Question 29 **(11 marks)**

Keratin is a substance made up of several different proteins that form the structure of various anatomical features such as human hair and nails.

(a) Keratins are known to contain relatively large amounts of the α-amino acid valine. A property of α-amino acids is that they can form zwitterions.

(i) Draw the structure of valine as a zwitterion. (2 marks)

(ii) State the condition that is required for zwitterions of α-amino acids to form in aqueous solution. (1 mark)

(b) The strength of hair keratin is attributed to a relatively high content of the α-amino acid cysteine.

(i) State which interaction is possible in proteins due to the presence of cysteine. (1 mark)

(ii) Define 'protein tertiary structure' and describe how it is formed. (3 marks)

Definition: _____

_____

Description: _____

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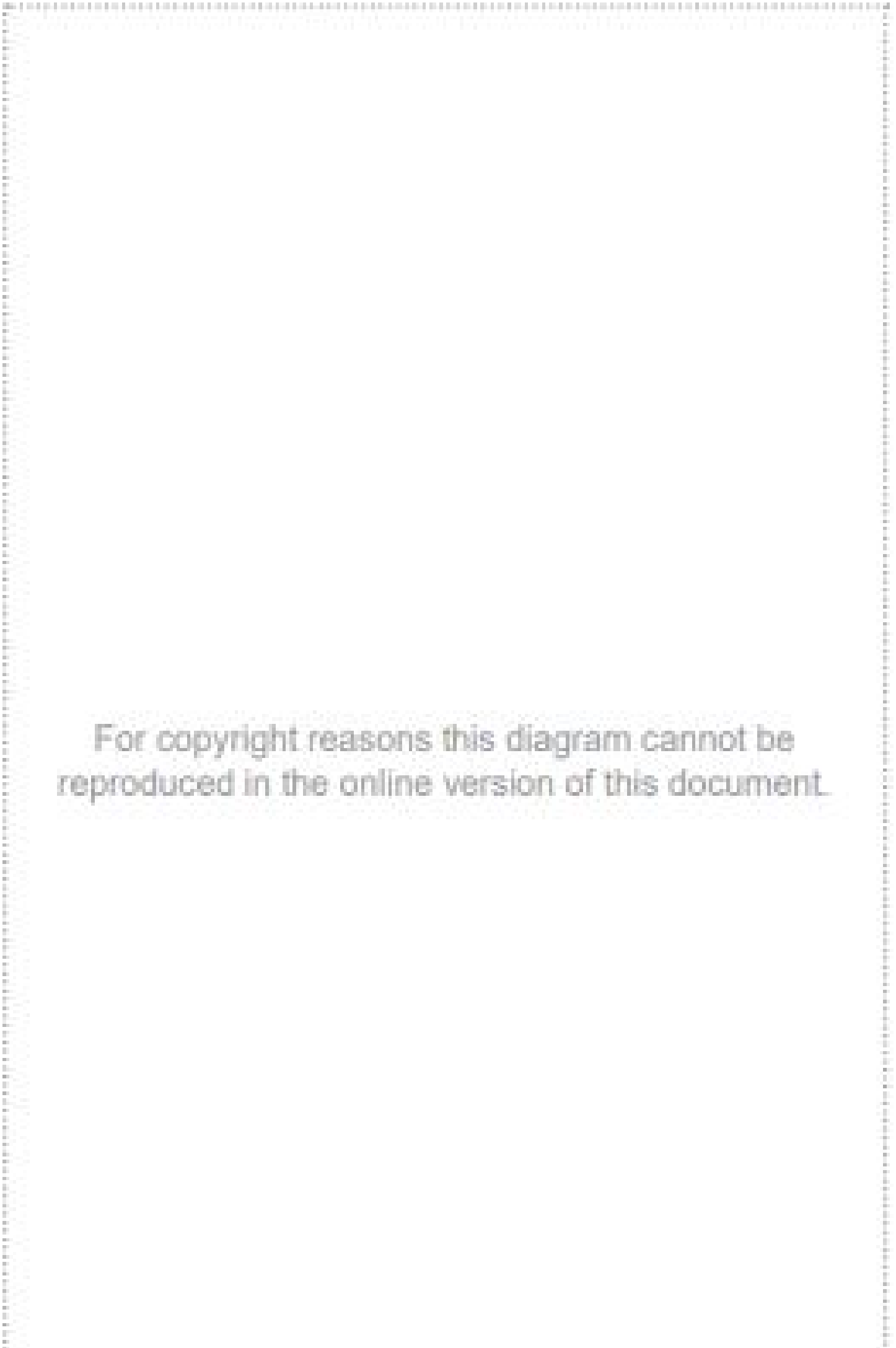
(c) Proteins are distinguished at the level of the primary structure. Describe this level of protein structure. (2 marks)

The α-helix is a common secondary structure observed in keratins.

(d) Draw dotted lines (.....) on the diagram below to show the position of at least **two** hydrogen bond interactions that stabilise the helical shape. (1 mark)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(e) Identify **one** α-amino acid from the Data booklet with a non-polar side chain. (1 mark)

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