Surname	Centre Number	Candidate Number
Other Names		0

GCSE

3400U20-1

S19-3400U20-1

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

FOUNDATION TIER

TUESDAY, 14 MAY 2019 – AFTERNOON

1 hour 45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**10**	
2.	**16**	
3.	**9**	
4.	**13**	
5.	**12**	
6.	**10**	
7.	**10**	
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. Do not use correction fluid.

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

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Answer **all** *questions.*

1. Read the information about obesity.

Fact file on Obesity

- In 2015, one in five adults and many children in the UK showed signs of being overweight or obese.
- Obesity makes it more likely that a person will develop medical conditions such as arthritis and type 2 diabetes as well as life-threatening diseases such as heart disease and cancer.
- There are more obese men than obese women but high blood pressure and type 2 diabetes are four times more common in obese women than in obese men.
- A diet low in saturated fat combined with regular exercise can be an effective way to reduce or avoid obesity.

(a) (i) Use the information to complete the table. Write '**true**' or '**false**' for each statement. [3]

Statement	True or False
In 2015, 20% of the population of the UK was obese.	
Obesity increases the risk of serious diseases.	
Obese women are more likely than obese men to have cells in their bodies which do not respond to insulin.	
A healthy lifestyle will reduce obesity.	

(ii) Complete the following sentence by selecting your answer from the words below. [1]

nerves **blood** **bile**

Hormones such as insulin are chemical messengers carried in the ..... .

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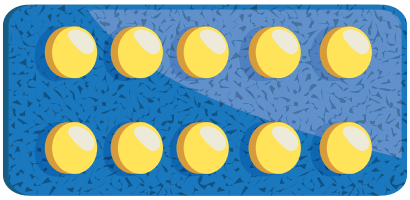
(b) In 2010 a drug, Sibutramine, was developed to help treat obesity.

Ten patients in a hospital tested the drug for a month and doctors observed that it resulted in considerable weight loss.

Medical researchers then carried out a double-blind clinical trial, where 600 patients took the drug for two years. Patients in group **A** received Sibutramine tablets and patients in group **B** received a placebo.



Sibutramine tablets

(i) State **two** differences between the trial carried out by the medical researchers and the test carried out in the hospital. [2]

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(ii) State the meaning of the term *placebo*. [1]

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(iii) Explain why a placebo is necessary in trials of new drugs. [1]

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(iv) Choose the letter (**A**-**D**), which gives the meaning of the term double-blind trial. [1]

A Only the doctor knows whether the patient is in group A or group B

B The doctor and the patient both know whether the patient is in group A or group B.

C Neither the doctor nor the patient know whether the patient is in group A or group B.

D Patients can choose whether they wish to be in group A or group B.

Answer

(c) Before new medicines are tested on human patients they are usually tested on animals in laboratories. It is now possible to test some medicines using computer programs which can model the human body or use tissue cultures from human cells in Petri dishes.

State **one** advantage of using computer programs or tissue cultures rather than animals for testing medicines. [1]

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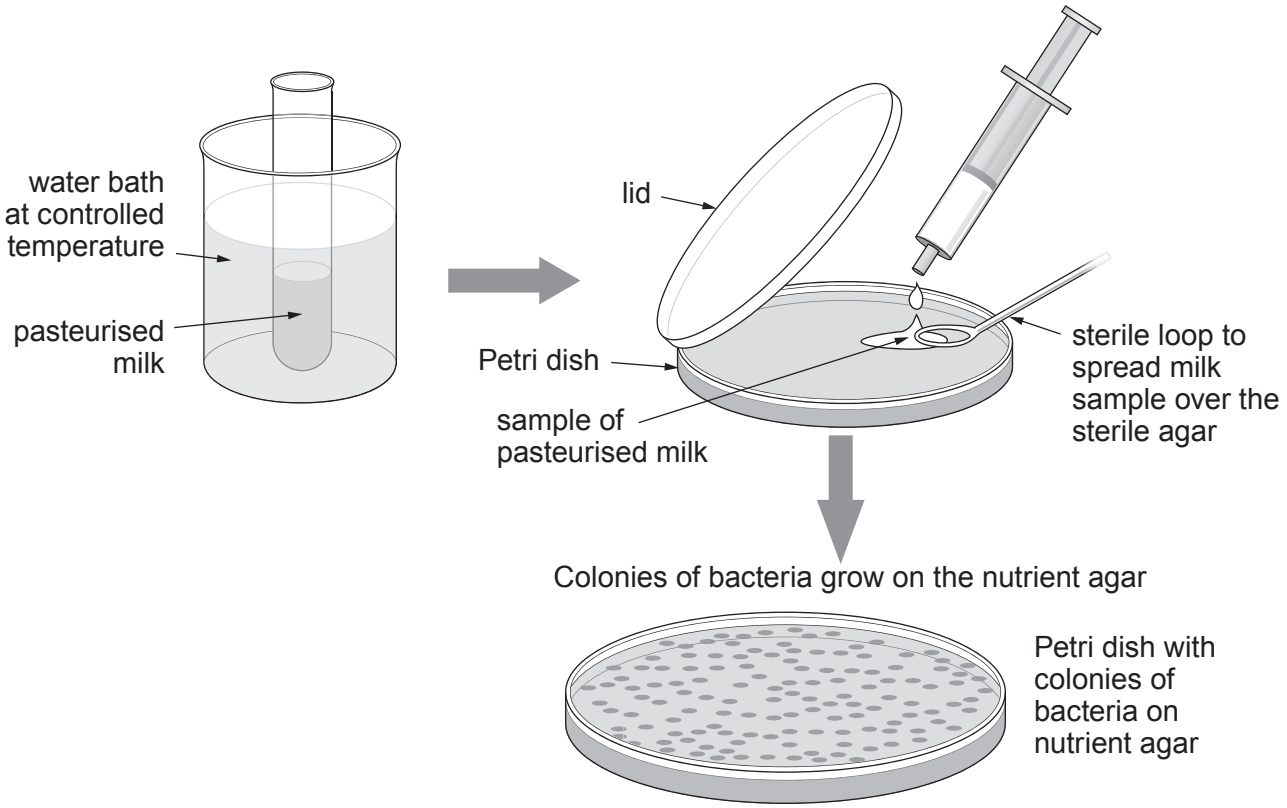
2. Fresh milk contains bacteria. Milk sold by supermarkets is pasteurised and has been heated to 72 °C for 20 seconds to kill most of the bacteria before it is bottled and stored.

Students investigated the growth of bacteria in pasteurised milk which they stored at temperatures of 10, 25 and 35 °C. They took samples of the milk at regular intervals and placed them on sterile nutrient agar to compare the growth of bacteria.

The diagram shows their procedure.



(a) (i) State why it would be important for each milk sample to be of the same volume. [1]

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(ii) Describe how the loop used for spreading the sample could be sterilised and why this sterilisation was important. [2]

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(iii) State what the students would do to the Petri dish to ensure aseptic conditions, after the milk sample had been spread on the agar. [1]

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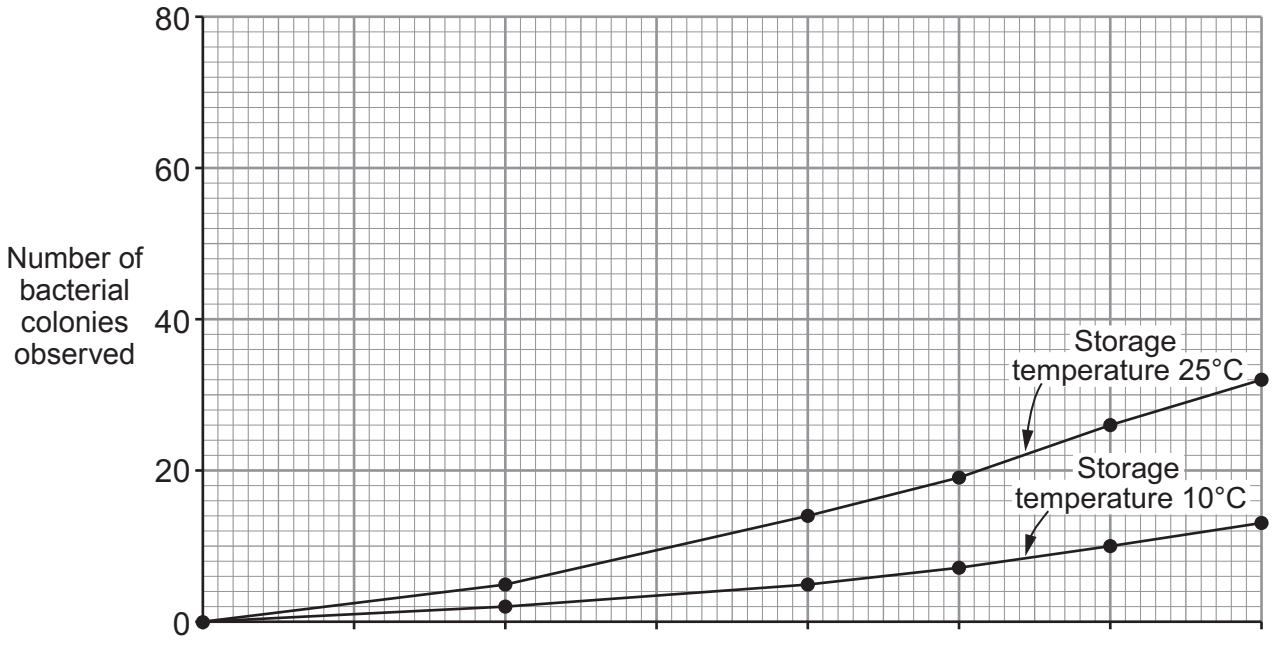
The results of the investigation are shown in the table and graph below.

Time of storage (hours)	Number of bacterial colonies observed		
	Storage temperature 10 °C	Storage temperature 25 °C	Storage temperature 35 °C
Start 0	0	0	0
10	2	5	9
20	5	14	28
25	7	19	39
30	10	26	50
35	13	32	57

(b) (i) Complete the graph by: [4]

I. adding the scale and label for time;
II. plotting the results for 35 °C;
III. joining your plots with a ruler and labelling your line.



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(ii) Describe how the number of bacterial colonies changes over time and how this is affected by storage temperature. [2]

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(iii) I. Use the graph to estimate the difference in the number of colonies of bacteria between:

10 °C and 25 °C at 15 hours. [2]

Number of colonies .....

II. In the investigation, 50 colonies were found to have grown on the agar in a Petri dish. State how many bacteria would have been present in the sample of milk. Circle your answer. [1]

5 **15** **50** **500**

Examiner only

(c) Food hygiene inspectors visited a restaurant in South Wales in the summer of 2010. They reported problems. The diagrams show some of their observations.

Buckets of yogurt made from pasteurised milk in a store cupboard at room temperature.

Close-up of a label on a bucket of yogurt.

From the problems they reported, the inspectors concluded that the level of hygiene at the restaurant was so low that it failed the inspection.

From the diagrams and your own knowledge explain the scientific reasons for the conclusion drawn by the inspectors. **Write your answers in the table below.** [3]

Problems reported by inspectors	Scientific reasons for inspectors' conclusion.
storage temperature	
lids of yogurt containers	
risk to customers' health	

16

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3. *(a)* (i) State how the skin defends the body against disease. [1]

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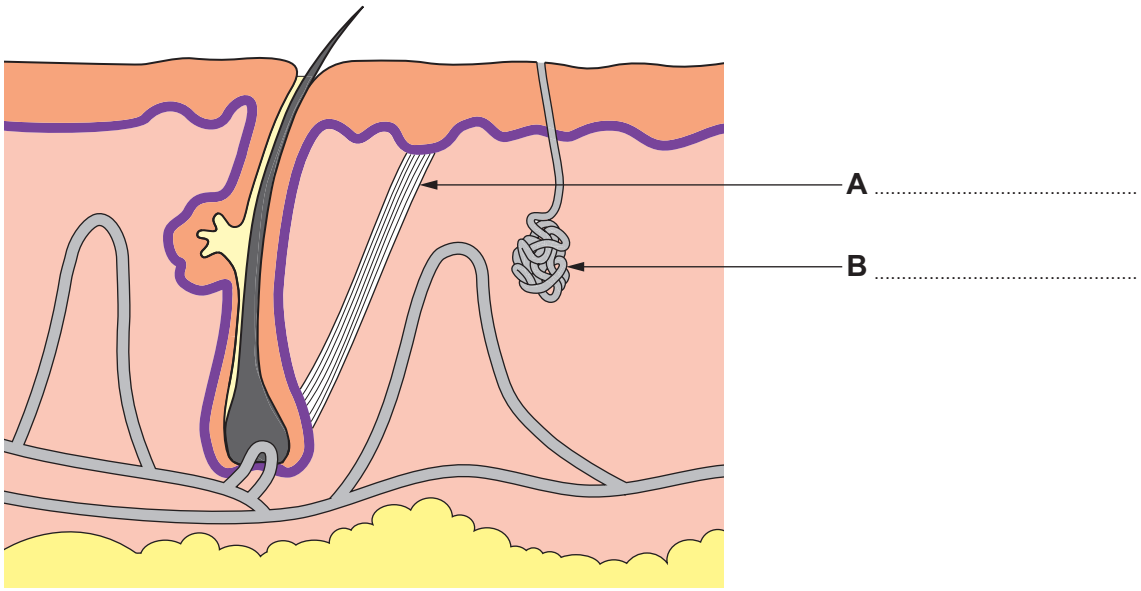
The diagram below shows a section through human skin.



(ii) Label **A** and **B** on the diagram. [2]

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(b) After playing rugby in warm conditions Steve undergoes a session in a cryotherapy chamber. This is a small room where the temperature is very low.

Describe and explain the changes that would occur in his skin in the cold conditions of the cryotherapy chamber. [6 QER]

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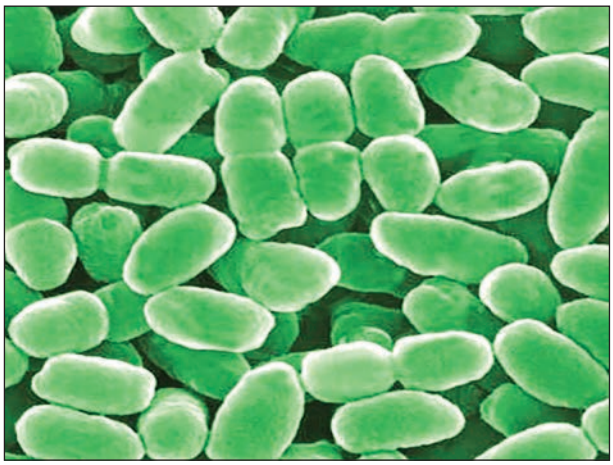
4. Whooping Cough is a disease caused by the bacterium *Bordetella pertussis* and it can be very serious or even fatal in young children and babies. In the UK, since 1950, young children and babies have been protected from Whooping Cough by vaccination and this reached the target of 95% of children by 1970. By this time there were very few cases.



Bordetella pertussis

In 1974, a medical journal published a report stating that the vaccine had damaged the nervous system in some children. Newspapers spread alarming information to parents throughout the UK and the percentage of children vaccinated fell to 30%.

"Whooping Cough vaccine can cause brain damage and death!"

In 1978, the number of cases of Whooping Cough had risen to 2 000 and by 2012 it was 7 730. The antibiotic drugs used to treat Whooping Cough were becoming ineffective.

The negative media reports were discredited and by 2017 the percentage of young children vaccinated in the UK had gone back up to 73%. The target remains at 95%.

Use the information to answer the questions.

(a) (i) State the scientific name of the micro-organism which causes Whooping Cough. [1]

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(ii) Complete the sentence, by choosing words from the list: [2]

antibodies **antigens** **lymphocytes** **phagocytes**

Micro-organisms which cause infections carry ..... .

The ..... in the bloodstream then produce large numbers of

..... which can destroy the infecting micro-organisms.

Examiner only

(b) Choose the correct answer to complete the sentence. [1]

The percentage of children vaccinated against Whooping Cough decreased after 1974 because of newspaper articles which said

A The vaccine had become less effective.

B The vaccine had serious side effects.

C The disease had become less serious.

D Cases of the disease were reducing.

Answer ☐

(c) (i) Calculate the percentage increase in cases of Whooping Cough between 1978 and 2012. [2]

Use the formula:

$$\frac{\text{number of cases in 2012} - \text{number of cases in 1978}}{\text{number of cases in 1978}} \times 100$$

Percentage increase = ...

(ii) State the evidence that the increase in the number of cases of Whooping Cough was linked to a reduction in the percentage of children being vaccinated. [2]

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Examiner only

(d) (i) By 2017, the number of cases of Whooping Cough had reduced. The NHS continued to encourage the vaccination of young children and pregnant women.

Use the information on page 11 to give **two** reasons why it was necessary to continue to encourage these vaccinations. [2]

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(ii) In some countries the vaccination of children is compulsory. Suggest why some people object to compulsory vaccination. [1]

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(e) The following six sentences explain why antibiotics became ineffective for treating Whooping Cough, but they are not in the correct order.

1 Many doctors over-used the antibiotics.

2 The resistant bacteria multiplied rapidly.

3 The antibiotics could no longer be used to kill the bacteria.

4 Almost all the bacteria became resistant to the antibiotics.

5 Doctors discovered antibiotics which killed Whooping Cough bacteria.

6 Some bacteria survived because they were resistant to the antibiotics.

Complete the list below to put the six sentences in the correct order by writing the missing numbers on the dotted lines. [2]

5

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6

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4

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13

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5. Himalayan balsam *(Impatiens glandulifera)* is a non-native, invasive species found in the UK. Himalayan balsam grows rapidly, out-competing many local species.

Himalayan balsam in flower

In laboratory trials, scientists found that a fungus could kill Himalayan balsam.

Leaf of Himalayan balsam infected with fungus

Scientists investigated the possibility of using fungus to reduce the growth of the invasive plant on a larger scale.

(a) State the term that describes the use of a living organism to reduce the growth of an invasive species. [1]

.....

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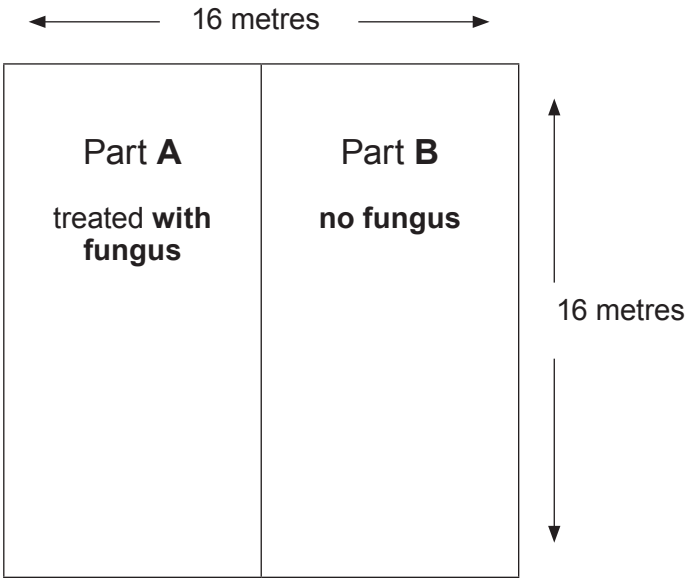
(b) The scientists marked out an area, 16 metres × 16 metres, on which many Himalayan balsam plants were growing and were evenly distributed.

They then applied the fungus to half of the section (part **A**). They did not apply any treatment to the other half (part **B**).

Plan of field trial



After six weeks, the scientists estimated the total number of Himalayan balsam plants by quadrat sampling in parts **A** and **B**.

(i) State why it was important that the quadrats were placed at random. [1]

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(ii) Describe a sampling technique they would carry out, using 1 m^2 quadrats. [3]

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(c) For part **A**, the total number of Himalayan balsam plants found in 12 quadrats was 36.

Calculate

(i) the mean number of plants per 1 m^2 quadrat in part **A**. [1]

..... plants / m^2

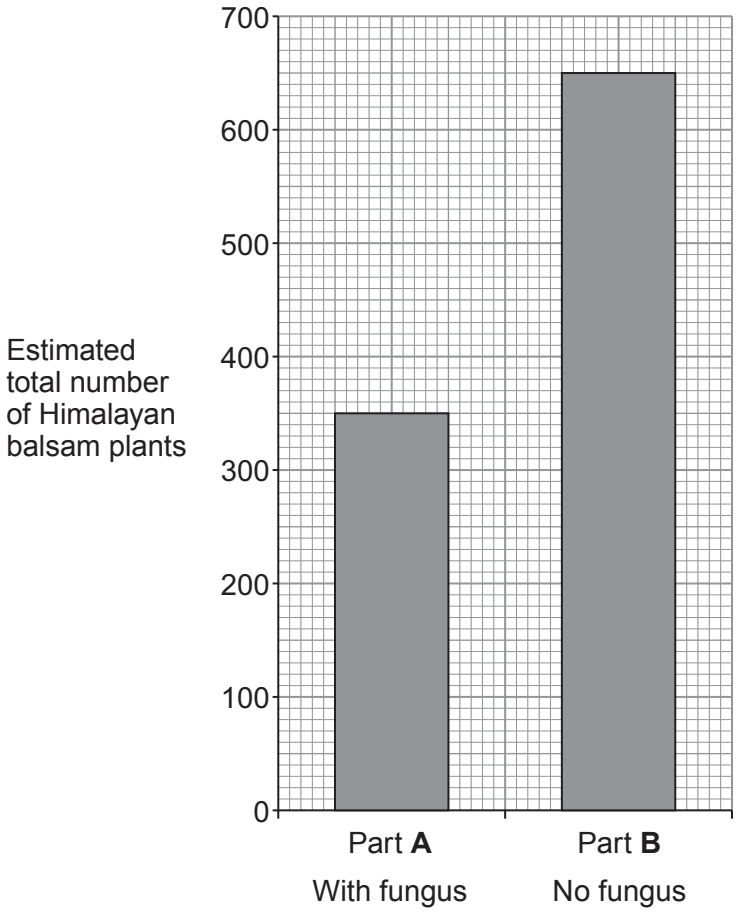
(ii) I. the area of part **A**. [1]

..... m^2

II. the estimated total number of plants in part **A.** [1]

..... plants

(d) The scientists carried out their investigation a further 5 times to be confident that their results were repeatable. The mean results of all their investigations are shown in the bar chart.



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(i) State the conclusion that could be drawn from these results. [1]

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(ii) State how the scientists could test that the results were reproducible. [1]

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(e) (i) The scientists went on to investigate the effects of the fungus on many native plant species. State why this was necessary. [1]

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(ii) State how biodiversity would be affected if the Himalayan balsam plants were not controlled. [1]

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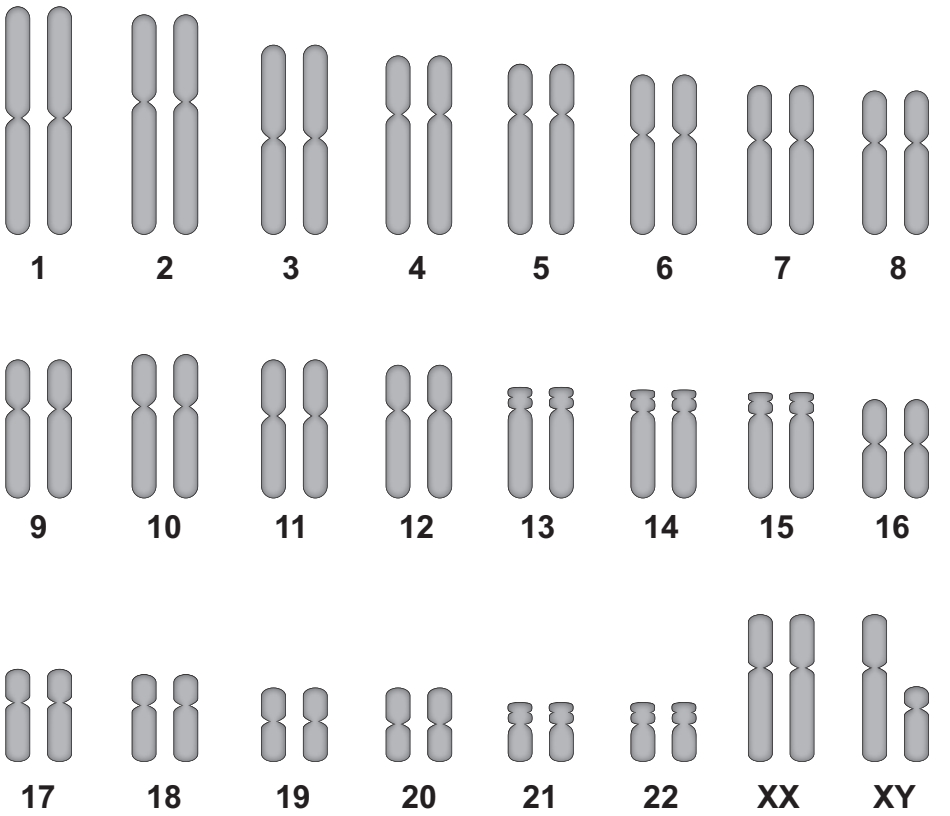
6. *(a)* The image shows human chromosomes.



(i) State the number of pairs of chromosomes present in a single body cell of a human. [1]

.....

(ii) State which sex chromosomes are present: [1]

in body cells of a man; .....

in body cells of a woman. .....

Examiner only

(iii) Complete the Punnett square below to show the sex chromosomes in the gametes of a male and female parent and in their possible offspring. [2]

Male Parent

	Gametes		
Female Parent			

(b) Height in humans is controlled by many genes as well as by environmental factors. Females usually reach their full height by age 18 and males by 25.

Students investigated the heights of male and female airline cabin crew. All cabin crew must be between 1.58 m and 1.90 m in height and between 18 and 45 years of age.

The students said that they expected the males to be taller than the females.

They collected their data by selecting seven males and seven females at random and asking them to state their heights. They gave their heights in feet and inches and the students converted the data into metres.

The results, expressed to two decimal places, are shown in the table below.

Heights of females (m)	Heights of males (m)
1.80	1.84
1.78	1.80
1.83	1.72
1.68	1.70
1.75	1.61
1.82	1.81
1.69	1.73
mean height = ...	mean height = 1.74

Examiner only

(i) **Complete the table** by calculating the mean height for females. [2]
Space for working.

(ii) I. State the hypothesis that the students were testing in their investigation. [1]

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II. State whether the results of the investigation support their hypothesis, giving the reason for your answer. [1]

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III. Give **one** way in which the strength of the evidence could be improved. [1]

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(c) State **one** source of inaccuracy in the method. [1]

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7. Cystic Fibrosis (CF) is a serious medical condition which affects the lungs. It results from a mutation in the DNA of a single gene which gives rise to a recessive allele.

(a) Explain the meaning of the term *recessive allele*. [2]

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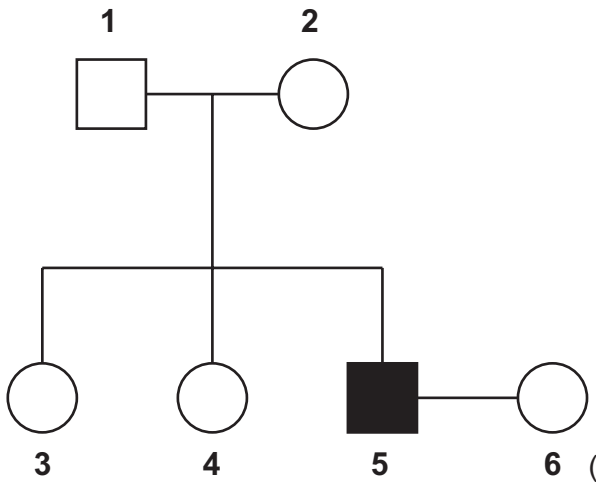
(b) The diagram below shows part of the family tree of a family which has one member who has CF.



Key
Female without CF
Female with CF
Male without CF
Male with CF

(from a family which DNA testing has shown does **not** have CF)

(i) State the effect of a mutation on DNA. [1]

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.....

(ii) From the family tree:

I. State the numbers of **two** individuals who are known to be heterozygous for the allele which causes CF. [1]

.....

II. Suggest what advice a genetic counsellor would give individuals **5** and **6** about the chance of them having a child with CF. Explain your answer. [2]

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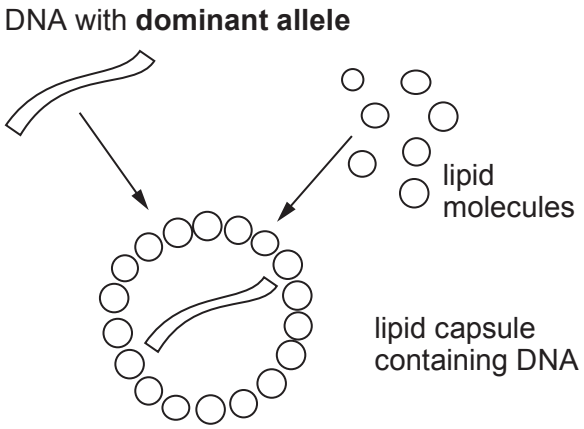
(c) CF is usually treated by intensive physiotherapy which can be very stressful. Medical scientists are now working to develop an alternative treatment called *gene therapy*. This process is summarised in the flow chart below.

Physiotherapy for CF



Gene therapy for CF

(i) Lipid capsules are introduced into the lungs. State how this would be done. [1]

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(ii) In order for this therapy to be successful two further difficulties must be overcome. Describe these **two** difficulties and suggest why this therapy is **not** a permanent cure. [3]

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END OF PAPER

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

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