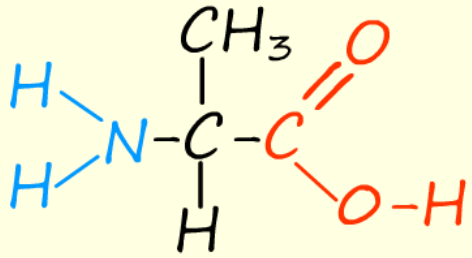
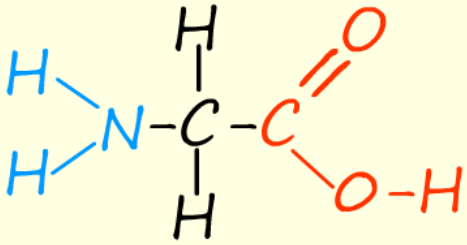
Answer all the questions below as fully as you can then check your answers

1. The amino acids glycine and alanine are shown below:



alanine



glycine

a. What two functional groups are present in these two amino acids?

i. Amino acids are amphoteric. What does this mean?

b. Give the IUPAC names for these two amino acids.

c. Draw the structure of the zwitterions for the amino acids alanine and glycine at their isoelectric points.

d. What is a zwitterions?

e. Draw the structure of the cation and the anion produced when the alanine zwitterion is added firstly to hydrochloric acid and then to sodium hydroxide solutions.

f. Glycine has an isoelectric point at pH6. Draw the structure of glycine at:

i. pH 6

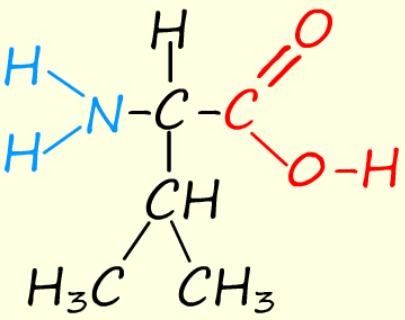
ii. pH 3

iii pH10

g. Explain why alanine is optically active but glycine is not.

i. Draw displayed formula to clearly show the structure of the two enantiomers of alanine and mark the chiral carbon atoms with an asterisk (*)

ii. The amino acid valine is shown opposite. Draw 3d structures to show the two enantiomers of valine, mark the chiral carbon atoms with an asterisk (*)

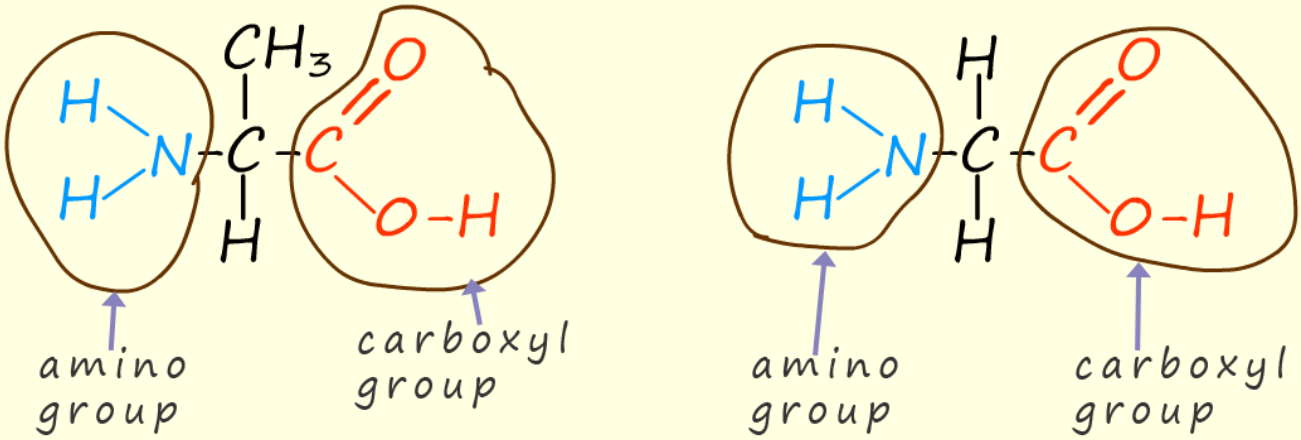


The amino acid valine

2. Explain why the melting points of amino acids are much higher than might be expected from their molecular mass.

Answers

1. The amino acids glycine and alanine are shown below:



a. What two functional groups are present in these two amino acids?

see diagram above

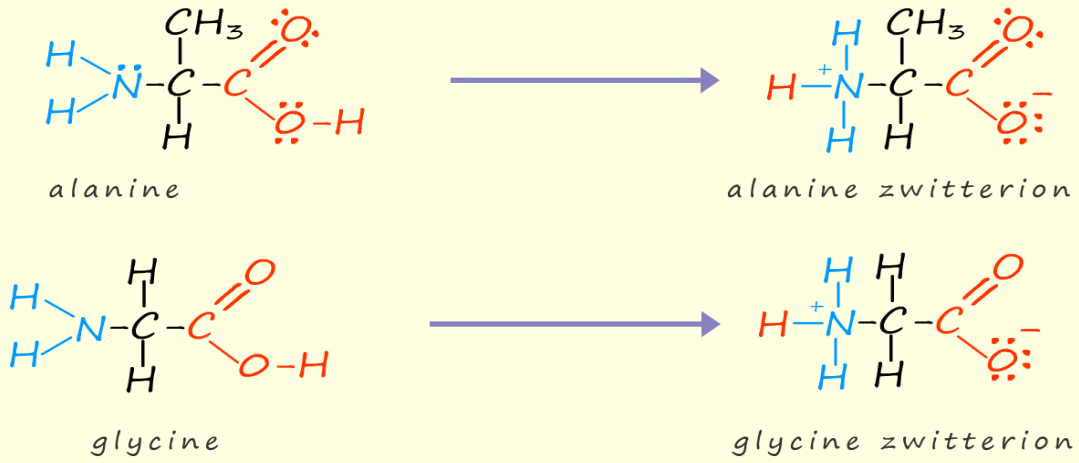
i. Amino acids are amphoteric. What does this mean?

Reacts with both acids and alkalis.

b. Give the IUPAC names for these two amino acids.

Alanine is 2-aminopropanoic acid glycine is aminoethanoic acid

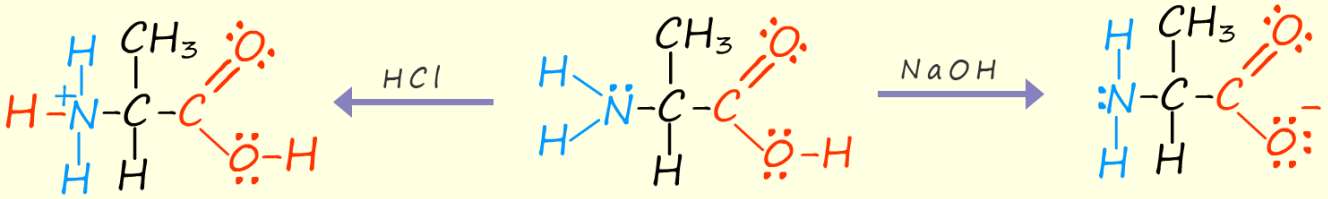
c. Draw the structure of the zwitterions for the amino acids alanine and glycine at their isoelectric points.



d. What is a zwitterion?

An ion with a positive charge on one end and a negative charge on the other, it's often referred to as a dipolar ion, it has no overall charge, it is neutral since it contains a positive and negative charge which cancel each other out.

e. Draw the structure of the cation and the anion produced when the alanine zwitterion is added firstly to hydrochloric acid and then to sodium hydroxide solutions.



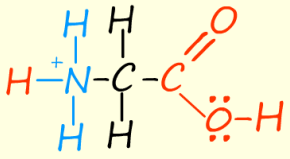
alanine

f. Glycine has an isoelectric point at pH6. Draw the structure of glycine at:

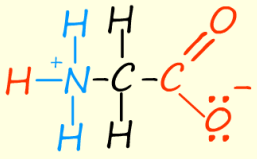
i. pH 6

ii. pH 3

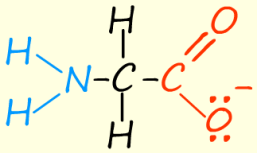
iii pH10



glycine cation
pH 3



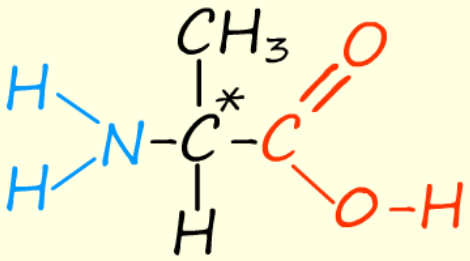
glycine zwitterion
pH6



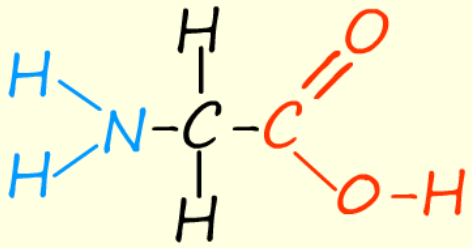
glycine anion
pH9

g. Explain why alanine is optically active but glycine is not.

alanine

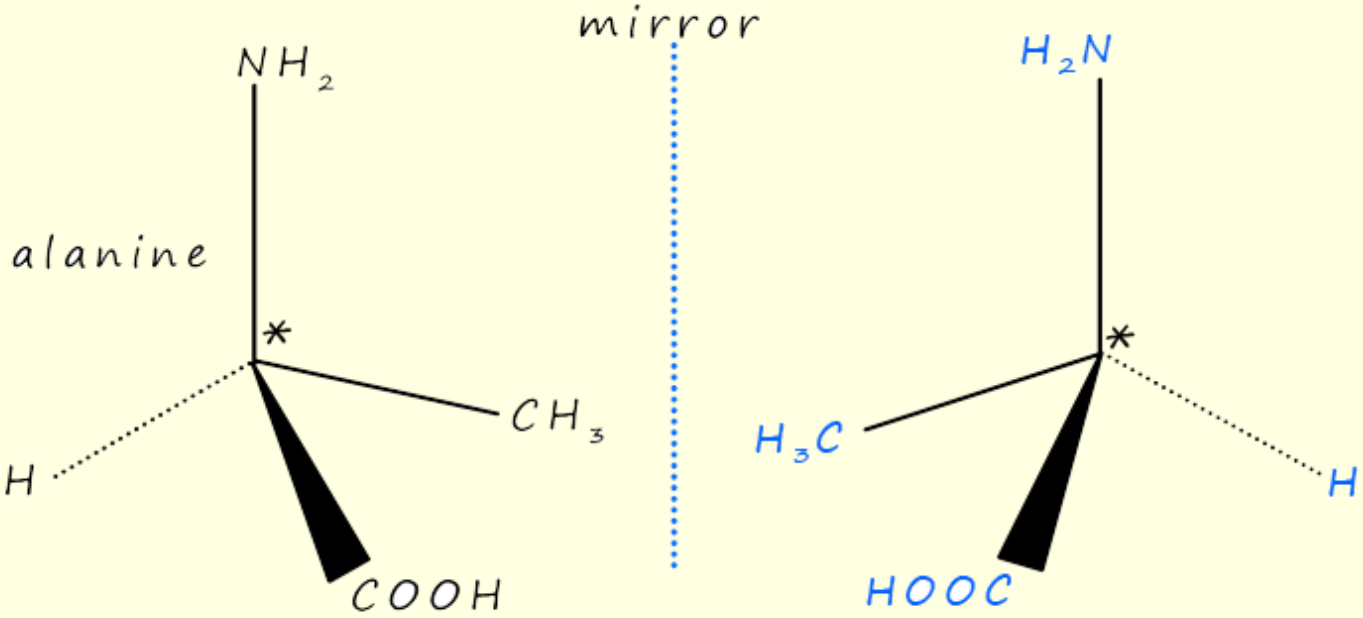


glycine



alanine has a chiral or asymmetric carbon atom but glycine has no chiral centres so is not an optically active molecule.

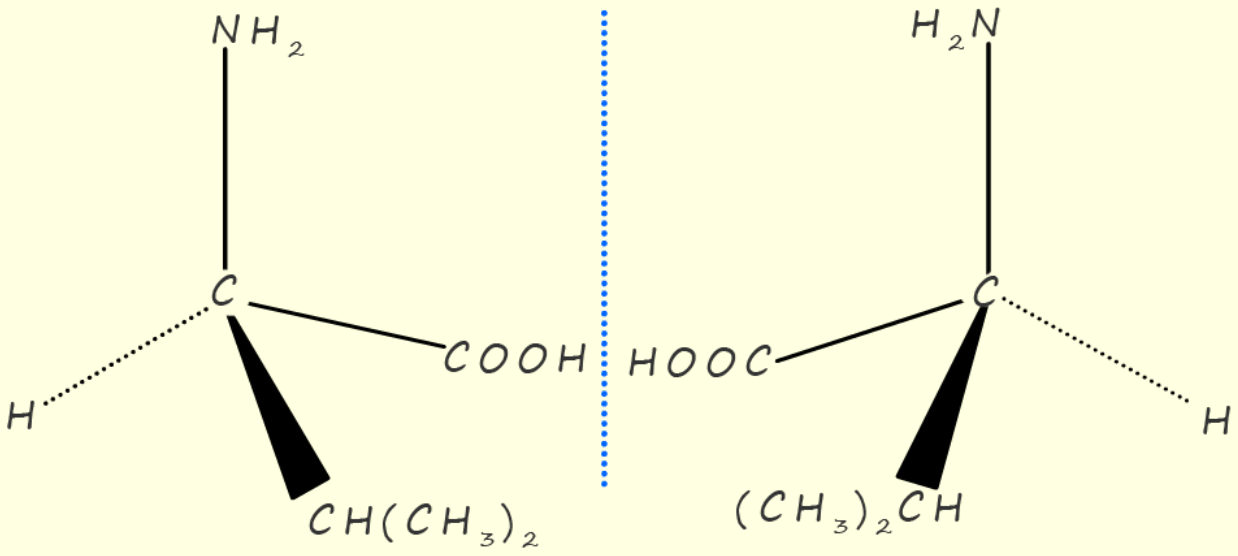
i. Draw displayed formula to clearly show the structure of the two enantiomers of alanine and mark the chiral carbon atoms with an asterisk (*)



* indicates chiral carbon atom.

ii. The amino acid valine is shown opposite. Draw 3d structures to show the two enantiomers of valine, mark the chiral carbon atoms with an asterisk (*)

Since each carbon atom makes 4 bonds it will have a tetrahedral arrangement, this is necessary for a chiral carbon atom.



The carbon atoms at the centre of each tetrahedral molecule are chiral.

2. Explain why the melting points of amino acids are much higher than might be expected from their molecular mass.

Amino acids consist of an ionic salt with strong ionic bonding between the zwitterions in the structure; they therefore have many of the properties associated with ionic solids and NOT the organic compounds you might expect them to be by first glance at their formulae.