Surname	Centre Number	Candidate Number
First name(s)		0

GCSE

3400UA0-1

Z22-3400UA0-1

WEDNESDAY, 15 JUNE 2022 – MORNING

BIOLOGY – Unit 1:
Cells, Organ Systems and Ecosystems

HIGHER TIER

1 hour 45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**9**	
2.	**11**	
3.	**9**	
4.	**5**	
5.	**12**	
6.	**11**	
7.	**8**	
8.	**7**	
9.	**8**	
Total	**80**	

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ADDITIONAL MATERIALS

In addition to this paper you may require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid. You may use pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

Question **6**(b) is a quality of extended response (QER) question where your writing skills will be assessed.

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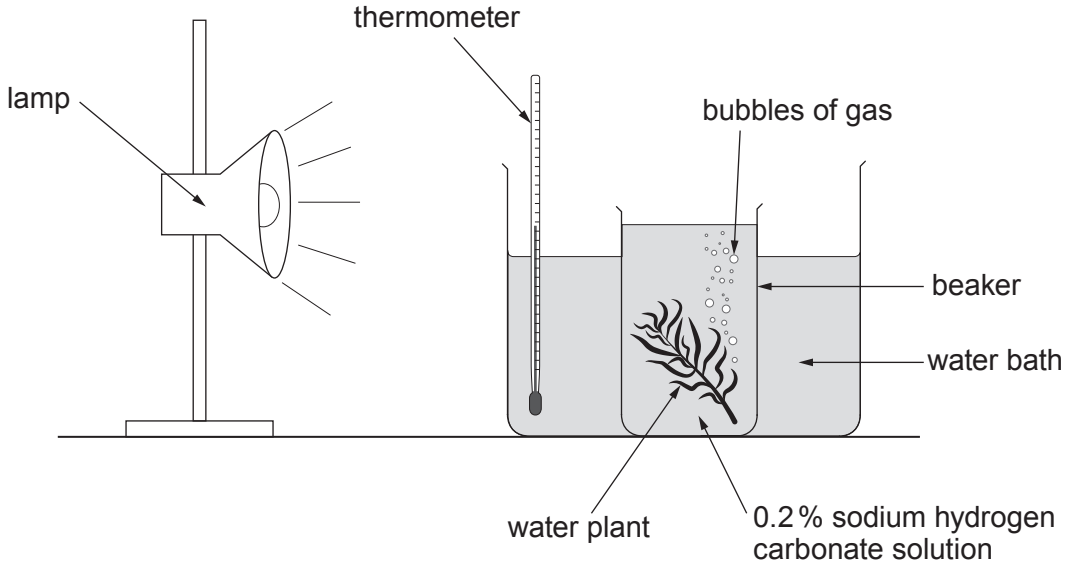
Answer **all** questions.

1. Students were instructed to investigate the effect of temperature on photosynthesis. They used the apparatus shown in **Image 1.1**.

Image 1.1



- The number of bubbles of gas produced by the water plant per minute was counted at different temperatures.
- The experiment was carried out three times at each temperature.
- The results are in **Table 1.2**. Means were calculated to the nearest whole number.

Table 1.2

Temperature of water bath (°C)	Number of bubbles of gas produced per minute			
	Test 1	Test 2	Test 3	Mean
20	18	21	12	17
25	15	24	21	20
30	24	27	30	27
35	26	25	26	26
40	14	13	10	12
45	3	5	6	.....
50	0	0	0	0

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(a) (i) State the name of the gas produced during photosynthesis. [1]

.....

(ii) State **two** ways in which plants use the glucose produced during photosynthesis. [2]

I. .....

II. .....

(b) (i) Calculate the mean number of bubbles per minute for 45 °C. **Write your answer in Table 1.2.** [2]

(ii) Describe the relationship between the temperature and the number of bubbles produced per minute. [2]

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(iii) Explain the result for 50 °C. [2]

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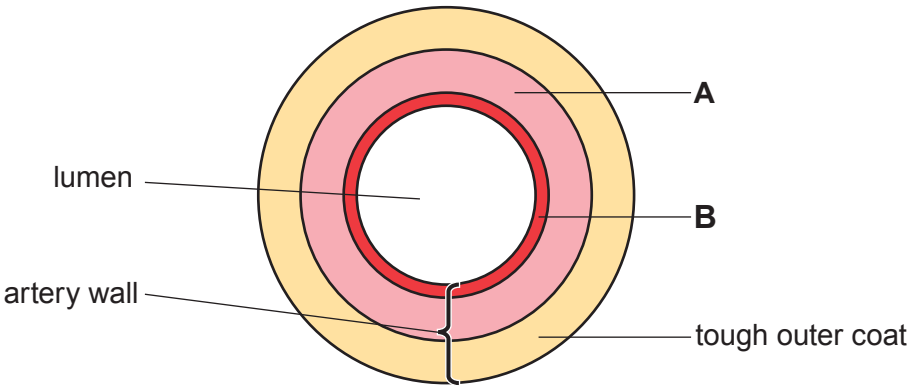
2. **Image 2.1** shows a cross section through a healthy coronary artery.

Image 2.1



(a) (i) State the names of **tissues A** and **B**. [2]

A .....

B .....

(ii) Suggest how the diameter of the lumen would differ in an individual with cardiovascular disease and explain the difference. [2]

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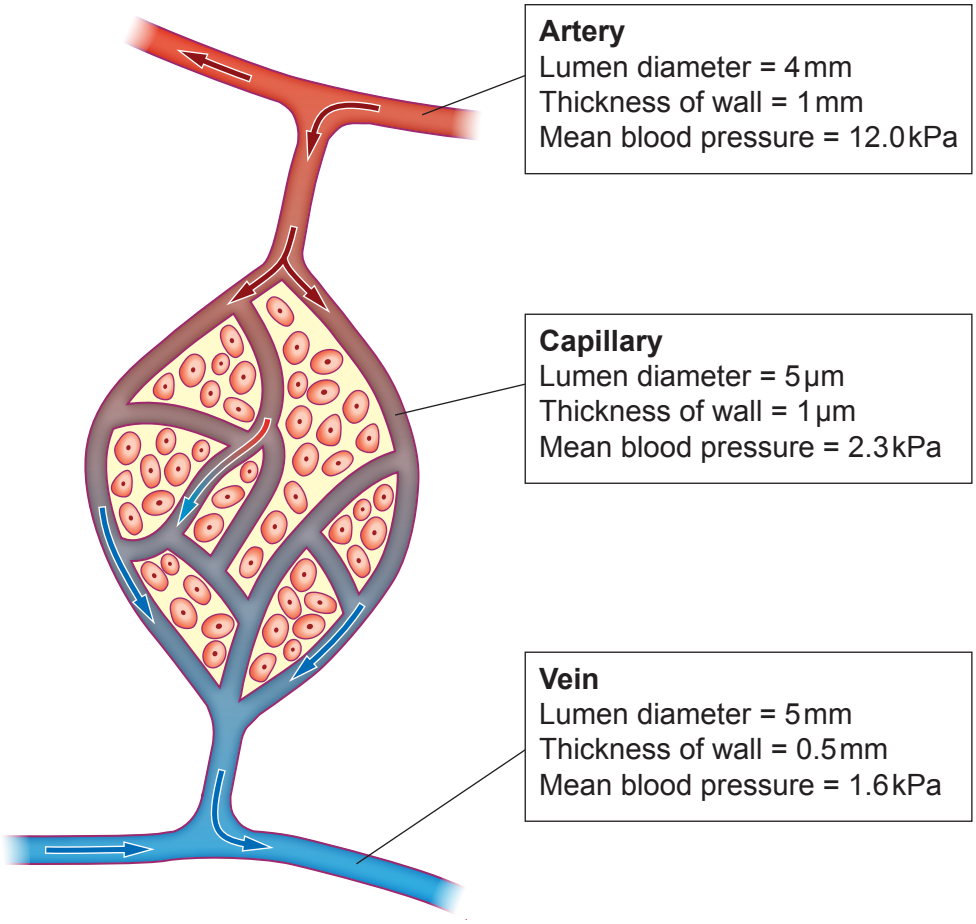
(b) **Image 2.2** shows a cross section of blood vessels found in muscle tissue, along with some information about them.

Image 2.2



(i) Use **Image 2.2** to give **two** differences between the structure of an artery and a vein. [2]

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(ii) Veins contain structures that are not present in arteries or capillaries. State the name of these structures and describe their function. [2]

Name of structures .....

Function .....

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(c) (i) State the name of **one** substance which passes from the blood into the body cells. [1]

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(ii) State **one** way in which capillaries are adapted for their function. Give an advantage for this adaptation. [2]

Adaptation

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Advantage

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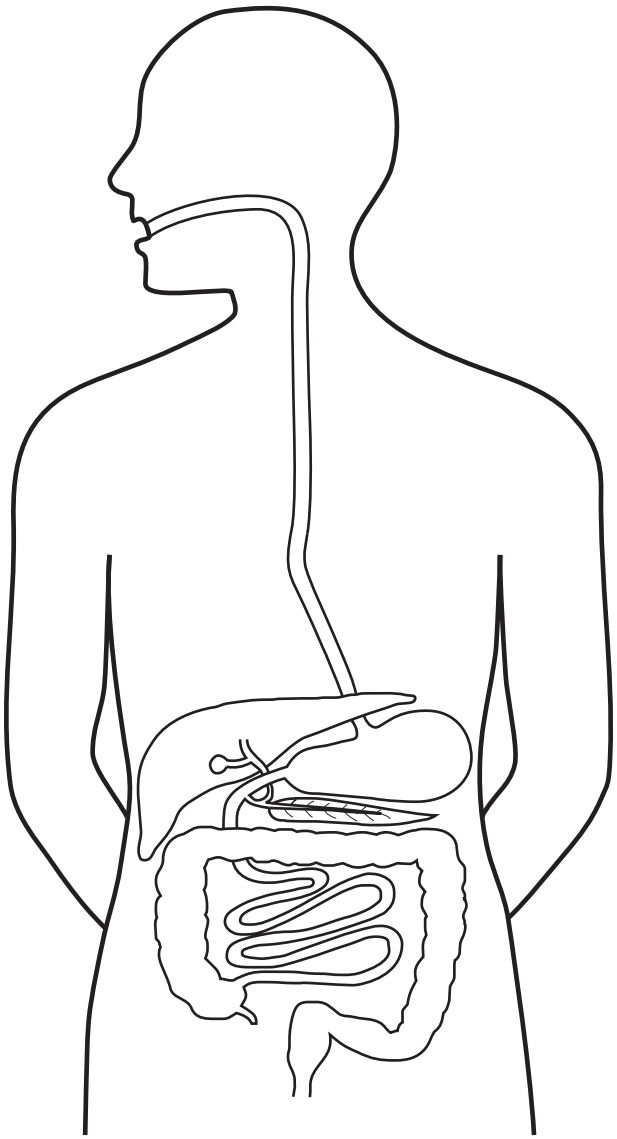
3. (a) **Image 3.1** shows the human digestive system.

(i) **Draw an arrow** labelled **P** on **Image 3.1** to show an organ where **only** protein is digested. [1]

(ii) **Draw an arrow** labelled **B** to show an organ where fat and oil (lipids) are digested. [1]

Image 3.1



(iii) State the purpose of digestion. [2]

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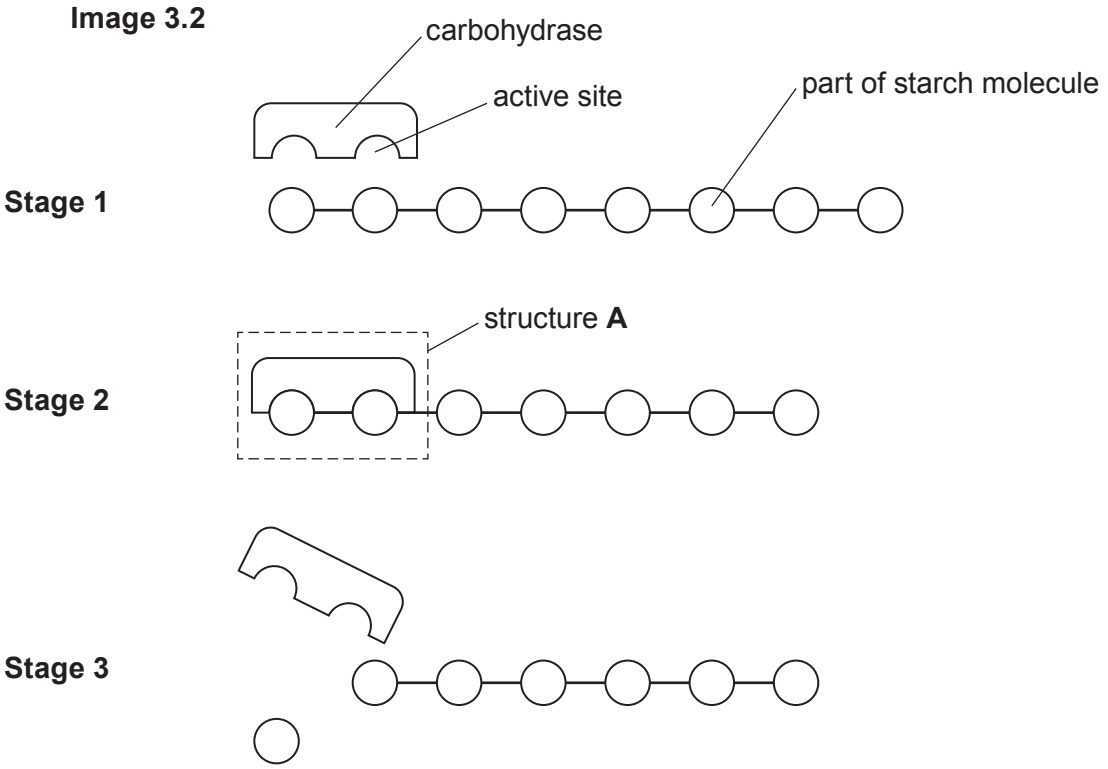
(b) **Image 3.2** shows part of a starch molecule being digested by carbohydrase in the mouth.

Image 3.2



(i) State the name of structure **A**, indicated by the box in **stage 2**. [1]

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(ii) State the name of the molecule produced by the digestion of starch **and** describe **one** way in which it is used by the body. [2]

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(iii) Describe and explain what will happen to the active site of the carbohydrase enzyme when it is inside the stomach. [2]

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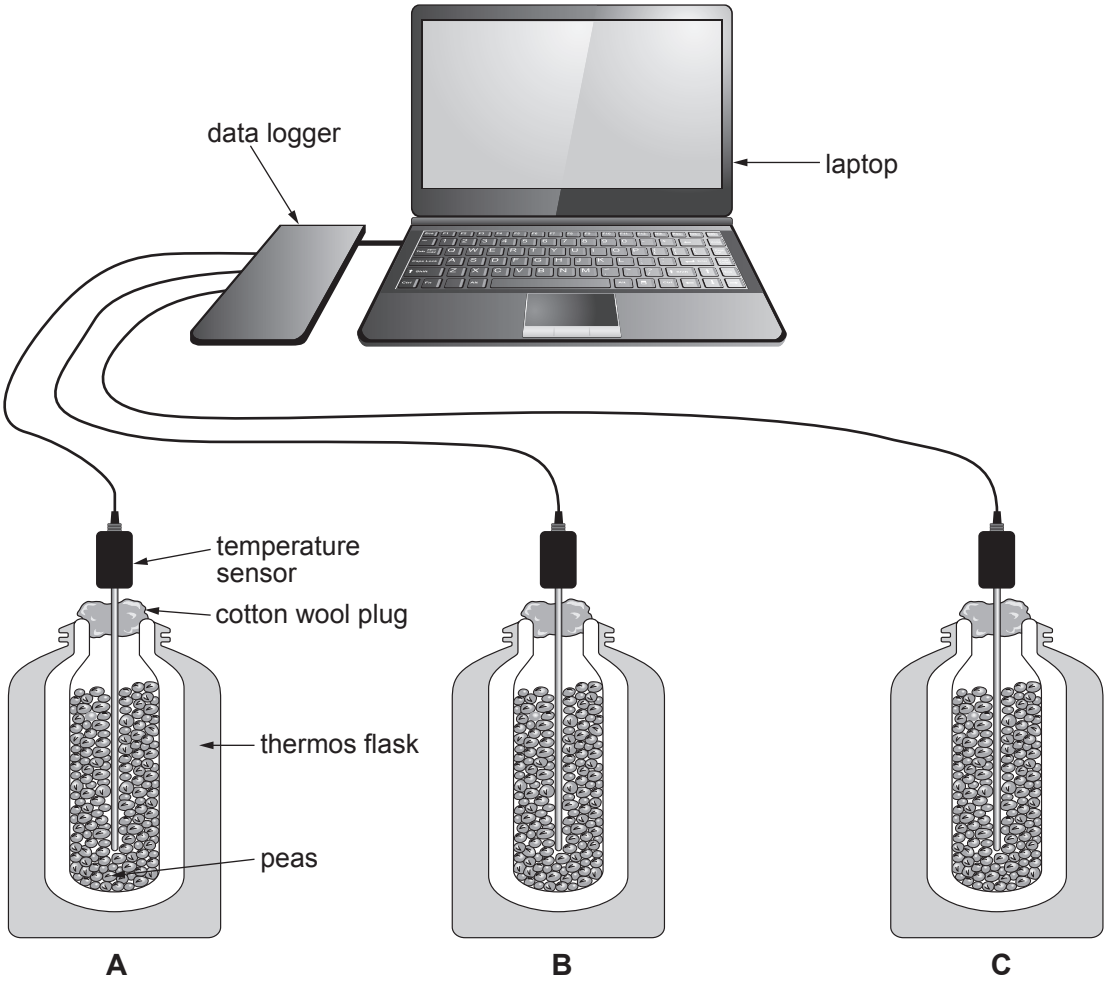
4. The experiment shown in **Image 4.1** was set up to investigate respiration in germinating peas.

Image 4.1



The flasks all contained an equal mass of peas. **Table 4.2** shows the treatment that each flask received:

Table 4.2

Flask	Treatment
A	Germinating peas soaked in disinfectant.
B	Germinating peas which had been boiled for 30 minutes then soaked in disinfectant.
C	Germinating peas which had been boiled for 30 minutes.

The temperature of the flasks was monitored for 120 hours.

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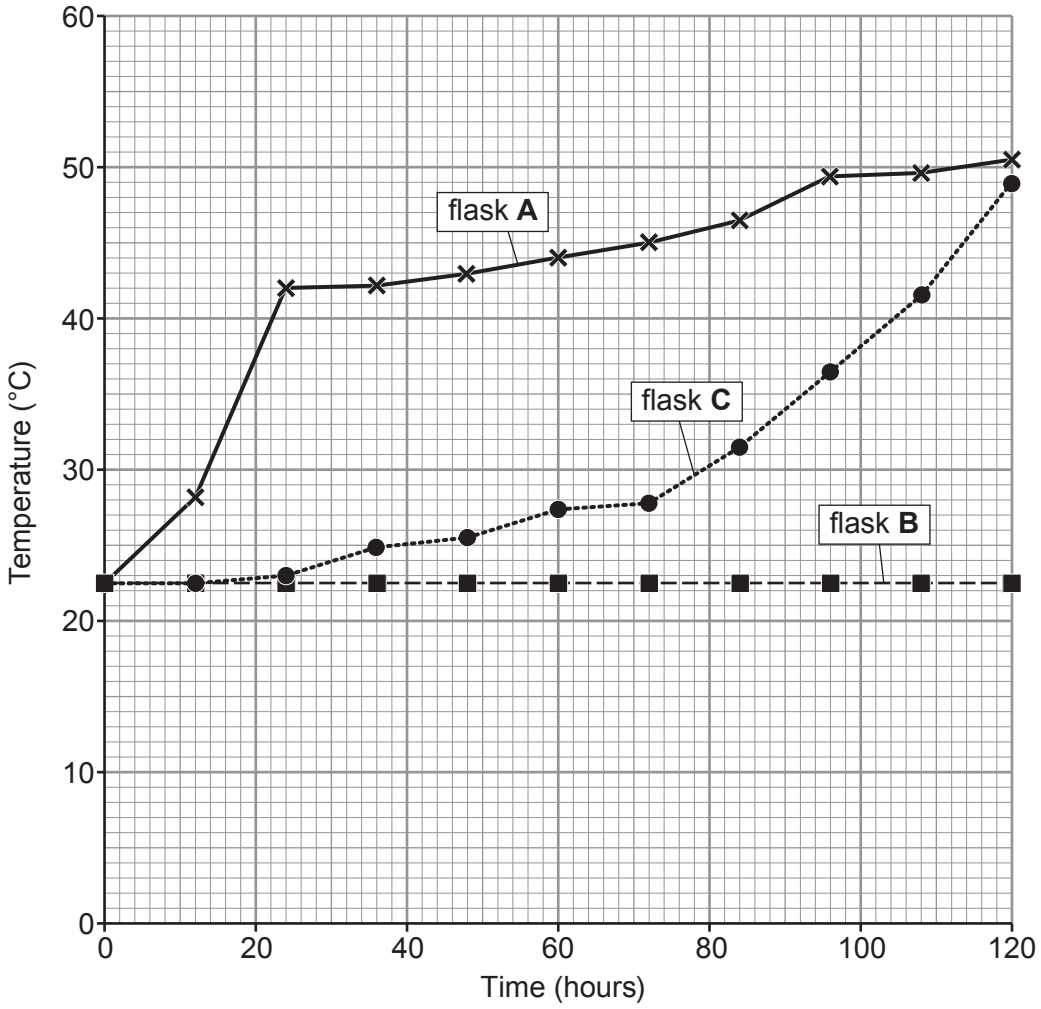
The results of the experiment are shown below in **Graph 4.3**.

Graph 4.3



(a) (i) State the purpose of soaking the peas in disinfectant in flasks **A** and **B**. [1]

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(ii) Explain the results for flask **A** between 0 and 24 hours. [2]

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(b) Explain how flask **B** acts as a control experiment for flask **A**. [1]

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(c) Aerobic respiration of one molecule of glucose releases 38 molecules of ATP.
State whether the number of molecules of ATP produced from anaerobic respiration would be **higher** or **lower** than 38. Give a reason for your answer. [1]

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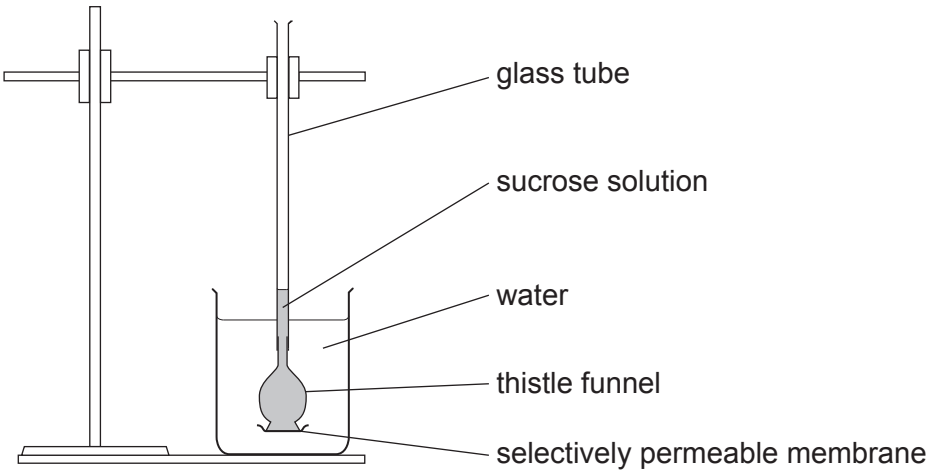
5. The following experiment was used to study the movement of water in and out of cells.

- A glass thistle funnel was half filled with sucrose solution.
- The bottom of the thistle funnel was closed by a selectively permeable membrane.
- The thistle funnel was placed in a beaker containing distilled water. As shown in **Image 5.1**.
- The level of sucrose solution in the glass tube was marked.
- The apparatus was left for 30 minutes and then the level of the sucrose solution in the glass tube was measured.
- The distance the sucrose solution had moved was calculated.
- If the level of the sucrose solution went up, the number was recorded as a positive number, but if the level of the sucrose solution went down, the number was recorded as a negative number.
- The experiment was repeated by placing the thistle funnel in salt solutions of 0.2, 0.3, 0.6 and 0.8 mol/dm^3.

Image 5.1



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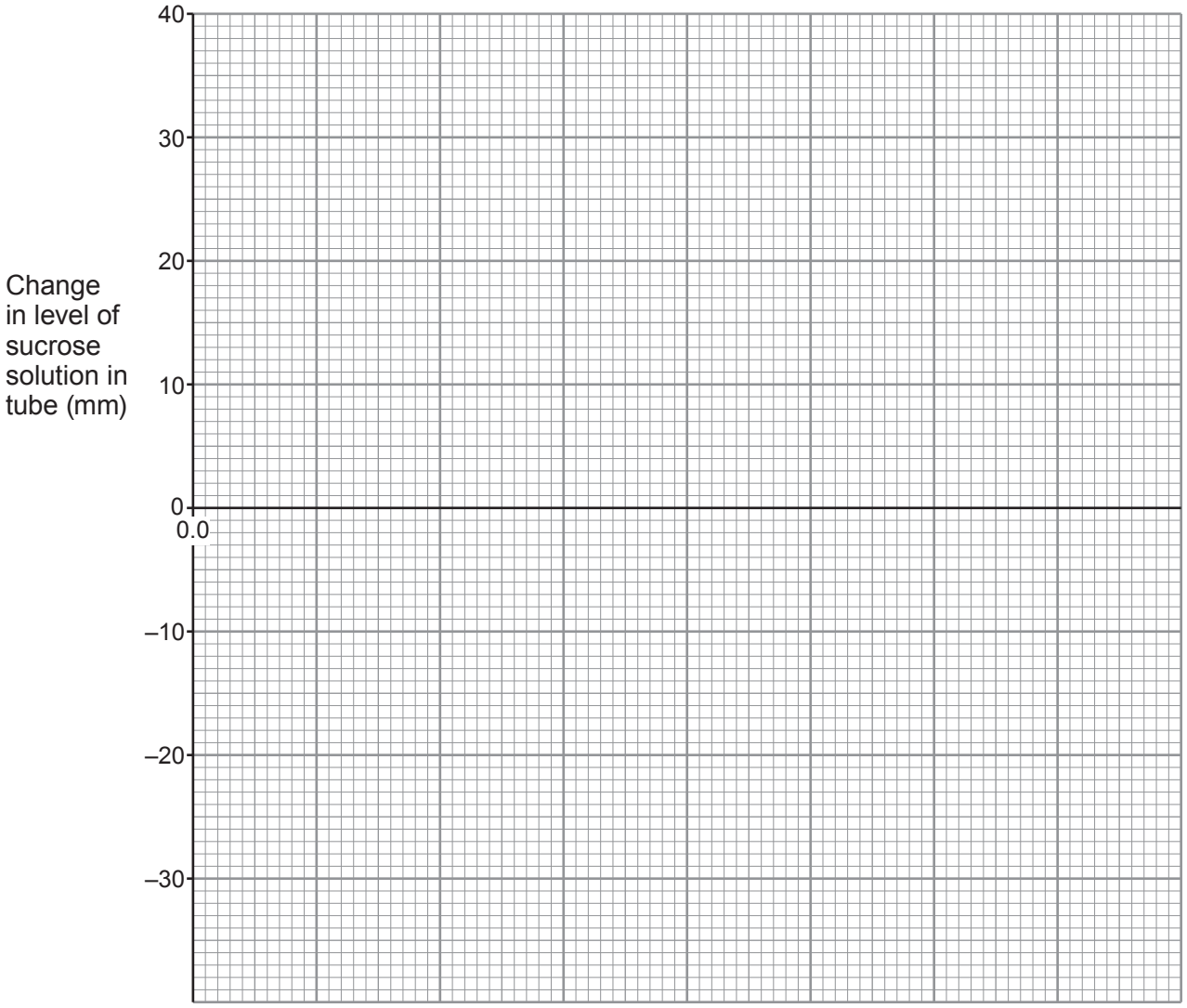
The results of the experiment are shown in **Table 5.2**.

Table 5.2

Salt concentration (mol / dm^3)	Change in level of the sucrose solution in tube (mm)
0.0 (distilled water)	+36
0.2	+23
0.3	–7
0.6	–17
0.8	–23

(a) Use the results from **Table 5.2** to produce a line graph on **Graph 5.3** below. The scale and label for the y axis have been completed for you, along with the origin for the x axis [5]

Graph 5.3



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(b) (i) Explain why the sucrose solution moved up the glass tube when the thistle funnel was placed in distilled water. [4]

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(ii) Use **Graph 5.3** to estimate the concentration of the sucrose solution in the thistle funnel. [3]

Concentration ..... mol / dm^3

Explain your answer in terms of water movement at this concentration.

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6. Nitrate Vulnerable Zones (NVZ) are areas where nitrate concentrations are a risk to human health, or harmful to the aquatic environment.

Llangorse lake is the largest natural lake in south Wales. Approximately two-thirds of the surrounding land is used for intensive farming. Natural Resources Wales (NRW) has calculated that 99 % of the nitrate found in Llangorse lake comes from intensive farming.

Table 6.1 is used by NRW to estimate the risk from nitrate levels in water.

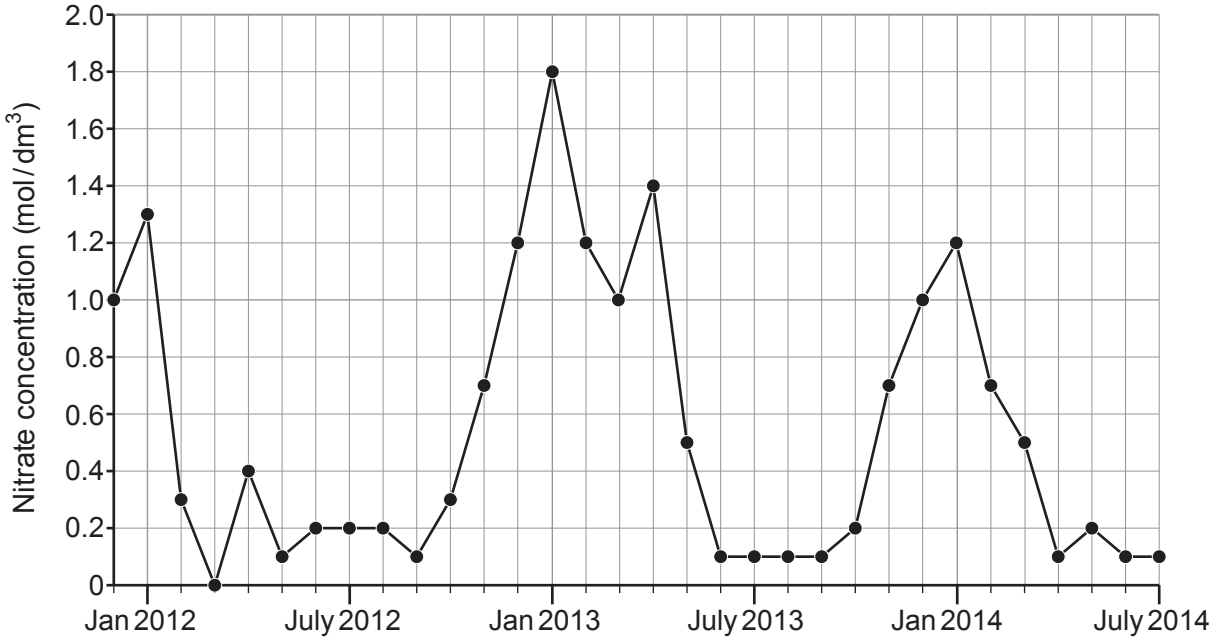
Table 6.1

Nitrate concentration (mol / dm^3)	Risk
< 0.5	very low
0.5 – 1.0	low
>1.0 – 1.7	low – medium
>1.7 – 3.5	medium
>3.5 – 6.0	medium – high
>6.0	high

Between December 2011 and July 2014, water samples were taken from Llangorse lake and the nitrate concentration analysed.

The results are shown in **Graph 6.2**.

Graph 6.2



Algal blooms were observed in Llangorse lake between April and October for each year shown in **Graph 6.2**.

(a) (i) Using the information above, state the risk level for nitrates in Llangorse lake in January 2013. [1]

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(ii) Describe the annual trend common to all years shown in **Graph 6.2**. [2]

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(iii) Suggest a possible explanation for the common annual decrease in the nitrate levels in Llangorse lake. [2]

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(b) Explain how intensive farming leads to the formation of algal blooms and how these algal blooms can be harmful to aquatic animals. [6 QER]

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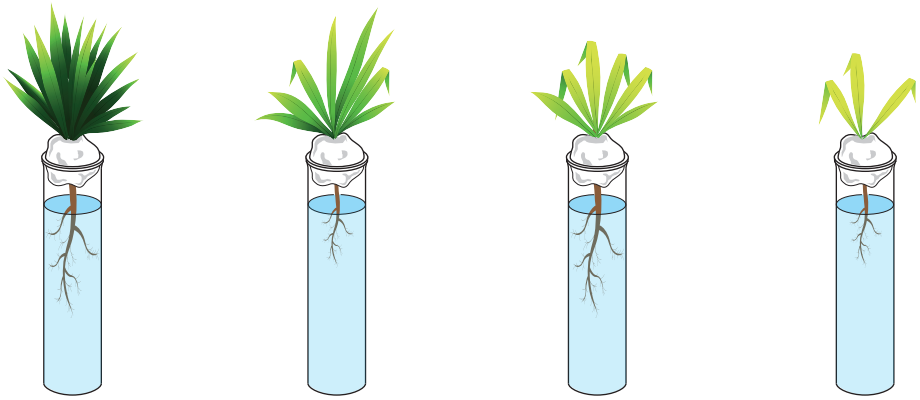
7. Julius von Sachs was a 19th century German scientist who studied the effect of plant nutrients on growth. He developed a growth solution which contained all the nutrients a plant needed for healthy growth.

A version of one of his experiments is shown below.

1. Seedlings of the same age were placed on cotton wool in four test tubes, each containing an equal volume of a different nutrient solution.
2. All four test tubes were placed on a shelf in full sunlight.
3. The growth of the seedlings was observed and recorded after one month **(Image 7.1)**.

Image 7.1



Tube **1** Tube **2** Tube **3** Tube **4**

	Tube **1**	Tube **2**	Tube **3**	Tube **4**
Content of growth solution	all nutrients present	no nutrient **X**	no nutrient **Y**	no nutrient **Z**
Description of growth after one month	healthy growth	poor root growth	yellowing of leaves	poor growth

(a) Identify the missing nutrients. [3]

Nutrient **X** = ...

Nutrient **Y** = ...

Nutrient **Z** = ...

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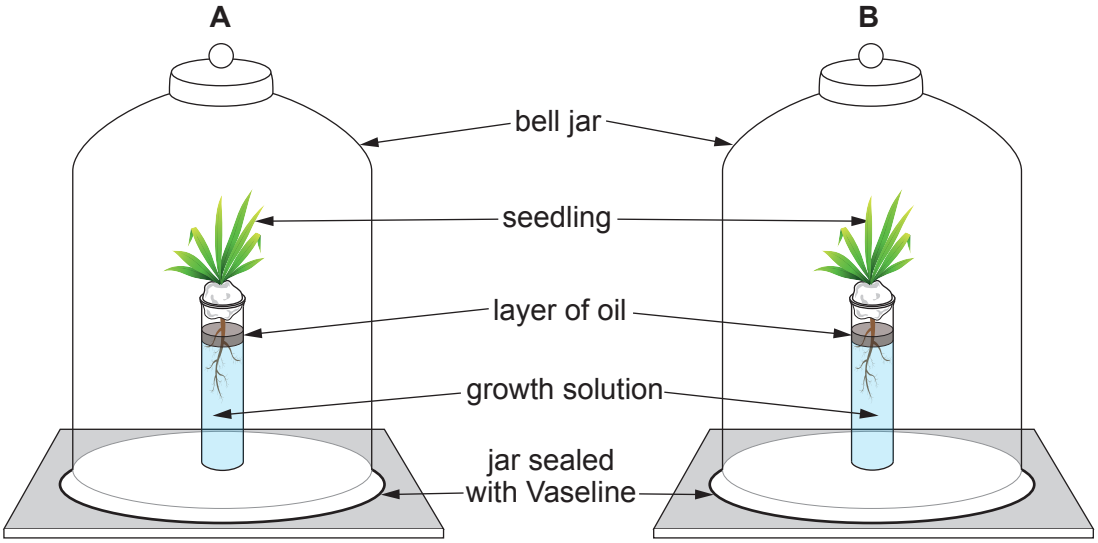
(b) Students modified the experiment by taking two seedlings of similar age and placing them in a sealed bell jar as shown in **Image 7.2**.

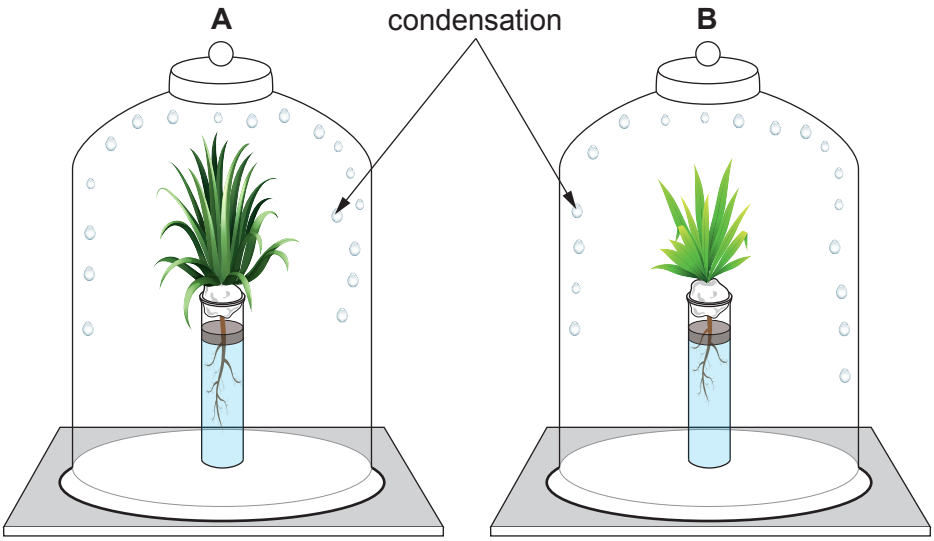
Image 7.2



Bell jar A	**Bell jar B**
Seedling in growth solution containing all nutrients	Seedling in growth solution containing all nutrients **and** a chemical which reduces the rate of respiration in root hair cells

Image 7.3 shows the appearance of the apparatus after 2 weeks.

Image 7.3



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(i) Suggest the purpose of the layer of oil in the experiment. [1]

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(ii) Explain the presence of the condensation (water droplets) inside the bell jars in **Image 7.3**. [2]

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(iii) Using your knowledge of how nutrients are absorbed, explain the difference in growth between the plants in bell jars **A** and **B** during the 2 weeks. [2]

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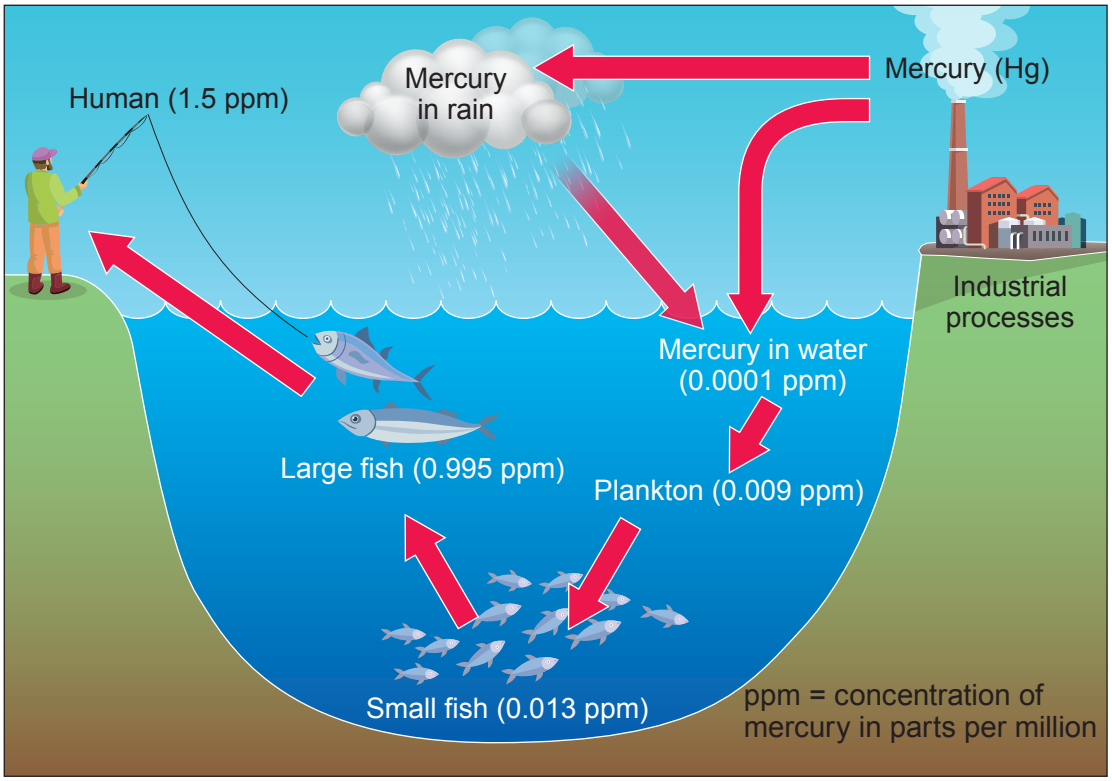
8. The United Nations Minamata Convention on Mercury is a global treaty to protect human health and the environment from the toxic effects of the heavy metal mercury.

In 2010, combustion of fossil fuels by industrial processes produced 24% of the total global emissions of mercury. **Image 8.1** shows how this mercury is cycled in the environment.

Image 8.1



(a) (i) Calculate the percentage increase in mercury from the plankton to humans. **Give your answer to two significant figures.** [3]

Percentage increase = ...

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(ii) Using **Image 8.1** and your own knowledge, explain how the mercury released during the combustion of fossil fuels by industrial processes becomes harmful to humans. [3]

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(b) Apart from reducing mercury pollution, explain how reducing the combustion of fossil fuels can benefit the environment. [1]

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9. Popcorn lung is a lung disease which results in scarring and inflammation of the bronchioles. Symptoms of the disease are coughing and difficulty breathing. **Image 9.1a and 9.1b** show a healthy bronchiole and a bronchiole affected by popcorn lung.

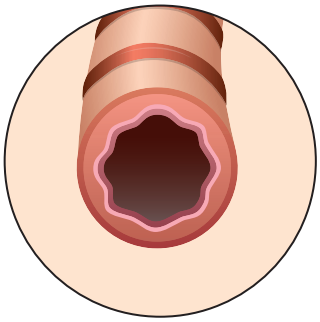


Image 9.1a – healthy bronchiole

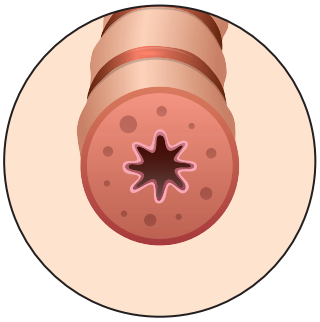


Image 9.1b – bronchiole affected by popcorn lung

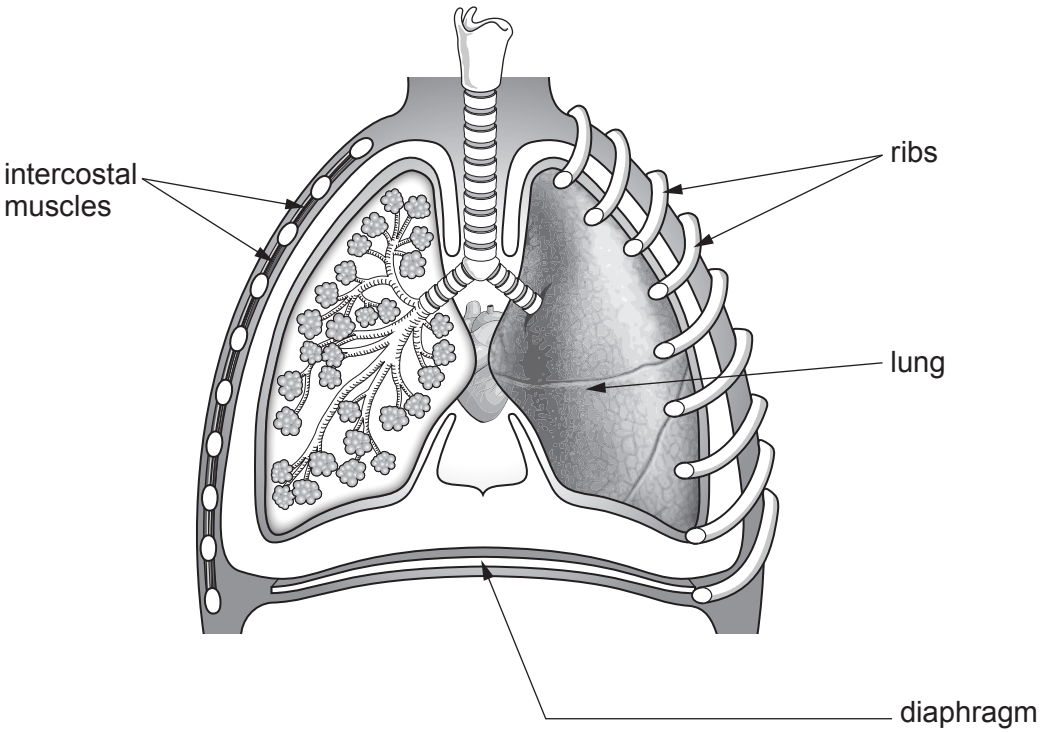
A chemical called diacetyl is used in the manufacture of popcorn. A link between inhaling diacetyl and the lung disease was made when a group of workers from a popcorn factory was found to have developed the disease.

In the US there have been increasing numbers of cases of popcorn lung linked to the use of e-cigarettes. There are around 7 700 flavours for e-cigarettes sold in the US. A single study of 51 e-cigarette flavours in 2016 found that 39 contained diacetyl. Diacetyl was banned in e-cigarette flavourings in the UK in 2016.

In 2019, a report in the journal Nature showed that diacetyl reduced the number of ciliated cells in the airways.

(a) **Image 9.2** shows the human respiratory system.

Image 9.2



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(i) **Use a labelled arrow** to identify an alveolus on **Image 9.2**. [1]

(ii) State **two** ways in which the alveolus is adapted for gas exchange. [2]

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(b) Explain why a person affected by popcorn lung shows the following symptoms:

(i) coughing. [1]

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(ii) breathing difficulties. [2]

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(c) Use the information given to evaluate the validity of the following conclusion:
'E-cigarette flavours cause popcorn lung'. [2]

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END OF PAPER

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Question number	Additional page, if required. Write the question number(s) in the left-hand margin.	Examiner only

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