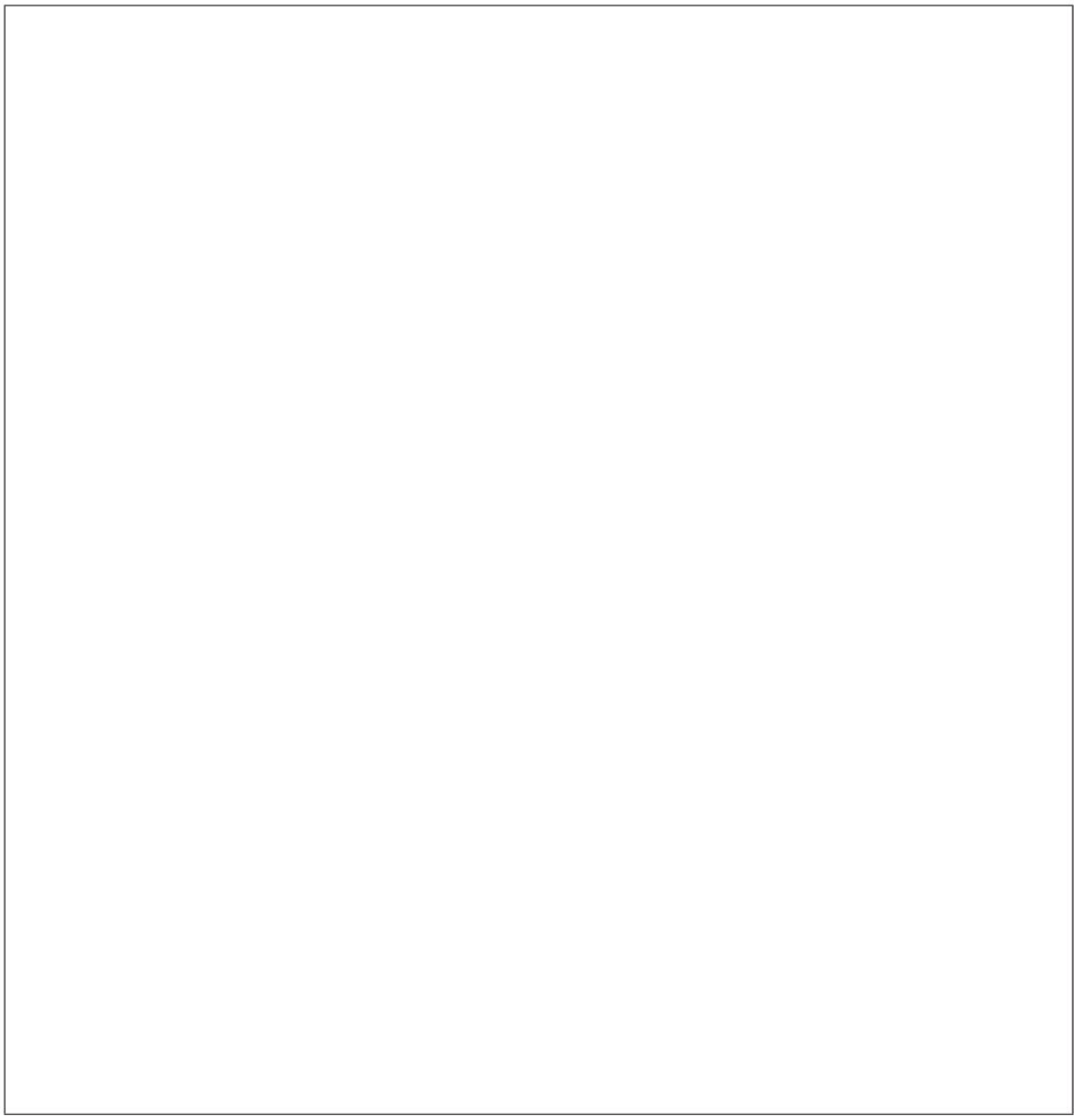
Question 40 **(15 marks)**

The properties of human hair can be attributed to it being composed almost entirely of the strong fibrous protein, keratin.

Structure of keratin:

- Keratin is a polypeptide and consists of a repeating pattern of amino acids.
- Common amino acids in keratin, in order from most to least abundant, are:
  cysteine (17.5%), serine, glutamic acid, threonine, glycine, leucine, valine, arginine, aspartic acid and alanine (4.8%).

(a) Draw a section of the polypeptide that is composed of the **three** most abundant amino acids found in keratin. (4 marks)



(b) With reference to the structure drawn in part (a), state **three** types of attractive forces/bonding other than dispersion forces, that can occur **between** neighbouring keratin polypeptide chains. (3 marks)

One: _____

Two: _____

Three: _____

(c) Describe the α-helix structure of keratin. (2 marks)

_____

_____

_____

_____

One of the physical properties of hair is its capacity to absorb water, increasing a strand's diameter by roughly 20%.

(d) State why hair can absorb water. (1 mark)

_____

_____

Keratin is often chemically analysed for cysteine, due to its effect on the strength of hair. One method of determining the proportion of cysteine is titration with bromide in an acidic solution. Under these conditions, the cysteine is oxidised to cystine and then to cysteic acid.

Two cysteine molecules joined together by a disulfide bond is called cystine.

(e) Draw the structure of cystine. (2 marks)

(f) On the structural formula of cysteic acid drawn below, circle and label any functional groups as acidic or basic. (3 marks)