Worksheet 13.4
Protein structure and function

NAME: **CLASS:**

INTRODUCTION

Proteins are very important molecules in living things. As chemicals, they are examples of natural polymers, but their structure and chemistry is complex. The following questions consider aspects of the structure and function of proteins. You may need to refer to the textbook and a general chemistry reference book for information for some of these questions.

No.	Question	Answer
1	**a** Draw the general structure of an α-amino acid. **b** Draw two examples of amino acids other than glycine and alanine.	
2	Draw the two dipeptides that can be formed from the amino acids drawn in question **1b**.	
3	For the amino acid valine, draw its: **a** likely structure at pH 2 **b** likely structure at pH 12 **c** zwitterion form.	

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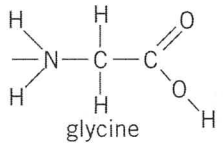
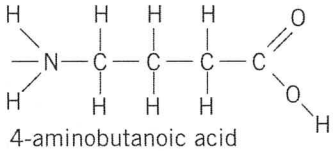
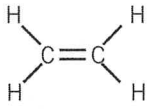
No.	Question	Answer
4	How many water molecules are formed when: **a** 2 amino acids join? **b** 3 amino acids join? **c** 5 amino acids join? **d** 1000 amino acids join?	
5	**a** Draw a section of the polymer formed from each of the monomers shown below. **i**  glycine **ii**  4-aminobutanoic acid **iii**  ethene **b** Name the type of polymerisation (addition or condensation) for each of the polymers formed in part **a**. **c** How does a protein differ from the first polymer drawn in part **a**?	

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6	Amino acids contain nitrogen and oxygen atoms, both of which introduce significant dipoles into the structure of molecules that include these atoms. Use a diagram to explain how these dipoles are involved in the secondary structure of a protein molecule.	
7	Many proteins also have a tertiary structure. The tertiary structure can be used to explain how enzymes function. **a** What is an enzyme? **b** Give one example of an enzyme that catalyses a particular reaction in the human body.	
8	Some drugs are described as 'blockers'. They take up an active site on an enzyme and inhibit undesirable reactions from occurring. Draw a diagram to explain how you think a blocker might work.	
9	When a few drops of vinegar are added to milk, the milk curdles, forming lumps. How is this change related to the tertiary structure of a protein?	
10	Acid and heat are known to denature proteins. Name two other agents that can cause denaturation of proteins.	

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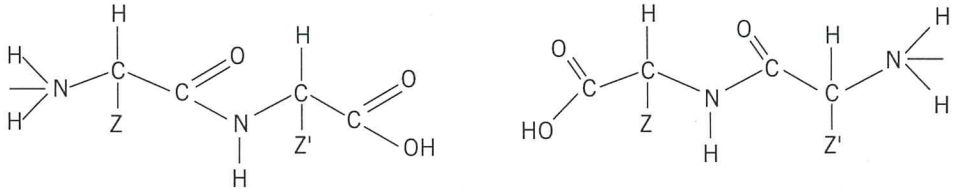
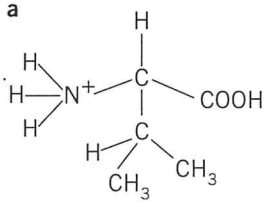
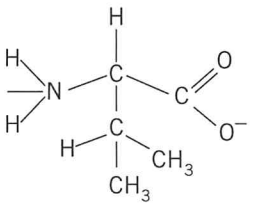
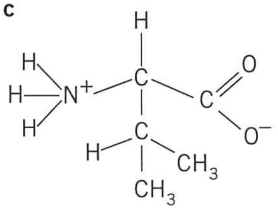
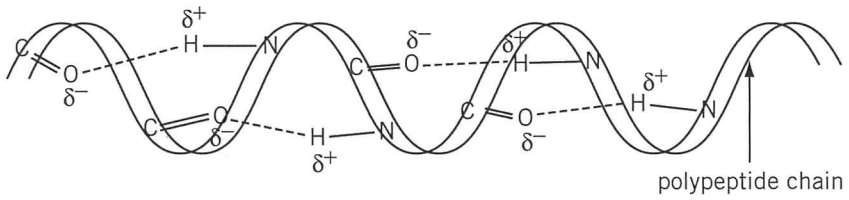
No.	Answer
1	**a** Refer to Figure 12.23 on page 345 of the textbook. Note that the COOH and NH_2 groups are attached to the same carbon atom. **b** Refer Figures 12.23 and 13.8 for examples of amino acids.
2	
3	**a**  **b**  **c** 
4	**a** 1 **b** 2 **c** 4 **d** 999 (in general $n - 1$)
5	**a i** $-NHCH_2CONHCH_2CONHCH_2CO-$ **ii** $-NH(CH_2)_3CONH(CH_2)_3CONH(CH_2)_3CO-$ **iii** $-CH_2CH_2CH_2-$ **b i** Condensation **ii** Condensation **iii** Addition **c** A protein has a complex sequence of many different amino acids. It does not use a single monomer like this.
6	 The oppositely charged dipole ends along the chain align, as the chain forms a helix.

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No.	Answer
7	**a** An enzyme is a biological catalyst. It is a protein with a specific 3D structure. It is this structure/shape that allows it to catalyse a particular reaction. **b** For example: lactase is required for the digestion of milk; sucrase for the breakdown of sucrose and catalase to break down peroxide molecules.
8	'Inhibitors' or blockers can act by either filling the active site on the enzyme, thus making it no longer a catalyst, or by changing the shape of the active site so that it no longer performs its usual function.
9	This is an example of denaturation of the protein (casein) in the milk. Denaturation is a breakdown of the complex tertiary structure of the protein.
10	Strong base, ultraviolet light and other organic molecules can all cause denaturation.