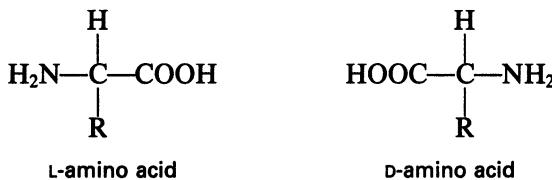
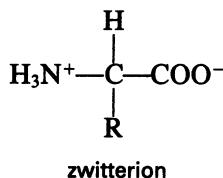


The building blocks of proteins are  $\alpha$ -amino acids, and there are 20 common amino acids. Amino acids are named on the basis of the side (R) group attached to the  $\alpha$ -carbon. Amino acids are optically active and occur in two isomeric forms.



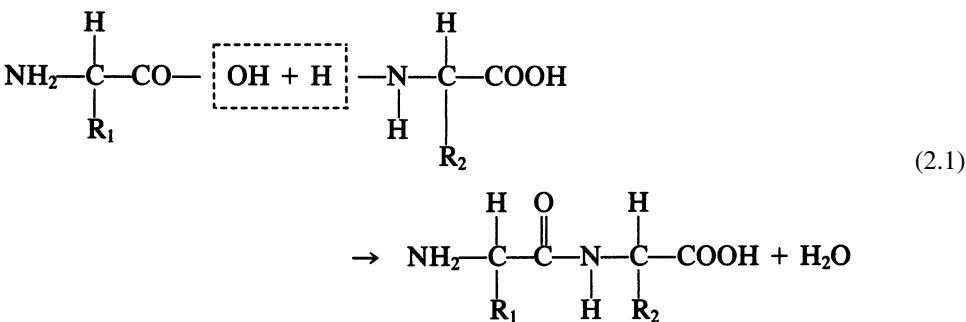
Only L-amino acids are found in proteins. D-amino acids are rare in nature; they are found in the cell walls of some microorganisms and in some antibiotics.

Amino acids have acidic ( $-\text{COOH}$ ) and basic ( $-\text{NH}_2$ ) groups. The acidic group is neutral at low pH ( $-\text{COOH}$ ) and negatively charged at high pH ( $-\text{COO}^-$ ). At intermediate pH values, an amino acid has positively and negatively charged groups, a dipolar molecule called a *zwitterion*.



The pH value at which amino acids have no net charge is called the *isoelectric point*, which varies depending on the R group of amino acids. At its isoelectric point, an amino acid does not migrate under the influence of an electric field. Knowledge of the isoelectric point can be used in developing processes for protein purification. A list of 21 amino acids that are commonly found in proteins is given in Table 2.4.

The proteins are amino acid chains. The condensation reaction between two amino acids results in the formation of a *peptide bond*.



The peptide bond is planar. Peptides contain two or more amino acids linked by peptide bonds. Polypeptides usually contain fewer than 50 amino acids. Larger amino acid chains are called *proteins*. Many proteins contain organic and/or inorganic components other than amino acids. These components are called *prosthetic groups*, and the proteins containing prosthetic groups are named *conjugated proteins*. Hemoglobin is a conjugated protein and has four heme groups, which are iron-containing organometallic complexes.