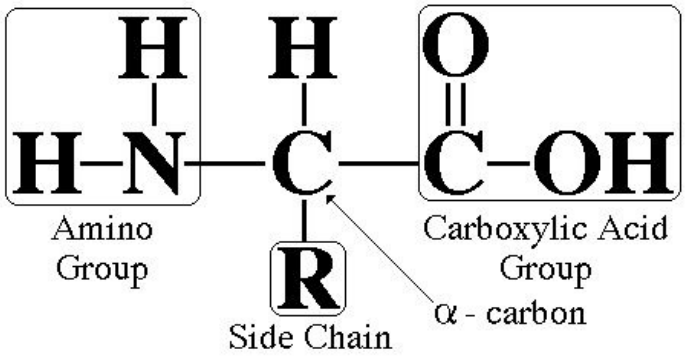
7.7 Reaction pathway for Amide Formation

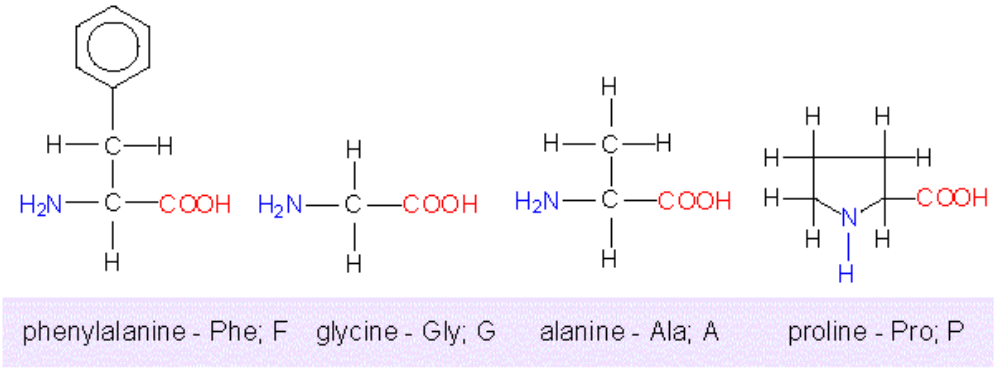
The reaction pathway for amide formation is very similar to that of ester formation, with the amine substituting for the alcohol in the reaction pathway.

Try the following problems showing the reaction pathway at both low temperature and high temperature:

7.8 Amino Acids and proteins. Alpha amino acids (often just referred to as amino acids are particularly important examples of amines and have the structure:

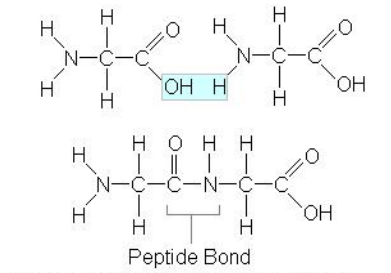


They contain both amine groups and carboxylic acids. There are 20 different common R groups on the primary amino acids. In most cases the R group is different than the other three groups and hence the alpha C has 4 different groups bonded to it and is a chiral center. The structure of some common amino acids are:



Notice that the central C has 4 different groups and hence is a chiral center in all of the above structures except glycine. Also note the common but confussing COOH notation for the carboxylic acid functional group.

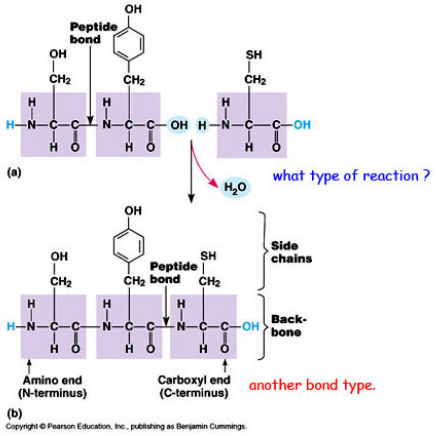
Two amino acids can link together head-to-toe to form an amide bond between them. The amide bond between two amino acids is called a **peptide bond** and we call the resulting molecule a **dipeptide**.



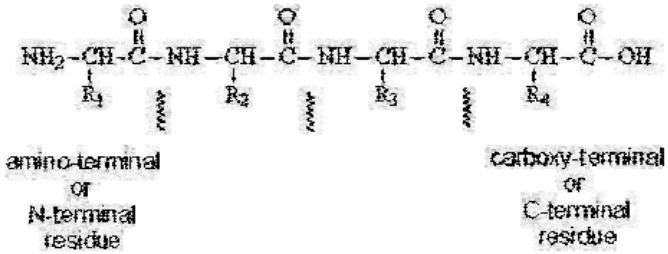
A molecule of water is removed from two glycine amino acids to form a peptide bond.

The resulting dipeptide still has an amine group on one end and a carboxylic acid on the other end so additional amino acids can be covalent bonded to both ends of the molecule. A molecule containing three amino acids is called a **tripeptide**; one with four amino acids is called a **tetrapeptide** and so forth. The end with a free amine group is called the N terminal end and the end with the free carboxylic acid group is called the C terminal end of the peptide.

Tripeptide

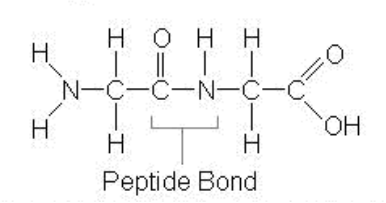


Tetrapeptide

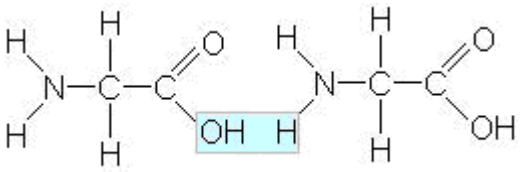


Long chains of less than 50 amino acids are referred to as **polypeptides.** When 50 or more amino acids are linked together, it is commonly referred to as a **protein.**

In the presence of acid catalysis and water amino acids linked by amide (peptide) bonds can hydrolyze back to separate amino acids:



+ H_2O —>



This is in fact what happens when one eats proteins. They are hydrolyzed back to short peptides and amino acids with the help of HCl and the protease pepsin in the stomach and an additional collection of **protease** enzymes in the small intestine. The amino acids are absorbed and then rebuilt into proteins by your body.