OXFORD
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I declare this is my own work.

# INTERNATIONAL AS
# BIOLOGY (9610)

## Unit 1 The Diversity of Living Organisms

Monday 4 January 2021  07:00 GMT  Time allowed: 1 hour 30 minutes

**Materials**
For this paper you must have:
- a ruler with millimetre measurements
- a scientific calculator, which you are expected to use where appropriate.

**Instructions**
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided.
  Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

**Information**
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

| For Examiner's Use | |
|---|---|
| Question | Mark |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| **TOTAL** | |

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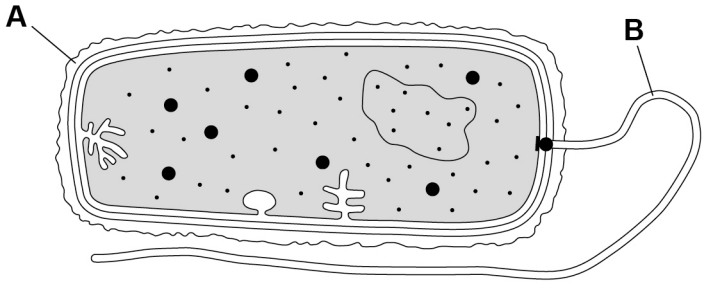
Answer **all** questions in the spaces provided.

**0 1** **Figure 1** shows the structure of a bacterial cell.

**Figure 1**




**0 1 . 1** Name the structures labelled **A** and **B** in **Figure 1**.

**[2 marks]**

Structure **A** _____

Structure **B** _____

**0 1 . 2** Name **one** structure found in a bacterial cell that is **also** found in a eukaryotic cell.

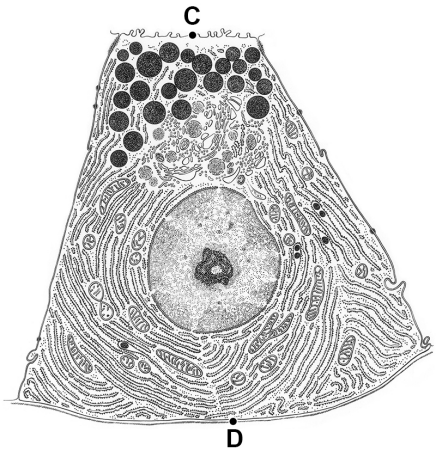
**[1 mark]**

_____

**Figure 2** shows a drawing of a cell from the pancreas.

The magnification of the cell is x8000

**Figure 2**



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**0 1 . 3** Calculate the actual length of the cell shown in **Figure 2** from **C** to **D**.

Give your answer in μm.

**[2 marks]**

Actual length **C** to **D** = _____ μm

**0 1 . 4** An electron microscope was used for viewing the cell shown in **Figure 2**.

Give **two** reasons for using an electron microscope instead of a light microscope.

**[2 marks]**

Reason 1 _____

_____

_____

Reason 2 _____

_____

_____

The pancreas produces enzymes and hormones.

**0 1 . 5** Complete the table by stating **one** function for each organelle in a cell from the pancreas.

**[3 marks]**

| **Organelle** | **Function** |
|---|---|
| Mitochondria | |
| Rough endoplasmic reticulum | |
| Golgi apparatus | |

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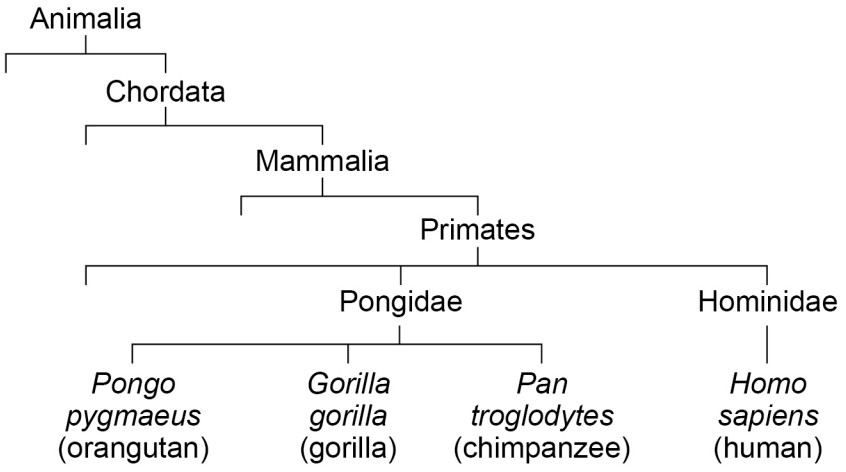
**0 2** **Figure 3** shows the classification of some primates.

The classification uses groups called taxa. The taxa are organised into a hierarchy.

**Figure 3**




**0 2 . 1** Define hierarchy.

**[2 marks]**

Use **Figure 3** to answer Questions **02.2** and **02.3**.

**0 2 . 2** State the class these primates are in.

**[1 mark]**

**0 2 . 3** State the genus of the chimpanzee.

**[1 mark]**

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**Question 2 continues on the next page**

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**ANSWER IN THE SPACES PROVIDED**

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Scientists discovered the body of an ape-like animal, **Species X**, frozen in ice in Siberia.

The scientists extracted a protein called albumin from the blood of **Species X**.

There are differences in the amino acid sequence of albumin in different species of animal.

The scientists used the principles of immunology to compare different albumins from different species:

- the scientists inject albumin from **Species X** into a rabbit
- the rabbit's white blood cells produce antibodies specific to the **Species X** albumin
- the antibodies cause the albumin molecules to clump together and form a precipitate.

**Figure 4** shows the procedure the scientists used.

**Figure 4**

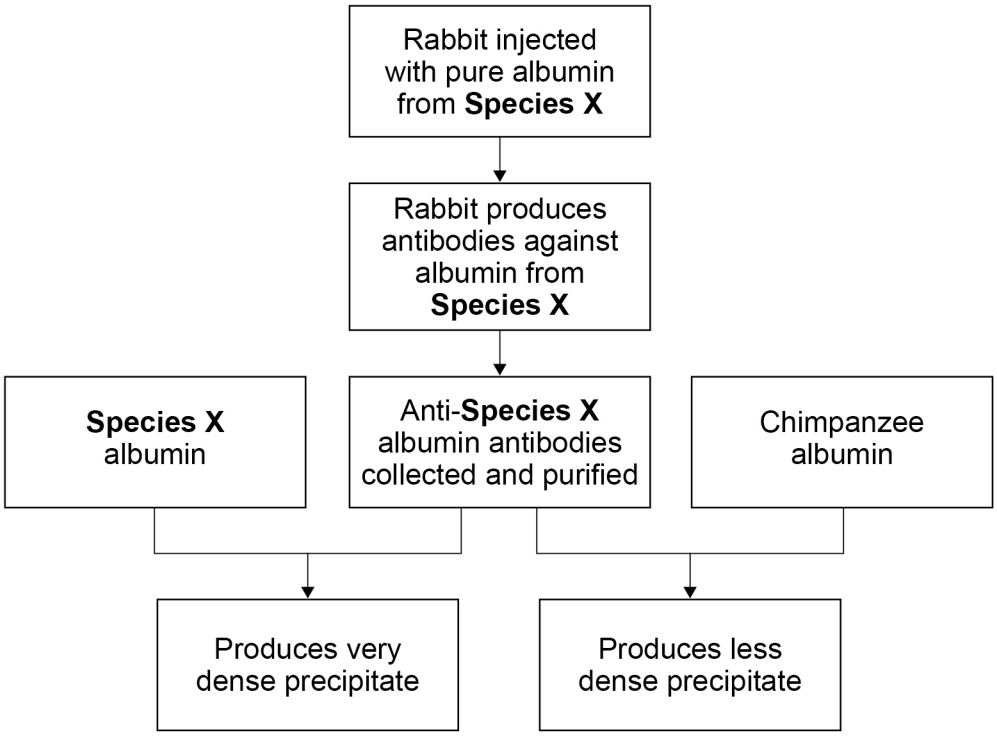


**Table 1** shows the scientists' results.

**Table 1**

| Species tested against anti-**Species X** albumin antibodies | Density of precipitate as percentage of the amount of precipitate with **Species X** albumin |
|---|---|
| **Species X** | 100 |
| Chimpanzee | 95 |
| Gorilla | 95 |
| Orangutan | 85 |

Do not write outside the box

**0 2 . 4** Explain why the chimpanzee albumin produces a less dense precipitate than the **Species X** albumin when added to the anti-**Species X** albumin antibodies.

**[2 marks]**

_____

_____

_____

_____

_____

_____

**0 2 . 5** Give **two** conclusions the scientists could make from the results in **Table 1** about the taxonomic relationships between **Species X** and the other primates.

**[2 marks]**

1 _____

_____

_____

2 _____

_____

_____

**Question 2 continues on the next page**

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Another method scientists use to confirm taxonomic relationships is to compare amino acid sequences for important proteins such as haemoglobin.

**Table 2** shows a comparison of the positions of five amino acids in the haemoglobin of the four species from **Table 1** (on page 6).

**Table 2**

| **Species** | **α chain** | | **β chain** | | |
|---|---|---|---|---|---|
| | Position 11 | Position 23 | Position 87 | Position 104 | Position 115 |
| **Species X** | Ala | Glu | Thr | Arg | Pro |
| Chimpanzee | Ala | Glu | Thr | Arg | Pro |
| Gorilla | Ala | Asn | Thr | Lys | Pro |
| Orangutan | Thr | Asn | Lys | Arg | Gln |

**0 2 . 6** Complete **Table 3** to show the number of amino acids in the same positions in the four species.

Use information from **Table 2**.

**[1 mark]**

**Table 3**

| | **Species X** | Chimpanzee | Gorilla | Orangutan |
|---|---|---|---|---|
| **Species X** | | | | |
| Chimpanzee | | | | |
| Gorilla | | | | |
| Orangutan | | | | |

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**0 2 . 7** The scientists conclude that the comparison of amino acid positions supports the results of the immunological study shown in **Table 1** (on page 6).

Give evidence for and against the scientists' conclusion.

**[2 marks]**

Evidence for the scientists' conclusion. _____

_____

_____

_____

Evidence against the scientists' conclusion. _____

_____

_____

_____

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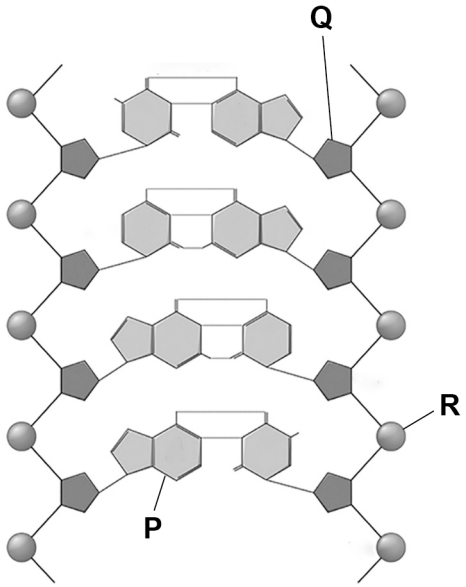
**0 3** **Figure 5** shows part of a DNA molecule.

**Figure 5**




**0 3 . 1** Name the structures labelled **P**, **Q** and **R** in **Figure 5**.

**[3 marks]**

Structure **P** _____

Structure **Q** _____

Structure **R** _____

**0 3 . 2** Describe **two** differences between a molecule of DNA and a molecule of mRNA.

**[2 marks]**

Difference 1 _____

_____

_____

Difference 2 _____

_____

_____

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**0 3 . 3** Describe the role of tRNA in the process of translation.

**[3 marks]**

**Figure 6** shows the sequence of bases in a section of DNA that codes for a polypeptide containing seven amino acids.

**Figure 6**

TACAAGGTCGTCTTTGTCAAG

Hydrolysis of the polypeptide produced the four different amino acids shown in **Table 4**.

**Table 4**

| Amino acid | Number present |
|---|---|
| Phe | 2 |
| Met | 1 |
| Lys | 1 |
| Gln | 3 |

**0 3 . 4** Give the amino acid sequence in the polypeptide.

Use the base sequence shown in **Figure 6**.

Write your answer in **Table 5**.

**[2 marks]**

**Table 5**

| | | | | | | |
|---|---|---|---|---|---|---|
| Met | | | | | | |

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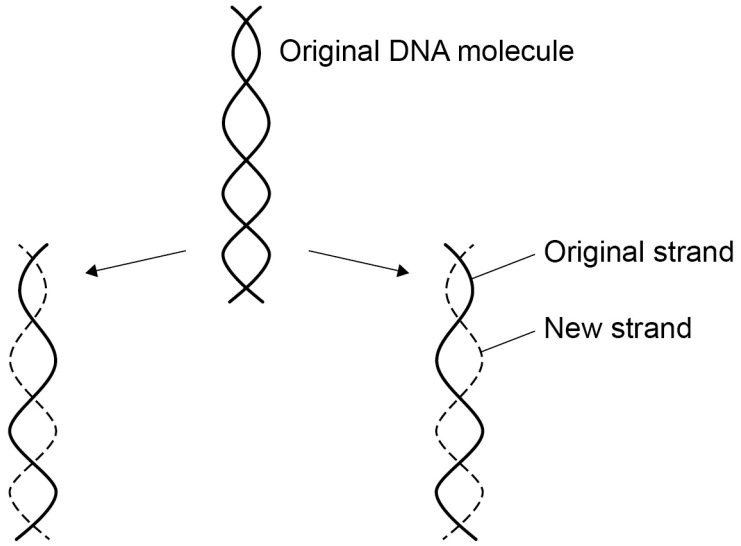
**0 4** **Figure 7** shows the process of DNA replication.

**Figure 7**




**0 4 . 1** Explain why the process of DNA replication is described as semi-conservative.

**[2 marks]**

Bacteria must have a supply of nitrogen to make the bases used for DNA replication.

In an investigation into DNA replication:

- a group of bacteria (group **X**) was grown for many cell divisions with a supply of nitrogen, $^{14}N$.
- a second group of bacteria (group **Y**) was grown for many cell divisions with a supply of 'heavy' nitrogen, $^{15}N$.
- some of the bacteria grown with the $^{15}N$ were then removed, given $^{14}N$ and allowed to divide **once** (group **Z**).

DNA was isolated from each group of bacteria and centrifuged.

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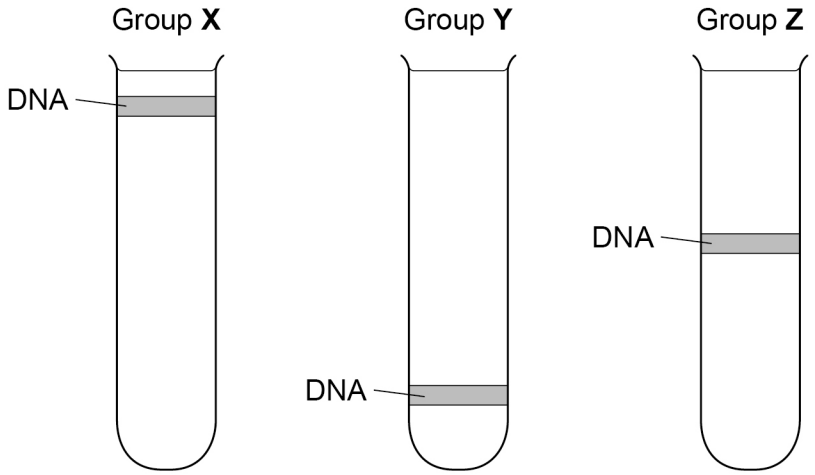
**Figure 8** shows the DNA bands formed in the centrifuge tubes.

**Figure 8**




**0 4 . 2** Describe how the DNA is isolated from the bacteria.

**[2 marks]**

**0 4 . 3** What do the tubes from group **X** and group **Y** show about the density of DNA found in the two different groups of bacteria?

**[1 mark]**

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**0 4 . 4** Explain the position of the DNA band formed from the bacteria in group **Z**.

**[2 marks]**

7

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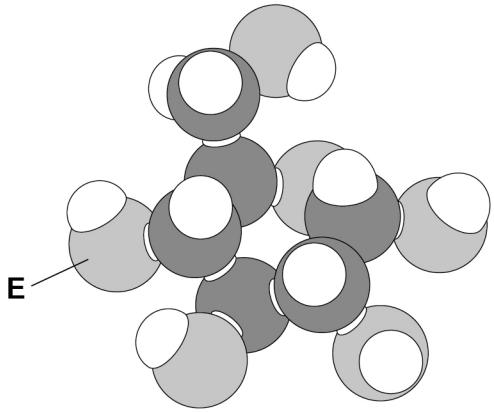
**0 5** Scientists use physical 3D models to represent biological molecules.

**Figure 9** shows a model of an α-glucose molecule.

**Figure 9**




**0 5 . 1** Name the element represented by **E** in **Figure 9**.

**[1 mark]**

Element **E** = _____

**0 5 . 2** α-glucose and β-glucose are known as **isomers**.

Define **isomer**.

**[1 mark]**

_____

_____

_____

**0 5 . 3** α-glucose can form 1,4 and 1,6 glycosidic bonds.

Name **one** polysaccharide that contains 1,4 and 1,6 glycosidic bonds.

**[1 mark]**

_____

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In **Figure 9** the shape representing:

- oxygen has a mass of 6 g
- hydrogen has a mass of 2 g
- carbon has a mass of 5 g

Assume the bonds between the molecules have a mass of zero.

**0 5 . 4** The model of an α-glucose molecule has a mass of 90 g

Show how this number is obtained.

**[2 marks]**

**0 5 . 5** Calculate the mass of a model of a maltose molecule.

**[2 marks]**

Mass of a model of maltose = _____ g

**Question 5 continues on the next page**

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Glycine is an amino acid.

The R-group of glycine is a hydrogen atom.

Glycine contains an element that is not found in α-glucose.

In a model of glycine, the shape representing this element has a mass of 6.5 g

**0 5 . 6** Name the additional element needed to make a molecule of glycine.

**[1 mark]**

_____

**0 5 . 7** Calculate the mass of the model of a glycine molecule.

**[2 marks]**

Mass of the model of a glycine molecule = _____ g

**10**

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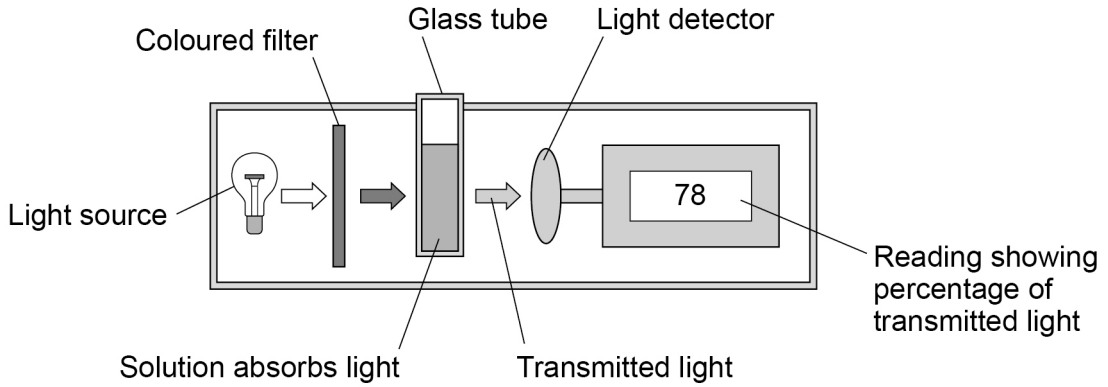
**0 6** Casein is a protein found in milk. It can be hydrolysed by the protease enzyme, trypsin.

Casein forms a cloudy suspension and can be hydrolysed by trypsin to form a clear solution.

The clearer a solution is, the more light can pass through the solution. This means that the progress of the hydrolysis of casein can be monitored using a colorimeter.

**Figure 10** shows a colorimeter.

**Figure 10**




Students investigate the effect of the concentration of casein on the rate of hydrolysis using trypsin.

The students:

1. make 10 $cm^3$ of a 0.8% trypsin solution
2. make a suspension of casein of concentration 0.1 g $dm^{-3}$
3. mix 2 $cm^3$ of the casein suspension with 1 $cm^3$ of the trypsin solution in a glass tube
4. put the glass tube into the colorimeter and set the percentage transmission to zero
5. measure the percentage transmission at 1-minute intervals for 8 minutes
6. wash out the glass tube with distilled water and dry it thoroughly
7. repeat steps 2 to 6 using concentrations of casein from 0.2 g $dm^{-3}$ to 0.5 g $dm^{-3}$

**0 6 . 1** Name a piece of laboratory apparatus that the students could use for measuring the volume of the solutions precisely.

**[1 mark]**

_____

**Question 6 continues on the next page**

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**0 6 . 2** Suggest why the students wash the glass tube with distilled water and why they dry it thoroughly between each set of readings.

**[2 marks]**

Washing _____

Drying _____

**0 6 . 3** The students are not able to keep the temperature constant during the experiment.

Name **the other variable** the students do not control.

Describe how this variable could be controlled.

**[2 marks]**

Name of variable _____

How this variable is controlled _____

_____

This method uses a colorimeter to monitor the progress of the reaction.

An alternative method can be used to obtain data for this experiment. An 'X' is drawn on the outside of the glass tube. The students look through the solution and time how long it takes before the 'X' can be seen.

**0 6 . 4** Explain the limitations of this method.

**[2 marks]**

_____

_____

_____

_____

_____

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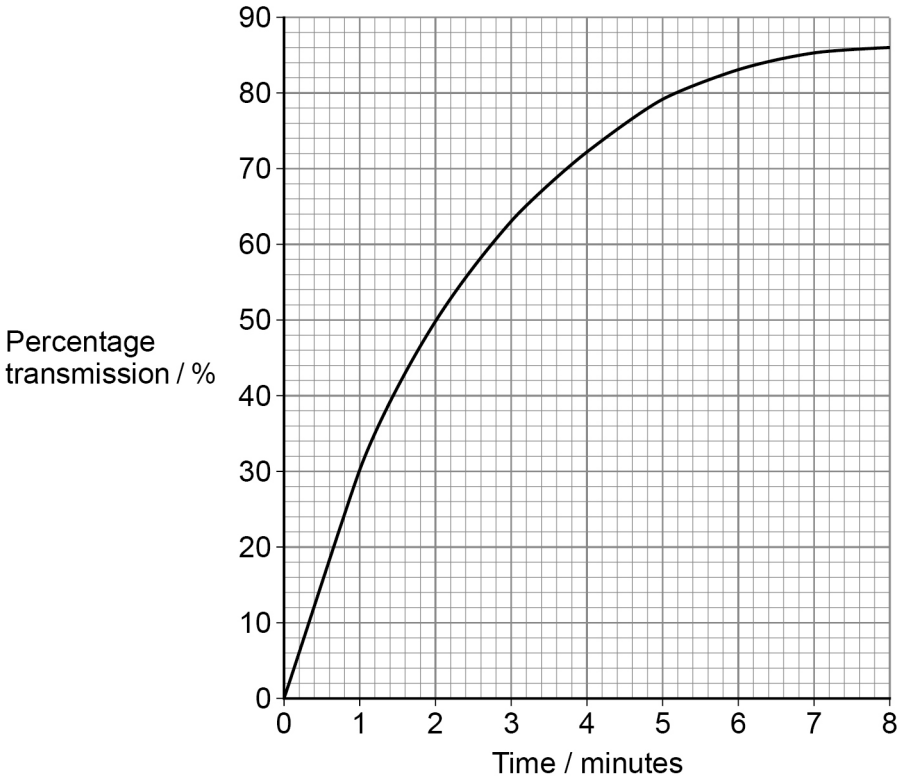
**Figure 11** shows the data the students obtain for the hydrolysis of casein using trypsin, at a casein concentration of 0.2 g $dm^{-3}$

**Figure 11**




**0 6 . 5** Calculate the rate of hydrolysis **at** 6 minutes.

**[2 marks]**

Rate of hydrolysis = _____ percentage transmission $min^{-1}$

**Question 6 continues on the next page**

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**0 6 . 6** The rate of hydrolysis at 6 minutes is lower than the initial rate of reaction.

Explain why.

**[2 marks]**

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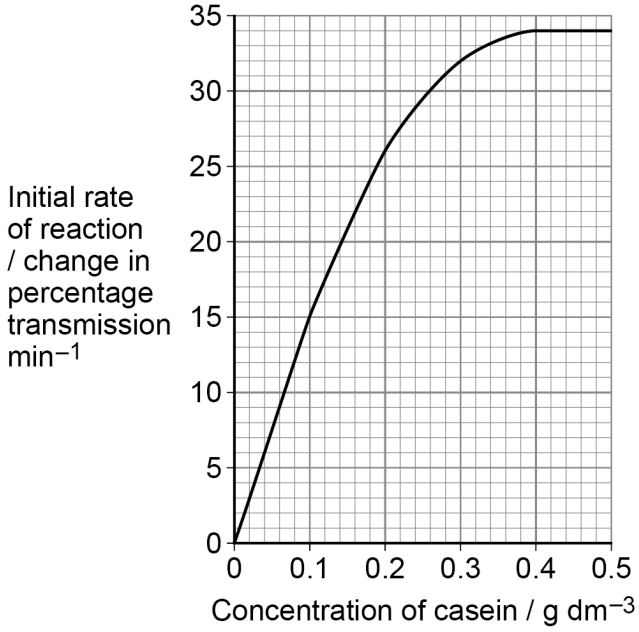
The students calculate the initial rate of reaction for each of the concentrations of casein.

**Figure 12** shows the results.

**Figure 12**




**0 6 . 7** Describe the results, using data from **Figure 12**.

**[2 marks]**

_____

_____

_____

_____

_____

_____

**Question 6 continues on the next page**

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**0 6 . 8** Using information from **Figure 12**, explain what limits the rate of reaction:

- at 0.1 g $dm^{-3}$ of casein
- at 0.5 g $dm^{-3}$ of casein.

**[3 marks]**

At 0.1 g $dm^{-3}$ of casein _____

_____

_____

_____

At 0.5 g $dm^{-3}$ of casein _____

_____

_____

_____

**0 6 . 9** The experiment is repeated using milk instead of casein solution. Although all of the casein has been hydrolysed, the liquid is still not completely clear.

Suggest why.

**[1 mark]**

_____

_____

_____

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**Turn over for the next question**

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**ANSWER IN THE SPACES PROVIDED**

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**0 7** Read the following passage.

Olestra is an artificially manufactured chemical that can be used as a fat substitute in foods. Olestra is made from sucrose and fatty acid chains. Ester bonds join the sucrose to the fatty acid chains. Olestra contains from 6 to 8 fatty acid chains, and these chains can be of different lengths. The different numbers and lengths of fatty acid chains allows the manufacturers to create products with different melting points. **Figure 13** shows a molecule of Olestra containing 8 fatty acid chains.

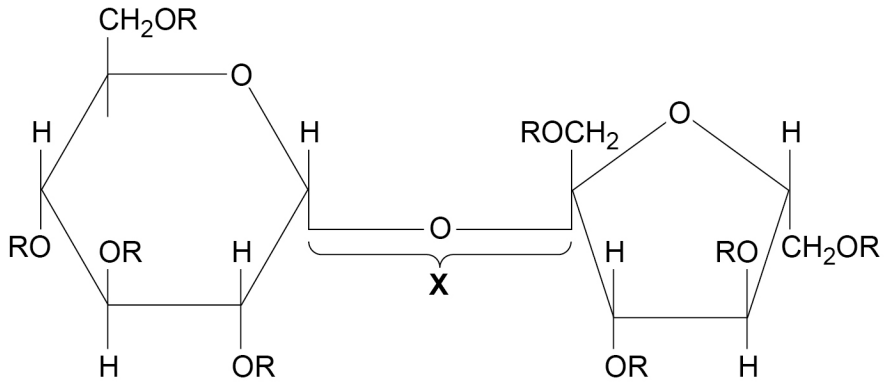
Olestra is not able to move through the walls of the intestine and enter the bloodstream. This means that although Olestra has the same taste as fat, the Olestra passes through the gastrointestinal tract undigested and doesn't contribute calories or nutrients to the diet.

Vitamins are required in the diet for many body functions. Some lipid soluble vitamins dissolve in Olestra. This has resulted in Olestra being banned from sale in the European Union and Canada.

Use information from the passage and your own knowledge to answer the questions.

**Figure 13** shows a molecule of Olestra. **R** represents a fatty acid chain.

**Figure 13**



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**0 7 . 1** Olestra contains sucrose.

Describe the structure of sucrose.

**[2 marks]**

**0 7 . 2** Name the type of reaction that forms the bonds between the sucrose and the fatty acid molecules in Olestra.

**[1 mark]**

**0 7 . 3** Olestra contains from 6 to 8 fatty acid chains (lines 3–4).

Give the number of molecules of water that would be needed to hydrolyse one molecule of Olestra containing 8 fatty acid chains into separate fatty acids and monosaccharides.

**[1 mark]**

**0 7 . 4** The length of the fatty acid chains in Olestra may vary.

State another possible way that the fatty acids may be different from each other.

**[1 mark]**

**0 7 . 5** Suggest why Olestra is **not** able to move through the intestine walls (line 8).

**[1 mark]**

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**0 7 . 6** Give **one** reason why triglycerides are a better way of storing energy than carbohydrates, in the human body.

**[1 mark]**

_____

_____

_____

**0 7 . 7** Olestra can be used as a fat substitute in food.

Describe a biochemical test for fat.

Include a positive result for this test.

**[2 marks]**

Description _____

_____

_____

Positive result _____

_____

_____

**0 7 . 8** Suggest why Olestra has been banned in some countries (lines 12–14).

**[1 mark]**

_____

_____

_____

10

**END OF QUESTIONS**

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