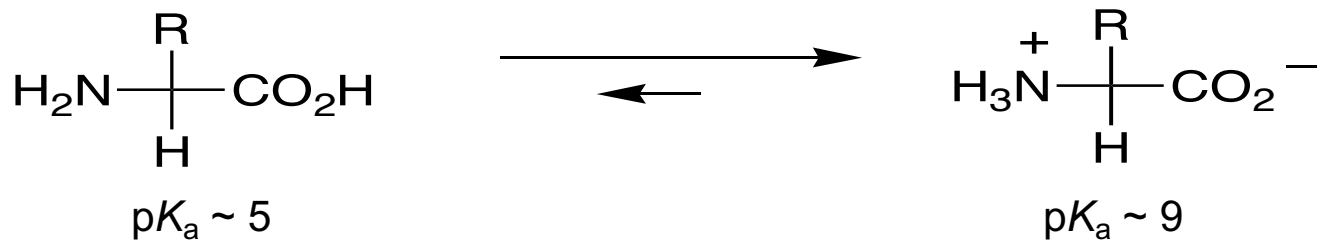


AMINO ACIDS, PEPTIDES AND PROTEINS

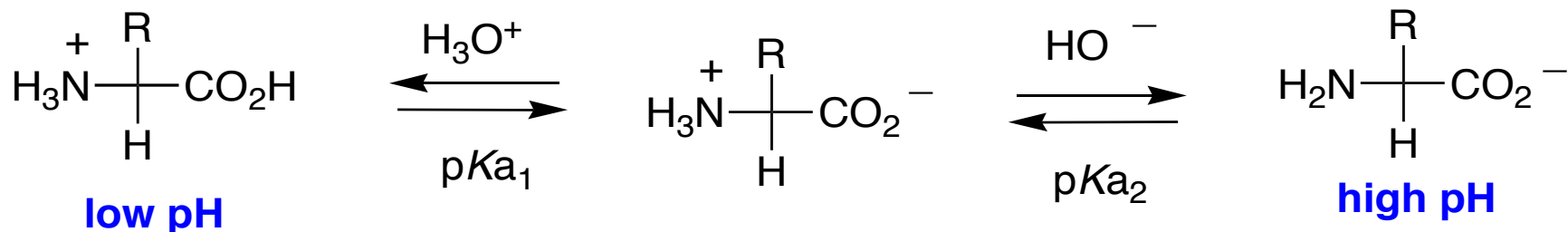
المرحلة الثالثة / قسم الكيمياء / الفصل الثاني
أ.د. فيحاء مقداد خليل

Acid-Base Behavior of Amino Acids. Amino acids exist as a zwitterion: a dipolar ion having both a formal positive and formal negative charge (overall charge neutral).

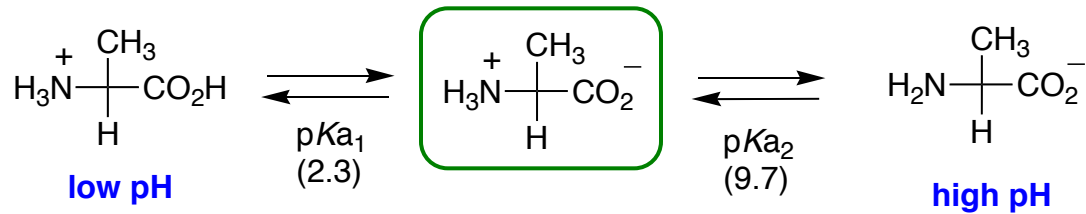


Amino acids are *amphoteric*: they can react as either an acid or a base. Ammonium ion acts as an acid, the carboxylate as a base.

Isoelectric point (pI): The pH at which the amino acid exists largely in a neutral, **zwitter ionic** form (influenced by the nature of the side chain)

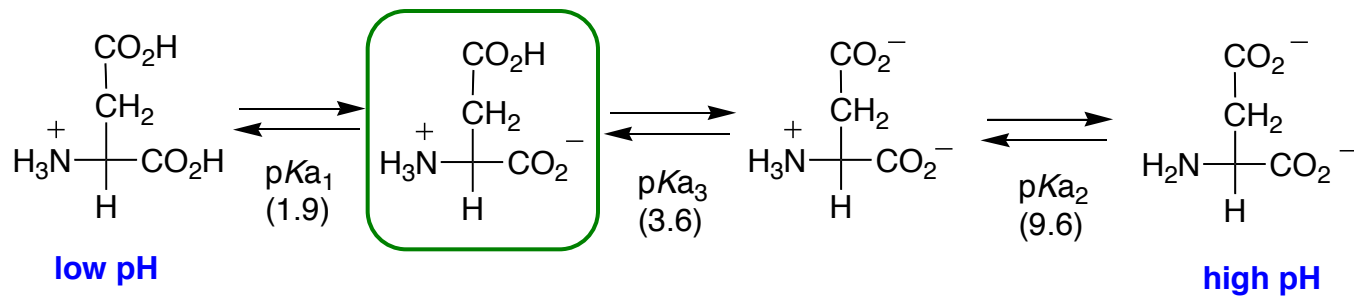


$$pI = \frac{pK_{a_x} + pK_{a_y}}{2}$$



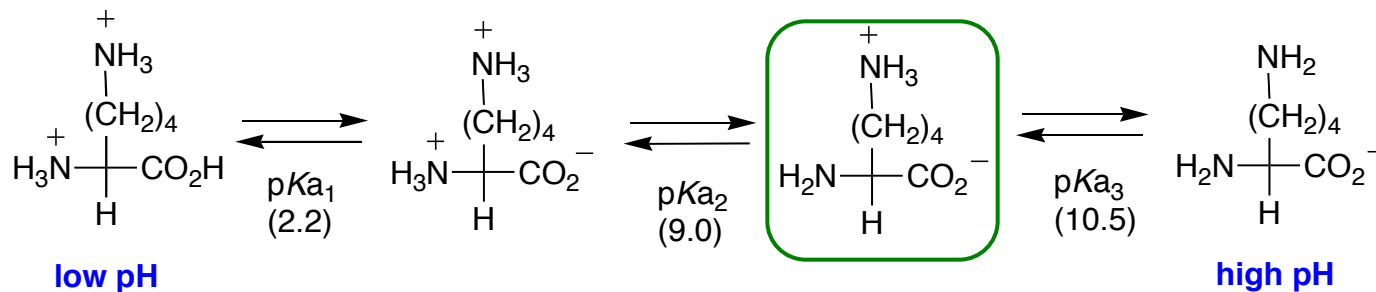
$$pI = \frac{pK_{a_1} + pK_{a_2}}{2}$$

pI = 6.0



$$pI = \frac{pK_{a_1} + pK_{a_3}}{2}$$

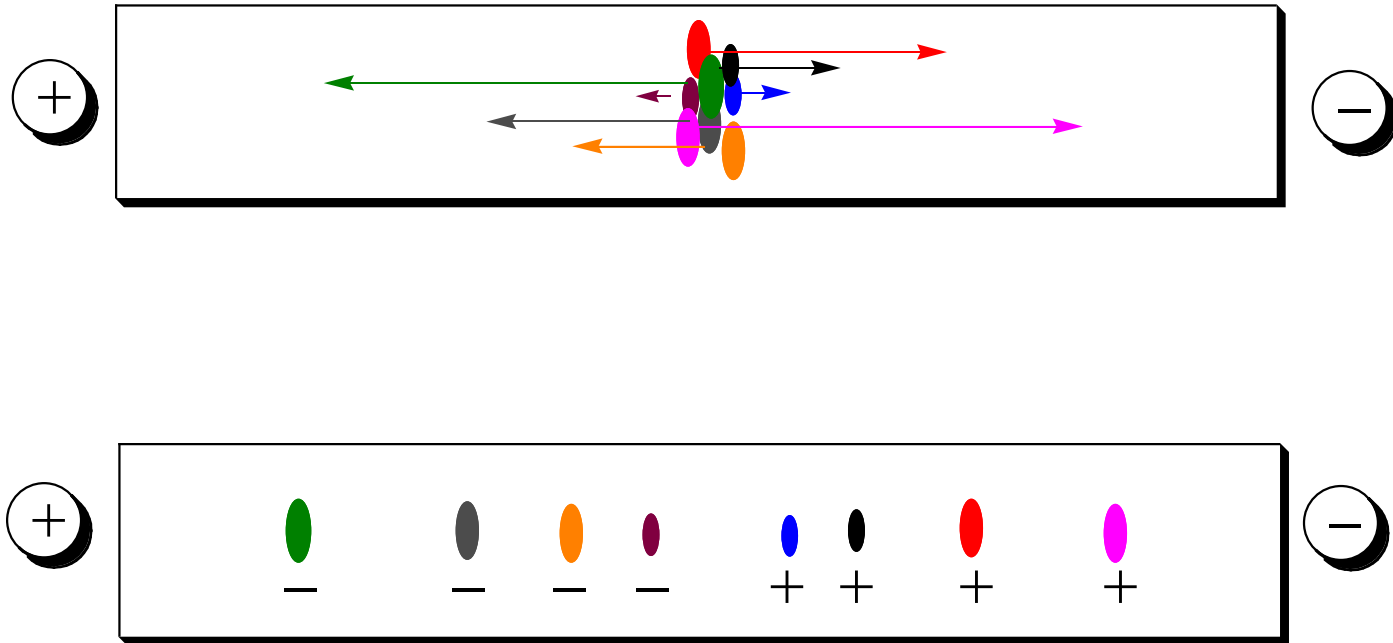
pI = 2.7



$$pI = \frac{pK_{a_2} + pK_{a_3}}{2}$$

pI = 9.7

Electrophoresis: separation of polar compounds based on their mobility through a solid support. The separation is based on charge (pI) or molecular mass.



Types of Amino Acids

There are 20 amino acids our body uses to synthesize proteins. These amino acids can be classified as essential, non-essential, or conditionally essential. The table below shows how the 20 amino acids are classified. The body cannot synthesize nine amino acids. Thus, it is essential that these are consumed in the diet. As a result these amino acids are known as essential, or indispensable, amino acids.

Essential

Histidine

Isoleucine

Leucine

Lysine

Methionine

Phenylalanine

Threonine

Tryptophan

Valine

Conditionally Essential

Arginine

Cysteine

Glutamine

Glycine

Proline

Tyrosine

Non-essential

Alanine

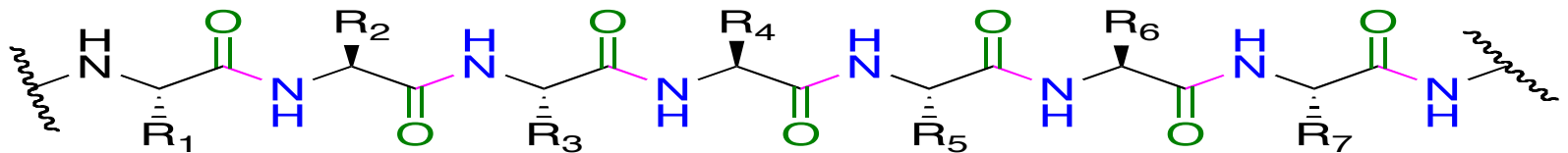
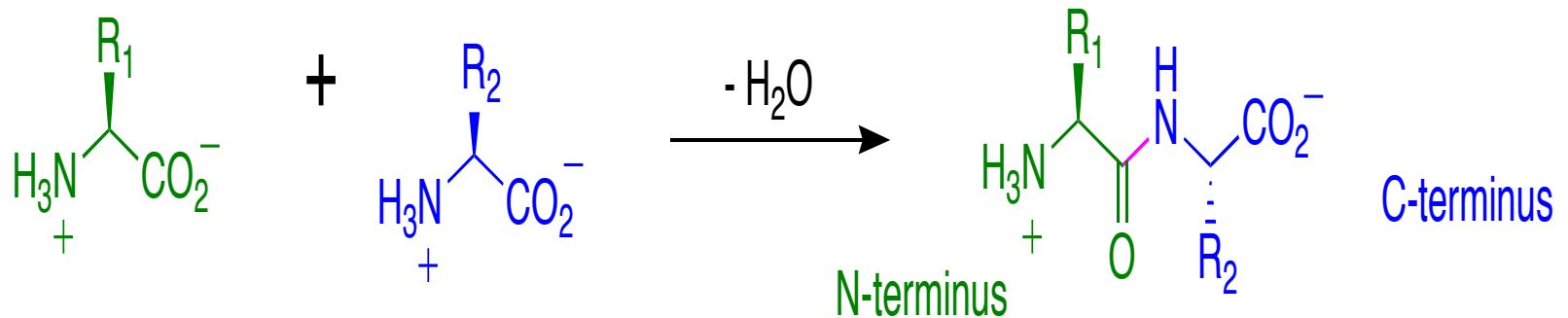
Asparagine

Aspartic Acid or Aspartate

Glutamic Acid or Glutamate

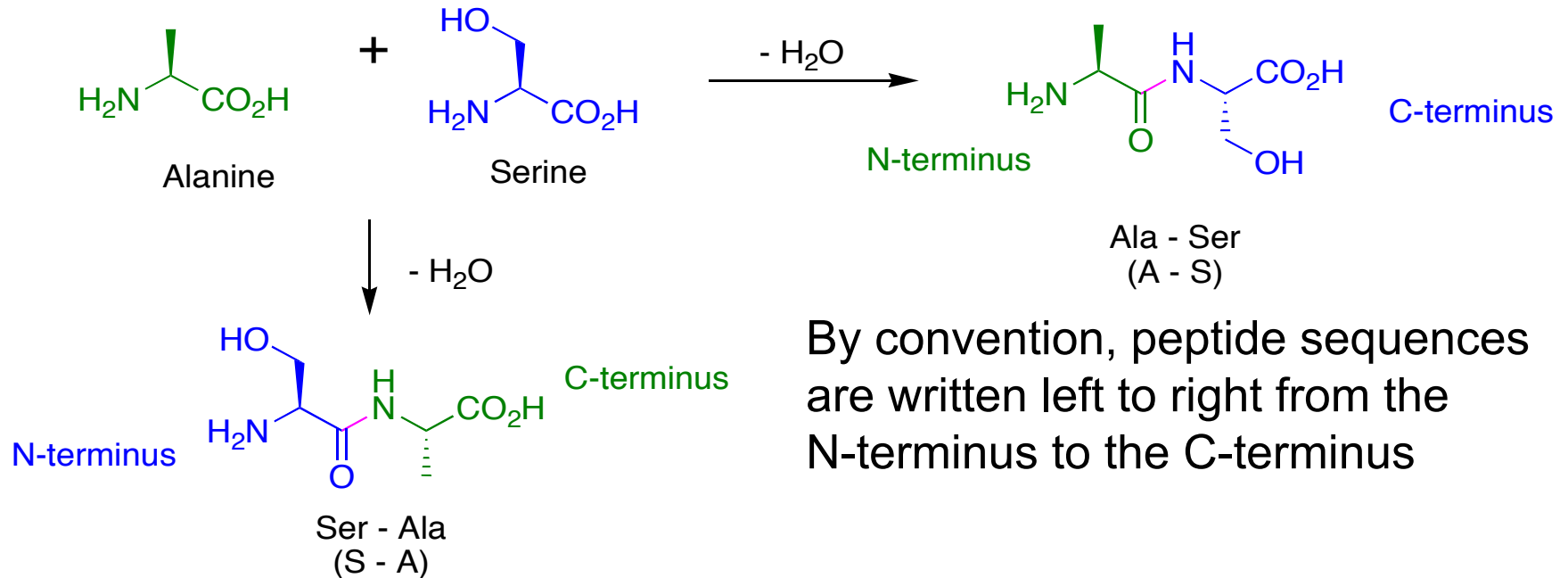
Serine

Biopolymer: the monomeric amino acids are linked through an amide bond (the carboxylic acids of one AA with the α -amino group of a second)

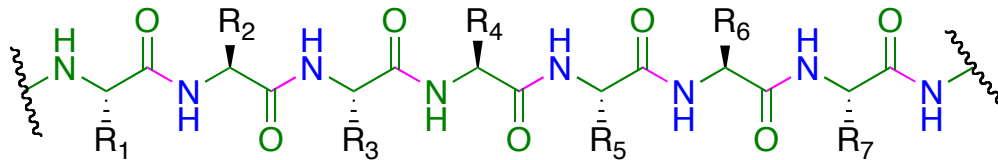


Peptide or protein (polypeptide)

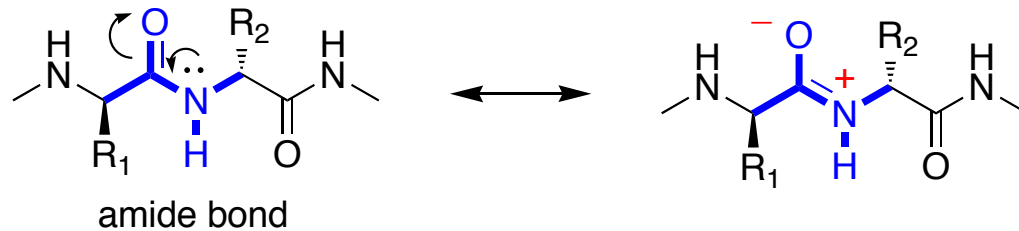
Peptides. Proteins and peptides are polymers made up of amino acid units (residues) that are linked together through the formation of amide bonds (peptide bonds) from the amino group of one residue and the carboxylate of a second residue



By convention, peptide sequences are written left to right from the N-terminus to the C-terminus

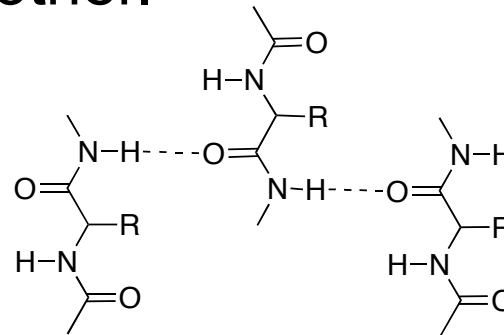


The amide (peptide) bond has C=N double bond character due to resonance resulting in a planar geometry



restricts rotations
resistant to hydrolysis

The N-H bond of one amide linkage can form a hydrogen bond with the C=O of another.



N-O distance 2.85 - 3.20 Å

optimal N-H-O angle is 180 °

Disulfide bonds: the thiol groups of cysteine can be oxidized to form disulfides (Cys-S-S-Cys)

