Surname	Centre Number	Candidate Number
First name(s)		0

GCSE

S25-3400U20-1

3400U20-1

TUESDAY, 13 MAY 2025 – AFTERNOON

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

1 hour 45 minutes

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**	

3400U201
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ADDITIONAL MATERIALS

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 a 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 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.

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Answer **all** questions.

1. **Images 1.1 and 1.2** show the two types of cell division, mitosis and meiosis.

Image 1.1
Mitosis

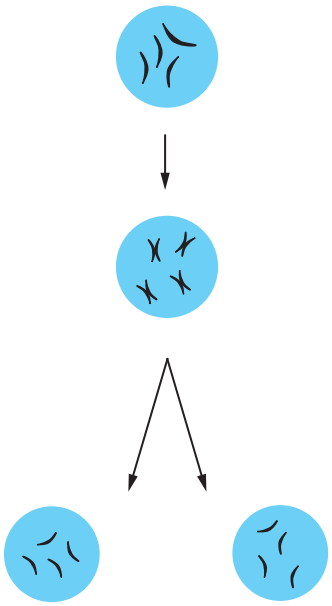
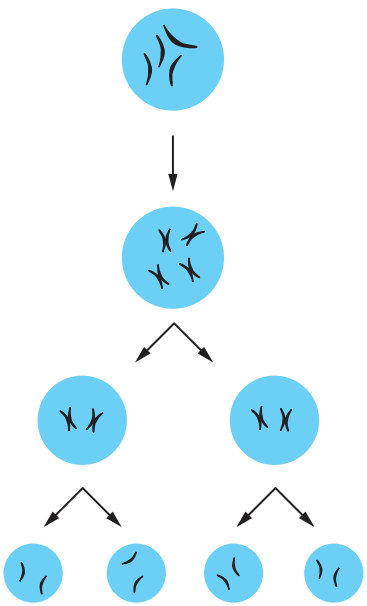


Image 1.2
Meiosis



(a) **Complete the following table** by **placing a tick** (✓) in the correct column for each of the statements. [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		

(b) State the name of the disease caused by uncontrolled mitosis. [1]

.....

3400U201
03

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 as shown in **Image 2.1** and **Image 2.2**.

Image 2.1

Image 2.2

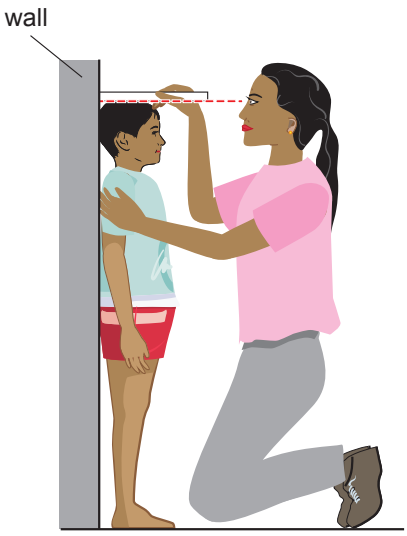


Table 2.3 shows the results of 20 students in the year 8 class.

Table 2.3

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

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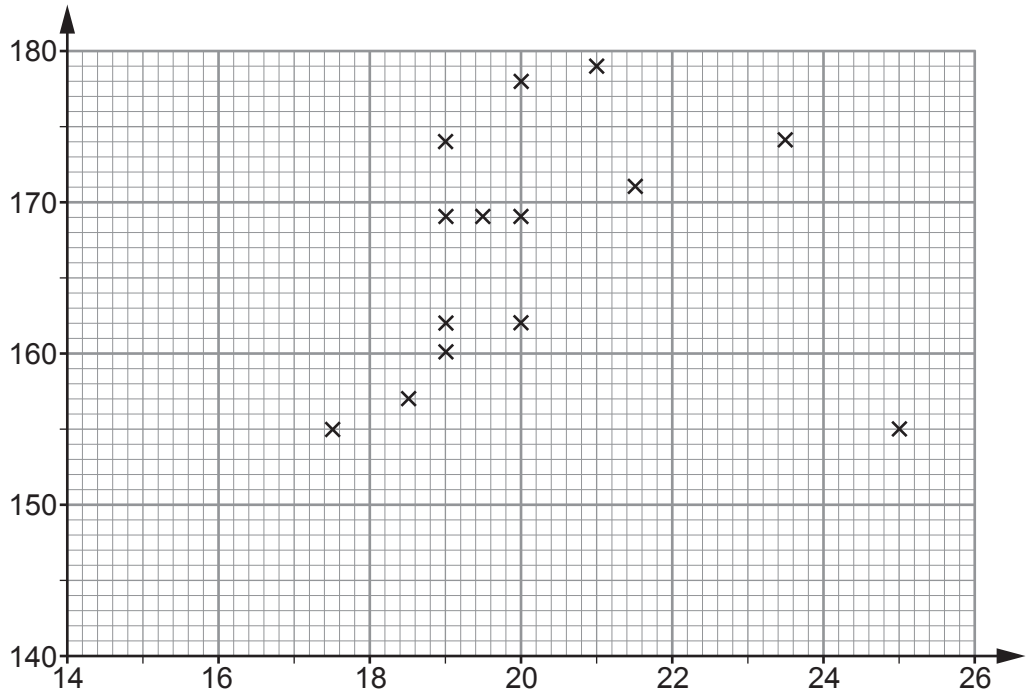
Some of the results of the investigation were then plotted as a graph as shown in **Graph 2.4**.

(a) (i) **Complete Graph 2.4** by:

I. adding the labels to **both** axes, including units; [2]

II. plotting the results for **students 1–5** from **Table 2.3**. [3]

Graph 2.4



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(ii) I. **Circle the anomalous result** on **Graph 2.4**. [1]

II. Explain why you chose this result. [1]

.....

.....

.....

(iii) Use **Graph 2.4** to describe the relationship between hand span and height. [1]

.....

.....

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

.....

.....

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

.....

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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]

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.

(ii) Use the sentences above to suggest **one** reason why the white blood cells multiply to form clones. [1]

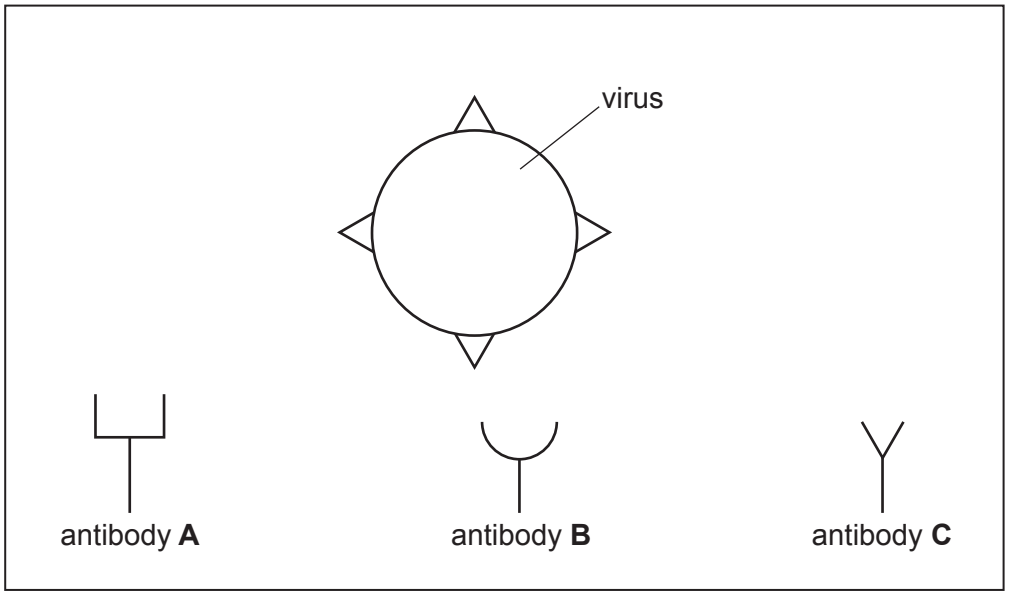
.....

.....

(b) Antibodies are specific.

Image 3 shows a virus and antibodies **A**, **B** and **C**.

Image 3



Circle the antibody (**A**, **B** or **C**) in **Image 3** that would destroy the flu virus. [1]

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(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]

Choose to have vaccine

.....

.....

Choose not to have vaccine

.....

.....

(ii) Explain why a doctor would not prescribe antibiotics to treat flu. [1]

.....

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09

8

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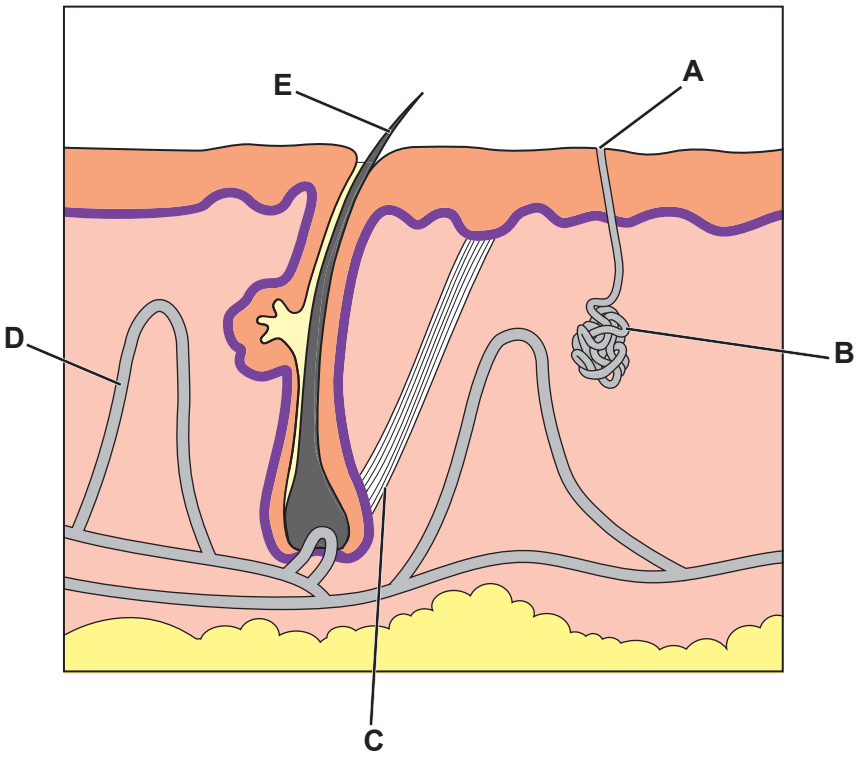
4. (a) **Image 4.1** shows a diagram of a section through the skin.

Image 4.1



(i) Use letters (**A–E**) from **Image 4.1** to identify the following structures. [3]

Structure	Letter
Blood vessel	
Hair	
Sweat gland	

(ii) **Table 4.2** describes what happens to different structures in the skin during cold and hot conditions.
Complete **Table 4.2** by filling in the blank boxes. [4]

Table 4.2

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

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(b) **Image 4.3A** shows Dylan in hot conditions and **Image 4.3B** shows him in cold conditions.

Image 4.3A

Image 4.3B

(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]

.....

.....

.....

.....

(ii) Shivering is a response to cold conditions.
State how shivering helps maintain a constant body temperature. [1]

.....

.....

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

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3400U201
11

12

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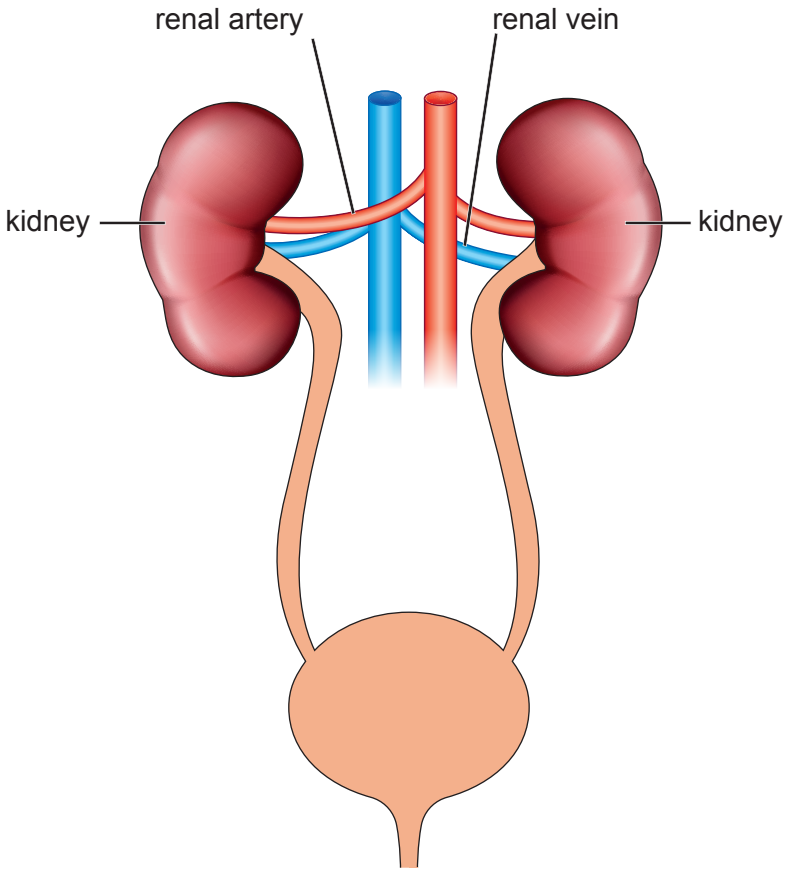
5. (a) **Image 5.1** shows the human excretory system.

Image 5.1



(i) **Draw one arrow** on a **renal artery** in **Image 5.1** to show the direction of blood flow. [1]

(ii) On **Image 5.1 draw a labelled arrow to name** and **identify** where urine is stored. [2]

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(b) **Table 5.2** shows comparisons of fluids in the excretory system.

Table 5.2

Substance	Concentration (mg per 100 cm^3 of fluid)		
	Blood in renal artery	Urine	Blood in renal vein
Glucose	90	0	90
Urea	30	2000	24
Protein	740	0	740

(i) Use information from **Table 5.2** to suggest which substance is the waste product. [1]

.....

(ii) Suggest **one** difference that would be shown in **Table 5.2** if the person had kidney disease. [1]

.....

.....

5

Examiner only

6. Dune gentian (**Image 6.1**) is an endangered native species that can be found in Oxwich Dunes (**Image 6.2**) in South Wales.

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

Image 6.1 Dune gentian

Image 6.2 Oxwich Dunes

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

.....

.....

(ii) State **two** resources for which plants compete. [2]

1. .....

2. .....

(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]

.....

.....

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.....

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(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]

.....

.....

.....

.....

(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 m^2 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 6.3**.

(i) Complete the risk assessment in **Table 6.3**. [1]

Table 6.3

Hazard	Risk	Control measure
Uneven ground on sand dune	....	....

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(ii) **Table 6.4** shows the results of the sample at the start of the project.

Table 6.4

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

I. Use **Table 6.4** to calculate the mean number of dune gentian plants per m^2. **Give your answer to one decimal place.** [1]

Mean number of plants per m^2 = ...

II. Calculate the sample area of the 100 m × 100 m sand dune. [1]

Sample area = ... m^2

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:

Total number of plants = sample area in m^2 × mean number of plants per m^2 [1]

Total number of plants = ...

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(iii) Suggest **one** way in which the conservationists could increase their confidence in the results. [1]

.....

.....

(iv) State why the quadrats were placed at random in the sample area. [1]

.....

.....

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

1. .....

2. .....

15

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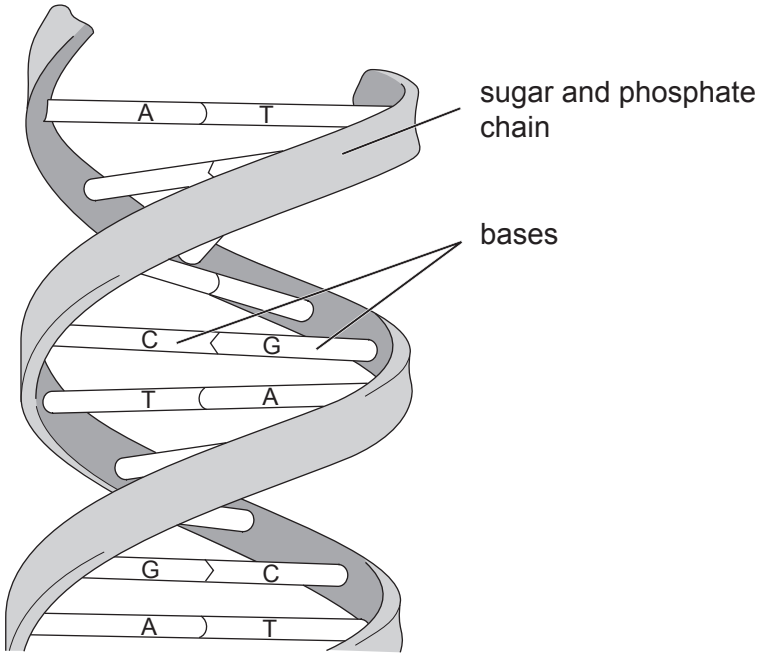
7. **Image 7** shows the structure of DNA.

Image 7



Describe the structure of DNA. Use **all the labels** on **Image 7** and your own knowledge in your answer. [6 QER]

6

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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]

1. .....

2. .....

(ii) Explain the meaning of the following terms:

I. gene; [2]

.....

.....

II. allele. [1]

.....

.....

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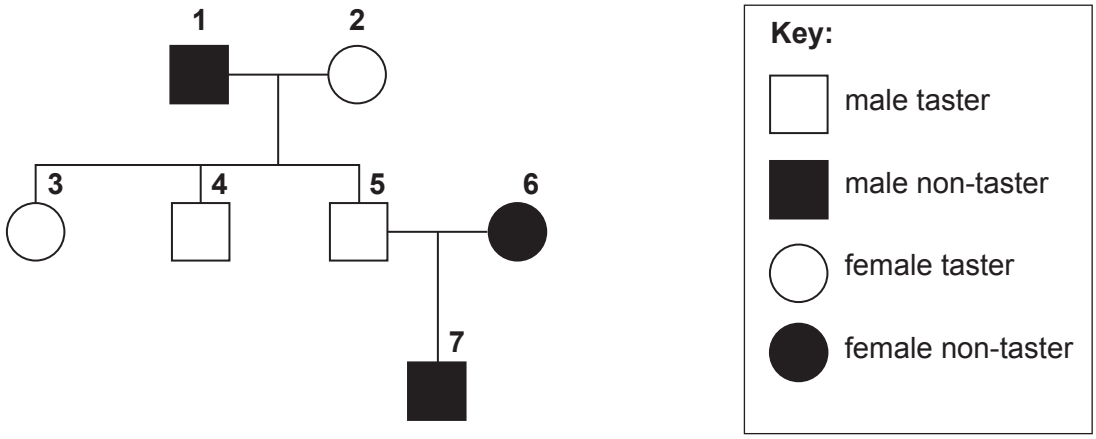
(b) **Image 8.1** is a family tree showing how the ability to taste PTC has been inherited within a family.

Image 8.1



(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]

key

T = allele for tasting PTC

t = allele for non-tasting PTC

(ii) **Circle a genotype** in the **Punnett square** that is **heterozygous**. [1]

(iii) Couple 5 and 6 have another child.
State the probability of this child being able to taste PTC. [1]

Probability = ...

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(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 shows the result of this test in these countries.

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

Use **Table 8.2** to state **two** reasons why the scientists can be confident in the results for PTC tasting. [2]

Reason 1

.....

.....

Reason 2

.....

.....

10

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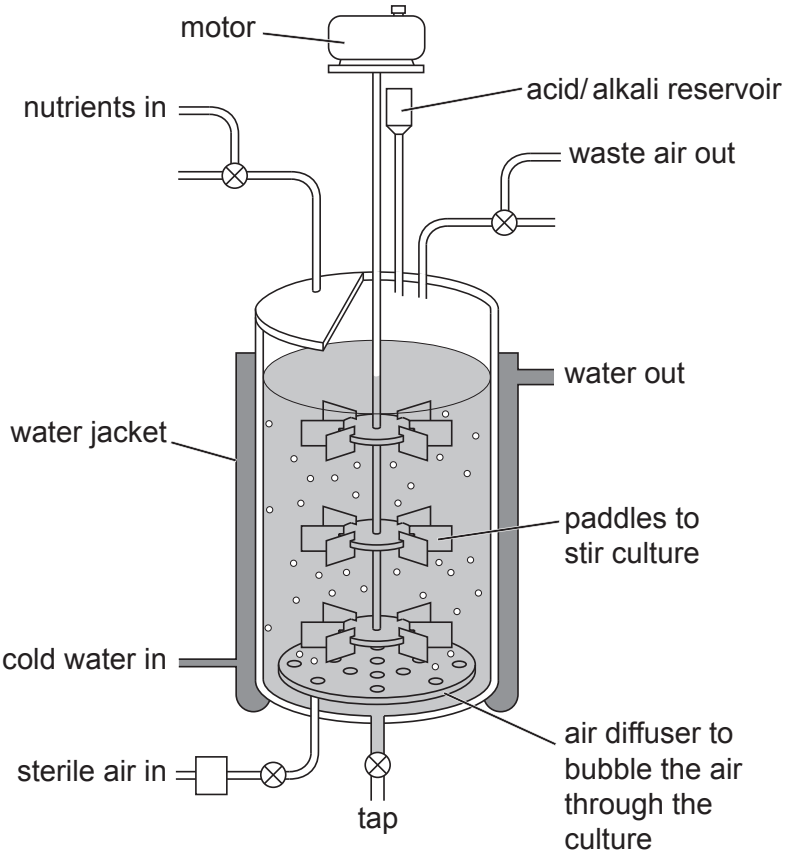
9. The antibiotic penicillin is produced from *Penicillium* grown in large stainless steel fermenters. The fermenters contain *Penicillium* in a liquid nutrient culture medium.

(a) Use the five Kingdom system of classification to state the kingdom to which *Penicillium* belongs. [1]

.....

(b) **Image 9.1** shows a diagram of a fermenter used to produce penicillin.

Image 9.1



(i) Aseptic techniques are used when *Penicillium* is added to the fermenter. State the purpose of using aseptic techniques. [1]

.....

.....

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(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]

Factor 1

.....

Explanation

.....

.....

Factor 2

.....

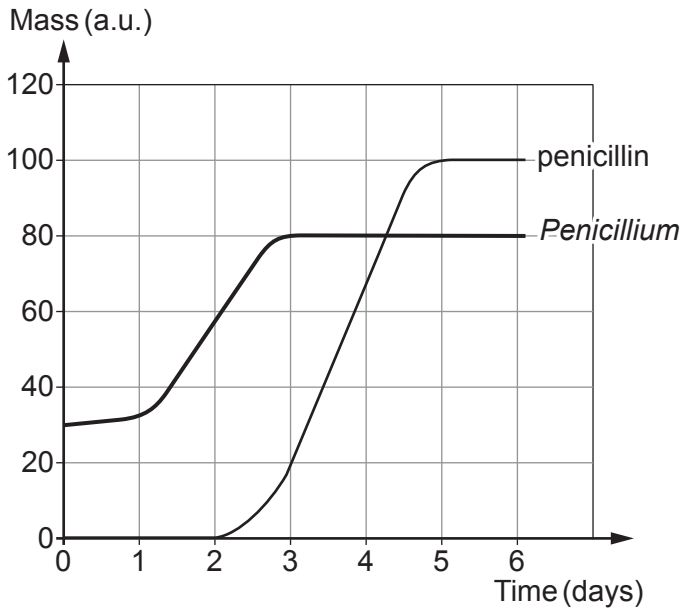
Explanation

.....

.....

(c) **Graph 9.2** shows how the contents of the fermenter changed over a period of six days.

Graph 9.2



(i) Use **Graph 9.2** to describe how the mass of ***Penicillium*** changed from **day 1 to day 6**. [2]

.....

.....

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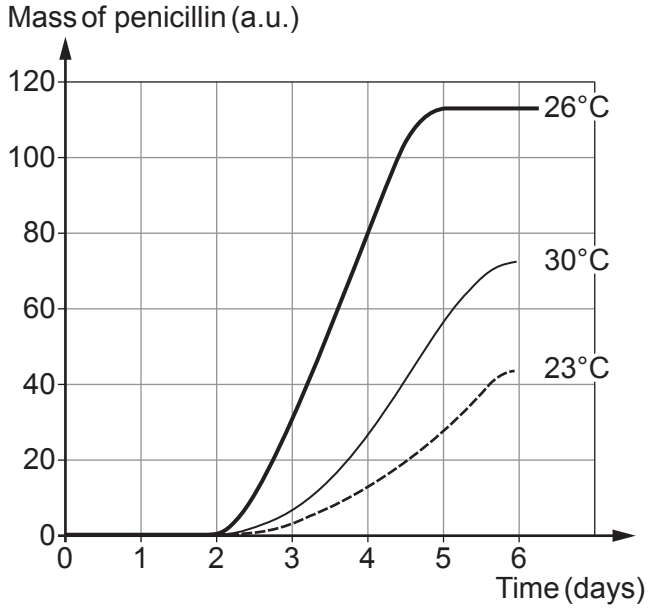
(ii) **Graph 9.3** shows the effect of different temperatures on the mass of penicillin produced over time.

Graph 9.3



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

Temperature .....

Time .....

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