Answer the questions below then check your answers.

1. Amines are good Brønsted–Lowry bases. Explain what a Brønsted–Lowry bases is and why amines are good bases.

a. Write an equation for the acid-base reaction of ammonia with hydrochloric acid.

b. What type of bond does ammonia form in this reaction?

2. Draw displayed formula for the following amines and label them as primary, secondary or tertiary amines.

a. triethylamine b. propylamine c. Methylamine

d. N-methylpropylamine e. N,N-dimethylethylamine

f. Aniline (phenylamine) g. Butane-1,4-diamine.

3. Several amines have the formula $C_4H_{11}N$. Draw the structural isomers of $C_4H_{11}N$ which are:

i. A primary amine ii. A secondary amine. iii. A tertiary amine.

4. What is the difference between an amine salt and a quaternary ammonium salt?

a. Draw the displayed formula of tetramethylammonium chloride.

5. Why are aromatic amines poor bases when compared to aliphatic amines?

a. Why are secondary amines generally stronger bases than primary amines?

b. Why will tertiary amines have lower boiling points than either primary or secondary amines despite being larger molecules with a larger M_r?

Answers

1. Amines are good Brønsted–Lowry bases. Explain what a Brønsted–Lowry bases is and why amines are good bases.

   A Brønsted–Lowry base id a proton acceptor or (H^+) acceptor. Amines have a lone pair of electrons which enable it to supply both electrons and form a dative covalent bond with a hydrogen ion (H^+)

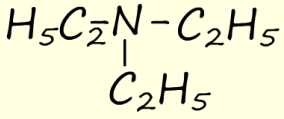
a. Write an equation for the acid-base reaction of ammonia with hydrochloric acid.

   $NH_3 + HCl \longrightarrow NH_4^+Cl^-$

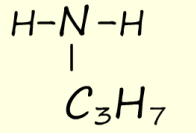
b. What type of does ammonia form in this reaction?

   A dative covalent bond.

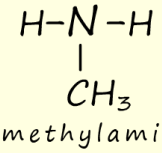
2. Draw displayed formula for the following amines and label them as primary, secondary or tertiary amines.



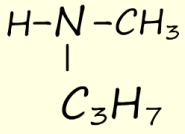
triethylamine



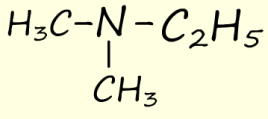
propylamine



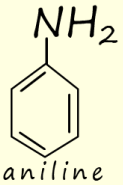
methylamine



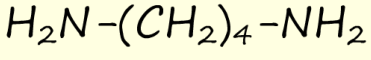
N-methylpropylamine



N,N-dimethylethylamine

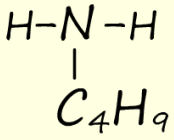


aniline
or
phenylamine

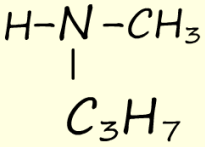


butane-1,4-diamine

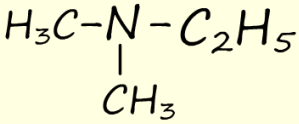
3. Several amines have the formula $C_4H_{11}N$. Draw the structural isomers of $C_4H_{11}N$ which are:



butylamine
primary amine



N-methylpropylamine
secondary amine



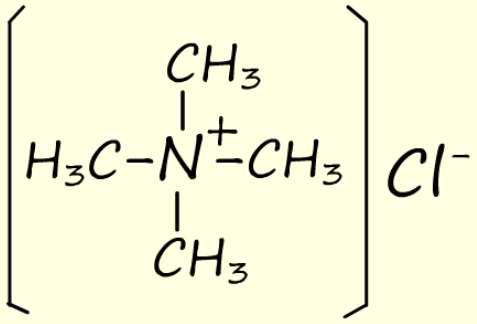
N,N-dimethylethylamine
tertiary amine

diethylamine and N-methylpropylamine are also good example of a secondary amine.

4. What is the difference between an amine salt and a quaternary ammonium salt?

In an amine salt the nitrogen atom makes 4 bonds and ends up with a positive charge, at least one of the atoms attached to the nitrogen is a hydrogen atom. In a quaternary ammonium salt there are no hydrogen atoms attached to the nitrogen, they have been replaced by alkyl groups.

a. Draw the displayed formula of tetramethylammonium chloride.



tetramethylammonium
chloride

5. Why are aromatic amines poor bases when compared to aliphatic amines?

In an aromatic bases the lone pair of electrons on the nitrogen atom is delocalised through the aromatic ring, this means that it is not available to form bonds with electrophiles such as hydrogen ions.

a. Why are secondary amines generally stronger bases than primary amines?

The alkyl groups exert a positive inductive effect and push electrons onto the nitrogen atom, increasing the electron density here. The more alkyl groups that are attached to the nitrogen atom the larger the electron density on the nitrogen atom and the better able the lone pair will be to form dative covalent bonds making it a stronger base.

b. Why will tertiary amines have lower boiling points than either primary or secondary amines despite being larger molecules with a larger M_r?

Primary and secondary amines still have a hydrogen atom attached to the nitrogen atom so can form hydrogen bonds to neighbouring molecules; tertiary amines cannot form hydrogen bonds since they do not have any hydrogen atoms attached to the nitrogen atom. This means that tertiary amines will have to use dipole-dipole and Van der Waals bonding to forms intermolecular bonds, these bonds are weaker than hydrogen bonds.