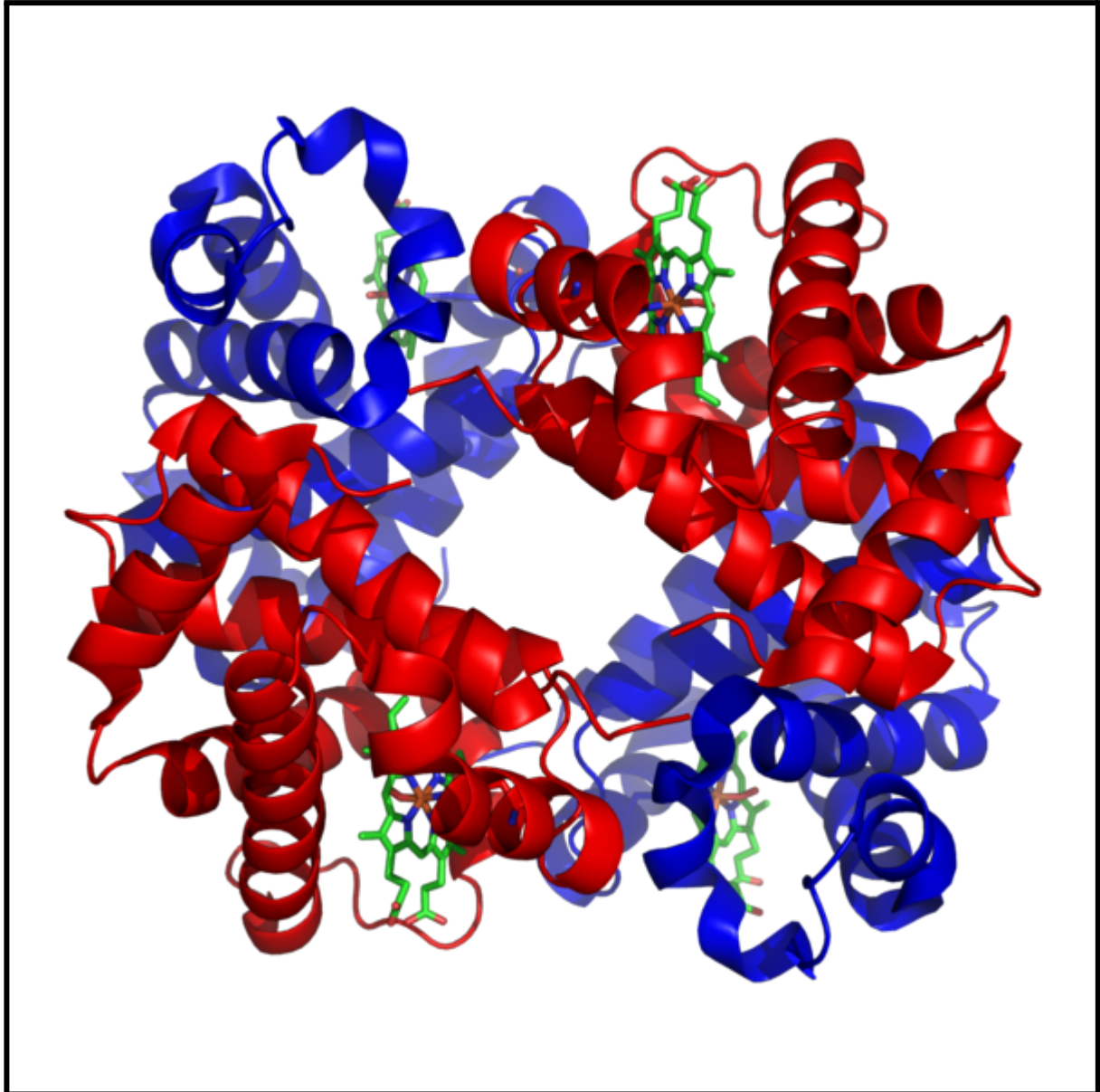


Proteins - Answers



Amino Acids

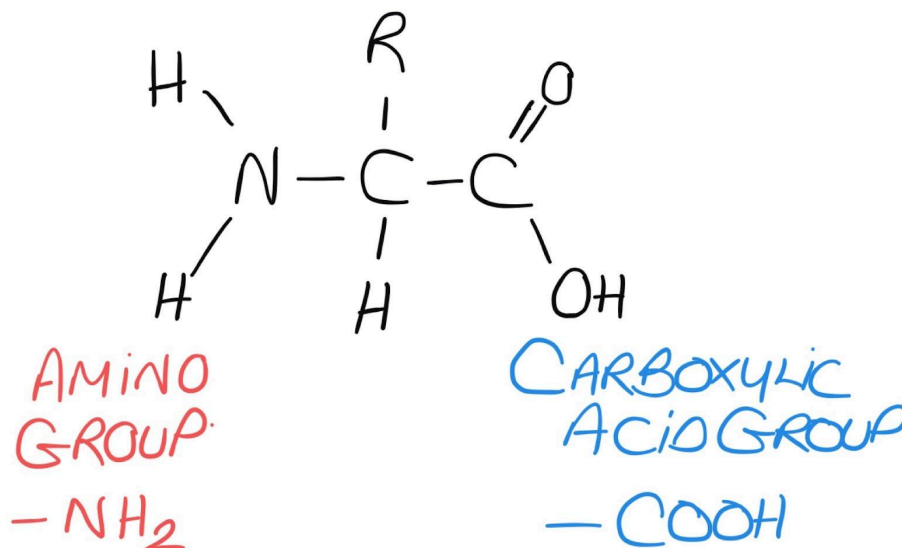
Proteins
1. Know the structure of an amino acid (structures of specific amino acids are not required).
2. Understand the formation of polypeptides and proteins (as amino acid monomers linked by peptide bonds in condensation reactions).
3. Understand the role of ionic, hydrogen and disulfide bonding in the structure of proteins.
4. Understand the significance of the primary, secondary, tertiary and quaternary structure of a protein in determining the properties of fibrous and globular proteins, including collagen and haemoglobin.
5. Understand how the structure of collagen and haemoglobin are related to their function.

Proteins.

→ Amino acids are the monomers from which proteins are made.

1. Draw the structure of an amino acid in the space below. Label the amino, carboxylic acid and R groups.

STRUCTURE OF AMINO ACID.



2. How many amino acids are there and how do they differ?

There are 20 amino acids that are used by all living organisms (there are more than 20 amino acids)

3. How many amino acids are considered to be essential amino acids? Why are they considered to be essential?

6 amino acids are deemed essential. These must be obtained through the diet.

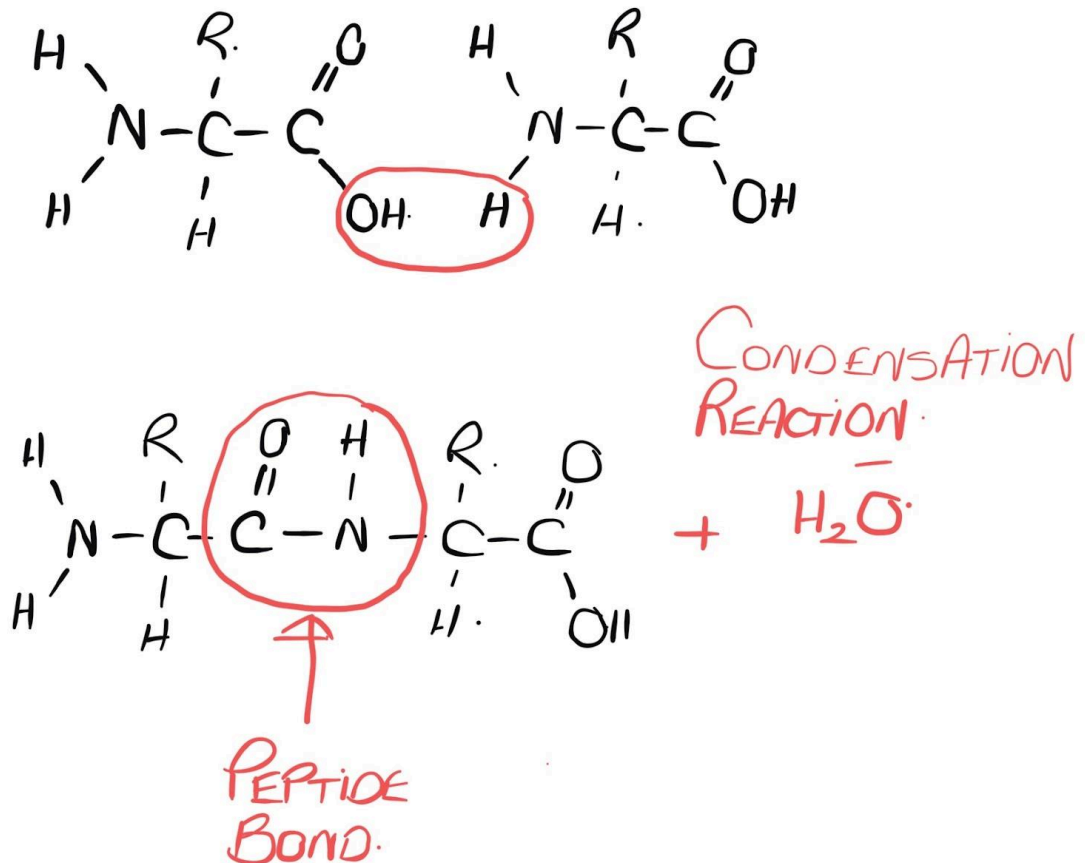
4. Practice drawing an amino acid again! Try to do it from memory.

Peptide Linkages.

A condensation reaction between two amino acids forms a peptide bond.

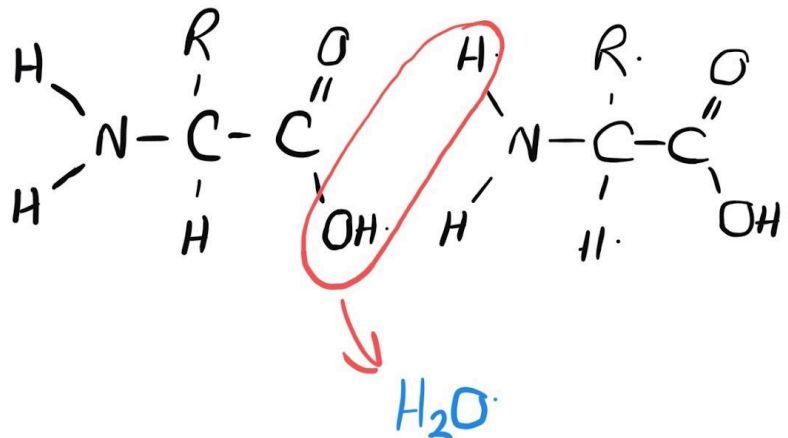
- Dipeptides are formed by the condensation of two amino acids.
- Polypeptides are formed by the condensation of many amino acids.

1. Show how two amino acids are joined together in a condensation reaction.



Or

ALTERNATIVE.



2. Why is this considered to be a condensation reaction?
3. Where would this condensation reaction take place in a cell?

This is a condensation reaction as a water molecule is released as a peptide bond forms between the -OH of a carboxylic acid of one amino acid and the hydrogen of an amino group on another amino acid.

4. Practice drawing a condensation reaction between two amino acids. Label the peptide bond.

As above

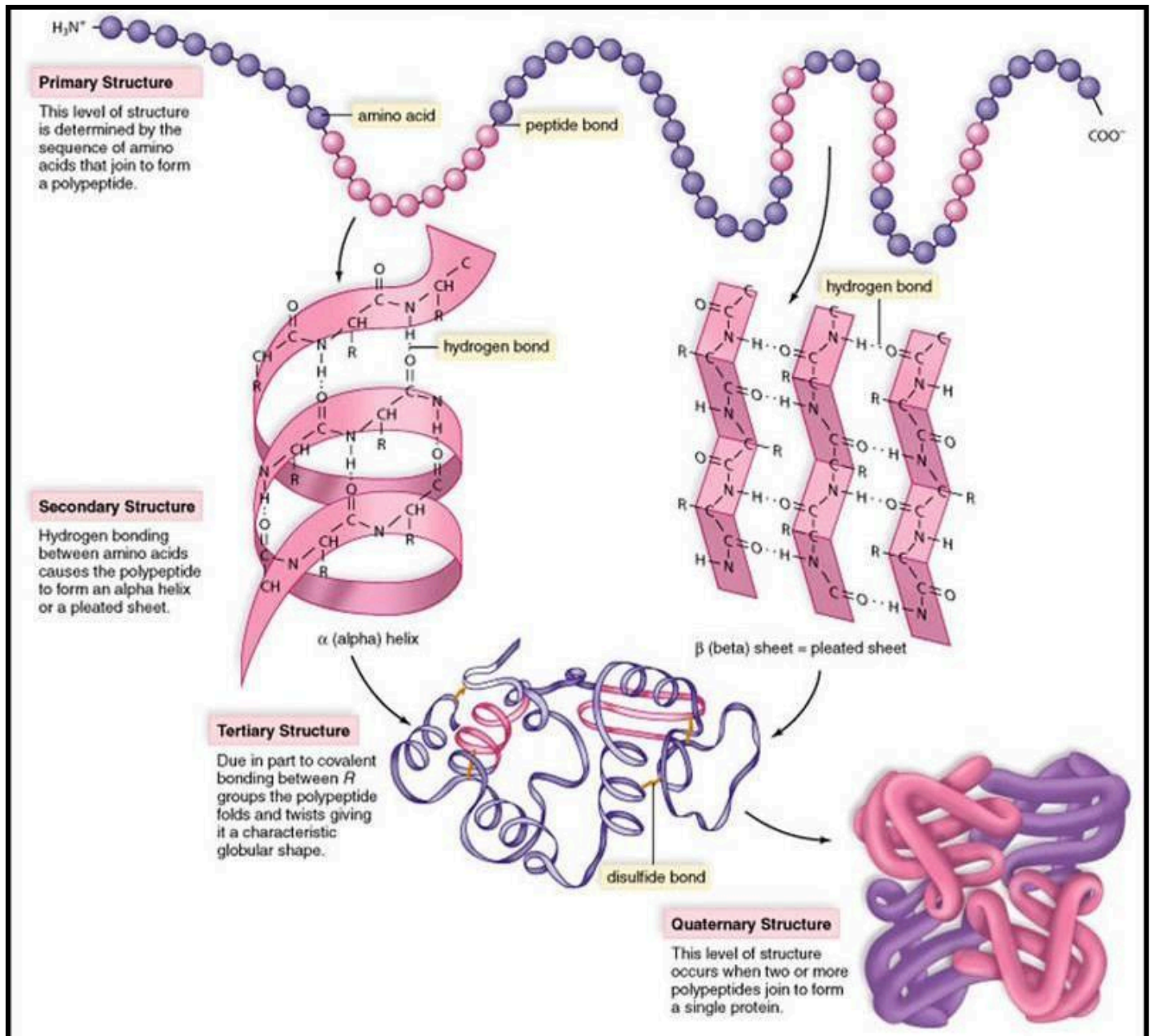
A functional protein may contain one or more polypeptides.

5. Give examples of proteins that consist of one or more polypeptides.

Protein	Number of polypeptide chains	Structure (globular or fibrous)and function
Haemoglobin	4	<ul style="list-style-type: none">→ Globular (biochemical role in red blood cells)→ Contains 4 heme groups with an Fe^{3+} ion at the centre→ Carries an oxygen molecule on each of its 4 heme groups
Collagen	3	<ul style="list-style-type: none">→ Fibrous (structural) provides support for tissues and organs.→ 3 polypeptides chains folded into a left handed single helix.
Antibodies	4	<ul style="list-style-type: none">→ Globular→ Contains variable regions, with unique shape due to tertiary structure that are complementary to the antigens on the surface of pathogens.
Insulin	6	<ul style="list-style-type: none">→ Insulin can form into granules consisting of 6 insulin polypeptide units grouped around 2 zinc ions.→ active form is a single unit polypeptide

Protein structure.

The role of hydrogen bonds, ionic bonds and disulfide bridges in the structure of proteins.



→ The relationship between primary, secondary, tertiary and quaternary structure, and protein function.

6. What are the four levels of protein structure?

Primary structure - determined by the sequence of amino acids that builds the polypeptide.

Secondary structure - alpha helix and beta pleated sheet.

Tertiary structure - Referring to the three dimensional shape of the protein.

Quaternary structure - Two or more polypeptides join to form a single protein.

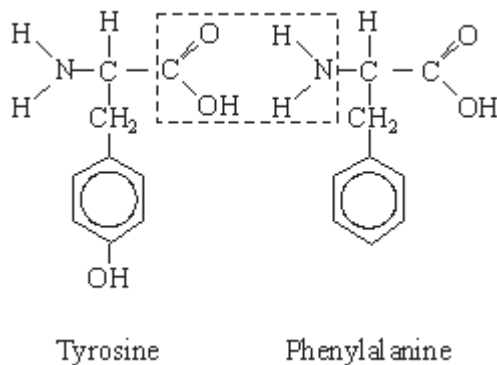
7. Describe and explain the bonds which are involved at each level of protein structure.

Bond	How this bond relates to protein structure.
Peptide	<ul style="list-style-type: none"> → Covalent bond between amino acids. → Contributes to the primary structure of the polypeptide.
Hydrogen	<ul style="list-style-type: none"> → Alpha Helix → Beta pleated sheet. → Both structures are held in shape by hydrogen bonds, which form between the carbonyl O of one amino acid and the amino H of another. → No R groups are involved.
Disulphide	<ul style="list-style-type: none"> → The tertiary structure is primarily due to interactions between the R groups of the amino acids that make up the protein. → Disulfide bonds (sulfur bridges) form between two cysteine's (an amino acid with sulfur as part of its R group structure)
Ionic	<ul style="list-style-type: none"> → The tertiary structure is primarily due to interactions between the R groups of the amino acids that make up the protein. → R groups with like charges repel one another, while those with opposite charges can form an ionic bond.

Practice Questions.

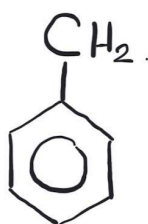
1.

→ The diagram shows the structure of two amino acid molecules, tyrosine and phenylalanine.



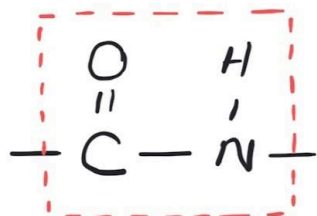
→ Copy from the diagram the R group in the phenylalanine molecule.

PHENYLALANINE R GROUP.



→ In the space below, draw the chemical bond formed when these two amino acids are joined by condensation.

CHEMICAL BOND - PEPTIDE BOND.



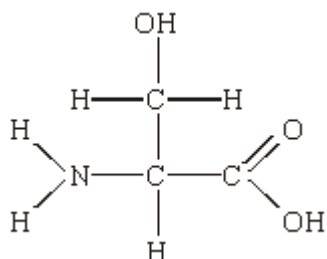
(2)

Name this bond.

Peptide Bond

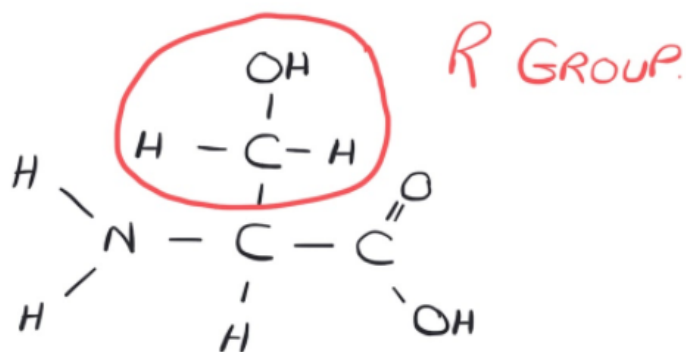
(1)

Q2. The diagram shows the structure of the amino acid serine.



(a) (i) Draw a box on the diagram around the R group of serine and label the box with the letter R.

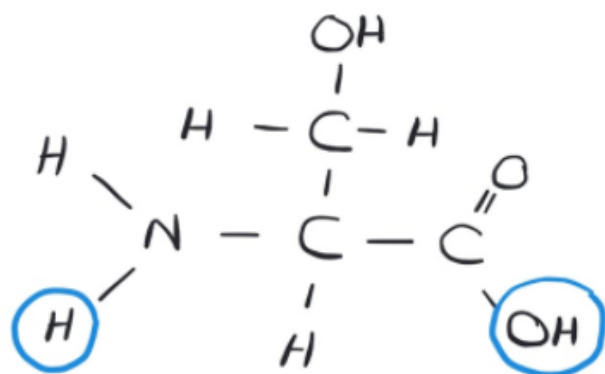
SERINE.



(1)

(ii) Draw a circle around each of the parts of the serine molecule which would be removed when two other amino acid molecules join directly to it.

(1)



REMOVED DURING
CONDENSATION

(b) (i) Which two substances are formed when two amino acid molecules join together?

1. Dipeptide
2. Water

(1)

(ii) Name the type of bond formed between the joined pair of amino acid molecules.

Peptide

(1)

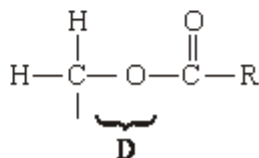
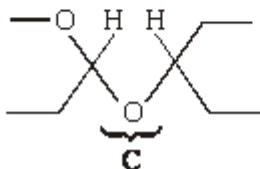
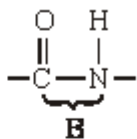
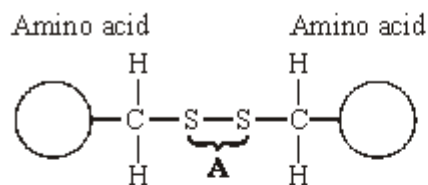
(c) Explain how a change in the primary structure of a globular protein may result in a different three-dimensional structure.

A change in primary structure results in a different amino acid, changing the amino acid sequence.
This change can result in a Hydrogen bond, ionic bond or disulphide bond not being able to form
Changing the tertiary / 3D structure of the globular protein formed.

(3)

(Total 7 marks)

Q3. The diagrams show four types of linkage, A to D, which occur in biological molecules.



(a) Name the chemical process involved in the formation of linkage B.

Condensation reaction

(1)

(b) Give the letter of the linkage which may occur in the tertiary, but not the primary structure of protein.

A - This is a disulphide bond formed between two Cysteines

(1)

FYI

A - Disulphide Bond

B - Peptide Bond

C - Glycosidic Bond

D - Ester bond

