1 Pepsin is an enzyme that digests protein foods in the mammalian stomach.

(a) Protein molecules are made from chains of amino acids.

(i) Name the covalent bond between two adjacent amino acids in a chain of amino acids.

..... **[1]**

(ii) Name the type of reaction involved in breaking this bond **and** describe what happens in this reaction.

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..... **[2]**

(b) Describe how an enzyme, such as pepsin, breaks down a substrate.

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..... **[5]**

(c) A student investigated how changing the pH affected the activity of pepsin.

- He used a blender to make a suspension of egg white (protein) in water.
- At the start of the investigation the suspension was cloudy.
- He prepared fixed concentrations of egg white suspension, acid and pepsin to add to each of six test-tubes.
- He removed 0.1 cm^3 of the mixture from each test-tube and used universal indicator to measure the pH of each mixture.
- He incubated each test-tube in a water bath at 35 °C and timed how long it took for the egg white suspension in each tube to clear.
- He prepared a table in which he recorded his results (Table 1.1).

Tube	Volume of egg white suspension	Volume of acid added (cm^3)	Amount of pepsin added (cm^3)	Measured pH	Time for suspension to clear (m)
1	5	2.0	3.0	1	
2	5	1.5	3.0	2	
3	5	1.0	3.0	3	
4	5	0.5	3.0	4	
5	5	0.0	3.0	5	
6	5	2.0	0.0	1	

Table 1.1

(i) Identify **three** errors the student made in the preparation of his **table** before he recorded his results.

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3 .....

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[3]

(ii) Identify a change the student could make to his procedure that would increase the **validity** of the investigation.

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..... **[1]**

(iii) State the term that best describes the purpose of **tube 6**.

..... **[1]**

(iv) Another student suggested that he should repeat the investigation at least twice.

How would this have improved the investigation?

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..... **[2]**

(d) Fig. 1.1 shows the effect of increasing the substrate concentration on the rate of activity of pepsin.

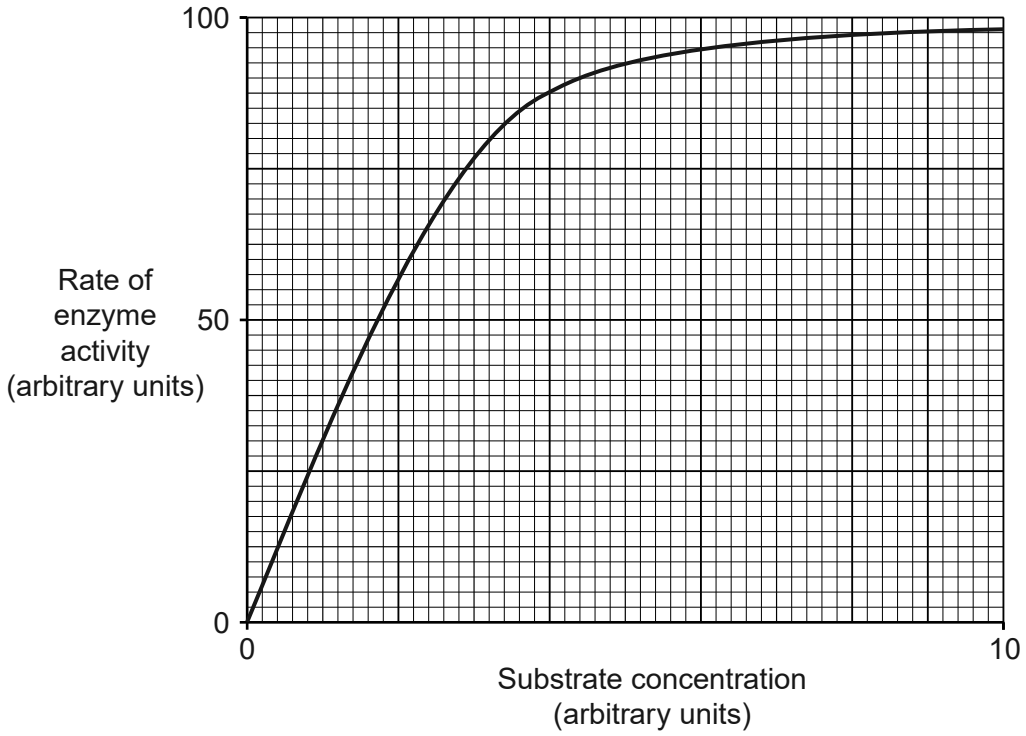


Fig. 1.1

(i) Pepstatin is a competitive inhibitor of pepsin.

On Fig. 1.1, draw a line to represent the effect of adding a fixed concentration of pepstatin on the rate of pepsin activity over the whole range of substrate concentrations.

..... *This should be answered on Fig. 1.1* .....**[2]**

(ii) Pepstatin acts as a competitive inhibitor of pepsin.

What can you conclude about the structure of pepstatin?

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..... **[2]**

[Total: 19]

2 Lipids are a group of fatty or waxy compounds.

Triglyceride, phospholipid and cholesterol are examples of lipid compounds that are important in living organisms.

(a) Table 7.1 lists a number of statements that could apply to these compounds.

Complete the table by indicating with a tick (✓) which of the compounds applies to each statement.

You may use more than one tick in a row.

Statement	Triglyceride	Phospholipid	Cholesterol
Contains only the elements carbon, hydrogen and oxygen			
Insoluble in water			
Contains glycerol			
Contains ester bonds			
Important in membrane structure			
Contains fatty acids			

[6]

Table 7.1

(b) Describe how to do the emulsion test for lipids and how a positive result would be identified.

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..... **[2]**

(c) Lipids form an essential part of a balanced diet. Some food, such as mycoprotein, is produced by microorganisms.

How might the **lipid** content of mycoprotein differ from food that comes from animals?

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..... **[2]**

[Total: 10]

3 Proteins are important biological molecules.

(a) Protein structure can be represented at four levels: primary, secondary, tertiary and quaternary.

Below is a set of features that may be used when describing the structure of a protein such as haemoglobin.

Features	Letter
hydrogen bonds	**A**
peptide bonds	**B**
α and β subunits	**C**
the sequence of amino acids	**D**
the initial folding of the polypeptide chain	**E**
the overall 3D shape	**F**
ionic bonds	**G**

(i) Select the letters of the features that describe the primary level of protein structure.

..... **[1]**

(ii) Select the letter or letters of the feature(s) found in the secondary level of protein structure that are **not** present in the primary structure.

..... **[1]**

(iii) Select the letter or letters of the feature(s) that are found in the tertiary level of protein structure that are **not** present in the primary and secondary structures.

..... **[1]**

(iv) Select the letter or letters of the feature(s) found only in the quaternary level of protein structure.

..... **[1]**

(b) Hydrogen bonds also form between water molecules.

(i) Describe the formation of a hydrogen bond between two molecules of water and explain why water can form these bonds.

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..... **[3]**

(ii) Hydrogen bonds allow water to act as a solvent.

Why is the ability of water to act as a solvent important for the survival of organisms?

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..... **[3]**

[Total: 10]

4 **(a)** Amino acids form part of the structure of proteins.

(i) State the name given to the sequence of amino acids in a protein molecule.

..... **[1]**

(ii) Draw the **general structure** of an amino acid molecule in the space below.

[3]

(b) Collagen is an important fibrous protein which forms part of the wall of blood vessels.

(i) State **one** property of collagen that makes it a useful component of blood vessel walls.

..... **[1]**

(ii) Describe the **structure** of the collagen molecule.

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..... **[6]**

(c) Another protein that is important in mammals is haemoglobin.

(i) State **one** function of haemoglobin.

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..... **[1]**

(ii) Haemoglobin contains a prosthetic group known as haem.

Collagen does not contain a prosthetic group.

Describe **three** other ways in which the structure of haemoglobin differs from that of collagen.

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[3]

[Total: 15]