Chemistry in dietetics

Education in Chemistry
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The study of the molecules of nutrients can help a dietician give practical dietary advice

The following questions test your knowledge of proteins, carbohydrates and fats – the three main types of nutrients essential for a healthy diet – as well as enzymes. This knowledge is key background knowledge for anyone studying to become a dietician.

Carbohydrates

1. Celery contains the carbohydrate cellulose, and crisps contain the carbohydrate starch.
   Explain why the body gets more energy from eating crisps than celery.

2. After eating, the pancreas releases insulin. Insulin instructs the liver and other cells to turn glucose into glycogen, which is a branched polymer of glucose. Another hormone called glucagon can instruct the cells to turn glycogen back into glucose.
   Explain how these reactions can regulate blood glucose levels.

3. The hormone insulin is composed of two polypeptide chains linked by two sulfur bridges.
   Explain what a sulfur bridge is.

Fats

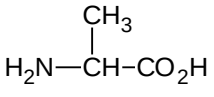
4. When a fat molecule is hydrolysed, three molecules of fatty acids and one other molecule are produced.
   Draw the structure of the other molecule that is not a fatty acid.

5. Octadecanoic acid is a fatty acid with 18 carbon atoms that makes up part of beef fat.
   Z,Z-octadeca-9-12-dienoic acid is a fatty acid that makes up part of sunflower oil.
   The melting point of octadecanoic acid is 70°C.
   The melting point of Z,Z-octadeca-9-12-dienoic acid is -5°C.

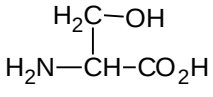
   a) Draw the skeletal formula of Z,Z-octadeca-9-12-dienoic acid.
   b) Explain why the melting points of the two fatty acids are different.

Proteins

The questions in this section will refer to the amino acids below:



alanine



serine

6. Draw the displayed structure of the zwitterion of the amino acid alanine.

7. Explain why amino acids have high melting points.

8. Explain how the amino acid serine can act as buffer.

9. What type of bond holds a polypeptide in an alpha helix shape?

10. Globular proteins often exist in aqueous environments. Polar side groups of amino acids in the protein will be orientated towards the aqueous environment. Non-polar side groups of amino acids tend to be orientated towards the interior of the protein.
Explain what orientation would be likely for alanine and serine within in a globular protein.

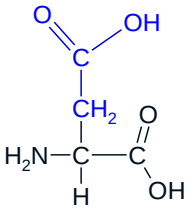
Enzymes

11. Explain what is meant by the lock and key mechanism.

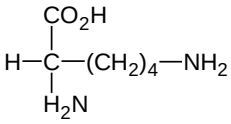
12. Explain the effect of changing temperature on the action of an enzyme.

13. Explain why if a substrate molecule is chiral only one enantiomer will fit in the active site.

14. The tertiary structure of protein such as an enzyme may have ionic interactions holding the protein in shape. Ionic interactions could form between acidic amino acids such as aspartic acid and basic amino acids such as lysine.



aspartic acid



lysine

a) Explain how an ionic interaction can form between the side chains of aspartic acid and lysine in a tertiary protein structure.

b) Explain how increasing the pH may disrupt this ionic interaction and cause the enzyme to denature.