GCSE

3400UA0-1

TUESDAY, 13 JUNE 2023 – MORNING

BIOLOGY – Unit 1:

Cells, Organ Systems and Ecosystems
HIGHER TIER

1 hour 45 minutes plus your additional time allowance

Surname _____

First name(s) _____

Centre Number _____

Candidate Number 0 _____

ADDITIONAL MATERIALS

In addition to this paper you will require a calculator.

ITEMS INCLUDED WITH QUESTION PAPER

A separate Diagram booklet.

The Diagram Booklet MUST be handed in to the invigilators and sent for marking.

INSTRUCTIONS TO CANDIDATES

Use black ink, black ball-point pen or your usual method.

Write your name, centre number and candidate number in the spaces provided on the front cover.

Answer ALL questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional pages 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 8(b) is a quality of extended response (QER) question where your writing skills will be assessed.

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	12	
2.	8	
3.	8	
4.	8	
5.	9	
6.	5	
7.	7	
8.	8	
9.	15	
Total	80	

Answer ALL questions.

1 Part of a plant root is shown in IMAGE 1.1 in the separate diagram booklet.

(a) Explain why water uptake in zone A is greater than in zone B. [1 mark]

_____

_____

_____

(b) IMAGE 1.2 in the separate diagram booklet represents a section through the leaf of a plant.

(i) On IMAGE 1.2, DRAW AN ARROW to show the tissue which transports water to all parts of the plant. LABEL THE ARROW WITH THE NAME OF THE TISSUE. [2 marks]

(ii) I. Name cells X shown in IMAGE 1.2. [1 mark]

_____

1 (b)(ii)

II. State how the stoma and cuticle are involved in the control of water loss from a leaf. [2 marks]

Stoma

Cuticle

1 (c) **Megan and Rhys investigated the loss of water from a leafy shoot. They used the apparatus shown in IMAGE 1.3 in the separate diagram booklet .**

They recorded the loss of mass after directing moving air, at different speeds, onto the shoot.

(i) **State the scientific term for the evaporation of water from the leaves of a plant. [1 mark]**

(ii) **State ONE way in which Megan and Rhys could ensure that they carried out a fair test. [1 mark]**

(iii) **State why it was important that the layer of oil was added. [1 mark]**

1 (c)(iv) The results of their investigation are summarised in GRAPH 1.4 in the separate diagram booklet.

I. Describe the effect of increasing the speed of moving air on the rate of water loss. [2 marks]

II. SKETCH A LINE ON GRAPH 1.4 to suggest the result you would expect if the HUMIDITY of the air was increased. [1 mark]

12

2 **IMAGE 2.1 in the separate diagram booklet shows chickens in two different farming systems.**

In 1950 chicken was an expensive food and most adults in the UK, on average, ate only 1 100 g each year. By 2000 they ate 25 kg per year as intensive farming had made chicken much cheaper.

In intensive farming, large numbers of chickens are reared indoors. Environmental conditions and food supply are constantly controlled. The chickens grow faster than free-range chickens and use less energy as their movement is restricted.

The farmer can monitor the chickens more easily than on a free-range farm. Much less land is used and labour costs are lower but larger amounts of concentrated waste are produced.

(a)(i) **Use the information given to calculate the increase in mass in the annual consumption of chicken for a FAMILY OF FOUR ADULTS in the UK between 1950 and 2000. [2 marks]**

Increase in mass = _____ kg / family / year

2 (a) (continued)

During an investigation, the growth of chickens from different farm systems was compared. The results are shown in GRAPH 2.2 and TABLES 2.3 and 2.4 in the separate diagram booklet.

(ii) Use GRAPH 2.2 to calculate the difference in the body muscle mass at 5 weeks between intensively farmed chicken and a free–range chicken. [1 mark]

Difference = _____ g

2 (b)(i) Use the information on page 7 in this question paper to suggest ONE advantage to farmers of farming chickens intensively. [1 mark]

_____

_____

_____

(ii) State ONE feature of intensive farming which is an environmental disadvantage. [1 mark]

_____

_____

2 (c) **Some groups of people have ethical objections to intensive farming because of animal welfare concerns.**

Using the information in TABLES 2.3 and 2.4, state THREE features of intensive farming which support this point of view. [3 marks]

8

3 IMAGE 3.1 in the separate diagram booklet shows the human digestive system.

(a) Label parts A and B on IMAGE 3.1. [2 marks]

(b) A length of Visking tubing was used to model a part of the digestive system. The Visking tubing was filled with a solution of starch and protein. The apparatus was kept at a temperature of 35ºC. The apparatus is shown in IMAGE 3.2 in the separate diagram booklet.

A sample of the water surrounding the Visking tubing was tested for protein, starch, amino acids and glucose at the start of the experiment. After 15 minutes, protease was injected into the Visking tubing. After 30 minutes, the water surrounding the Visking tubing was tested again.

(i) Describe how you would use a chemical to test the water for the presence of GLUCOSE. [2 marks]

3 (b)(ii)

Complete TABLE 3.3 in the separate diagram booklet to show the expected results for this experiment. One column has been done for you. [2 marks]

(c) **Suggest which part of the digestive system shown in IMAGE 3.1 is represented by the Visking tubing. Give a reason for your answer. [2 marks]**

8	

4 **A study of cilia length in the cells lining the bronchioles of 15 non-smokers and 15 smokers was carried out. The results are shown in GRAPHS 4.1 and 4.2 in the separate diagram booklet.**

IMAGE 4.3 in the separate diagram booklet shows three of the cells that line the bronchiole.

(a) **Describe the function of cilia in the human respiratory system and the effect of smoking on them. [2 marks]**

4 (b)(i) Measure the length of line **A – B** on IMAGE **4.3**. [1 mark]

length **A – B** = _____ mm

(ii) The actual value of **A – B** in IMAGE **4.3** is 5 μm. Calculate the magnification of the drawing. (1 mm = 1000 μm) [2 marks]

magnification = × _____

4 (c)(i) Using the information from GRAPHS 4.1 and 4.2, state TWO conclusions you can make about the effect of smoking on the length of cilia. [2 marks]

(ii) Suggest ONE way in which you could improve the confidence in your conclusions. [1 mark]

8

5 According to a report by the British Heart Foundation in 2017, more than 20 million people in the UK were physically inactive. The report warned that inactivity increases the risk of heart disease and costs the NHS around £1.2 billion each year.

A heart attack is a serious medical emergency in which the supply of blood to the heart is suddenly blocked, usually by a blood clot.

In the separate diagram booklet, IMAGE **5.1** shows the heart following a heart attack and IMAGE **5.2** shows a section through one of the heart's blood vessels.

(a)(i) State the name of the blood vessel shown in IMAGE **5.2**. [1 mark]

_____

_____

(ii) State which part of blood is responsible for clot formation. [1 mark]

_____

5 (b)(i) Explain how the atheroma has led to the death of heart muscle cells shown in IMAGES 5.1 and 5.2. [3 marks]

(ii) Apart from lack of exercise, state TWO other factors which are linked to the increased risk of developing an atheroma. [2 marks]

5 (b)(iii)

State the name of a surgical procedure which can be used to remove blockages in the blood vessels surrounding the heart. [1 mark]

_____

(iv) **Suggest ONE way in which the Welsh Government could reduce the number of cases of heart disease each year. [1 mark]**

_____

_____

_____

9

6 **IMAGE 6 in the separate diagram booklet shows gas exchange taking place between an alveolus and a blood capillary. The numbers shown represent the concentrations of oxygen (O_2) and carbon dioxide (CO_2) in arbitrary units (a.u.).**

(a) **State ONE way in which the alveolus and capillary are adapted to their function. [2 marks]**

Adaptation of alveolus

Adaptation of capillary

6 (b) **Using IMAGE 6 in the separate diagram booklet, name gas X and use the data to explain how this gas moves from the air in the alveolus into the blood. [3 marks]**

5	

7 **IMAGE 7 in the separate diagram booklet shows the total amount of energy entering a grassland habitat in kilojoules per square metre during a year. The transfer of energy in a food chain is shown, as well as the energy that is lost from it as heat.**

(a)(i) **State the name of the stage in IMAGE 7 which represents the herbivores. [1 mark]**

(ii) **State the name of ONE type of decomposer. [1 mark]**

---

7 (b)(i) Use the data from IMAGE 7 to calculate the percentage of energy transferred from the first stage consumer to the second stage consumer. GIVE YOUR ANSWER TO THREE SIGNIFICANT FIGURES. [2 marks]

Percentage of energy transferred = _____

(ii) Suggest why the food chain shown in IMAGE 7 would be unable to support a fourth stage consumer. [1 mark]

_____

_____

_____

7 (c) **In the space below, USE A RULER to draw a LABELLED pyramid of biomass to represent the food chain shown in IMAGE 7. THE PYRAMID DOES NOT NEED TO BE TO SCALE. [1 mark]**

(d) **State which process is responsible for the heat loss in IMAGE 7. [1 mark]**

8 **GRAPH 8 in the separate diagram booklet shows the percentage change in global food production, human population and the land used for food production between 1960 and 2014.**

(a) **Use the information in GRAPH 8 to state ONE conclusion about the efficiency of food production. Explain your answer. [2 marks]**

8 (b) **Use your knowledge of the nitrogen cycle to explain how farmers can increase the nitrogen available to their crops and so increase their yield. Diagrams will not gain credit.**
[6 marks QER]

continue answer on the next page

8

9 Catalase is an enzyme found in most cells. Catalase speeds up the breakdown of hydrogen peroxide to form water and oxygen.

IMAGE 9.1 in the separate diagram booklet represents the breakdown of hydrogen peroxide by the action of catalase.

(a)(i) State the name of the structure labelled **X** in IMAGE 9.1. **[1 mark]**

_____

_____

(ii) State the name of the model of enzyme action shown in IMAGE 9.1. **[1 mark]**

_____

_____

9 (b) **IMAGE 9.2 in the separate diagram booklet represents the effect of copper sulfate on catalase. If a copper sulfate molecule binds to catalase it prevents it from working.**

Students investigated the effect of copper sulfate on catalase activity in potatoes.

The students set up the four flasks as shown in IMAGE 9.3 in the separate diagram booklet.

The students measured the volume of gas produced from each flask using the apparatus shown in IMAGE 9.4 in the separate diagram booklet.

The results of the investigation are shown in TABLE 9.5 in the separate diagram booklet.

(i) **Describe AND explain the results for flask A. [4 marks]**

continue answer on the next page

9 (b)(ii)

The rate of gas production in flask **A** between 10 and 15 minutes is 1.6 cm^3/min. Use TABLE **9.5** in the separate diagram booklet to calculate the rate of gas production between 10 and 15 minutes in flask **C**. [2 marks]

Rate of gas production = _____ cm^3/minute

9 (b)(iii)

Use the information in IMAGE 9.2 to explain why less gas is produced in flask C than in flask A. [3 marks]

9 (c)(i) State the purpose of flasks **B** and **D** in IMAGE 9.3. [1 mark]

(ii) State TWO variables that should have been controlled in this investigation to make it a fair test. [2 marks]

(iii) Describe how the students could improve the accuracy of their investigation. [1 mark]

15

END OF PAPER

Question number	Additional page, if required. Write the question numbers in the left-hand margin.

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1 hour 45 minutes plus your additional time allowance

DIAGRAM BOOKLET

This Diagram Booklet MUST be handed in to the invigilators and sent for marking.

Surname _____

First name(s) _____

Centre Number _____

Candidate Number 0 _____

IMAGE 1.1

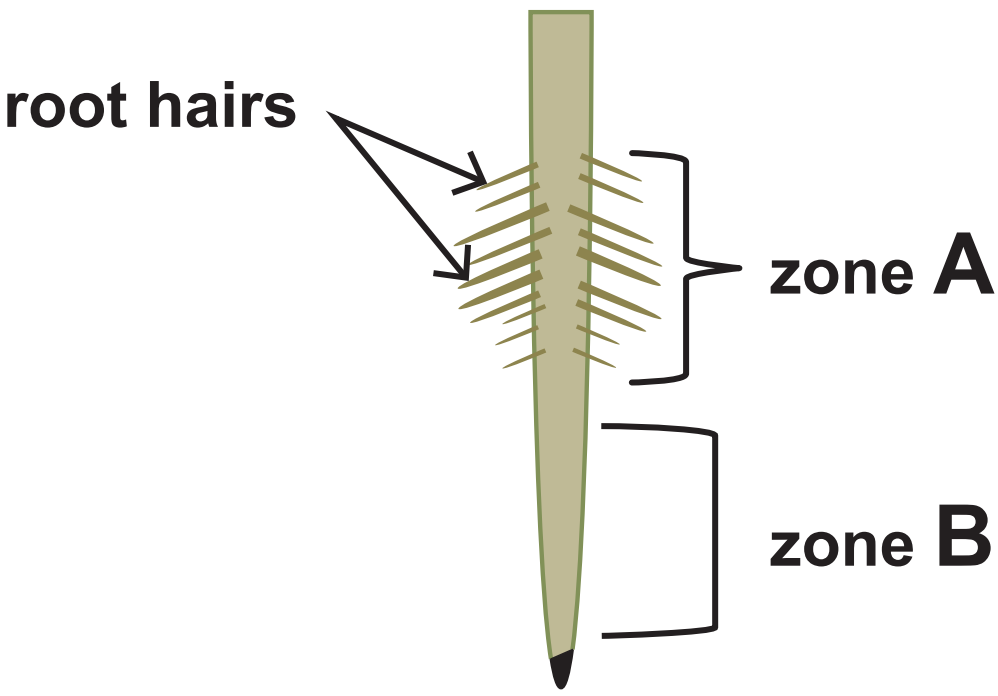


IMAGE 1.2

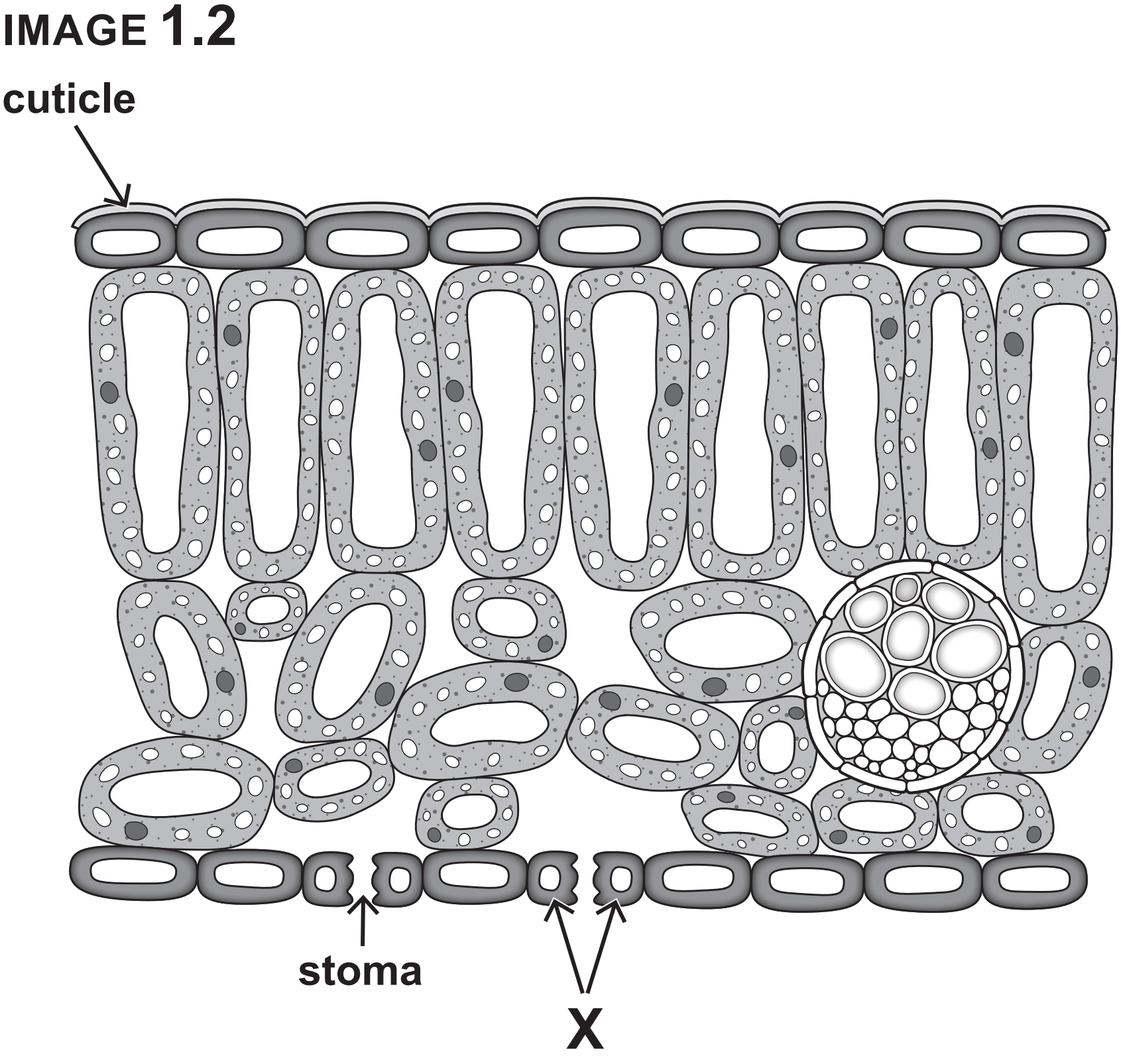
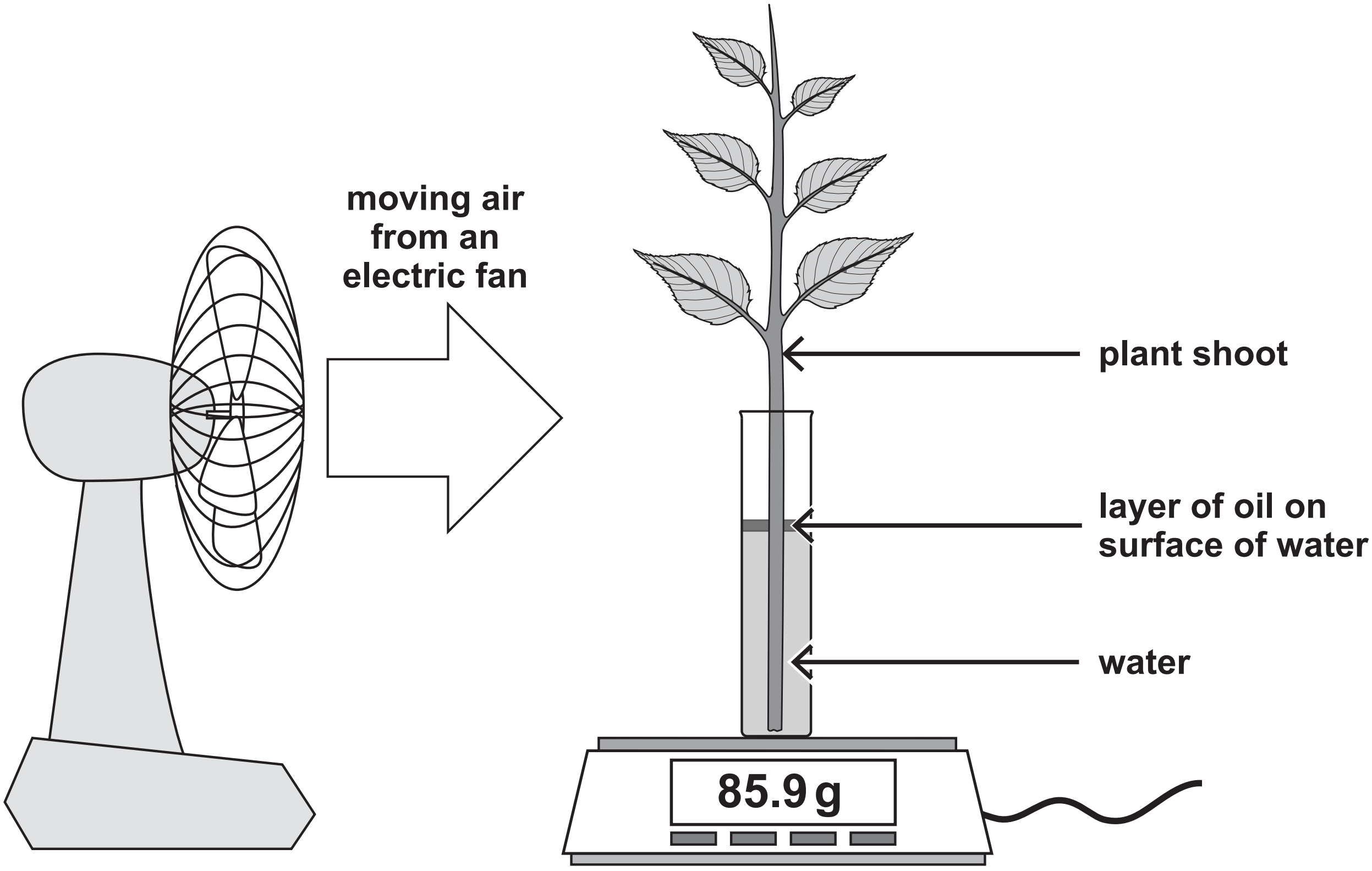


IMAGE 1.3


moving air from an electric fan
plant shoot
layer of oil on surface of water
water
85.9 g

GRAPH 1.4

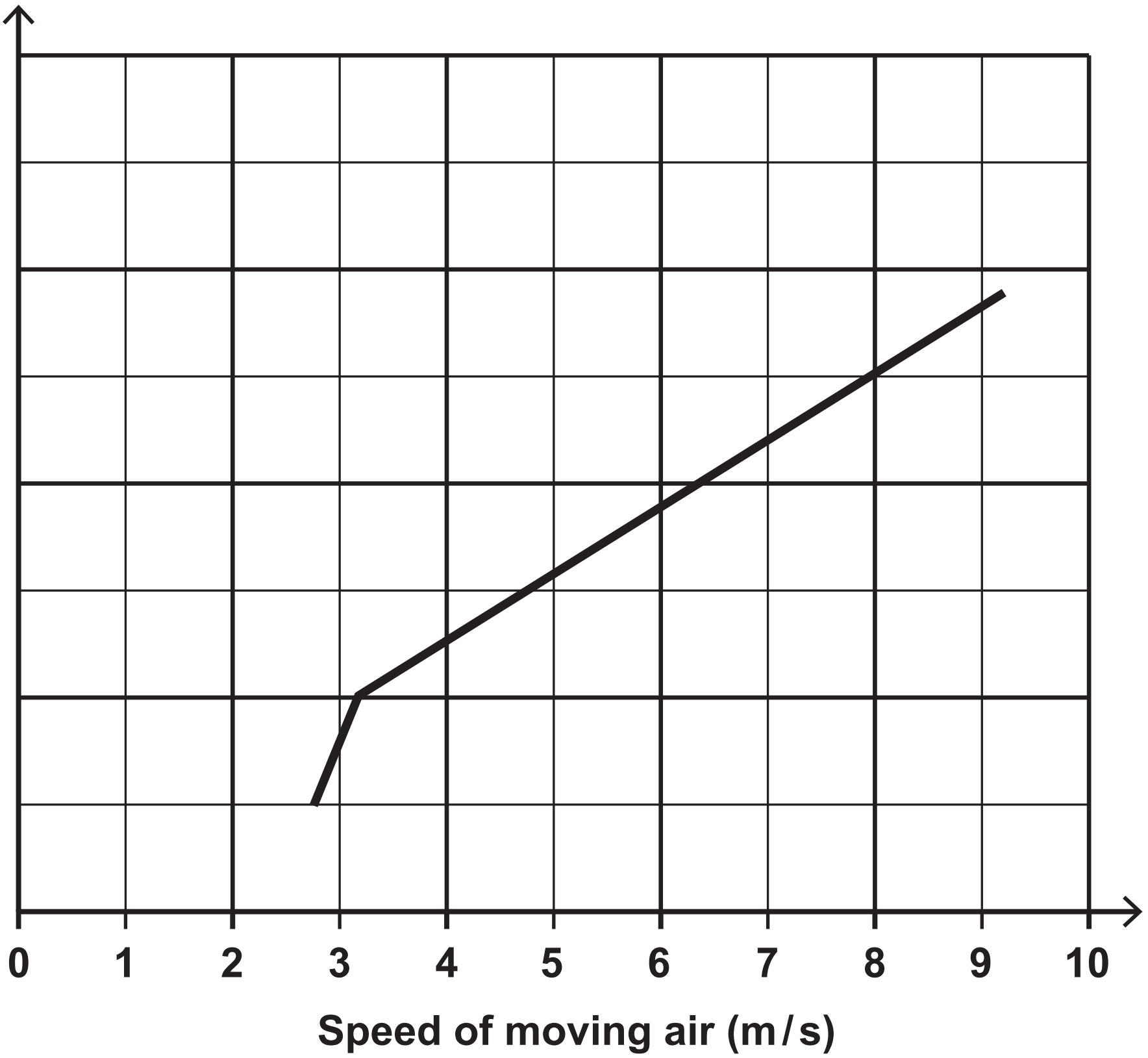


IMAGE 2.1

Free-range farm

Intensive farm

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GRAPH 2.2

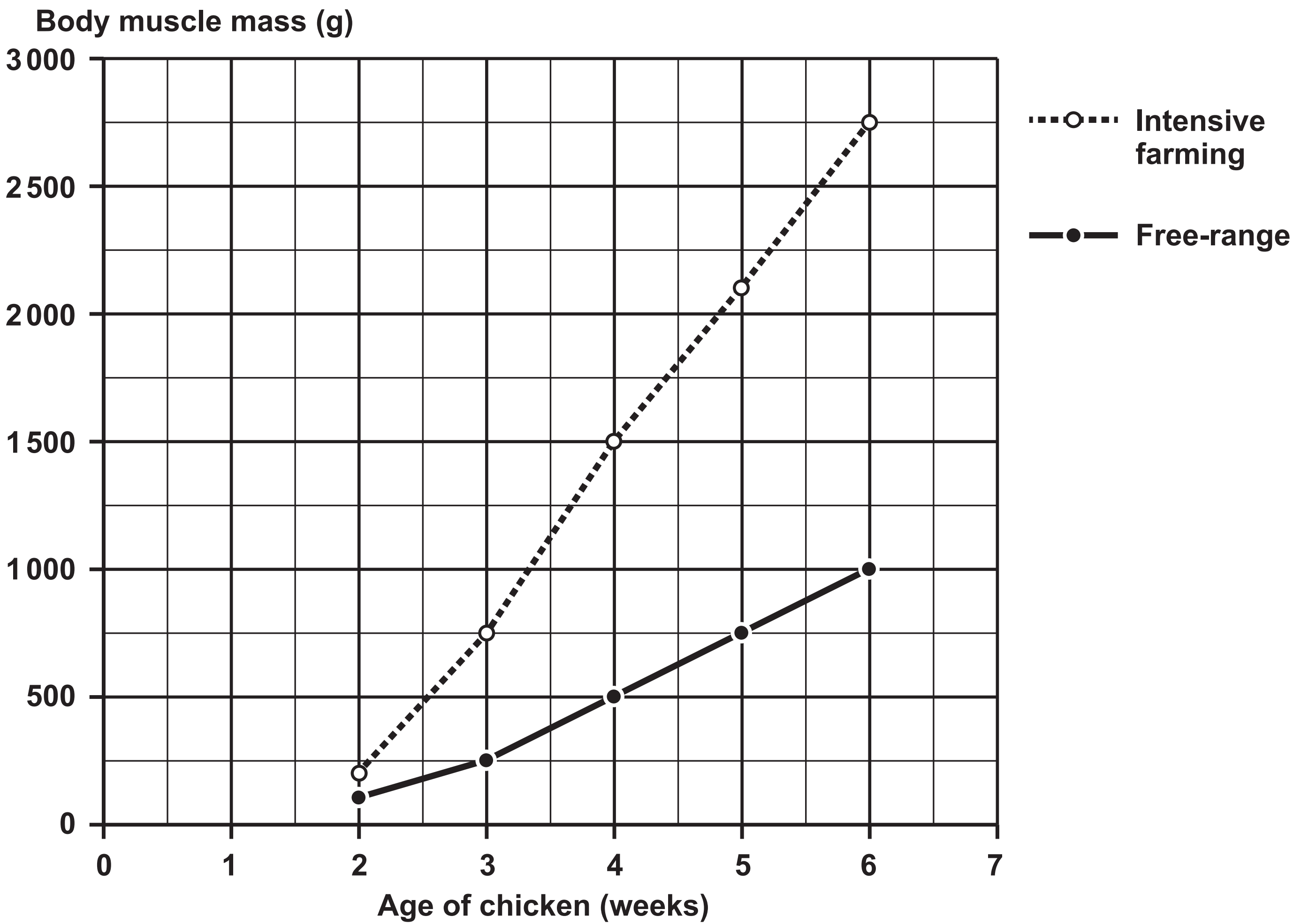

Body muscle mass (g)
3 000
2 500
2 000
1 500
1 000
500
0
0
1
2
3
4
5
6
7
Age of chicken (weeks)
Intensive farming
Free-range

TABLE 2.3 – ORGAN MASS IN CHICKENS AT SIX WEEKS

Organ	Mass (g)	
	Free-range	Intensively farmed
Heart	6.5	4.8
Lungs	4.0	3.5
Liver	20.0	15.0

TABLE 2.4 – BONE QUALITY IN CHICKENS AT SIX WEEKS

	Free-range	Intensively farmed
Bone density (g/cm^3)	1.29	0.79
Presence of broken bones (%)	2.5	37
Length of leg bones (mm)	73	118

IMAGE 3.1

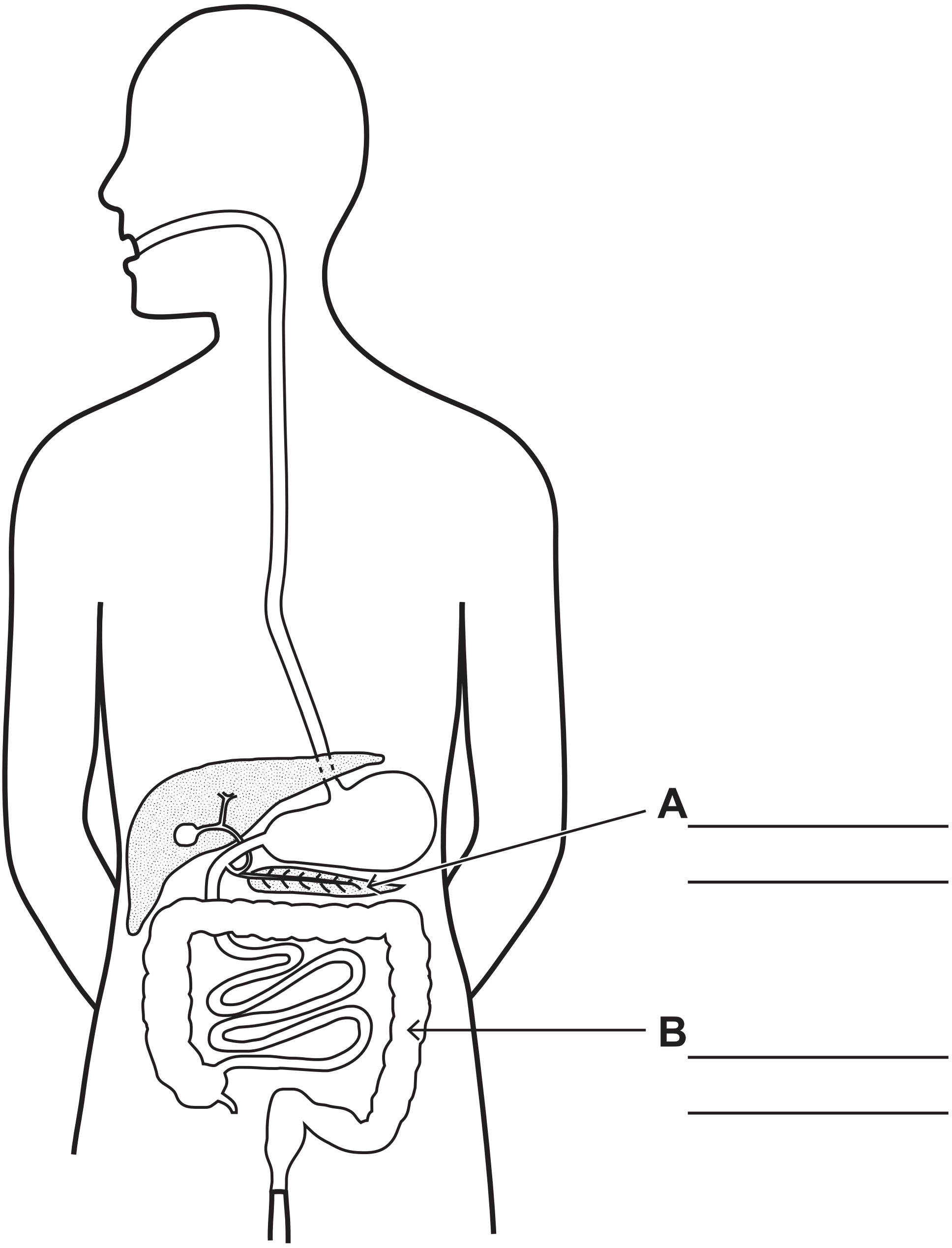


IMAGE 3.2

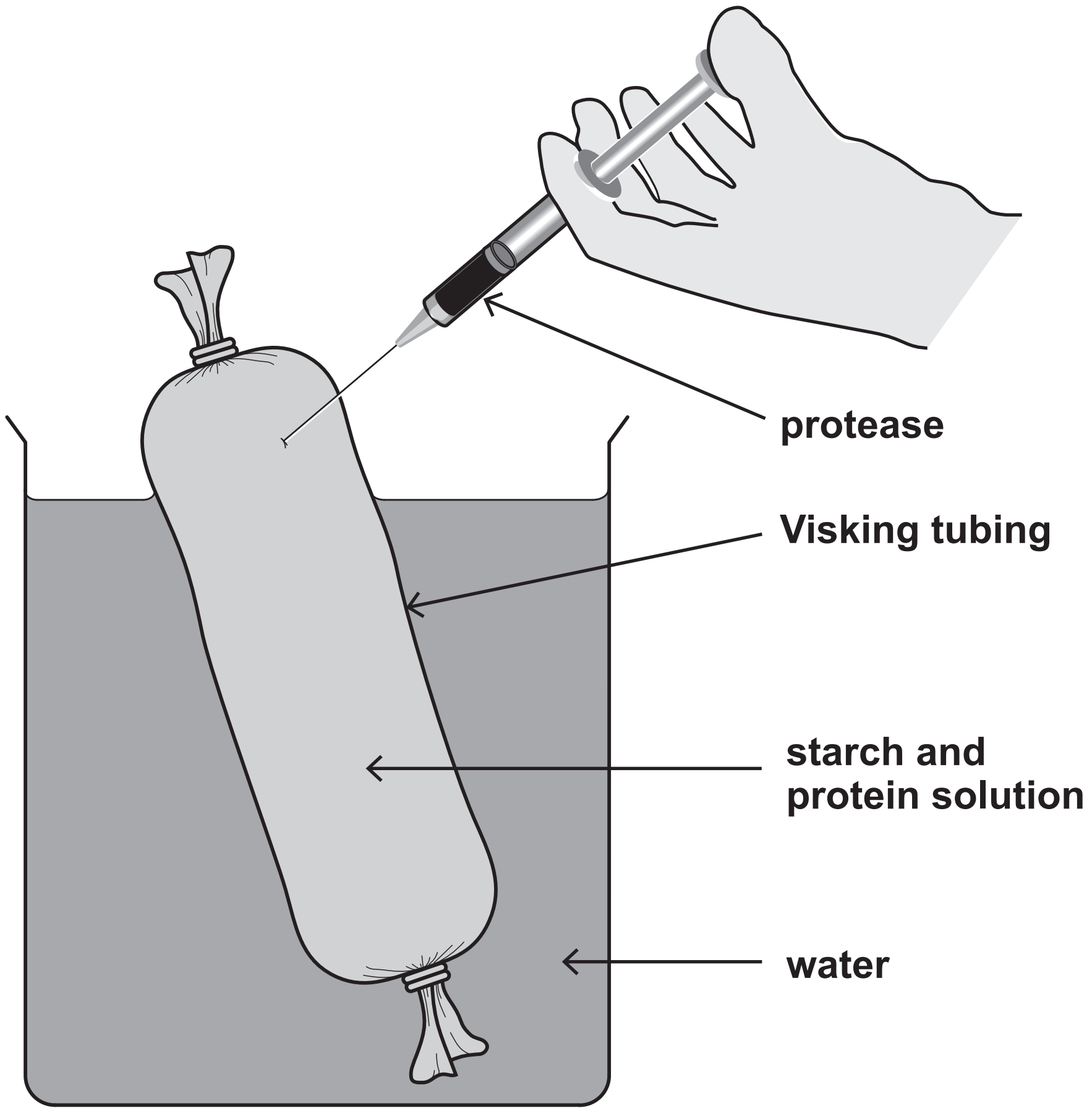

protease
Visking tubing
starch and
protein solution
water

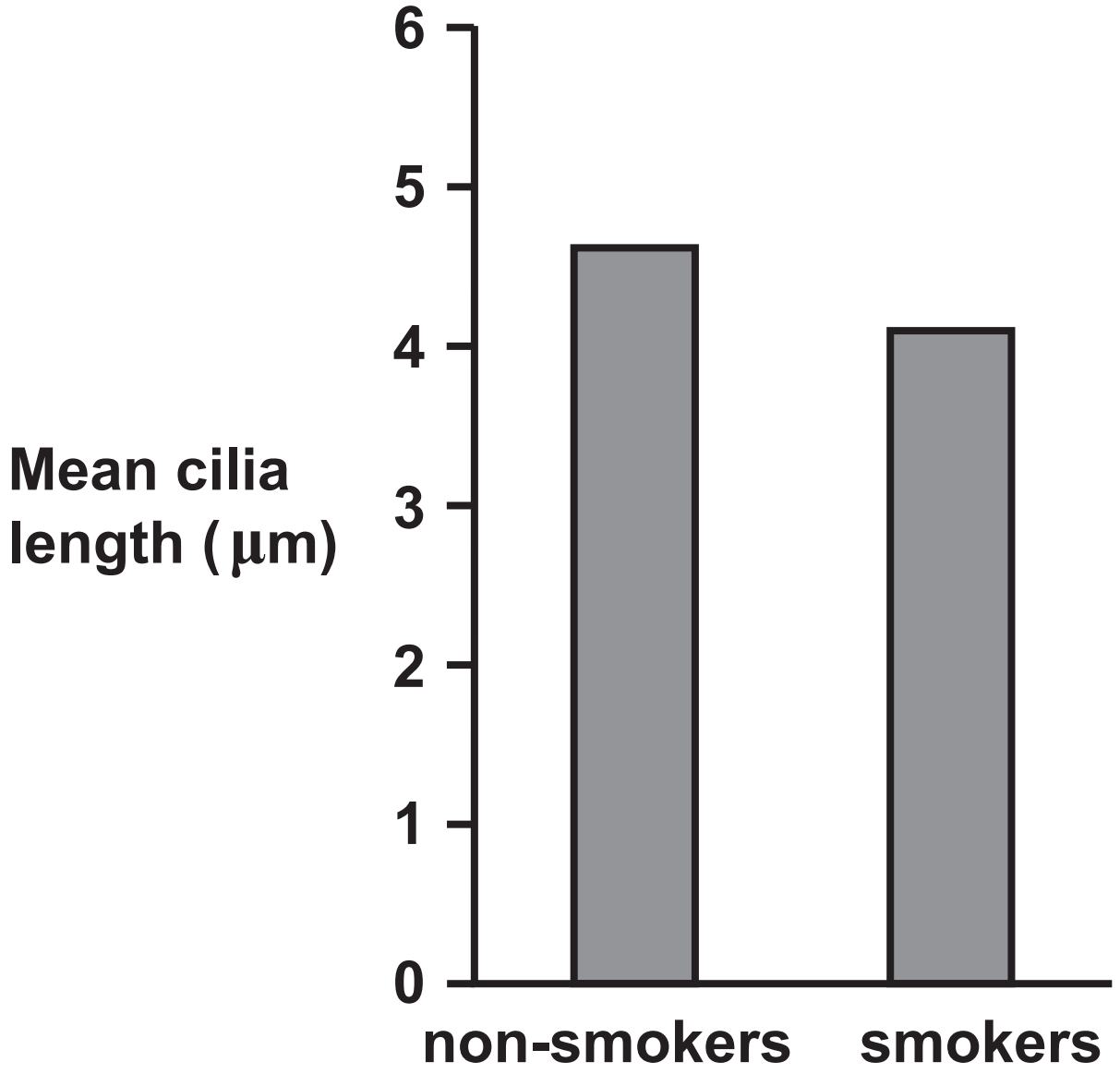
TABLE 3.3

✓ = present in the water surrounding the Visking tubing

✗ = absent in the water surrounding the Visking tubing

Time / minutes	Starch	Protein	Amino acids	Glucose
0	✗			
30	✗			

GRAPH 4.1
MEAN CILIA LENGTH IN NON-SMOKERS AND SMOKERS



GRAPH 4.2
VARIATION IN CILIA LENGTH IN NON-SMOKERS AND SMOKERS

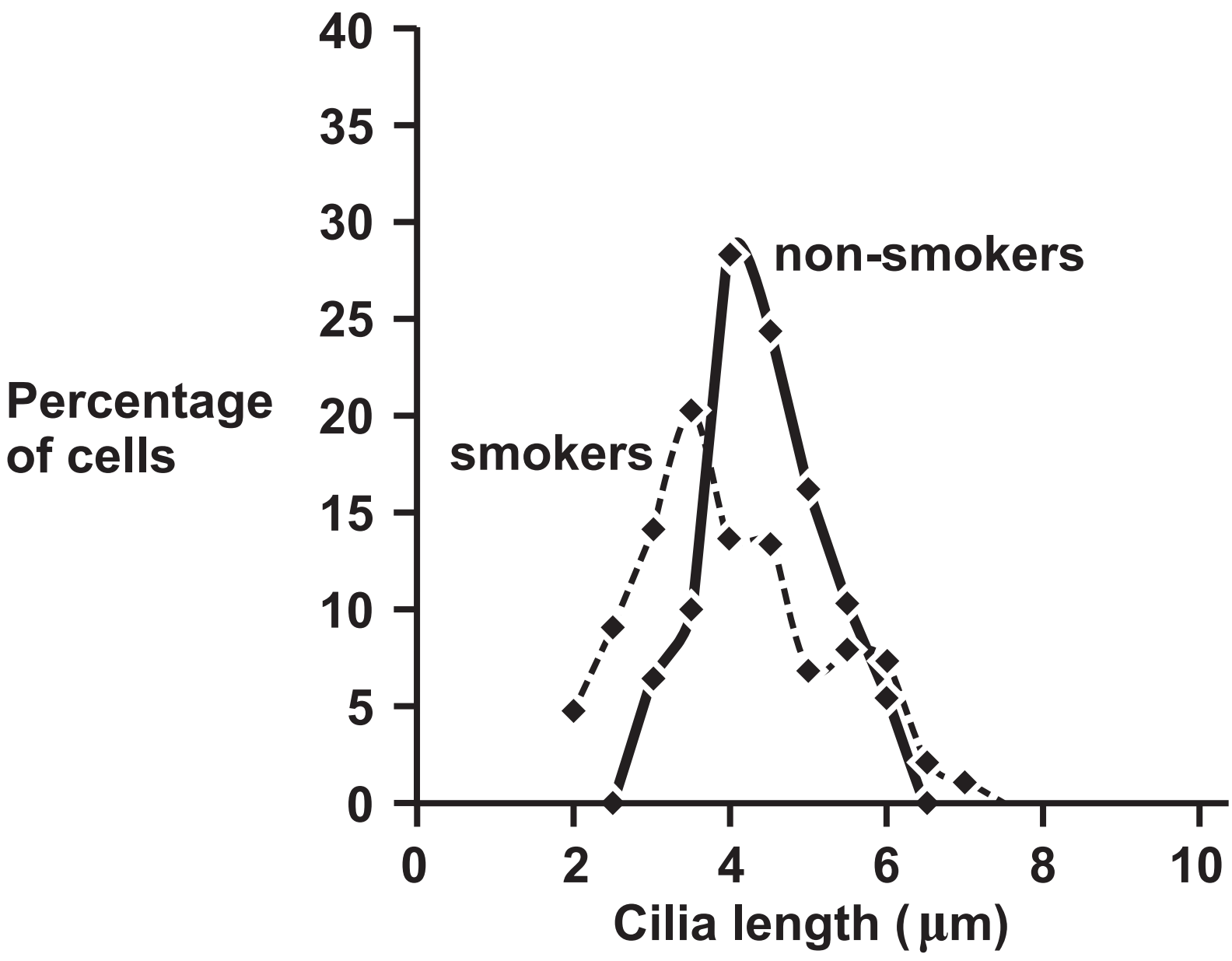
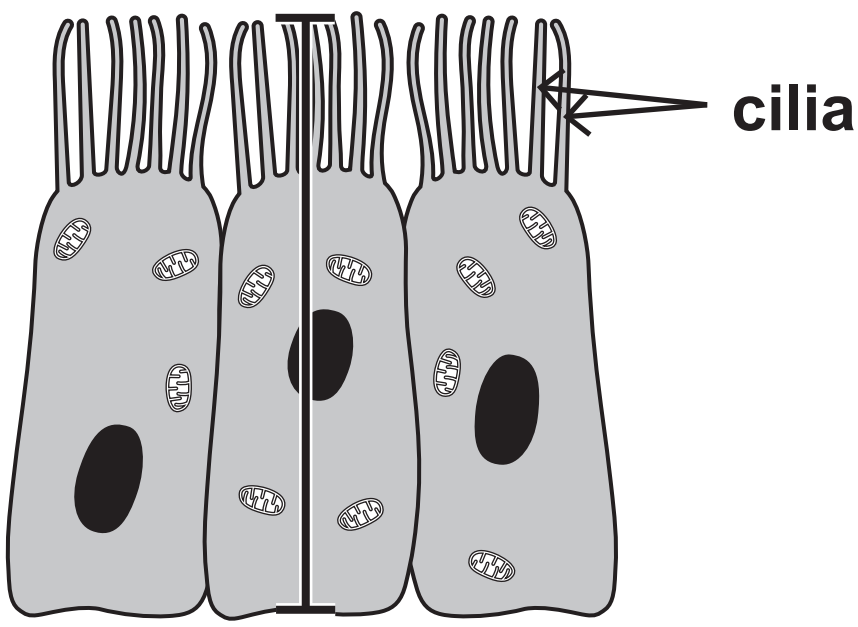


IMAGE 4.3 – CELLS LINING THE BRONCHIOLES

A



B

IMAGE 5.1

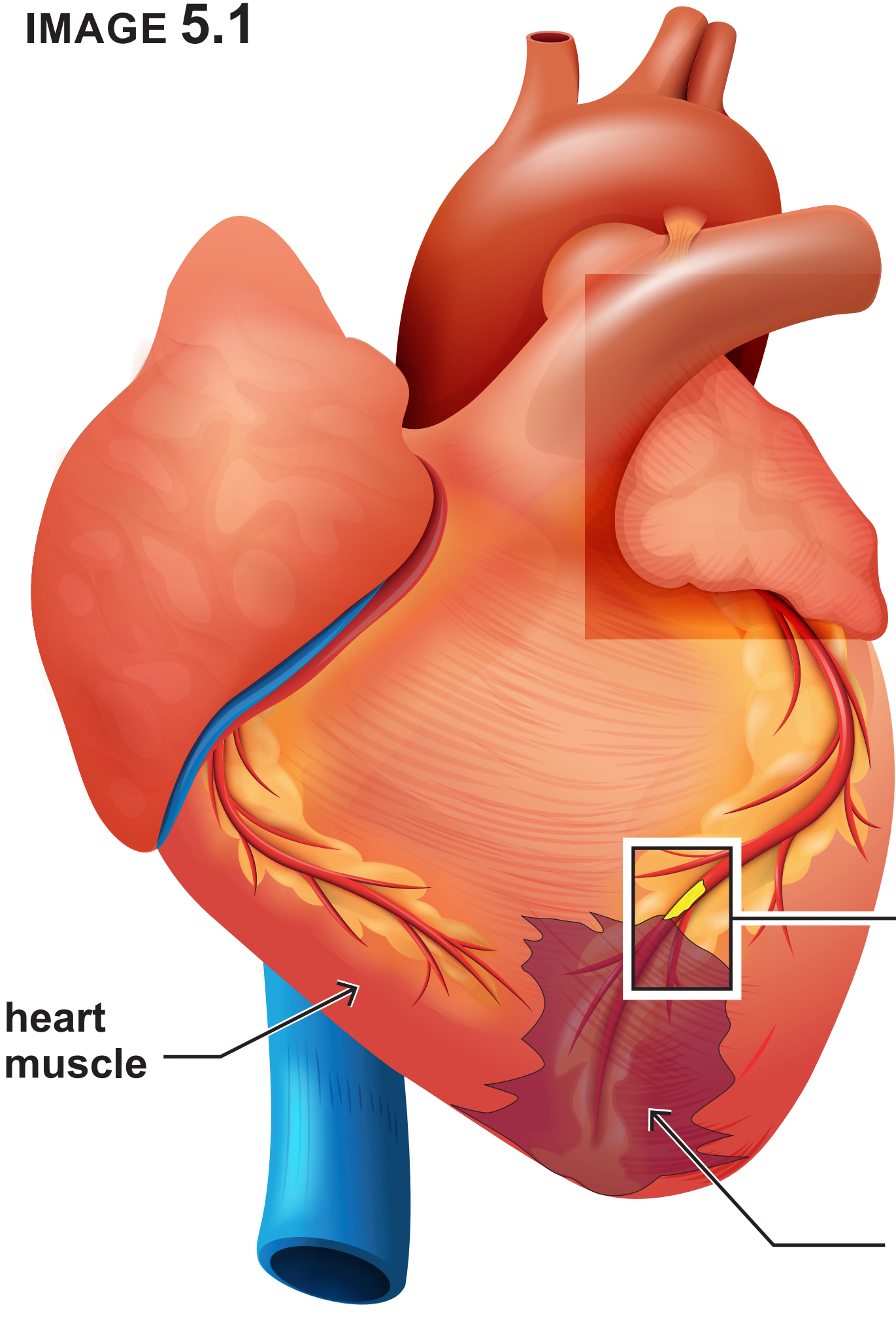


IMAGE 5.2

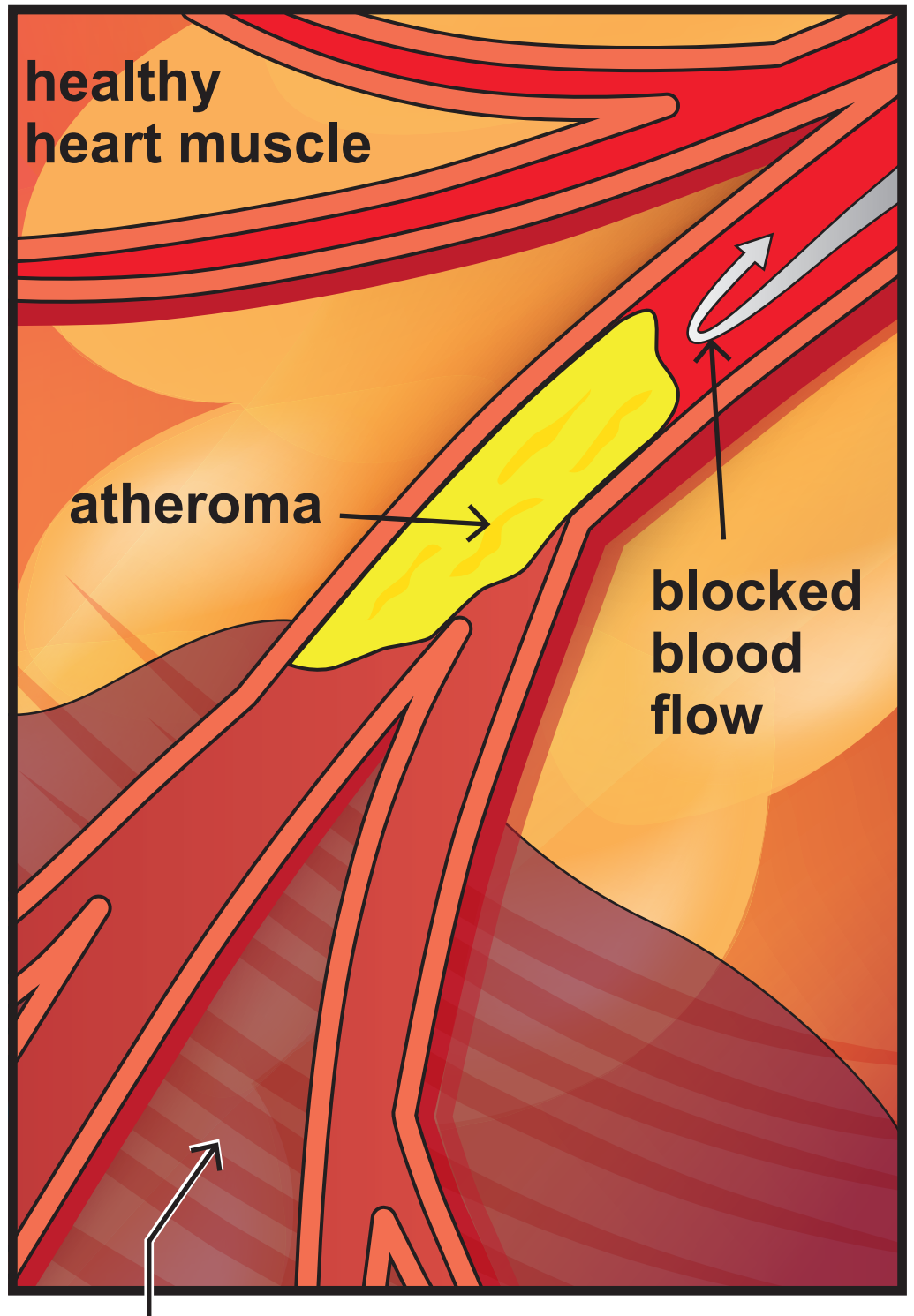


IMAGE 6

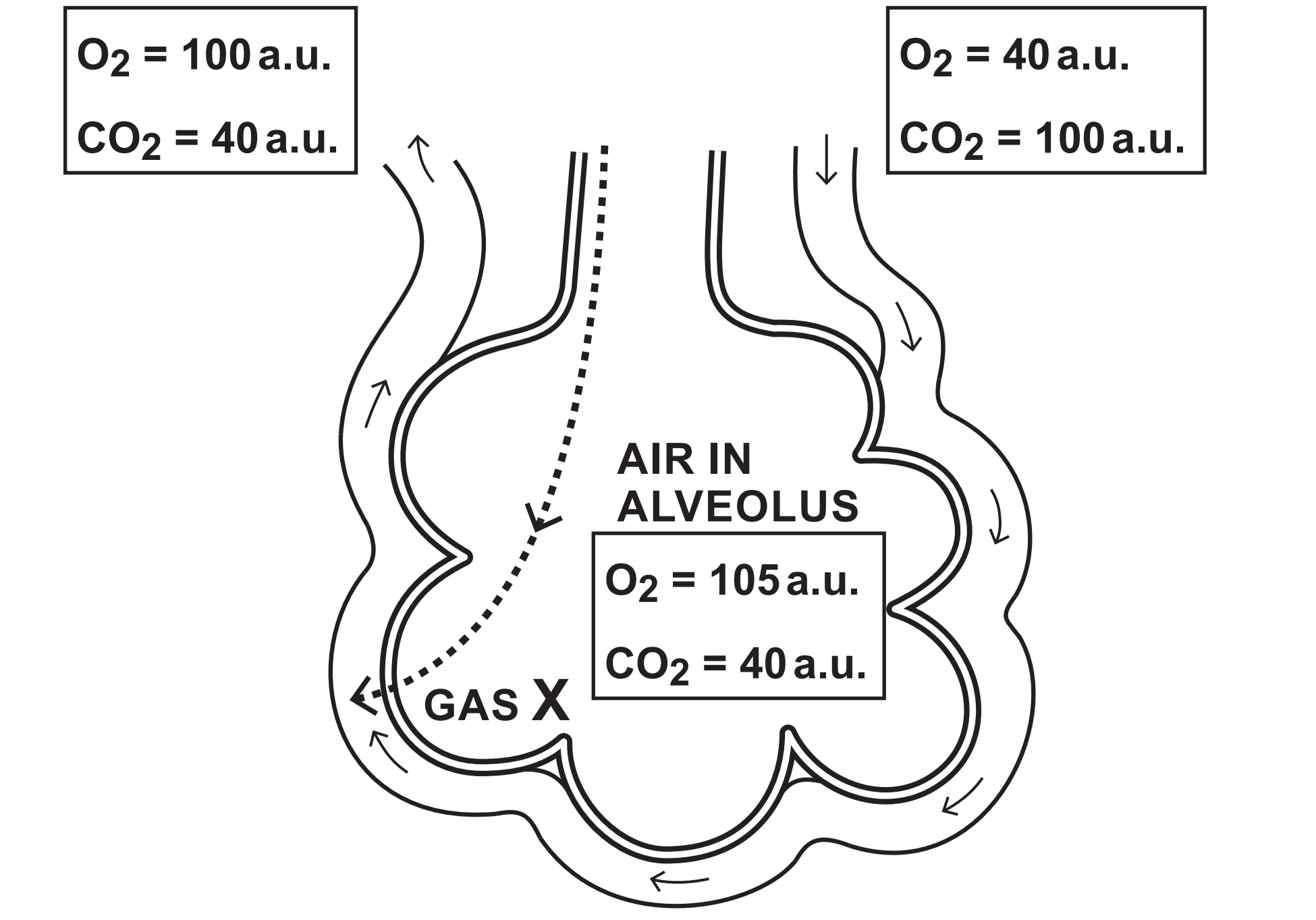
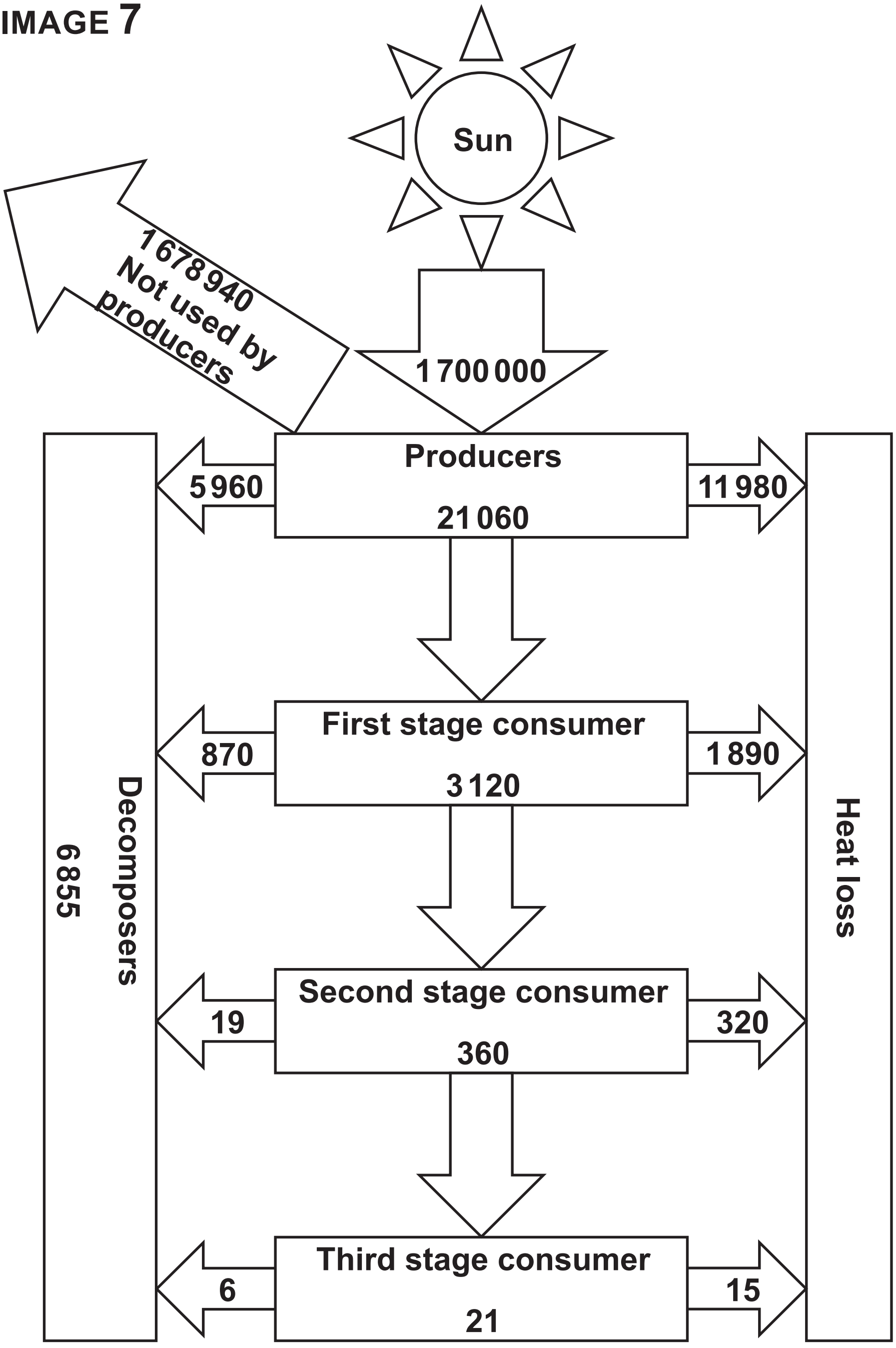

BLOOD FROM ALVEOLUS
O_2 = 100 a.u.
CO_2 = 40 a.u.
BLOOD TO ALVEOLUS
O_2 = 40 a.u.
CO_2 = 100 a.u.
AIR IN ALVEOLUS
O_2 = 105 a.u.
CO_2 = 40 a.u.
GAS X

IMAGE 7


Sun
1 678 940
Not used by
producers
1 700 000
Producers
21 060
5 960
11 980
First stage consumer
3 120
870
1 890
Second stage consumer
360
19
320
Third stage consumer
21
6
15
6 855
Decomposers
Heat loss

GRAPH 8

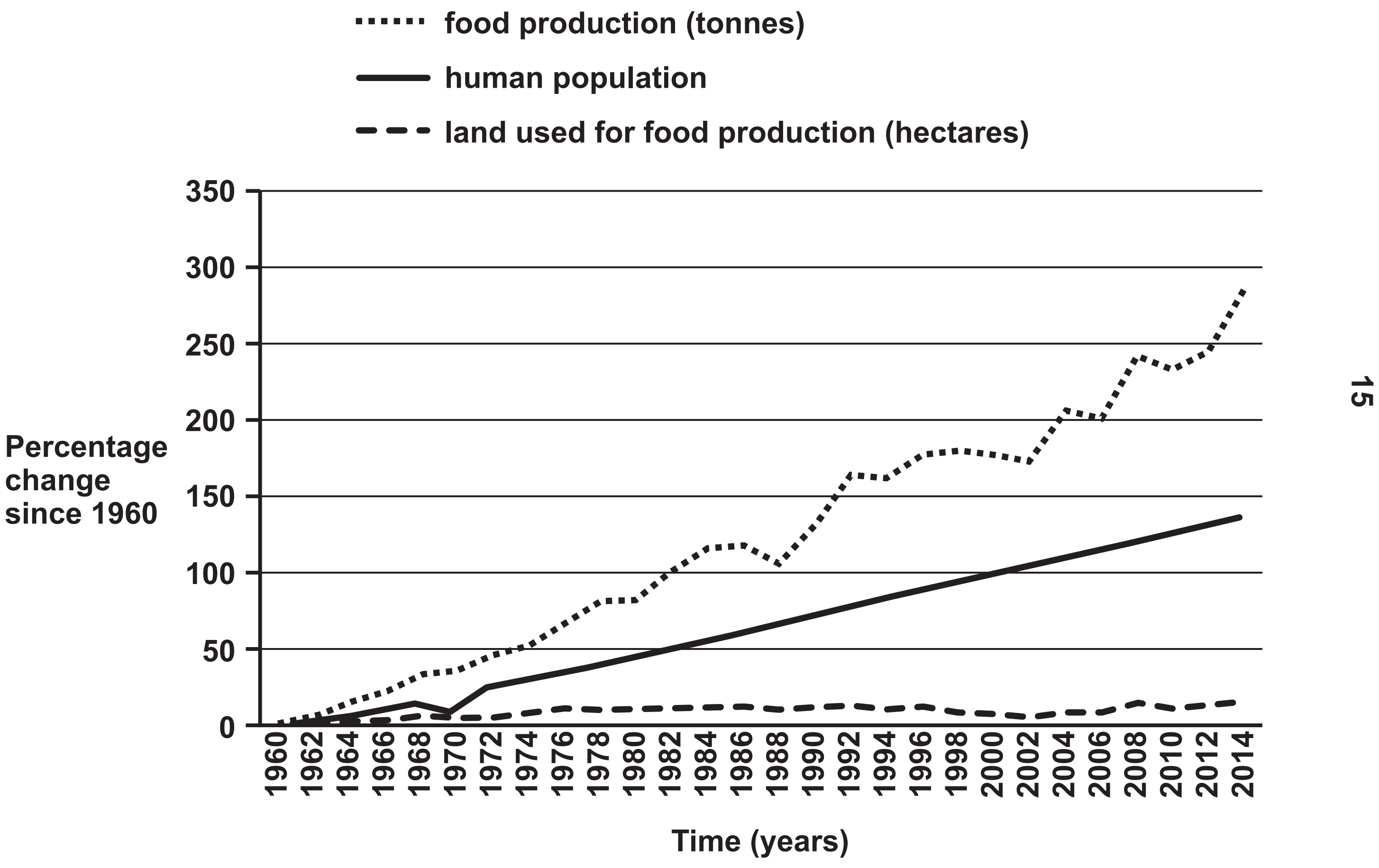

food production (tonnes)
human population
land used for food production (hectares)
Percentage change since 1960
350
300
250
200
150
100
50
0
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
Time (years)
15

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IMAGE 9.1

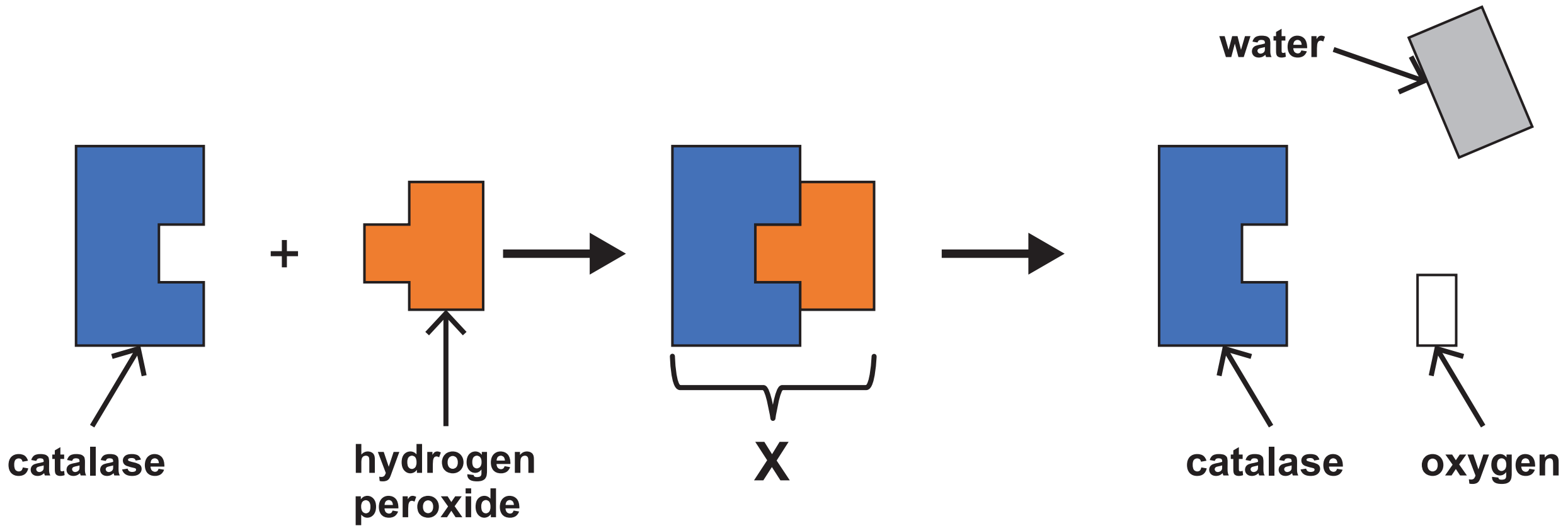

IMAGE 9.2

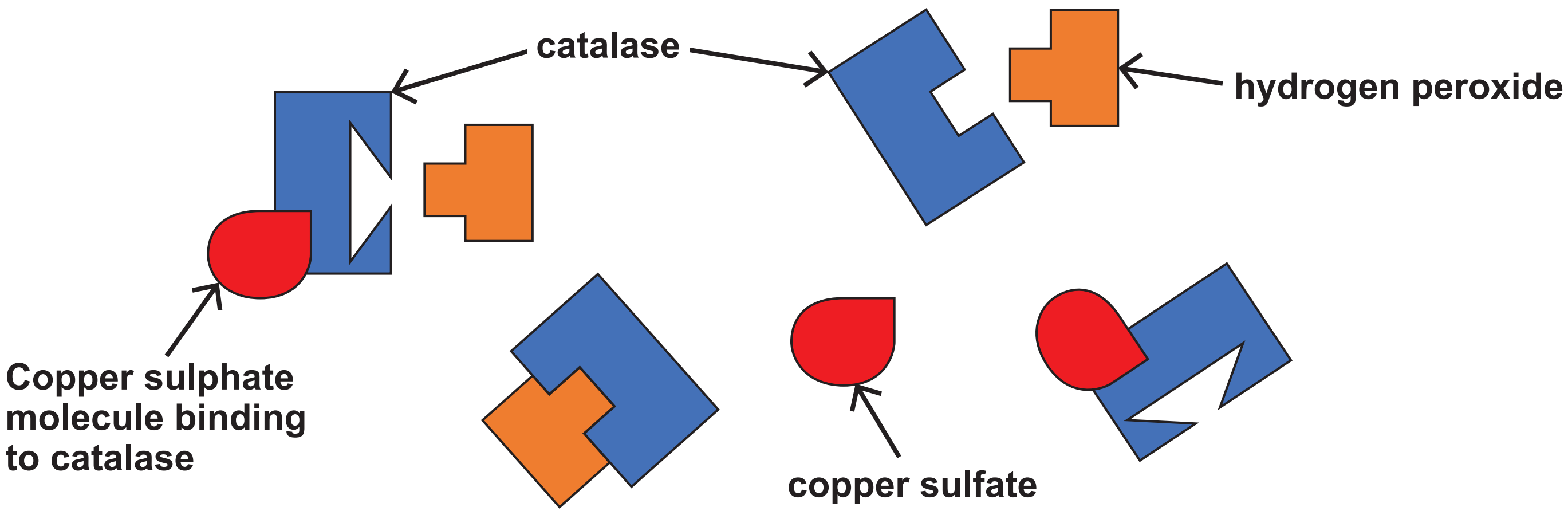
catalase
hydrogen peroxide
Copper sulphate molecule binding to catalase
copper sulfate

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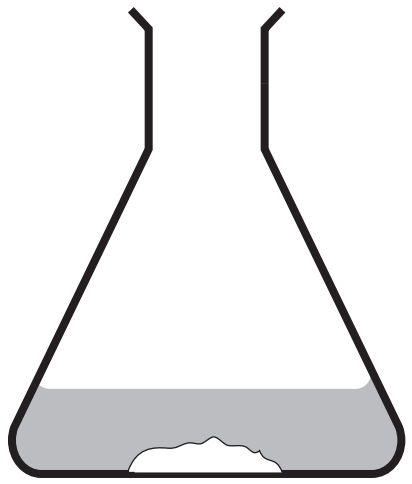
IMAGE 9.3

FLASK A

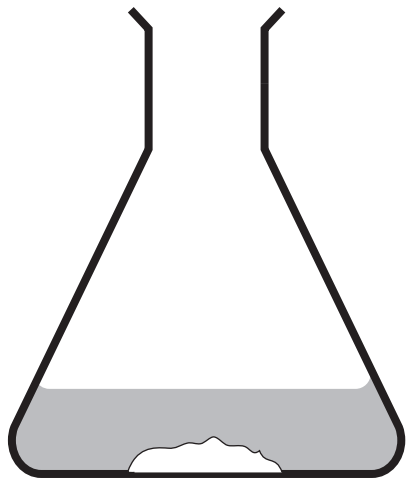


9 cm^3 hydrogen peroxide solution

1 cm^3 water

fresh potato pieces

FLASK B

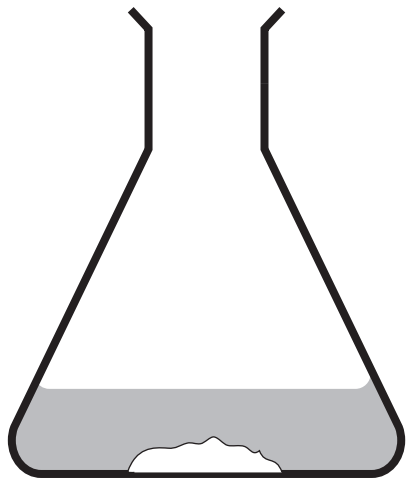


9 cm^3 hydrogen peroxide solution

1 cm^3 water

boiled potato pieces

FLASK C

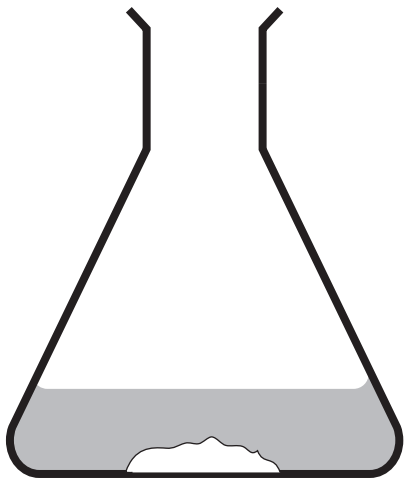


9 cm^3 hydrogen peroxide solution

1 cm^3 copper sulfate solution

fresh potato pieces

FLASK D



9 cm^3 hydrogen peroxide solution

1 cm^3 copper sulfate solution

boiled potato pieces

IMAGE 9.4

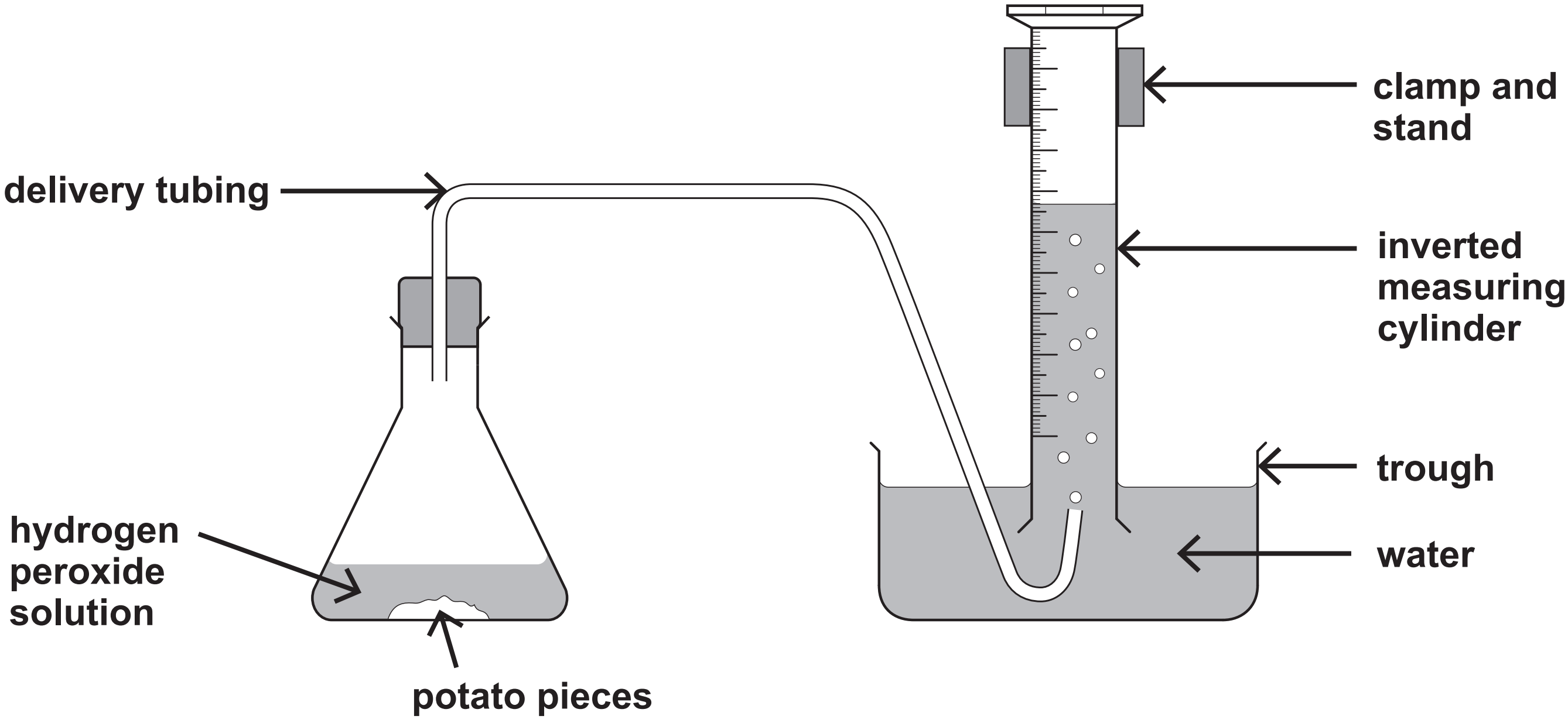

delivery tubing
clamp and stand
inverted measuring cylinder
trough
water
hydrogen peroxide solution
potato pieces

TABLE 9.5

Time (minutes)	Volume of gas present in the cylinder (cm^3)			
	Flask A	Flask B	Flask C	Flask D
0	0	0	0	0
5	12	0	3	0
10	20	0	5	0
15	28	0	7	0
20	34	0	10	0
25	38	0	12	0
30	38	0	14	0