Name:
Date:

QA1 - Amino Acid Biochemistry

1. How many possible different tripeptides could form, by combining three different amino acids?

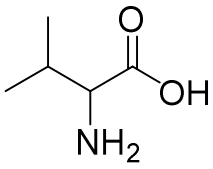
   Six

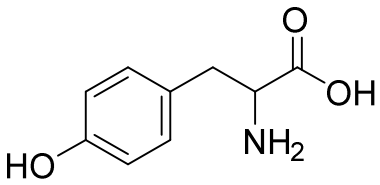
   Mathematical note – this is the same as 3!

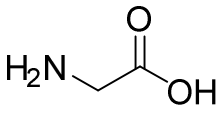
   By modelling each amino acid as A, B or C, you can get the following options:

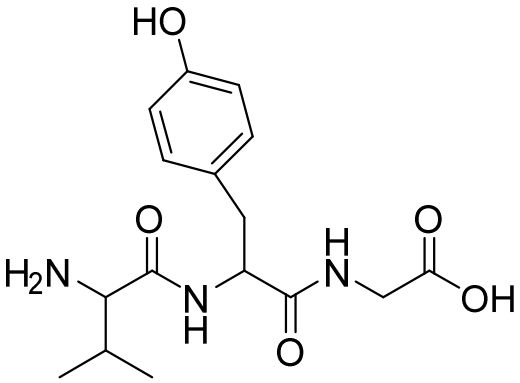
   ABC, ACB, BAC, BCA, CAB, CBA. It is actually slightly more complex than this, as the chains can start with the amine group, or the carboxyl group first, making 12 possible sequences. However, six of these have the same sequence as another read backwards. Because they are equal, they cancel out to give 6 distinct sequences.

2. Draw a tripeptide formed from the following amino acids: valine, tyrosine, and glycine



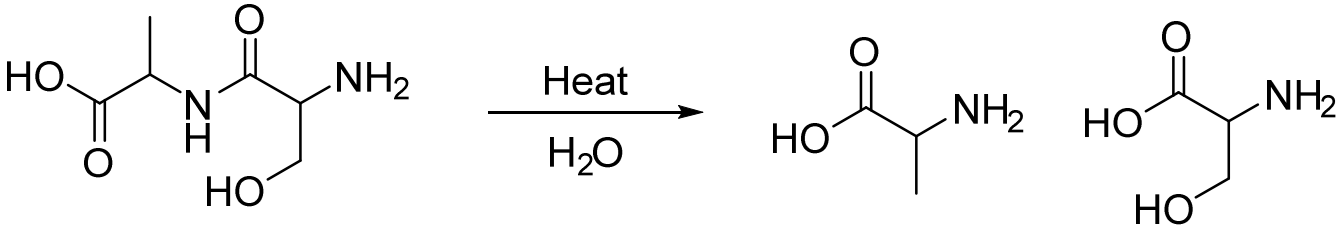






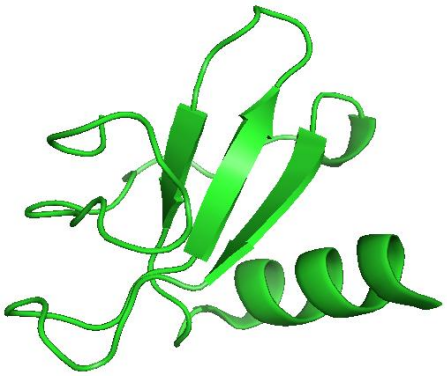
Note that there are six different ones possible, the most important feature is the **repeating peptide backbone**, apart from that, the side chains can be in any order.

3. Draw the products of the following reaction



4. Using the following diagram, define the terms **Primary Structure**, **Secondary Structure**, and **Tertiary Structure.** In your answer, explain how these structures form.

Primary structure: The **sequence of amino acids which makes up the polypeptide chain**. This forms by condensation of amino acids, releasing H_2O in the process.



Secondary structure: The organisation of the primary structure into 3D arrangements in specific parts of the chain. In this case, the polypeptide chain has arranged itself into **α-helices, β-sheets, and β-turns**. These common structural features are held together by hydrogen bonds between the carbonyl and amine groups on the amino acid residues in the polypeptide.

Tertiary structure: This is the o**verall 3D structure of the polypeptide**, taking into account the secondary structures as a collection. The tertiary structure is the polypeptide chain's overall shape. As well as hydrogen bonding, these structures can also be held together by strong S-S covalent bonds throughout.

5. Explain what would need to happen to the protein, for it to have a quaternary structure, and to be a conjugated protein.

Quaternary structure: has **multiple polypeptide chains** in the overall protein structure. So, in this case, a quaternary structure could be made by combining two of the protein subunits that you see in Q4.

Conjugated protein: has a **prosthetic group attached, i.e. a non-polypeptide group**, such as a haem ring.

6. How do genes determine the overall structure of a protein?

It is the **DNA code** which determines the **individual amino acids** which make up the **primary structure** of a polypeptide. As the primary structure interacts with itself, and other polypeptide chains, it **folds** and changes shape to produce **secondary structures**, as well as a **tertiary** one, and **possibly a quaternary** one. This overall protein which finally forms can be traced back to the genetic code which specifies the amino acids which constitute it.