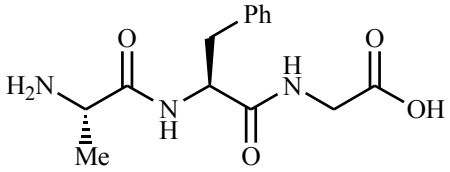
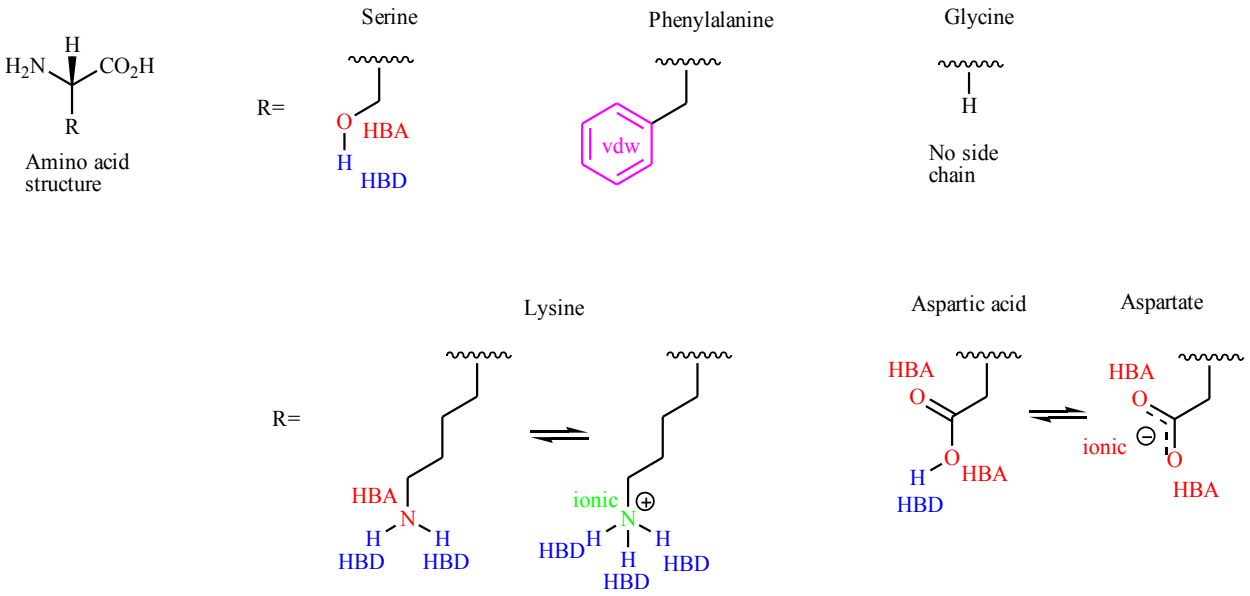
Answers to end-of-chapter questions

1)

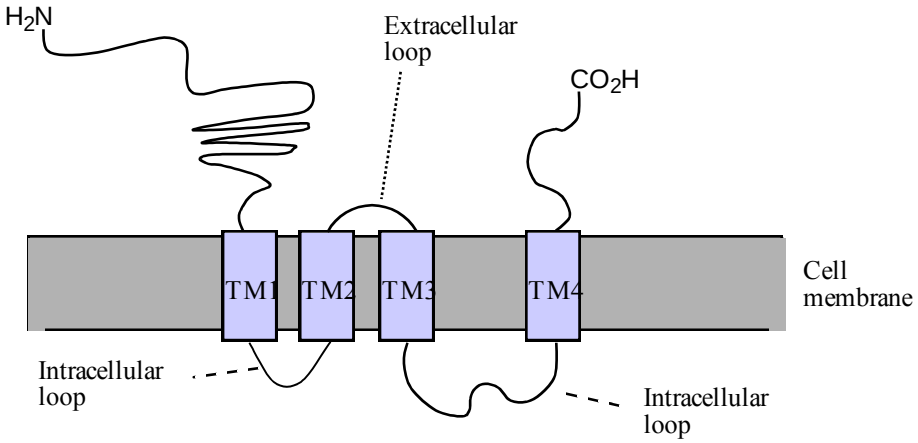


2) Glycine is the only amino acid with no side chain and is the only naturally occurring amino acid that is not asymmetric.

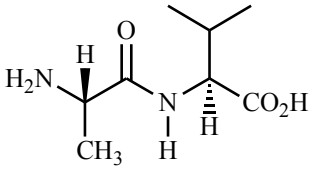
3) Possible interactions are shown below for the side chains of serine, phenylalanine, glycine, lysine, aspartic acid and aspartate (HBA= hydrogen bond acceptor; HBD = hydrogen bond donor; vdw = van der Waals interactions)



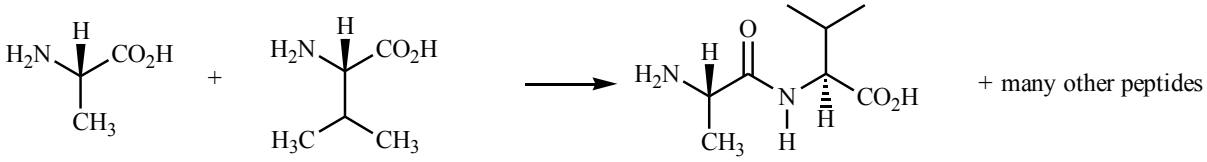
4) In the primary structure of the protein, a sequence of amino acids with hydrophobic side chains may indicate a transmembrane (TM) region (i.e it is located within the cell membrane as shown below) This is because hydrophobic side chains will interact more favourably with the fatty cell membrane than with the aqueous environments on either side of the cell membrane. Regions of the protein that are made up predominantly of polar side chains are almost certainly located intracellularly or extracellularly.
However, it would be wrong to conclude that all amino acids with hydrophobic side chains are located in transmembrane regions and that all amino acids with polar side chains are located intracellularly or extracellularly.



5)
The structure of L-alanyl-L-valine is shown below.

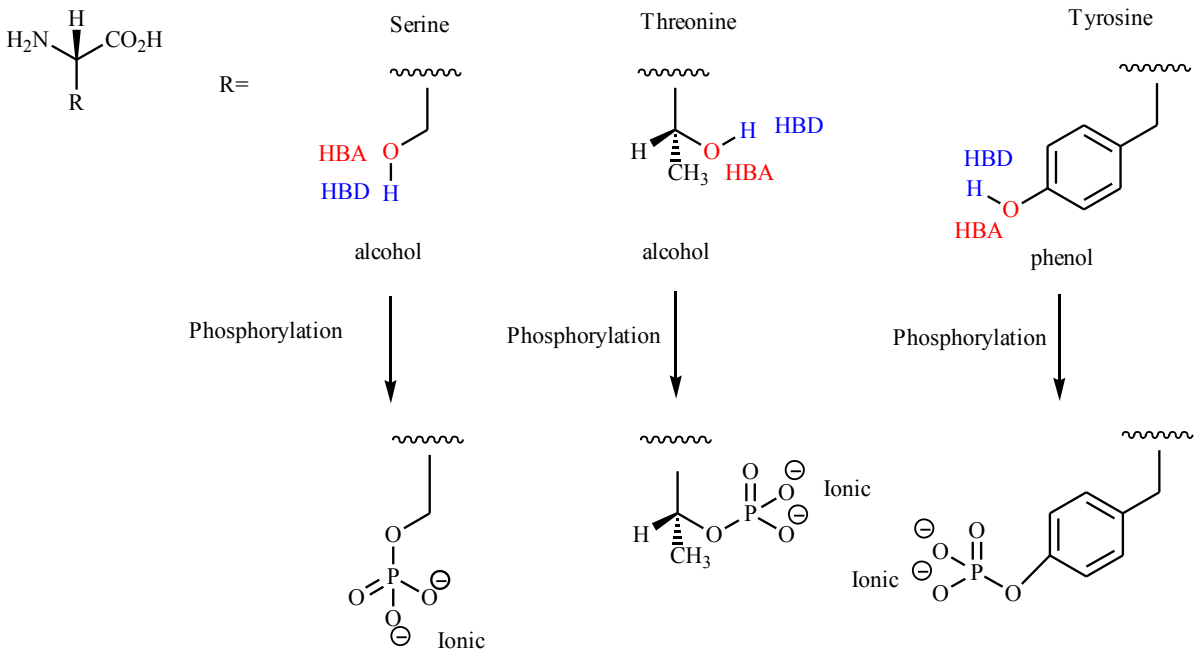


An attempt to couple alanine directly to valine may well produce the desired product but a whole range of other structures will also be formed.



For example, L-valyl- L-alanine is an equally likely product. There is also nothing to stop alanine coupling with itself, or valine coupling with itself to form L-alanyl- L-alanine and L-valyl- L-valine respectively.
Furthermore, there is no reason why any of the above dipetides that are formed could not undergo further coupling reactions to form tripeptides, tetrapeptides etc.
The reaction is also likely to need forcing conditions since one is attempting to form an amide between an amine and a carboxylic acid which are more likely to form a salt at room temperature. Forcing conditions are likely to result in racemisation of asymmetric centres.
Due to these problems, it is necessary to protect the amino group of one amino acid and the carboxylic acid of the other before a coupling reaction is attempted. It is also important to have coupling reagents (e.g. dicyclohexylcarbodiimide) in order to achieve milder, non-racemising conditions.

6) The functional groups involved are alcohols and phenols. Both of these functional groups can form hydrogen bonds. When the groups are phosphorylated, the phosphate groups are ionised and will interact with ionic groups rather than hydrogen bonding groups.



The tertiary structure will alter as a result (see section 5.2.6).

7) Glu-Leu-Pro-Asp-Val-Val-Ala-Phe-Lys-Ser-Gly-Gly-Thr

The one letter coding is ELPDVVAFKSGGT