



GCSE

3400U20-1

TUESDAY, 13 MAY 2025 – AFTERNOON

BIOLOGY – Unit 2:
Variation, Homeostasis and Micro-organisms

FOUNDATION TIER

1 hour 45 minutes plus your additional time allowance

Surname _____

First name(s) _____

Centre Number _____

Candidate Number 0 _____

ADDITIONAL MATERIALS

A calculator and a ruler.

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 7 is a quality of extended response (QER) question where your writing skills will be assessed.

(Turn over)

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	4	
2.	10	
3.	8	
4.	12	
5.	5	
6.	15	
7.	6	
8.	10	
9.	10	
Total	80	

Answer ALL questions.

- 1 IMAGE 1.1 AND 1.2 in the separate diagram booklet show the two types of cell division, mitosis and meiosis.**
- (a) COMPLETE TABLE 1.3 in the separate diagram booklet by PLACING A TICK (✓) in the correct column for each of the statements. [3 marks]**
- (b) State the name of the disease caused by uncontrolled mitosis. [1 mark]**
-

4

- 2** Some year 8 students investigated whether hand span was related to height. They measured the hand span and height of all the students in the class.

TABLE 2.1 in the separate diagram booklet shows the results of 20 students in the year 8 class.

Some of the results of the investigation were then plotted as a graph as shown in **GRAPH 2.2** in the separate diagram booklet.

(a)(i) COMPLETE GRAPH 2.2 by:

- I. adding the labels to BOTH axes, including units; [2 marks]**
- II. plotting the results for STUDENTS 1–5 from TABLE 2.1. [3 marks]**

(ii)

- I. CIRCLE THE ANOMALOUS RESULT on GRAPH 2.2. [1 mark]**
- II. Explain why you chose this result. [1 mark]**

2 (a)(iii)

Use GRAPH 2.2 to describe the relationship between hand span and height. [1 mark]

(iv) Explain why the students did not include their teacher in the investigation. [1 mark]

**(b) Differences in hand span and height are examples of variation.
State the meaning of the term variation.
[1 mark]**

3 Influenza (flu) is caused by a virus.

(a)(i) COMPLETE THE FOLLOWING SENTENCES
to describe the immune response following
infection with the flu virus.

Use some of the words from the list below.
[3 marks]

platelets lymphocytes phagocytes
antigens memory cells

- **On the surface of the flu virus there are**
_____ .

- **When the virus enters the blood, white blood**
cells called _____
multiply to form clones.

- **The clones produce antibodies which destroy**
the virus and _____
which will recognise the same virus if it gets
into the blood again.

(Turn over)

3 (a)(ii)

Use the sentences in part (i) to suggest ONE reason why the white blood cells multiply to form clones. [1 mark]

(b) Antibodies are specific.

IMAGE 3 in the separate diagram booklet shows a virus and antibodies A, B and C.

CIRCLE the antibody (A, B or C) in IMAGE 3 that would destroy the flu virus. [1 mark]

- 3 (c) Flu symptoms include fever and a cough. Most people who get flu recover in a few days, but some develop complications that may result in death.**

Complications are more common in elderly people and people who have other medical conditions such as heart disease. There is a vaccine available to prevent flu.

- (i) USE THE INFORMATION GIVEN to suggest why some people may choose to get the flu vaccine, but others choose not to. [2 marks]**

Choose to have vaccine

Choose not to have vaccine

3 (c)(ii)

Explain why a doctor would not prescribe antibiotics to treat flu. [1 mark]

8

- 4 (a) IMAGE 4.1** in the separate diagram booklet shows a diagram of a section through the skin.
- (i) Use letters (A–E) from IMAGE 4.1 to identify structures in TABLE 4.2 in the separate diagram booklet. [3 marks]**
- (ii) TABLE 4.3 in the separate diagram booklet describes what happens to different structures in the skin during cold and hot conditions.**
Complete TABLE 4.3 by filling in the blank boxes. [4 marks]
- (b)(i) When Dylan is in hot conditions his skin becomes more red than usual.**
Explain why this change takes place and how it helps to cool his body. [2 marks]

4 (b)(ii)

**Shivering is a response to cold conditions.
State how shivering helps maintain a constant
body temperature. [1 mark]**

**(iii) Dylan will need to drink more water in hot
conditions.
Use your knowledge of temperature control to
explain why. [2 marks]**

- 5 (a) IMAGE 5.1 in the separate diagram booklet shows the human excretory system.**
- (i) DRAW ONE ARROW on a RENAL ARTERY in IMAGE 5.1 to show the direction of blood flow. [1 mark]**
- (ii) On IMAGE 5.1 DRAW A LABELLED ARROW TO NAME and IDENTIFY where urine is stored. [2 marks]**
- (b) TABLE 5.2 in the separate diagram booklet shows comparisons of fluids in the excretory system.**
- (i) Use information from TABLE 5.2 to suggest which substance is the waste product. [1 mark]**

- (ii) Suggest ONE difference that would be shown in TABLE 5.2 if the person had kidney disease. [1 mark]**

- 6 Dune gentian is an endangered native species of flower that can be found in Oxwich Dunes in South Wales.**

Invasive species of plants have caused the number of dune gentian to decrease due to increased competition.

- (a)(i) State the meaning of the term invasive species. [1 mark]**

- (ii) State TWO resources for which plants compete. [2 marks]**

1.

2.

- 6 (b) Rabbits on the dunes eat grass and the invasive species of plant.
Describe how this would affect the number of dune gentian plants.
Explain your answer. [2 marks]**

- (c) Recently a disease has caused the population of rabbits to decrease. This has put the dune gentian at risk of extinction.**

**State the effect on biodiversity if the dune gentian became extinct.
Explain your answer. [2 marks]**

continue answer on the next page

(Turn over)

6(d) Conservationists are working on a project to increase the number of rabbits in Oxwich Dunes. The success of the project will be measured by counting the number of dune gentian plants at the start and then three years later. The conservationists used the following method.

- 1. Measure a 100 m × 100 m area of the sand dune.**
- 2. Place a 1 m² quadrat randomly in the sample area.**
- 3. Count and record the number of dune gentian plants in the quadrat.**
- 4. Repeat steps 2 and 3 to get a total of 10 results.**

Before carrying out the investigation the conservationists carried out a risk assessment shown in TABLE 6.1 in the separate diagram booklet.

- (i) Complete the risk assessment in TABLE 6.1.
[1 mark]**

6 (d)(ii)

TABLE 6.2 in the separate diagram booklet shows the results of the sample at the start of the project.

- I. Use **TABLE 6.2** to calculate the mean number of dune gentian plants per m^2 .
GIVE YOUR ANSWER TO ONE DECIMAL PLACE. [1 mark]

Mean number of plants per m^2 = _____

- II. Calculate the sample area of the $100\text{ m} \times 100\text{ m}$ sand dune. [1 mark]

Sample area = _____ m^2

(Turn over)

6 (d)(ii)

- III. Use your answers to I. and II. and the following equation to estimate the population size of the plants in the whole sample area:
[1 mark]

$$\begin{array}{ccccc} \text{Total number} & & & & \text{mean number of} \\ \text{of plants} & = & \text{sample} & \times & \text{plants per m}^2 \\ & & \text{area in m}^2 & & \end{array}$$

Total number of plants = _____

- (iii) Suggest ONE way in which the conservationists could increase their confidence in the results. [1 mark]

6 (d)(iv)

State why the quadrats were placed at random in the sample area. [1 mark]

(v) Suggest TWO factors that would need to be kept the same when the conservationists estimate the number of plants three years later. [2 marks]

1.

2.

7 IMAGE 7 in the separate diagram booklet shows the structure of DNA.

Describe the structure of DNA. Use ALL THE LABELS on IMAGE 7 and your own knowledge in your answer. [6 marks QER]

[illegible]

continue answer on the next page

(Turn over)

6

- 8** The ability to taste the chemical phenylthiocarbamide (PTC) is controlled by a single gene called TAS2R38. The allele that allows an individual to taste PTC is dominant to the allele for non-tasting.

(a)(i) Name the TWO sense organs involved in the detection of chemicals. [1 mark]

1. _____

2. _____

(ii) Explain the meaning of the following terms:

I. gene; [2 marks]

II. allele. [1 mark]

8 (b) **IMAGE 8.1** in the separate diagram booklet is a family tree showing how the ability to taste PTC has been inherited within a family.

- (i) Complete the Punnett square below to show the possibility of couple **5** and **6** having a child who can taste PTC. Use the key below. [2 marks]

KEY

T = allele for tasting PTC

t = allele for non-tasting PTC

- (ii) **CIRCLE A GENOTYPE** in the **PUNNETT SQUARE** that is **HETEROZYGOUS**. [1 mark]

(Turn over)

8 (b)(iii)

Couple 5 and 6 have another child.

State the probability of this child being able to taste PTC. [1 mark]

Probability = _____

- (c) In 1949, scientists developed a test to identify individuals who were non-tasters for PTC. They used the test to study the percentage of non-tasters in some European countries.

TABLE 8.2 in the separate diagram booklet shows the result of this test in these countries.

Use TABLE 8.2 to state TWO reasons why the scientists can be confident in the results for PTC tasting. [2 marks]

Reason 1

continue answer on the next page

(Turn over)

Reason 2

10

- 9 The antibiotic penicillin is produced from **Penicillium** grown in large stainless steel fermenters. The fermenters contain **Penicillium** in a liquid nutrient culture medium.
- (a) Use the five Kingdom system of classification to state the kingdom to which **Penicillium** belongs. [1 mark]
-
-
- (b) **IMAGE 9.1** in the separate diagram booklet shows a diagram of a fermenter used to produce penicillin.
- (i) Aseptic techniques are used when **Penicillium** is added to the fermenter. State the purpose of using aseptic techniques. [1 mark]
-
-

9 (b)(ii)

The level of nutrients in the fermenter is controlled.

Use IMAGE 9.1 to state TWO other factors that need to be controlled.

**Explain how each factor is controlled.
[4 marks]**

Factor 1

Explanation

Factor 2

Explanation

(Turn over)

9 (c) GRAPH 9.2 in the separate diagram booklet shows how the contents of the fermenter changed over a period of six days.

(i) Use GRAPH 9.2 to describe how the mass of **Penicillium** changed from **DAY 1 TO DAY 6**.
[2 marks]

(ii) GRAPH 9.3 in the separate diagram booklet shows the effect of different temperatures on the mass of penicillin produced over time.

Use GRAPH 9.3 to suggest the optimum temperature and time for penicillin to be extracted from the fermenter. [2 marks]

Temperature _____

Time _____

10

END OF PAPER

(Turn over)

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

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Surname _____

First name(s) _____

Centre Number _____

Candidate Number 0 _____

IMAGE 1.1
Mitosis

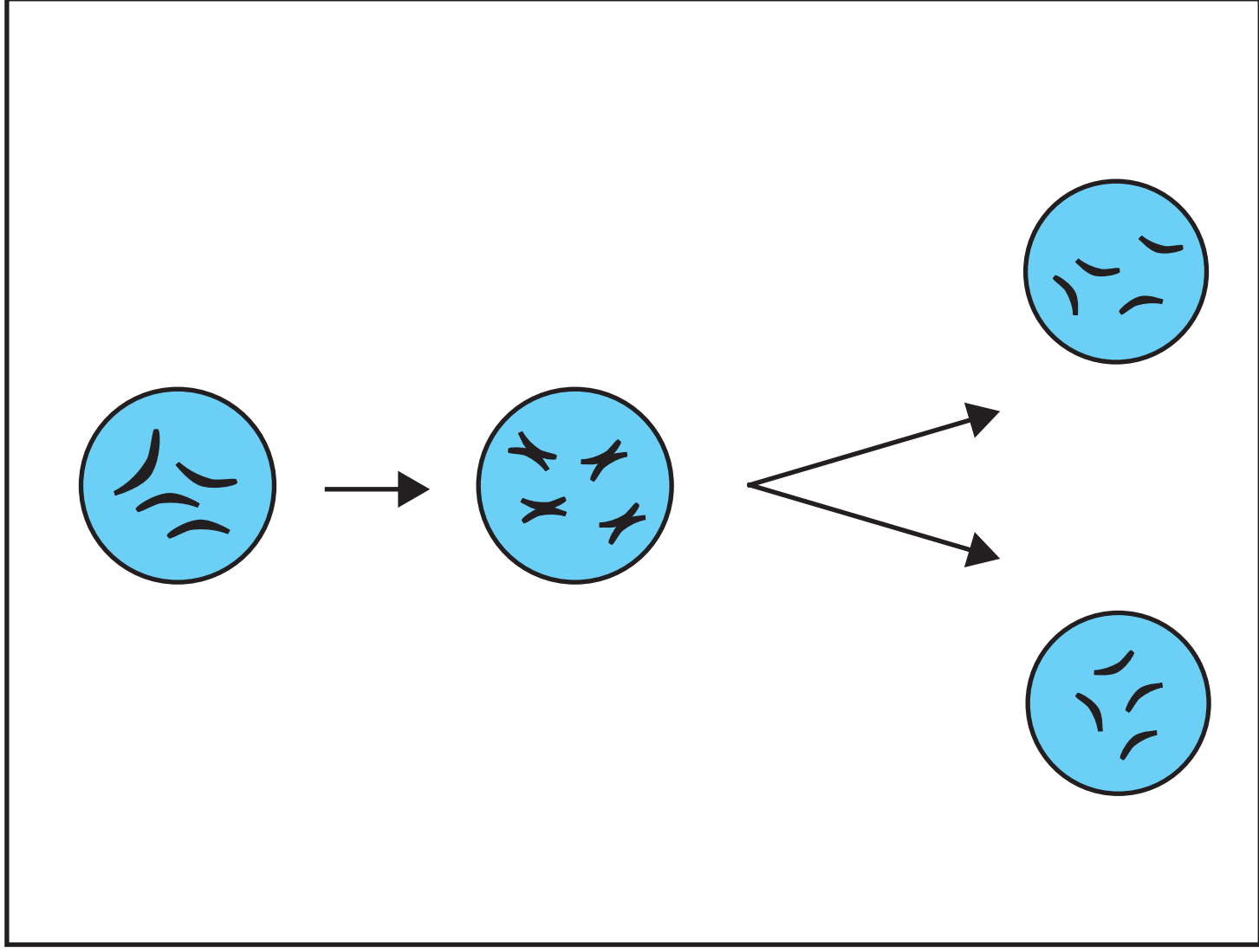


IMAGE 1.2
Meiosis

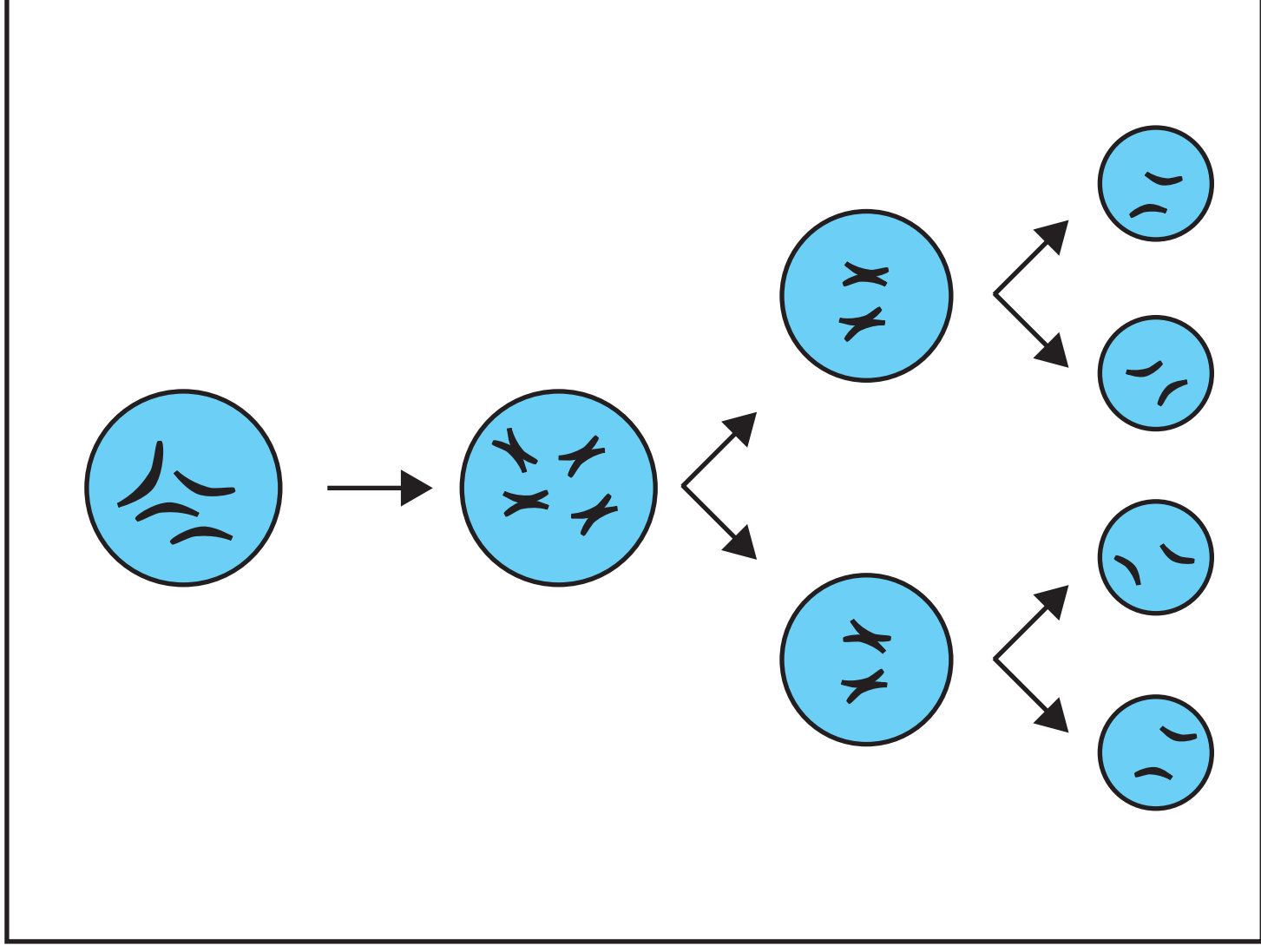


TABLE 1.3

Statement	Mitosis	Meiosis
produces 2 daughter cells		
produces daughter cells with half the number of chromosomes		
produces sex cells		
used for growth and repair		

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TABLE 2.1

Student	Hand span (cm)	Height (cm)
1	15.0	155
2	17.0	149
3	17.0	157
4	17.0	155
5	16.0	155
6	19.0	162
7	19.0	160
8	17.5	155
9	18.5	157
10	19.0	169
11	20.0	178
12	20.0	162
13	19.0	174
14	25.0	155
15	21.0	179
16	19.5	169
17	19.0	174
18	23.5	174
19	21.5	171
20	20.0	169

GRAPH 2.2

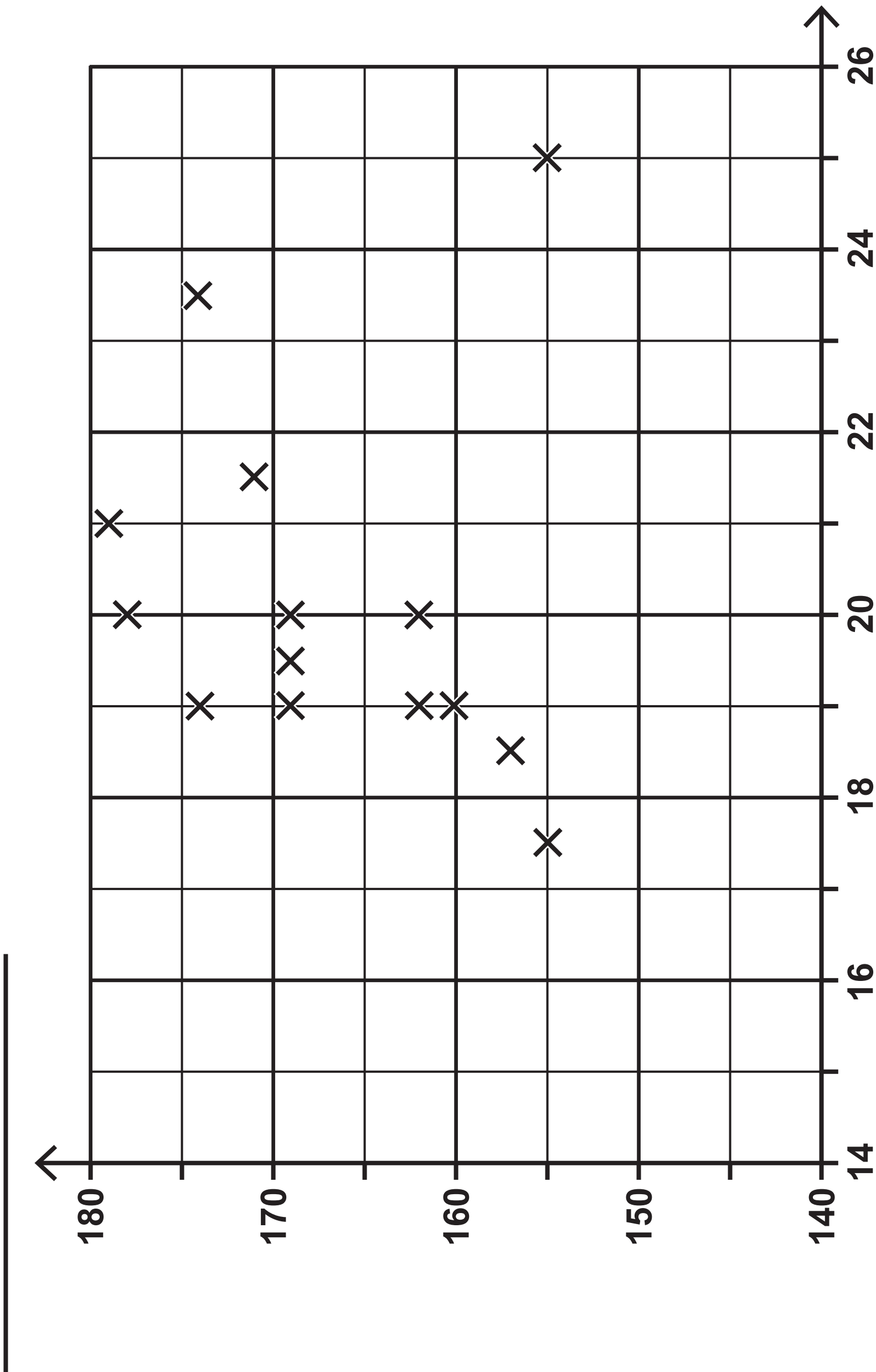
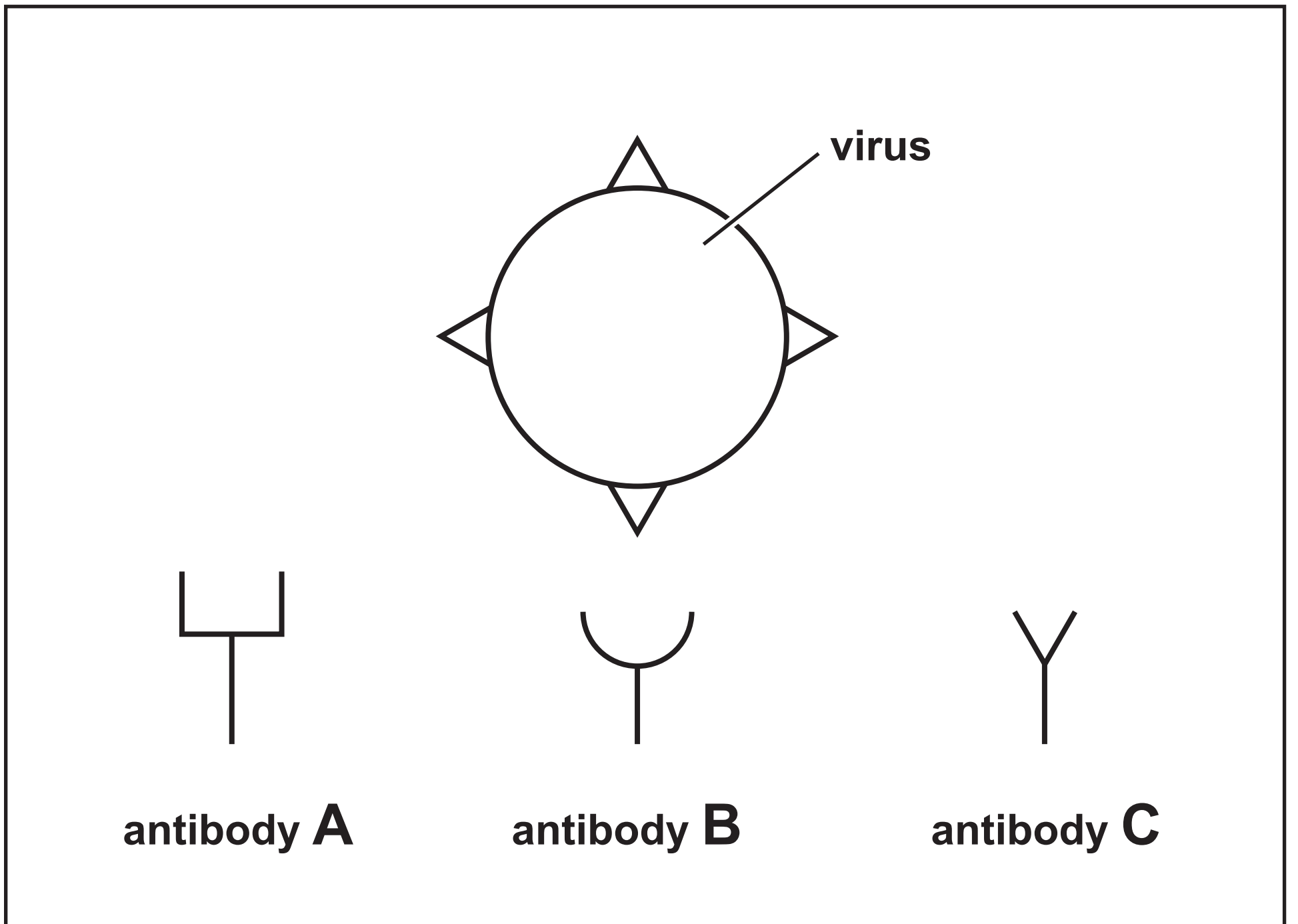


IMAGE 3



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IMAGE 4.1

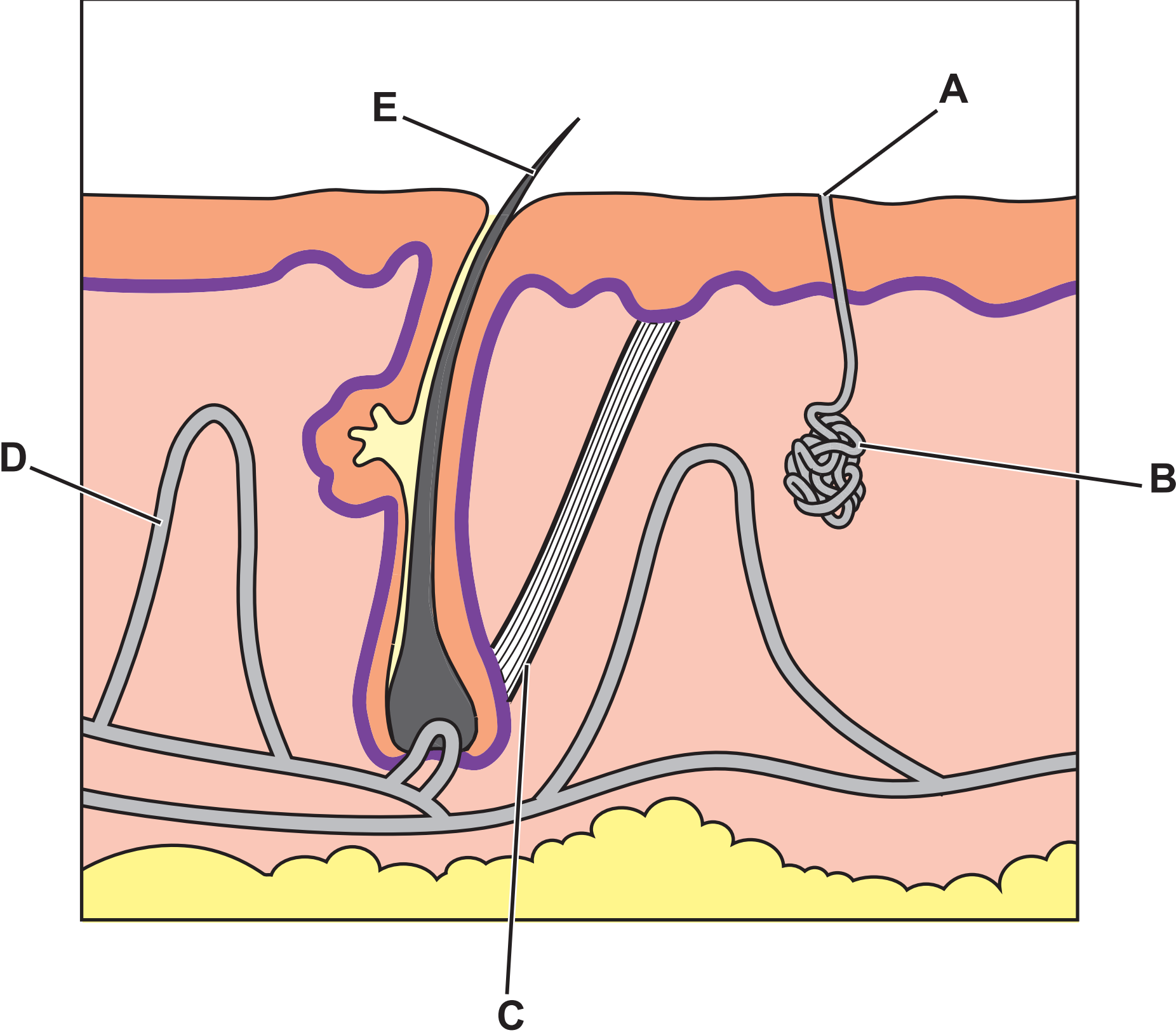


TABLE 4.2

Structure	Letter
Blood vessel	
Hair	
Sweat gland	

TABLE 4.3

Structure	Cold conditions	Hot conditions
Erector muscle	_____	relaxes
Hair	stands on end	_____
Sweat gland	_____	sweat is produced
_____	constricts / gets narrower	dilates / gets wider

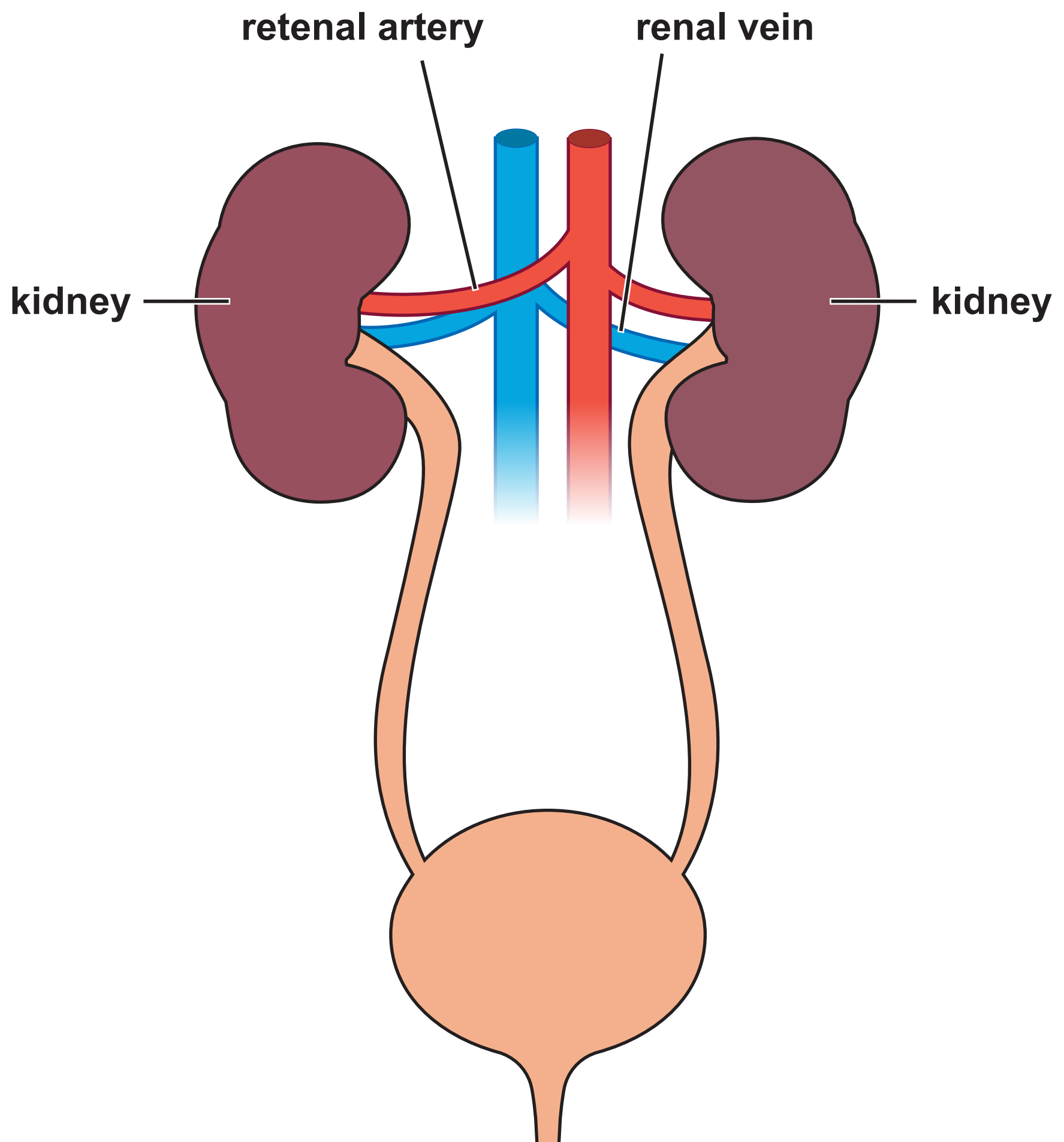
IMAGE 5.1

TABLE 5.2

Substance	Concentration (mg per 100 cm³ of fluid)		
	Blood in renal artery	Urine	Blood in renal vein
Glucose	90	0	90
Urea	30	2000	24
Protein	740	0	740

TABLE 6.1

Hazard	Risk	Control measure
Uneven ground on sand dune		

TABLE 6.2

Quadrat number	1	2	3	4	5	6	7	8	9	10
Number of dune gentian plants	1	0	0	0	0	0	0	0	0	0

IMAGE 7

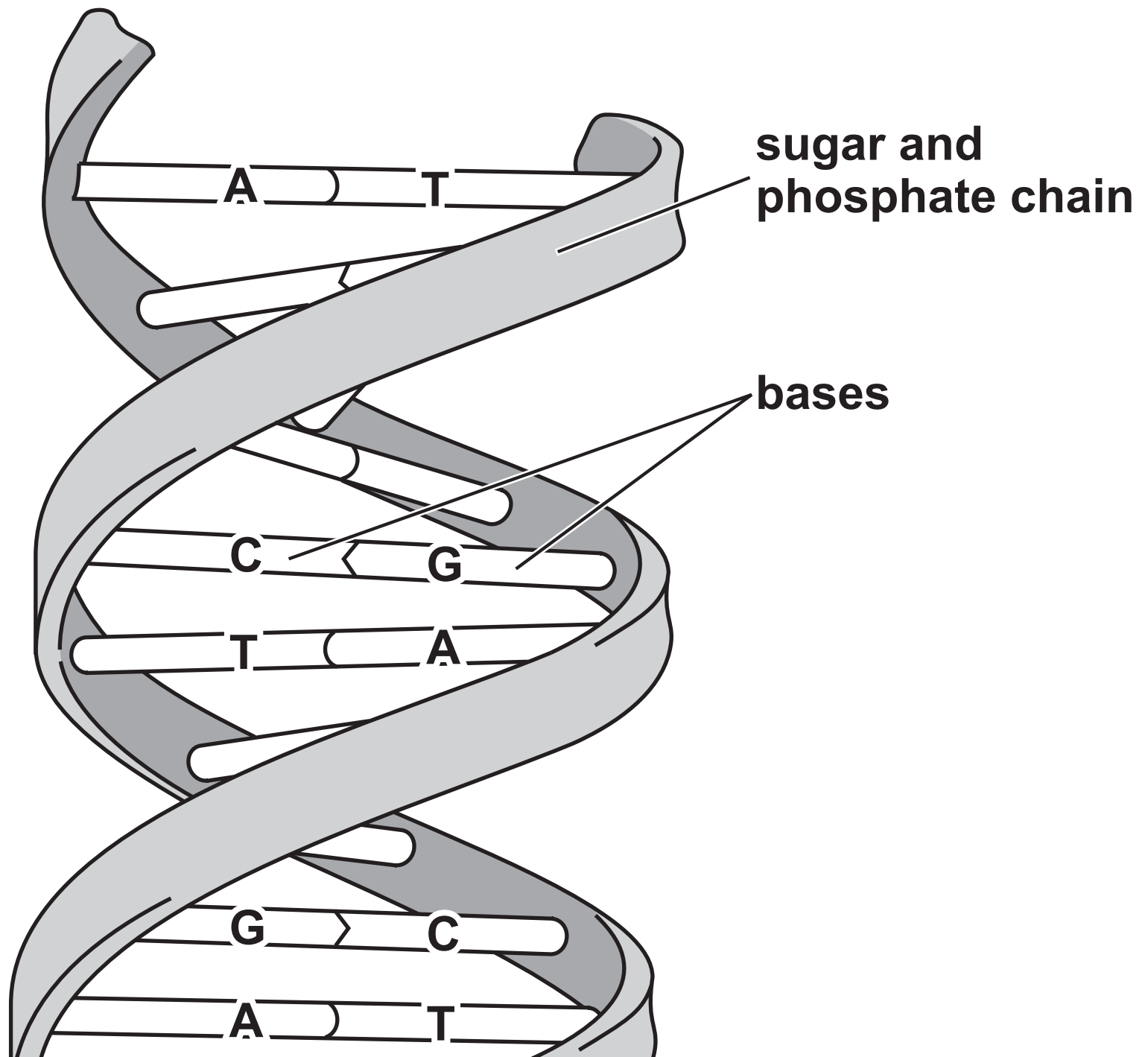


IMAGE 8.1

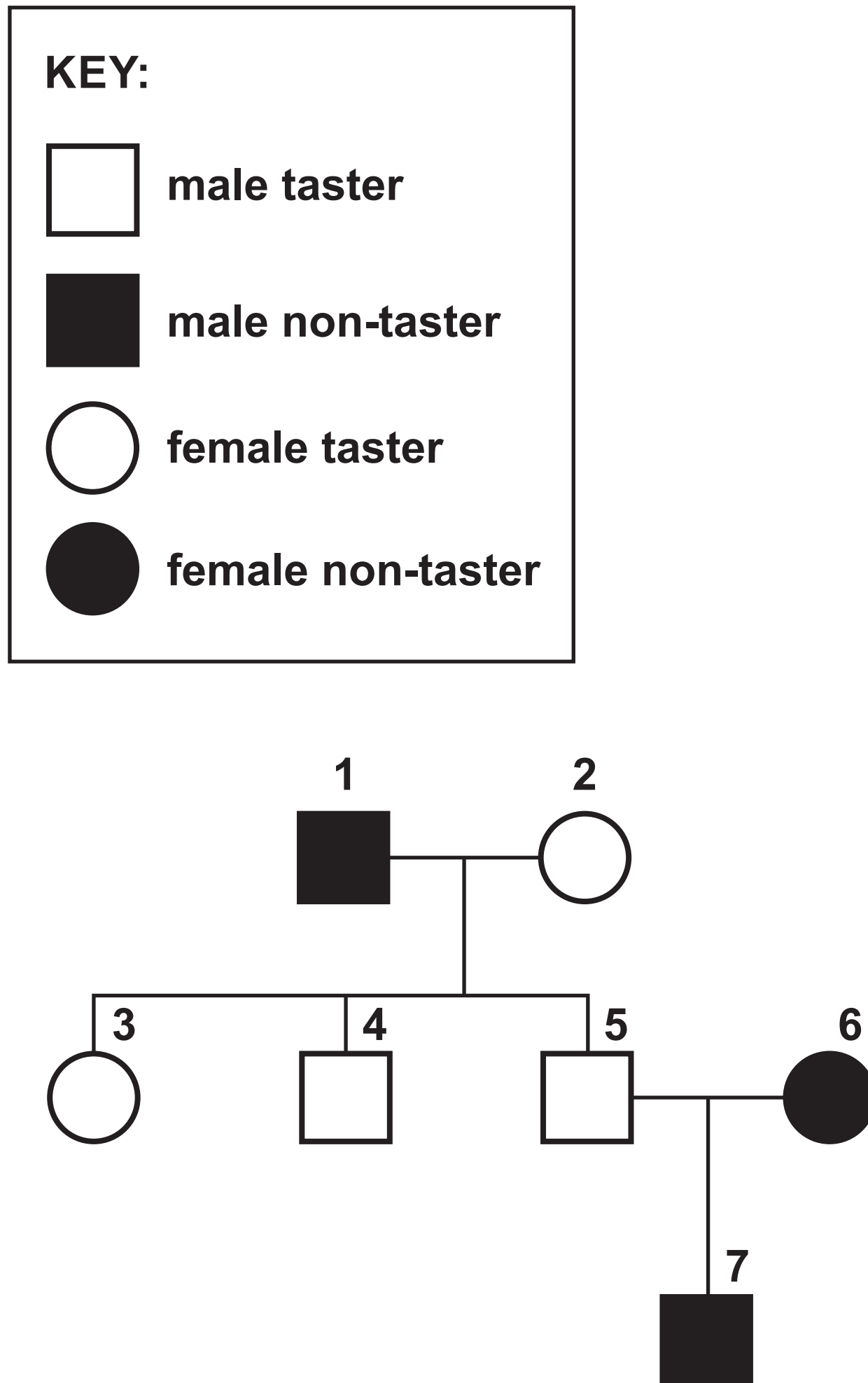
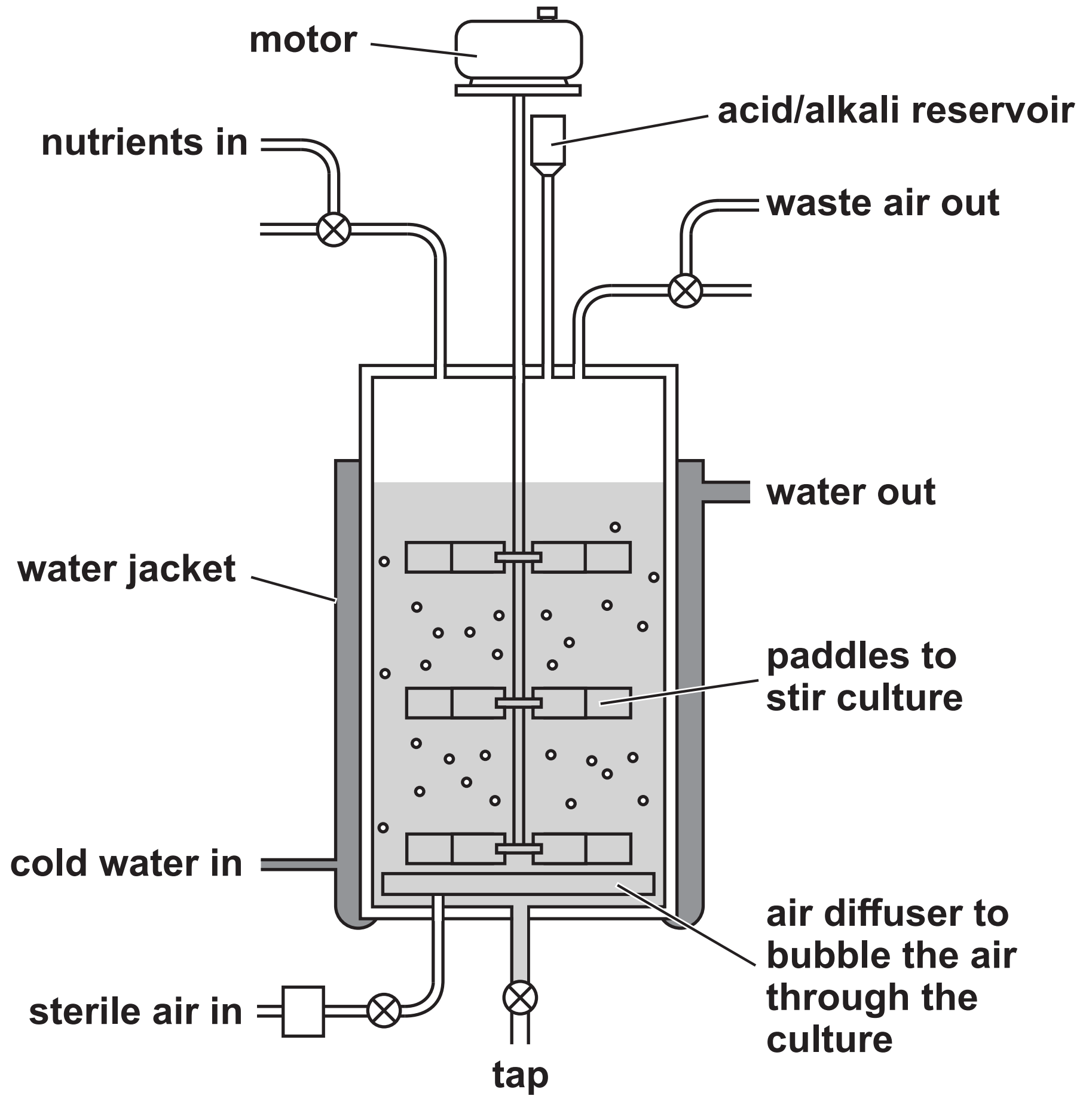


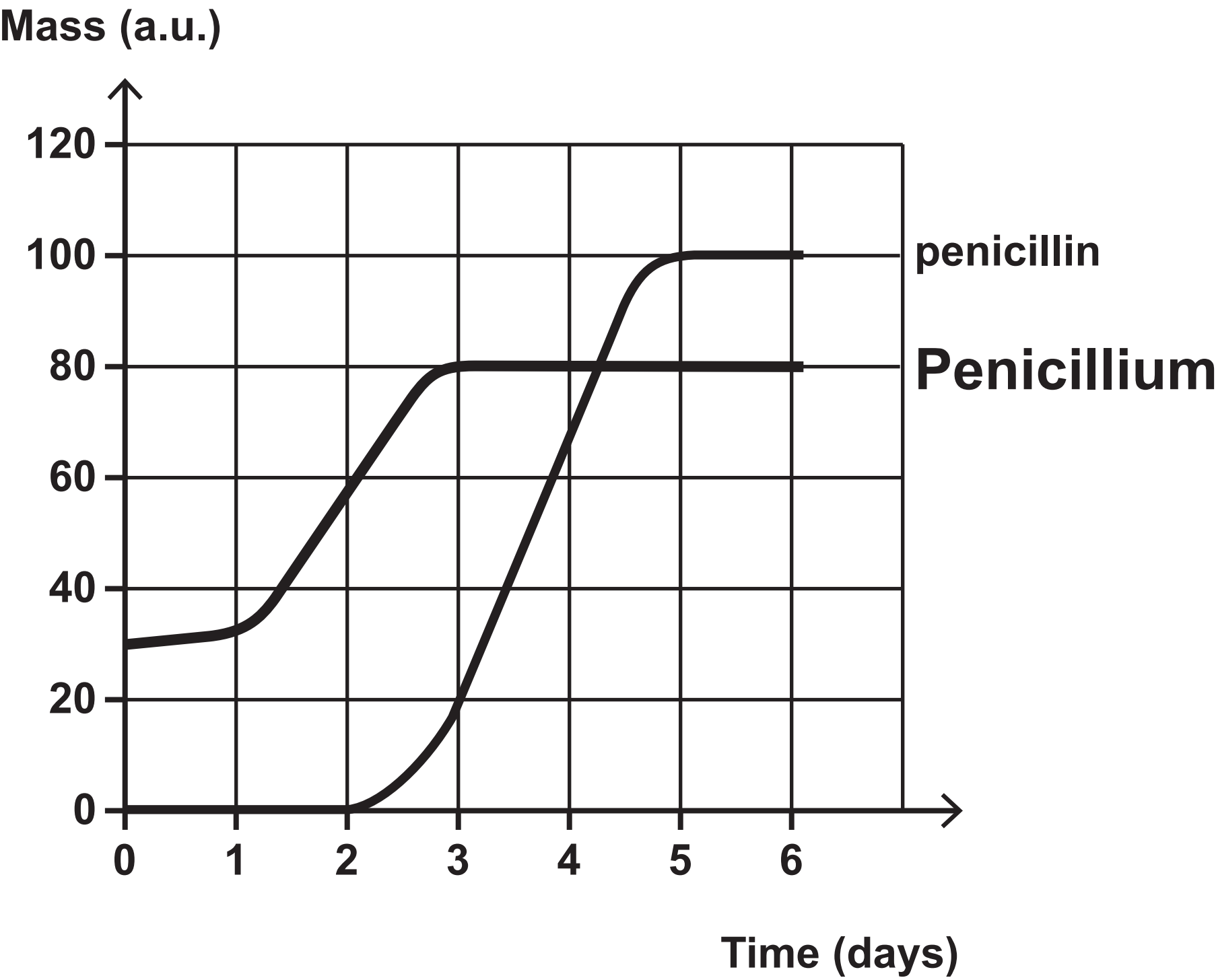
TABLE 8.2

Country	Number of individuals tested	Non-tasters (%)
Bosnia and Herzegovina	7362	32.0
Croatia	200	27.5
Czech Republic	785	32.7
Denmark	251	37.7
England	441	31.5
Hungary	436	32.2
Italy	1031	29.2
Montenegro	256	28.2
Russia	486	36.6
Slovenia	126	37.2
Spain	203	25.2

IMAGE 9.1



GRAPH 9.2



GRAPH 9.3

Mass of penicillin (a.u.)

