OXFORD AQA
INTERNATIONAL QUALIFICATIONS

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____
I declare this is my own work.

INTERNATIONAL A-LEVEL
BIOLOGY (9610)

Unit 5 Synoptic paper

Monday 20 January 2025 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	
TOTAL	

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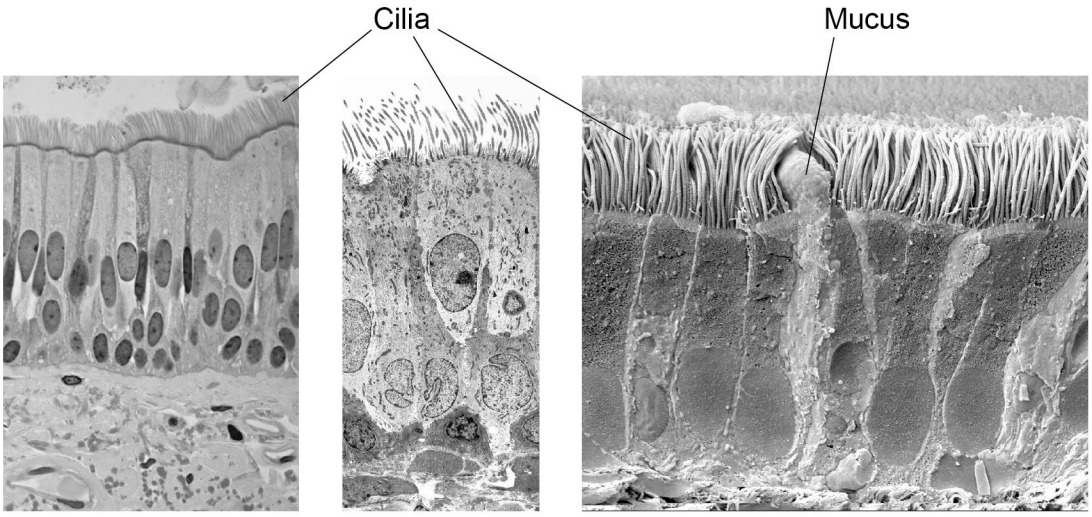
0 1 The trachea takes air to and from the lungs.

The trachea also helps to keep microorganisms out of the lungs.

Figure 1 shows cells that form the inner lining of the human trachea.

Most of the cells have tiny extensions, called 'cilia' (singular 'cilium'). The cilia are at the surface of the cells, in contact with the air in the trachea. Some cells in the lining of the trachea secrete a sticky substance called 'mucus'.

Figure 1



Photograph A **Photograph B** **Photograph C**

0 1 . 1 Photographs **A**, **B** and **C** in **Figure 1** were made using different types of microscope.

Name the type of microscope used for making each photograph.

[3 marks]

A _____

B _____

C _____

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0 1 . 2 **Photograph B** shows the structure of the cells in more detail than **Photograph A**.

Explain why.

[2 marks]

0 1 . 3 Each cilium in **Photograph C** appears as a continuous, 3-dimensional structure.

Many of the cilia in **Photograph B** do **not** appear to be continuous.

Suggest why some cilia in **Photograph B** do **not** appear as continuous structures.

[2 marks]

Question 1 continues on the next page

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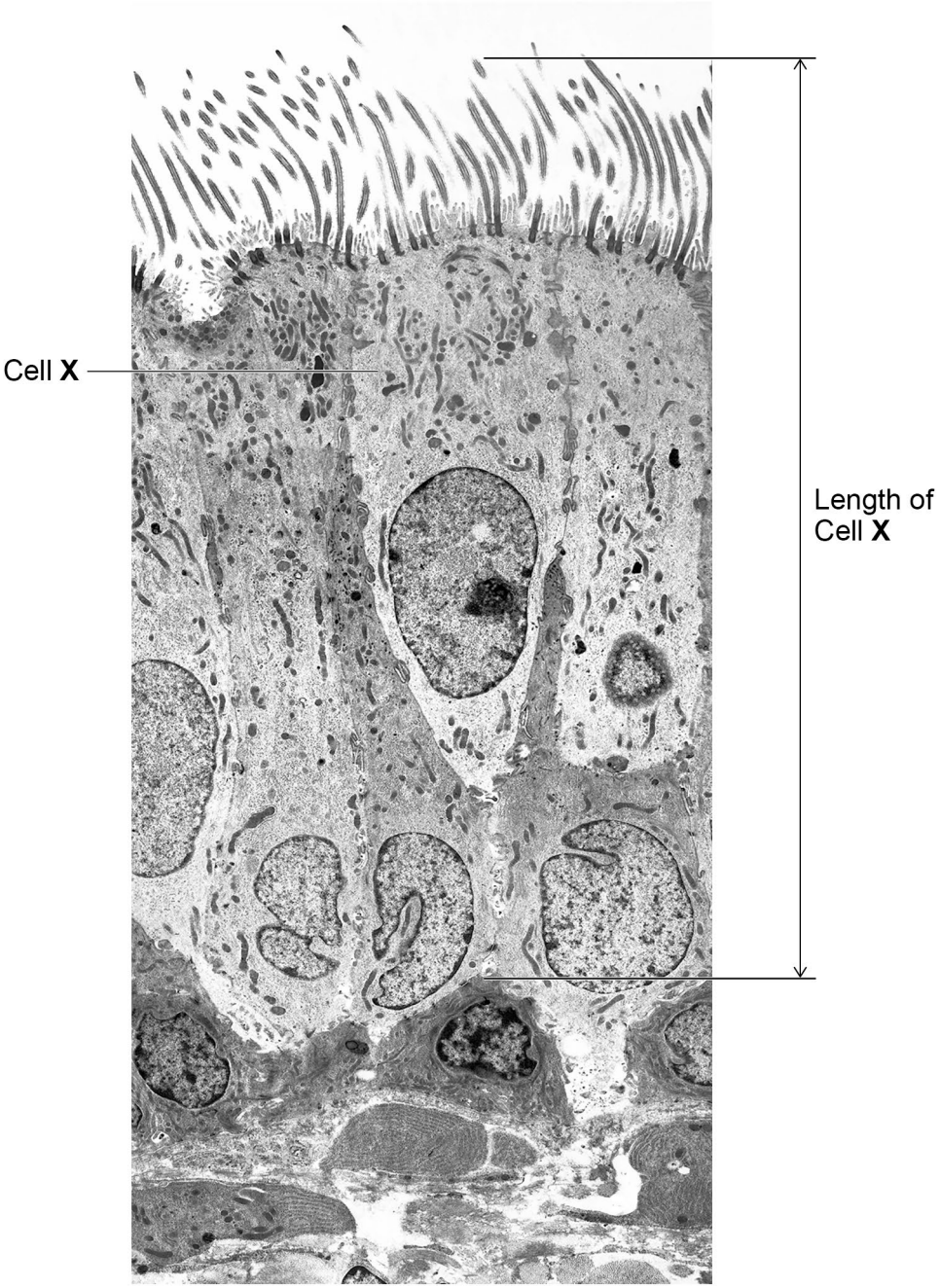
Figure 2 shows **Photograph B** from **Figure 1** (on page 2) at a higher magnification.

Figure 2



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0 1 . 4 Draw a large, clear diagram of cell **X** in **Figure 2**.

[3 marks]

Question 1 continues on the next page

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0 1 . 5 The real length of cell **X** is 60 μm

Calculate the magnification of **Figure 2** (on page 4).

Give your answer to **3** significant figures.

[3 marks]

Magnification = _____

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Question 1 continues on the next page

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0 1 . 6 **Photograph C** in **Figure 1** (on page 2) shows some mucus-secreting cells.

Mucus is a sticky substance.

Microorganisms can be trapped in this mucus.

The cilia beat and move the mucus up the trachea, away from the lungs.

Scientists investigate the effect of smoke from cigarettes on cilia in the human trachea and in the tracheas of mice.

Figure 3 shows the results for the human investigation.

Figure 4 shows the results for the mouse investigation.

The error bars show ± standard errors.

Figure 3

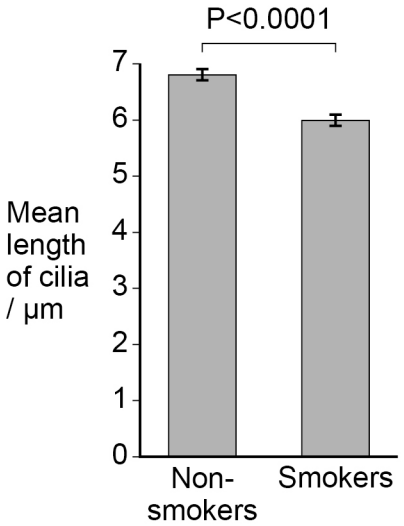
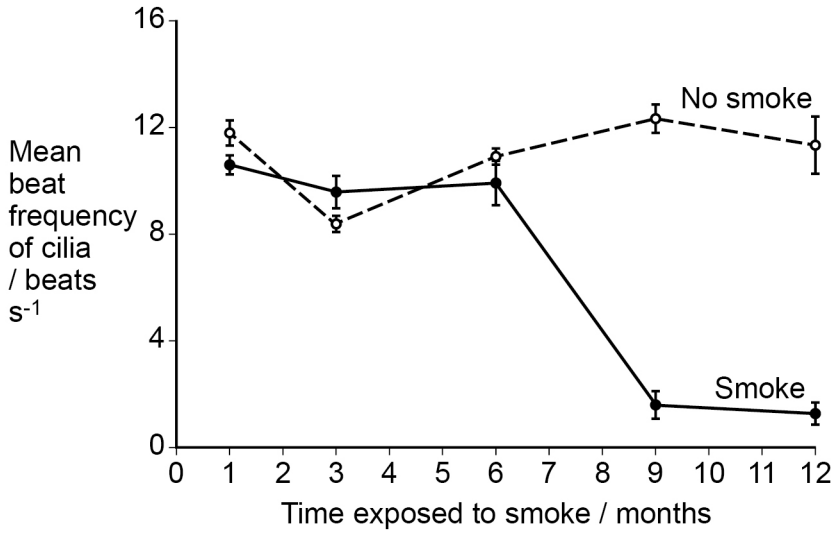


Figure 4



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Suggest why people who smoke cigarettes (smokers) are more likely to have lung infections than people who do not smoke cigarettes (non-smokers).

Use information from **Figure 3** and **Figure 4**, and information given earlier in Question **01**.

[4 marks]

17

Turn over for the next question

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0 2 Students investigate the effect of temperature on the rate of photosynthesis in plants.

The students use the pondweed *Elodea* in their investigation.

Figure 5 shows the equipment the students use.

Figure 5

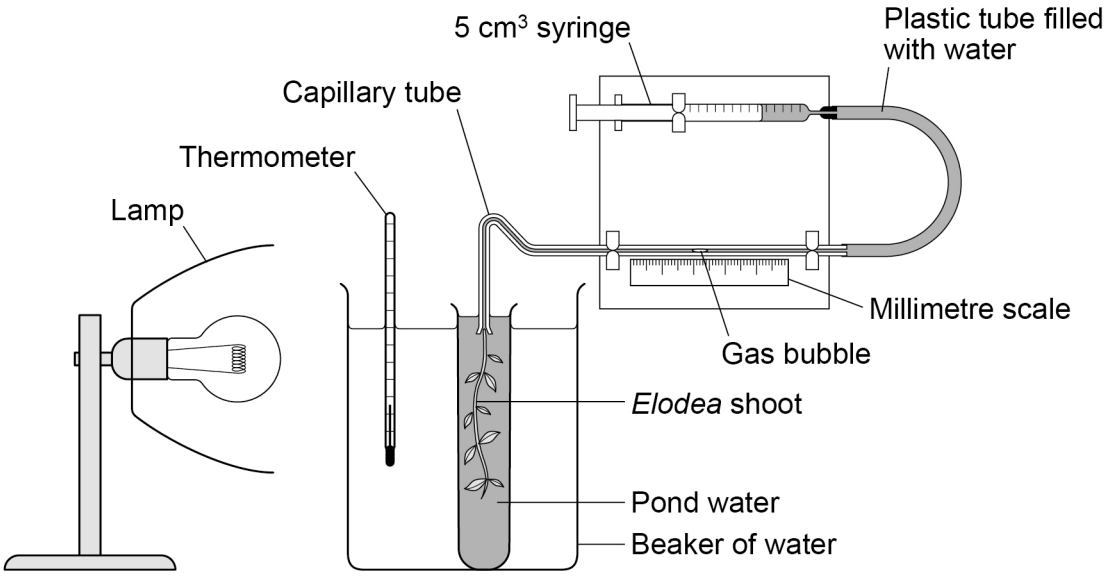

Table 1 shows the students' results.

Table 1

Temperature / °C	Mean rate of oxygen production ± SD / mm^3 min^{-1}
0	0.2 ± 0.1
10	4.3 ± 2.7
20	16.2 ± 8.0
30	32.3 ± 6.4
35	35.8 ± 3.5
40	17.7 ± 8.2
50	3.2 ± 2.3

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0 2 . 1 Describe, in detail, how the students could use the equipment shown in **Figure 5** to obtain the results shown in **Table 1**.

[7 marks]

Question 2 continues on the next page

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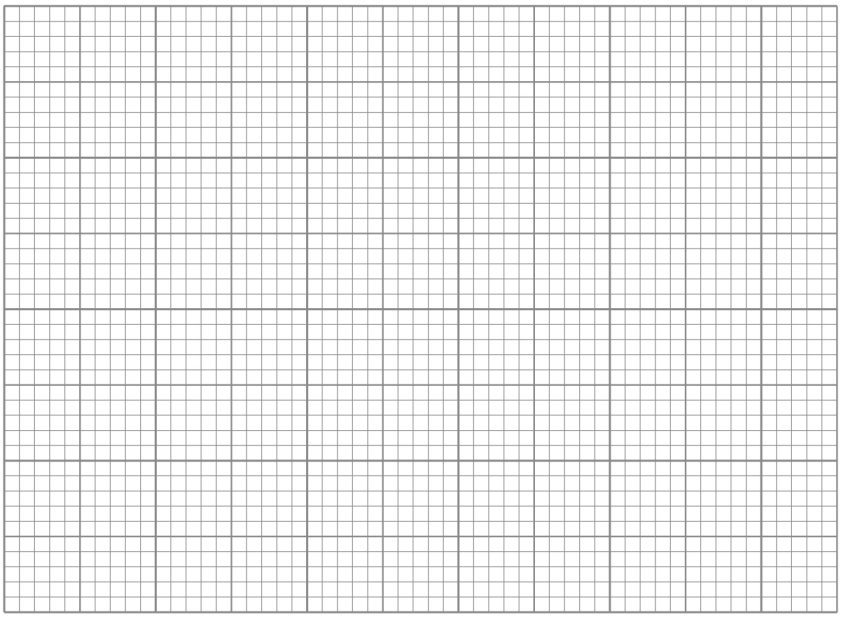
0 2 . 2 Plot a graph of the results shown in **Table 1**.

Do **not** include SD bars on your graph.

[4 marks]

Repeat of Table 1

Temperature / °C	Mean rate of oxygen production ± SD / mm^3 min^{-1}
0	0.2 ± 0.1
10	4.3 ± 2.7
20	16.2 ± 8.0
30	32.3 ± 6.4
35	35.8 ± 3.5
40	17.7 ± 8.2
50	3.2 ± 2.3



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0 2 . 3 Which temperature gives the most variation in results?

Give the evidence for your answer.

[1 mark]

Temperature _____

Evidence _____

_____

0 2 . 4 One student states:

'The optimum temperature for photosynthesis in plants is 35 °C.'

The teacher says this conclusion is **not** correct.

How could the students change their investigation to improve this conclusion?

[3 marks]

_____

_____

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15

Turn over for the next question

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0 3 Students investigate the effect of exercise on heart rate.

Each student:

- counts their pulse for 10 seconds while at rest
- multiplies the pulse count by 6 to find their heart rate in beats per minute
- is given the instruction to exercise for 0.5 minute and to count their pulse again for 10 seconds
- immediately repeats the exercise for 1 minute and for 2 minutes.

Table 2 shows the results.

Table 2

	Heart rate / beats per minute		
Length of exercise / minutes	**Student 1**	**Student 2**	**Student 3**
0	72	78	60
0.5	90	84	96
1.0	96	90	120
2.0	108	96	132

0 3 . 1 The students count their pulse rates for 10 seconds. They multiply the value by 6 to find the heart rate per minute.

Suggest **one** advantage and **one** disadvantage of measuring the pulse rates for 10 seconds.

[2 marks]

Advantage _____

_____

Disadvantage _____

_____

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0 3 . 2 Each student 'is given the instruction to exercise' for the stated times.

Suggest how this instruction could be improved to give more valid results.

[1 mark]

_____

_____

_____

0 3 . 3 Suggest **two** other improvements to the students' method.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

5

Turn over for the next question

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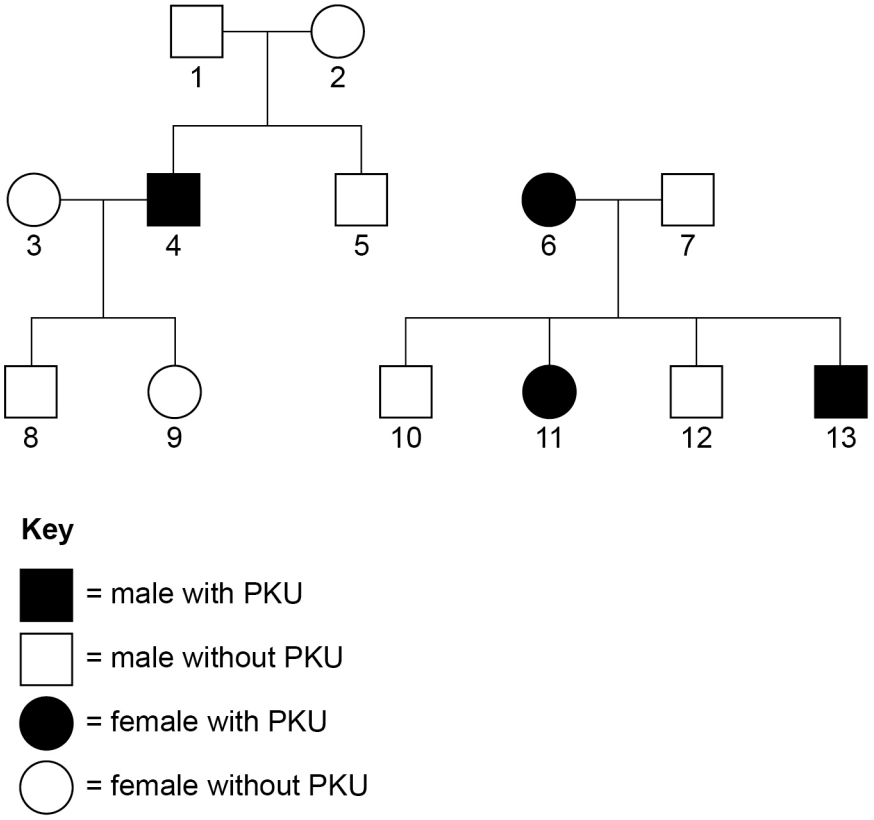
0 4 Phenylketonuria (PKU) is a genetic disorder.

If untreated, PKU causes brain and nerve damage.

PKU is caused by a recessive allele.

Figure 6 shows the inheritance of PKU in two families.

Figure 6



In this question, use the following symbols for alleles.

N = allele for **not** having PKU
n = allele for having PKU

0 4 . 1 Give evidence from **Figure 6** to show that the allele for PKU is recessive.

[1 mark]

_____

_____

Do not write outside the box

0 4 . 2 What are the genotypes of individuals **1** and **2**?

[1 mark]

1 _____

2 _____

0 4 . 3 Individuals **9** and **10** get married and plan to start a family.

Draw a genetic diagram to find the probability that their first child will have PKU.

[4 marks]

Probability = _____

Question 4 continues on the next page

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In one country, 1 in 2600 people has PKU.

The population of the country is 86 171 873

0 4 . 4 A student uses the Hardy–Weinberg equation to estimate the number of people in this country that do **not** have the allele for PKU in their genotype.

What answer should the student get?

[3 marks]

Number of people = _____

0 4 . 5 The use of the Hardy–Weinberg equation may **not** be appropriate in this situation.

Give **three** reasons why.

[3 marks]

1 _____

_____

2 _____

_____

3 _____

_____

12

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0 5 The control of blood glucose concentration depends on changing glucose into glycogen and changing glycogen into glucose.

0 5 . 1 Name **two** organs that store large amounts of glycogen.

[2 marks]

1 _____

2 _____

People with Type 2 diabetes often have a high concentration of glucose in their blood.

Scientists investigate the effect of a new drug called Tirzepatide on blood glucose concentration. Tirzepatide acts in the same way as naturally-occurring hormones that are released by the gut after a meal. These hormones stimulate the release of insulin from the pancreas and inhibit the release of glucagon.

0 5 . 2 Give the reason why it is important to inhibit the release of glucagon after a meal.

[1 mark]

_____

_____

_____

Question 5 continues on the next page

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The scientists work in India, Japan, Mexico and the USA, in 52 different medical research centres.

The scientists use a computer program to put 478 patients with Type 2 diabetes randomly into two groups. The two groups each have both men and women from a variety of ethnic groups, aged between 50 and 60.

In one of the groups, the patients are injected with Tirzepatide once a week for 40 weeks. Patients in the other group are injected each week with a placebo (a solution with no Tirzepatide).

The study is double-blind. This means that the scientists and the patients do not know who is in each group.

The scientists take blood samples from each patient at intervals during the 40 weeks of the investigation. The scientists measure the concentration of a substance called HbA1c in the blood samples. HbA1c is a compound of glucose and haemoglobin in the red blood cells.

The scientists calculate mean values for the placebo group and mean values for the group given Tirzepatide.

Figure 7 shows the scientists' results.

The error bars show ± standard errors.

Figure 7

Figure cannot be reproduced here due to third-party copyright restrictions

The graph is taken from the following article:

Efficacy and safety of a novel dual GIP and GLP-1 receptor agonist tirzepatide in patients with type 2 diabetes (SURPASS-1): a double-blind, randomised, phase 3 trial by *Julio Rosenstock et al, Lancet* 2021; 398: 143–55
Published Online June 26, 2021
https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(21)01324-6/abstract

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0 5 . 3 Give the reason why each of the following increases the validity of the scientists' investigation.

[2 marks]

Using 478 patients _____

_____

_____

Using a double-blind trial _____

_____

_____

0 5 . 4 The scientists calculated that the results for Tirzepatide at 40 weeks gave P<0.0001 compared with the placebo.

State the meaning of P<0.0001

[1 mark]

_____

_____

_____

6

Turn over for the next question

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You are reminded that **2 marks** will be awarded for the quality of written communication in **Question 6**.

0 6 Proteins are found in all living organisms.

0 6 . 1 Describe the different ways that proteins are used in the human body.

[6 marks]

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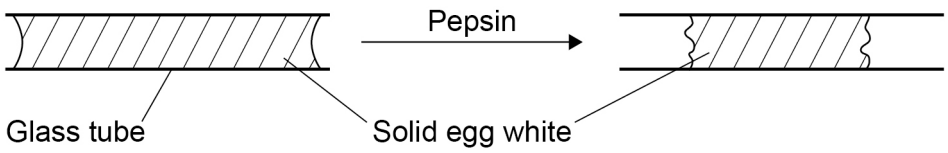
0 6 . 2 Pepsin is a protease enzyme produced by the human stomach.

Egg white contains the protein albumen.

Figure 8 shows the effect of pepsin on solid egg white.

Figure 8



Plan an experiment to find the optimum pH for the action of pepsin on egg white.
Use the equipment shown in **Figure 8**.

[6 marks]

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0 6 . 3 Describe how proteins are coded for and synthesised in **prokaryotic** cells.

[6 marks]

Quality of written communication [2 marks]

END OF QUESTIONS

20

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