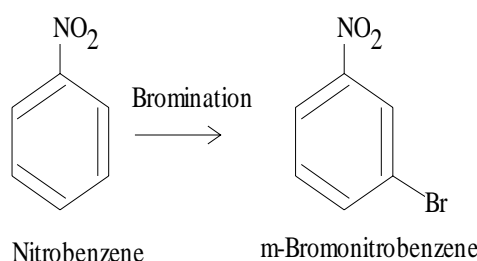
83. Which of the following functional groups of Cetirizine is responsible for its non-sedative effect?

- Chlorobenzene
- Ether
- Piperazine
- Carboxylic acid

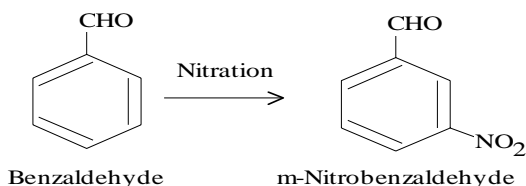
ANSWERS

with the group that directs ortho para directing. For example, bromine attached to benzene in bromobenzene is an ortho para directing group. Therefore, the nitration of bromobenzene would give us p-Bromonitrobenzene and o-Bromonitrobenzene as final products.

This would not be possible if we start the reaction with nitrobenzene since the $-\text{NO}_2$ group of nitrobenzene is a meta director group, which upon bromination will yield m-Nitrobenzene as the final product.

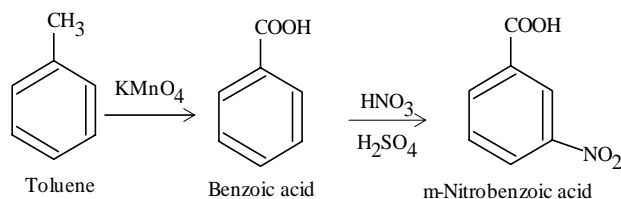


65. (c) As we know, the $-\text{CHO}$ group is a meta directing group. Therefore, the final product of the nitration would be m-Nitrobenzaldehyde.

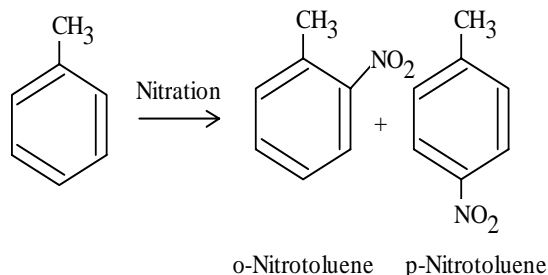


66. (b) In this question, we want to find out the starting material of the reaction that can give us p-Bromonitrobenzene as the final product. Since we like to get para derivative, we should start

67. (c) As we know, the oxidation of Toluene in presence of KMnO_4 will yield benzoic acid. Since the $-\text{COOH}$ group is a meta director, the nitration of benzoic acid will yield m-nitrobenzoic acid. Therefore, the correct choice should be "C."

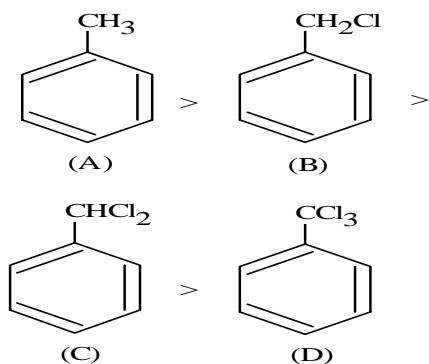


68. (c) II and III only. Since the $-\text{CH}_3$ group of toluene is an ortho, para directing group; a nitration of toluene would yield o-nitrotoluene and p-nitrotoluene as major products.



69. (b) To answer this type of question, one should apply the basic knowledge of organic chemistry. The electron donating group and electron withdrawing group play major roles determining the reactivity of the ring. In the above question, one must know that the $-\text{CH}_3$ group of toluene is an electron releasing group. The electron releasing group provides more electron to the ring, which in turn increases the reactivity of the ring. Therefore, nitration of toluene is 25 times faster than benzene.

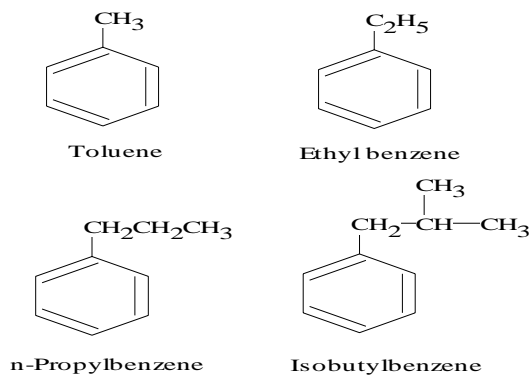
As we replace each hydrogen for a chlorine atom from $-\text{CH}_3$ group, we increase the electron withdrawing power of the group. Due to this electron withdrawing power of subsequent groups, the ring reacts slowly for each replacement of hydrogen with chlorine. Therefore, the $-\text{CCl}_3$ group is a strongly deactivating group compared to $-\text{CH}_3$. Thus one can predict the reactivity of the benzene ring in the following order:



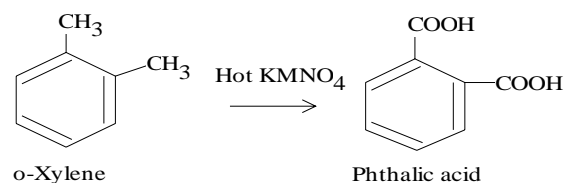
70. (c) One should memorize the list of electron releasing groups and electron-withdrawing groups.

<u>Electron releasing groups</u>	<u>Electron withdrawing groups</u>
$-\text{NH}_2$	$-\text{N}(\text{CH}_3)_3^+$
$-\text{OH}$	$-\text{NO}_2$
$-\text{OCH}_3$	$-\text{CN}$
$-\text{NHCOCH}_3$	$-\text{COOH}$
$-\text{C}_6\text{H}_5$	$-\text{CHO}$
$-\text{CH}_3$	$-\text{COR}$
	$-\text{X}$ (halogens)

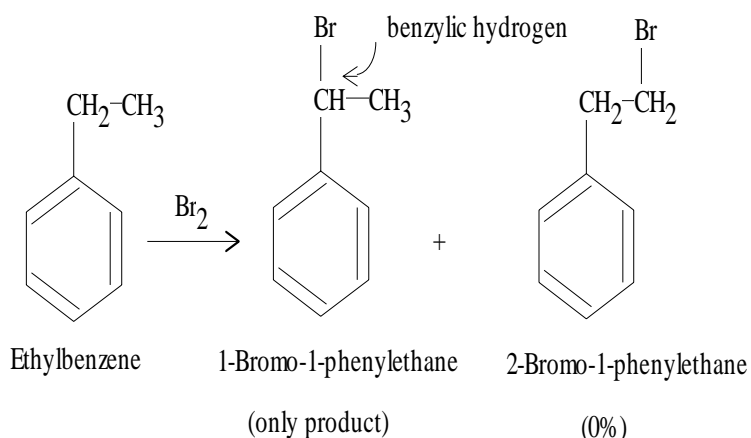
71. (d) As we learned previously, the compound with the group that has the most electron donating power will activate the ring the most. If we carefully examine each attached group in given choices, we could tell that the isobutyl group would have the most electron-donating power among the given choices. Therefore, the correct answer should be "D."



72. (b) Since the molecular formula indicates C_8H_{10} , the compound should be o-Xylene. This fact is also supported by the formation of Phthalic acid upon oxidation of unknown compound in the presence of hot KMnO_4 .

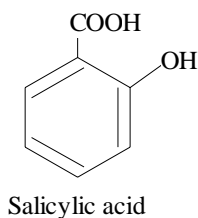


73. (a) The bromination of side chain of alkylbenzene should theoretically yield a mixture of two different products: 1-Bromo-1-phenylethane and 2-Bromo-1-phenylethane. However, interestingly it only yields 1-Bromo-1-phenylethane. This indicates that the benzylic hydrogen (hydrogen atoms attached to carbon joined directly to an aromatic ring) is greatly preferred for substitution over any other hydrogen present.



Therefore, the correct answer should be 'a'.

74. (c) The other name of ortho-Hydroxybenzaldehyde is Salicylaldehyde. If we replace the -CHO group with the -COOH group, we will get the anti-inflammatory agent known as Salicylic acid, a metabolite of the well-known drug Aspirin or Acetylsalicylic acid.

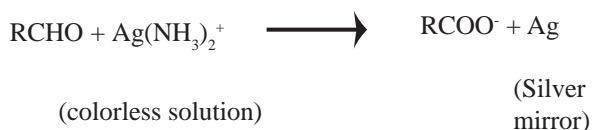


75. (c) As we stated previously, a chiral carbon is one that has four different "groups" attached to it. These groups can be anything from a single hydrogen to functional groups to one or more

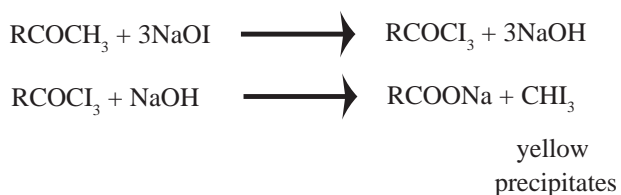
other carbons. In the above example the carbon denoted by 'X' fulfills the requirement of chiral carbon definition. Therefore, the correct choice should be "C."

76. (c) Tollens' reagent contains the silver ammonia ion, $\text{Ag}(\text{NH}_3)_2^+$. Oxidation of the aldehyde is accompanied by reduction of silver ion to free silver (in the form of a mirror). Tollens' reagent can be used to ascertain whether the compound is a ketone or an aldehyde.

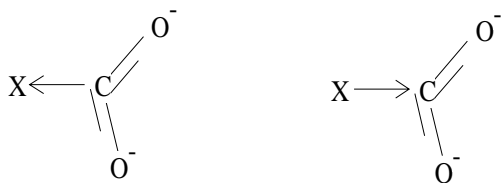
When adding the aldehyde or ketone to Tollens' reagent, put the test tube in a warm water bath. If the reactant under test is an aldehyde, Tollens' test results in a silver mirror. If the reactant is a ketone, it will not react because a ketone cannot be oxidized easily. A ketone has no available hydrogen atom on the carbonyl carbon that can be oxidized, unlike an aldehyde, which has this hydrogen atom.



77. (c) Whether or not a ketone is a methyl ketone is shown by the iodoform test. The ketone is treated with iodine and sodium hydroxide; a positive reaction gives iodoform. Iodoform (CHI_3) is a pale yellow substance. Due to its high molar mass due to the three iodine atoms, it is solid at room temperature. A visible precipitate of this compound will form from a sample only when a methyl ketone is present.



78. (c) To answer this type of question, one must know the basis of organic chemistry.



X withdraws electrons:
stabilizes anion

X releases electrons:
destabilizes anion

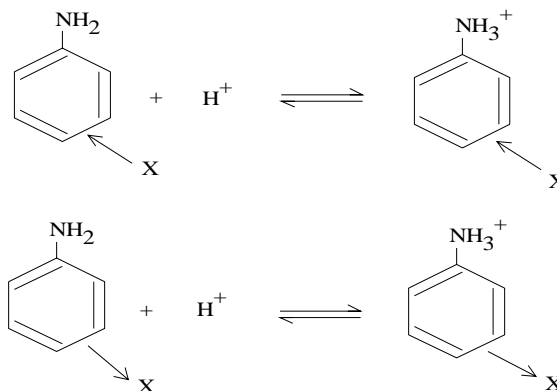
If you examine the above figure, we can tell that group (X) that stabilizes anion (oxygen of carboxylate ions) by withdrawing excess electrons from carboxylate ions generally leads to a stronger acid. As we learned previously, the acidity of a compound depends upon how easily the compound gives away its hydrogen. The same concept can be applied here. X withdraws excessive electrons from carboxylate ions to make them electron deficient. In order to make up for these electrons, oxygen pulls electrons from hydrogen of carboxyl groups. This may result in electron deficit or positively charged H^+ , which can be easily separated from the carboxyl group. More H^+ in the solution leads to strong acid.

The opposite is also true. The group (X) that destabilizes anions by supplying extra electrons to carboxylate ions may result in a weak acid. If we examine the given choices, we can see the following groups attached to the carboxyl group. For example, in CH_3COOH it is $-CH_3$; in $HCOOH$ it would be H ; in Cl_3CCOOH it should be $-Cl_3$ and in $BrCH_2COOH$ it would be $-BrCH_2$. In order to determine acidity of these compounds, we need to separate it out into electron-donating and electron-withdrawing groups.

The $-CH_3$ group of acetic acid is an electron donating group, H of formic acid is electron donating group (less donating power compared to $-CH_3$ of acetic acid), $-BrCH_2$ and $-Cl_3$ have powerful electron withdrawing group, bromine and chlorine. Therefore, the acidity of these compounds can be predicted in the following manner:



79. (a) Basicity of aromatic amines can be determined by understanding this basic concept.



The basicity of aromatic amines affected by substituents on the ring. Electron-releasing substituents increase the basicity of amine by providing enough electrons to stabilize the positive charge of NH_3^+ . This will discourage the hydrogen ion of NH_3 to leave and impart acidity to the solution. Therefore, electron-releasing substituents on the ring always increase the basicity of aniline.

Electrons releasing Substituents	Electrons withdrawing Substituents
$-NH_3$	$-NH_3^+$
$-OCH_3$	$-NO_2$
$-CH_3$	$-SO_3$
	$-COOH$
	-Halogens

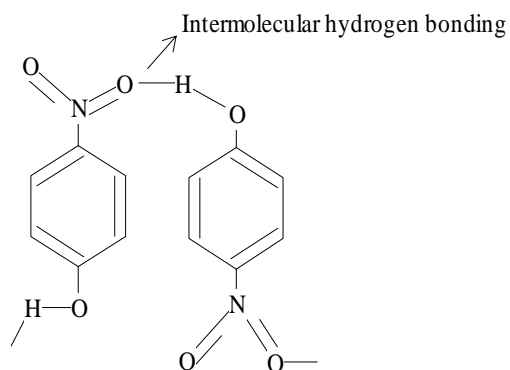
The opposite is also true. Electron-withdrawing substituents withdraw electrons and destabilize the positive charge of NH_3^+ even more. This will encourage electron deficit hydrogen ion of $-NH_3$ to leave and impart the acidity to the solution. Therefore, electron withdrawing substituents reduce the basicity of aniline.

Thus, p-toluidine should be the most basic ($-CH_3$ group is an electron donating group) followed by aniline followed by p-chloroaniline

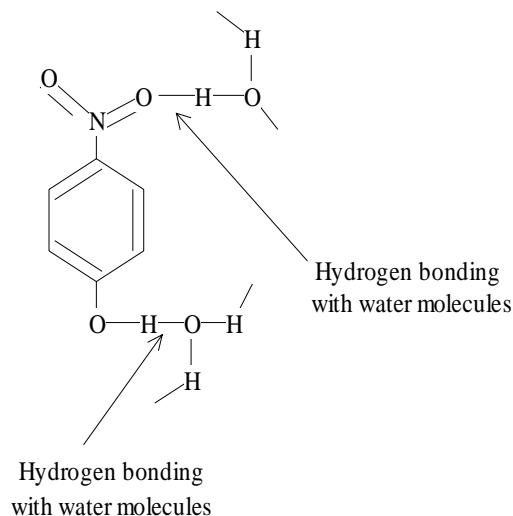
(Cl group is electron withdrawing) followed by p-nitroaniline (-NO₂ group is electron withdrawing). Therefore, the correct answer should be 'a.'

80. (d) The effects of various substituents on phenol will determine the acidity of the compound. As we learned previously, the substituent group that withdraws electrons makes H of -OH electrons deficit and positive charged. Due to this, the H can be easily detached from -OH, which imparts the acidity to solution. The opposite is also true. The substituent group that releases electrons makes it difficult to detach H from the -OH group, and thus weakens the acidity power of the compound. In the given choices, 2,4,6-trinitrophenol should be the most acidic since it has three -NO₂ (electron withdrawing groups). Therefore, the correct answer should be 2,4,6-trinitrophenol or picric acid.

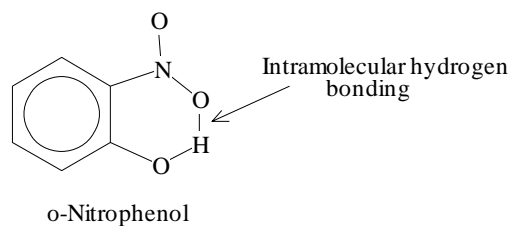
81. (c) Meta and para isomers of nitrophenol have very high boiling points compared to ortho nitrophenol because of intermolecular hydrogen bonding. For example:



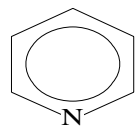
The solubility of these isomers in water is due to hydrogen bonding with water molecules. For example:



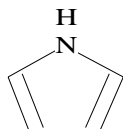
The whole scenario is different with ortho-nitrophenol. Since -NO₂ and -OH groups are located closely compared to meta and para isomers, a hydrogen bond is formed within a single molecule. This intramolecular hydrogen bonding takes the place of intermolecular hydrogen bonding with other phenol molecules and with water molecules. Therefore, o-nitrophenol has a lower boiling point and water solubility compared to its meta and para isomers.



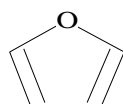
82. (d) The name of the six membered ring heterocyclic compound is pyridine. Below are a few important structures of five membered and six membered ring compounds. Please learn by heart these structures.



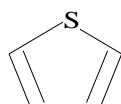
Pyridine



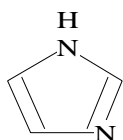
Pyrrole



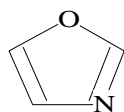
Furan



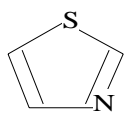
Thiophene



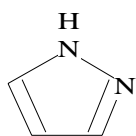
Imidazole



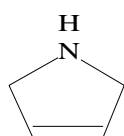
Oxazole



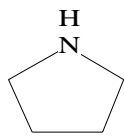
Thiazole



Pyrazole



3-Pyrroline



Pyrrolidine