Surname	Centre Number	Candidate Number
First name(s)		0

GCSE

3430UD0-1

Z22-3430UD0-1

TUESDAY, 17 MAY 2022 – MORNING

SCIENCE (Double Award)

Unit 4 – BIOLOGY 2
HIGHER TIER

1 hour 15 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**8**	
2.	**7**	
3.	**12**	
4.	**7**	
5.	**12**	
6.	**6**	
7.	**8**	
Total	**60**	

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

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Answer **all** questions.

1. Cystic fibrosis is a genetic condition that affects the lungs and other organs. It is caused by a mutation.

(a) State the meaning of the term mutation. [1]

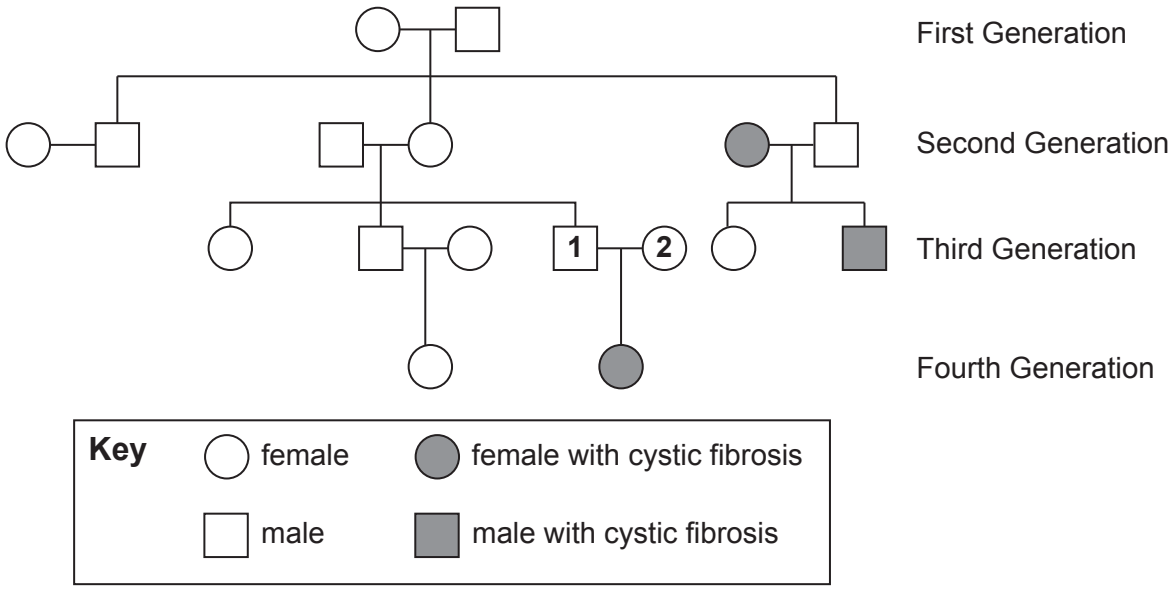
.....

.....

(b) State an environmental factor that will increase mutation rates. [1]

.....

(c) The family tree shows the inheritance of cystic fibrosis. Cystic fibrosis is caused by a recessive allele.



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(i) **Complete the Punnett square** below to show the possible genotypes of the future children of person **1** and person **2**. Use the letters **N** to represent the dominant allele and **n** to represent the allele that causes cystic fibrosis. [2]

(ii) Use the Punnett square to predict the probability of person **1** and person **2** having another child who has cystic fibrosis. [1]

.....

(d) One treatment for cystic fibrosis is to introduce dominant alleles (**N**) into the cells lining the lungs.

(i) State the name of this type of treatment. [1]

.....

(ii) State the method that is used to deliver the dominant alleles to the lungs. [1]

.....

(iii) State **one** problem with the use of this method. [1]

.....

.....

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2. Students used a quadrat to investigate the abundance of dandelions (*Taraxacum officinale*) on the school rugby pitch.

The method they used was:

1. Use a 1 m^2 quadrat.
2. Use a random number generator to place the quadrat on the rugby pitch.
3. Count the number of dandelions in the quadrat.
4. Repeat steps 2 and 3 another 5 times.
5. Calculate a mean.
6. Calculate the number of dandelions on the school rugby pitch.

The results they obtained are given in **Table 2.1**.

Table 2.1

Quadrat	Number of dandelions
1	3
2	5
3	2
4	7
5	15
6	6
Mean	.....

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(a) (i) **Draw a circle** around the anomalous result in **Table 2.1**. [1]

(ii) Calculate the mean number of dandelions per quadrat and **write your answer in Table 2.1**. **Do not use the anomalous result in your calculation.** [2]

(b) The teacher said that he did not have confidence in the mean. Suggest why. [1]

.....

.....

(c) The total area of the school rugby pitch is 7 350 m^2. Use your answer to part (a)(ii) to calculate the total number of dandelions on the school rugby pitch. [2]

Total number of dandelions on the school rugby pitch = ...

(d) State the name of the method the students should use to investigate the distribution of the dandelions across the pitch. [1]

.....

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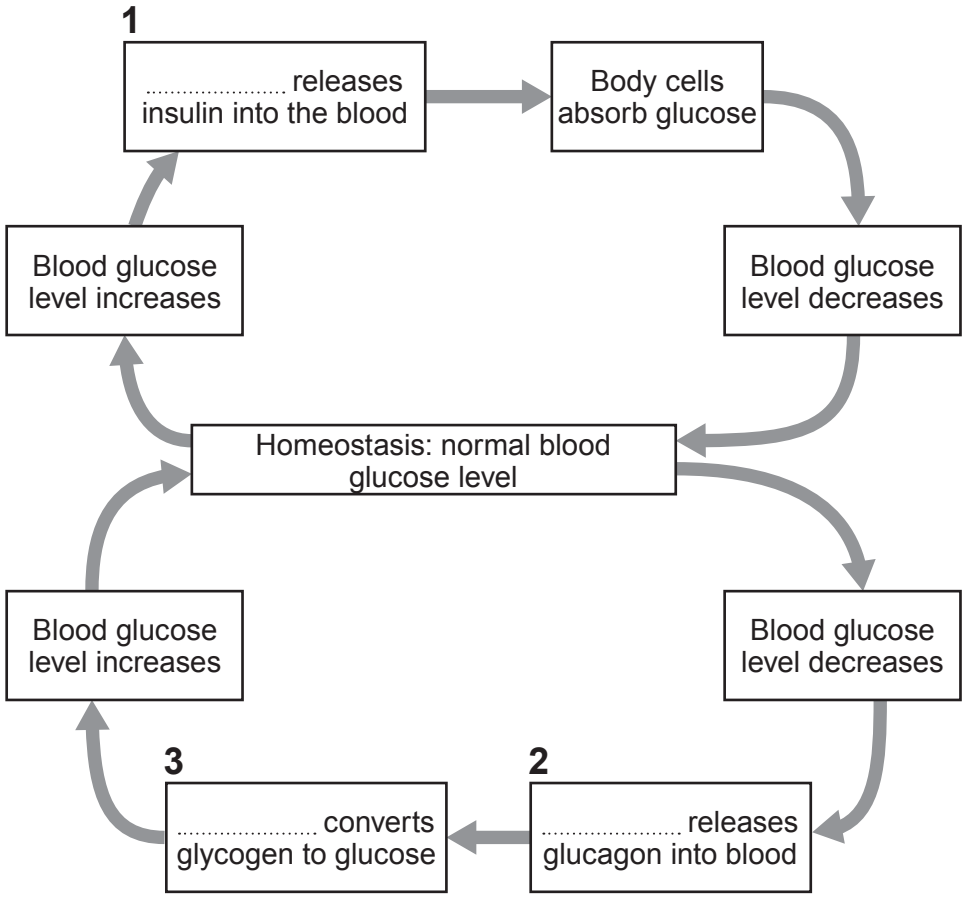
3. **Image 3.1** shows the homeostatic control of glucose levels in the blood of a person.

Image 3.1



(a) (i) **Complete the information** in boxes **1**, **2** and **3** in **Image 3.1** by writing in the name of the **organ** responsible. [3]

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

.....

.....

(iii) Insulin and glucagon belong to a group of chemicals which are produced in one part of the body but carry out their function in another part of the body. State the name of this group of chemicals. [1]

.....

(iv) **Image 3.1** shows that a fall in the level of glucose in the blood brings about a series of responses that result in its increase. State the name of this mechanism of control. [1]

.....

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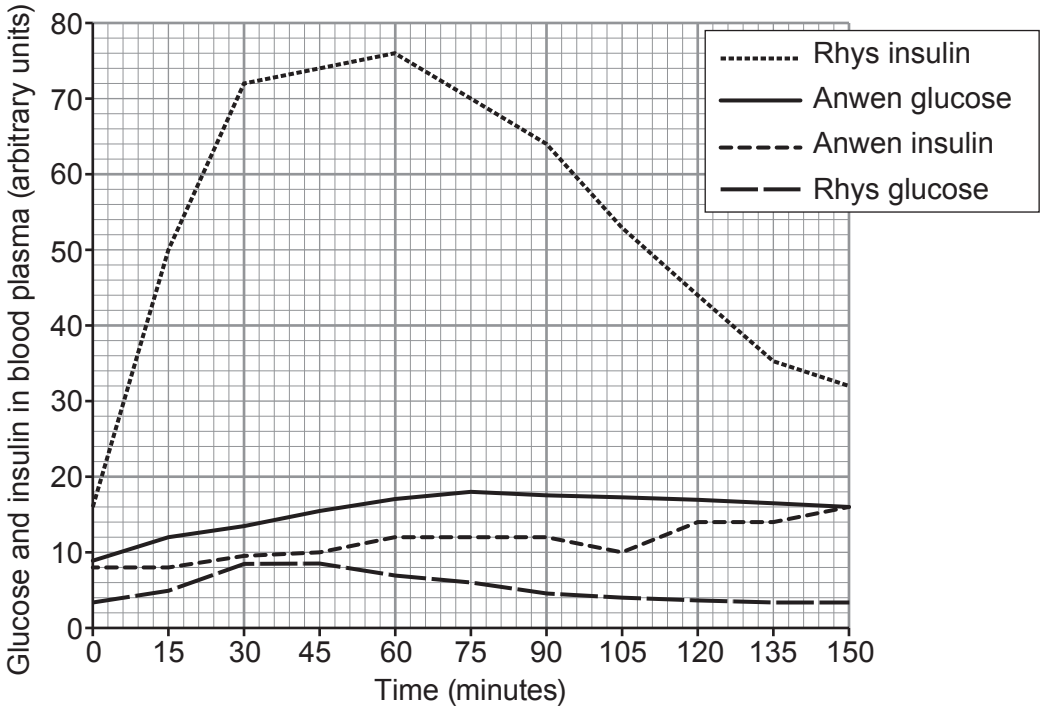
(b) Anwen and Rhys were each given an identical volume and concentration of glucose solution to drink. The concentration of glucose and of insulin in their blood was measured at regular intervals over the following 150 minutes. The results are shown in **Graph 3.2**.

Graph 3.2



(i) I. Describe **three** pieces of evidence from **Graph 3.2** which show that Anwen has diabetes. [3]

1. .....

.....

2. .....

.....

3. .....

.....

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II. State whether Anwen has Type 1 or Type 2 diabetes and explain your answer. [1]

.....

.....

(ii) State **two** ways in which diabetes can be treated. [2]

1. .....

2. .....

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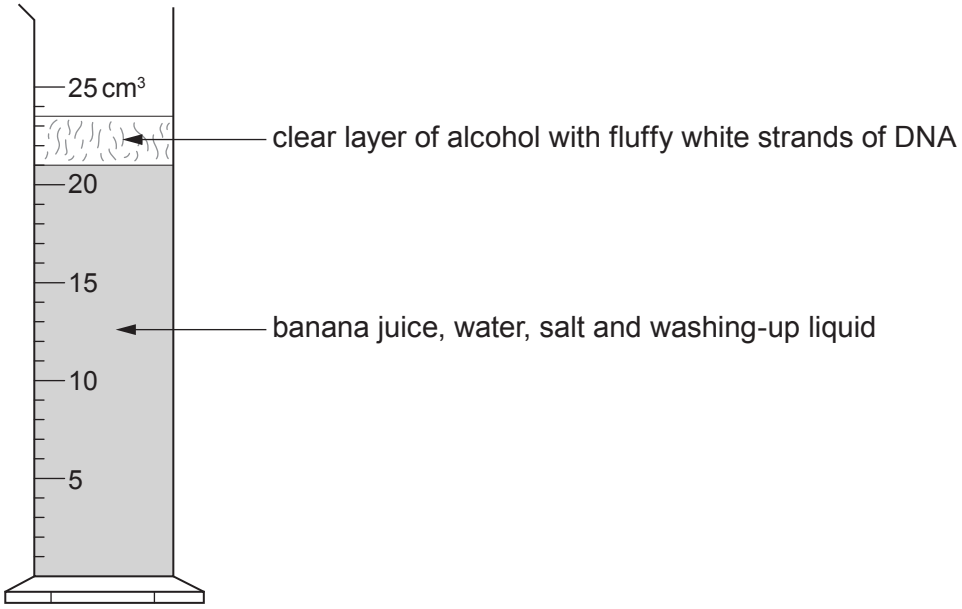
4. A group of year 11 students extracted DNA from bananas in the school laboratory. The result of this extraction process is shown in **Image 4.1**.

Image 4.1



The students collected the DNA from the measuring cylinder and took it to the local university where members of the biology staff had agreed to supervise the students whilst they analysed its base content. The readings they obtained are shown in **Image 4.2**.

Image 4.2

DNA base analysis. Source – banana

Adenine	33%
Cytosine	17%
Guanine	17%
Thymine	33%

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(a) State the ratio of: [1]

(i) I. adenine to thymine

..... : .....

II. guanine to cytosine.

..... : .....

(ii) Explain these ratios by referring to the arrangement of these bases in a molecule of DNA. [2]

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(iii) If the students had repeated the experiment with strawberries would the base analysis be the same as that of bananas? Explain your answer. [2]

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(b) Explain the role of the bases in protein synthesis. [2]

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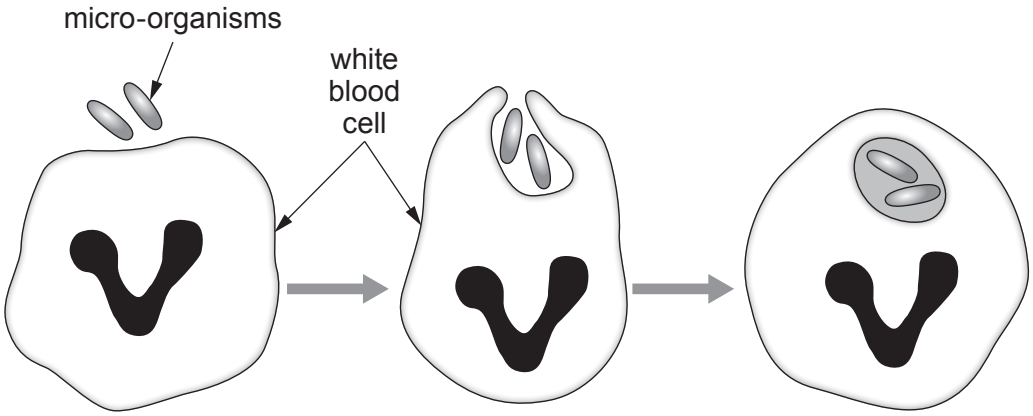
5. **Image 5.1** shows a white blood cell which is ingesting micro-organisms in the bloodstream of a person.

Image 5.1



(a) (i) State the type of white blood cell shown. [1]

.....

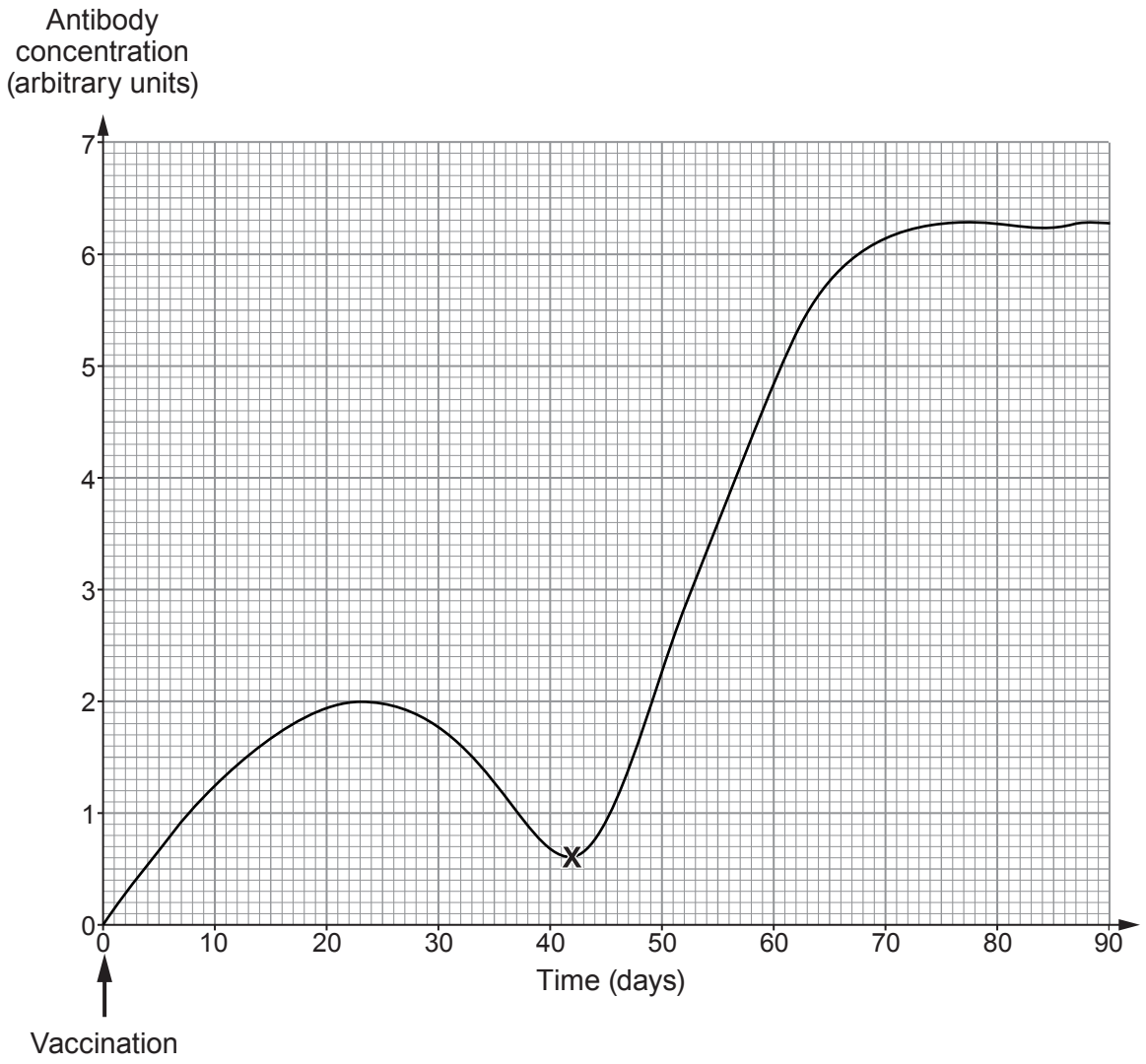
(ii) Suggest what will happen to the micro-organisms **after** they have been ingested by the white blood cell. [1]

.....

.....

(b) A person was vaccinated against an infectious disease caused by a virus. **Graph 5.2** shows the concentration of antibodies in the blood of the person over the next 90 days.

Graph 5.2



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(i) Explain the increase in antibody concentration over the first 20 days. [3]

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(ii) Give **two** possible reasons that could account for the increase in antibody concentration from point **X** on **Graph 5.2**. [2]

1. .....

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2. .....

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(iii) State the name of the cell that is responsible for the very rapid antibody production between days 45 and 65. [1]

.....

(iv) State the scientific term which could be used to describe this person in relation to the virus after day 65. [1]

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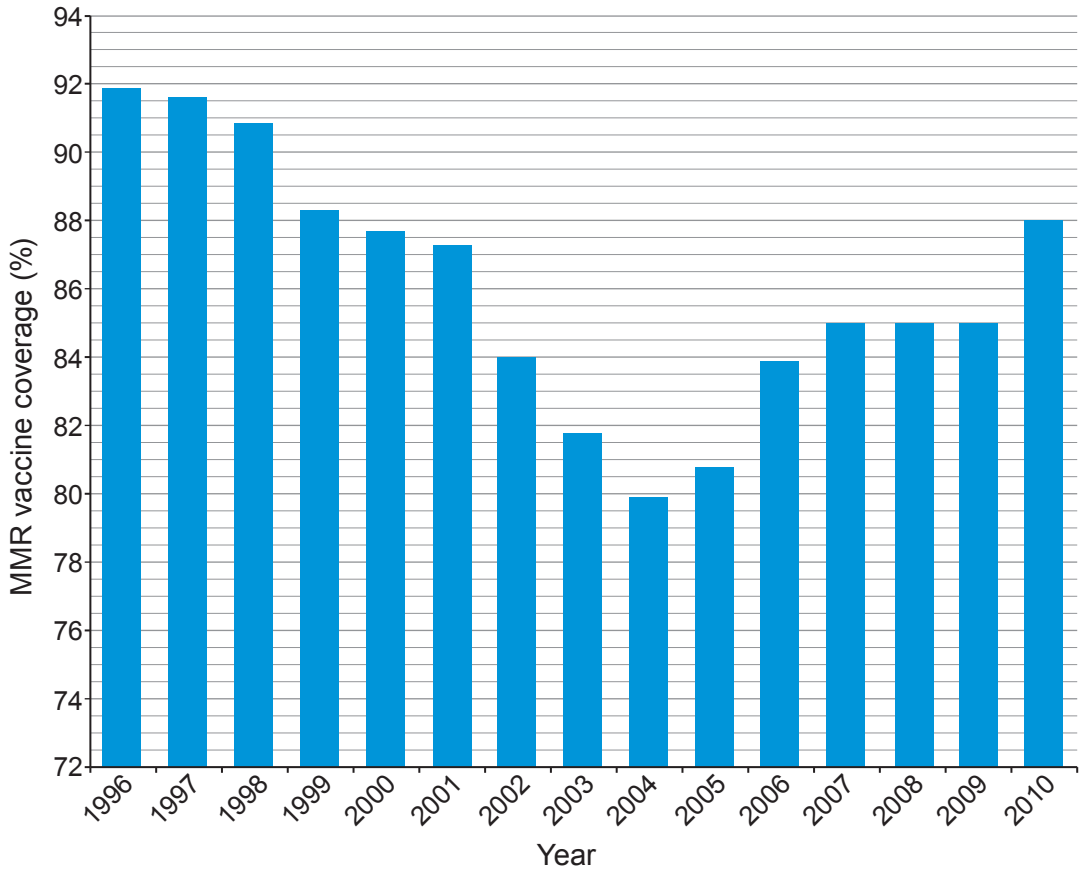
(c) MMR is a 3-in-1 vaccine that protects people against measles, mumps and rubella. Children should be fully vaccinated against these three diseases by school age.
In 1998, a British doctor published the results of his research in a medical journal. His work stated that there was a link between the MMR vaccine and a condition called autism. The General Medical Council found the work published by the doctor to be "dishonest" and the doctor was struck off the UK medical register. Unfortunately, before the work was discredited, it had been picked up by the media and spread across the World.

Graph 5.3 shows the percentage of school-age children who had received the MMR vaccine in England and Wales between 1996 and 2010.

Graph 5.3



(i) From **Graph 5.3**, state the effect the published work linking MMR vaccination with autism had on the percentage of children receiving the MMR vaccine. [1]

.....

.....

(ii) **Sketch a single line on Graph 5.3, extending between 1996 and 2010**, to show the effect the published work linking MMR vaccination with autism would have had on the **number of cases of measles** in England and Wales. No labels or numbers are required. [2]

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6. During both mitosis and meiosis, a single cell divides into a number of cells.
Give a description of both types of cell division by stating where each type of cell division occurs, the number of cells produced and the functions of both types of cell division.
Diagrams will not be credited. [6 QER]

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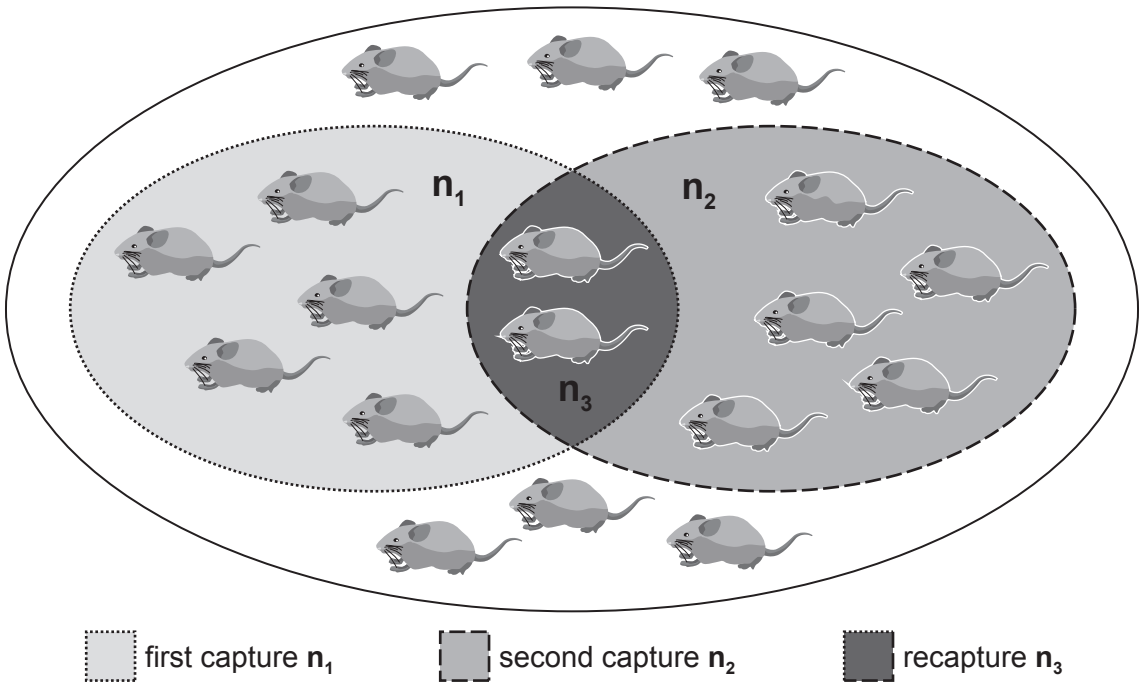
7. A pest control officer was asked to eradicate mice from a small food warehouse. By looking at the amount of food damage, she made an initial, on-the-spot, estimate of the number of mice in the warehouse. This initial estimate made by the pest control officer is the total number of mice shown in **Image 7.1**.

Image 7.1



In order to get a better estimate of the size of the mouse population in the warehouse the pest control officer used the capture/recapture technique. She set live-capture traps in the warehouse. On the next day the traps were inspected, all the mice caught were counted, marked and released. The mice caught in this first capture are represented by ($\mathbf{n_1}$) in **Image 7.1**.

Two days later the traps were reset. The next day the traps were again inspected. The mice caught in this second capture are represented by ($\mathbf{n_2}$). Within the second capture the number of marked mice were counted. These marked, recaptured, mice are represented by ($\mathbf{n_3}$) in **Image 7.1**.

(a) (i) Use the following equation to estimate the population size of the mice in the warehouse. Give your answer to the nearest whole number. [2]

$$\text{population size} = \frac{\text{number in 1st capture} \times \text{number in 2nd capture}}{\text{number in 2nd capture previously marked}}$$

Population size = ...

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(ii) State how the population size estimated by the capture/recapture technique compares to the pest control officer's initial on-the-spot estimate. [1]

.....

(iii) State **two** ways in which the accuracy of the estimated population size obtained by the capture/recapture technique could be improved. [2]

1. .....

2. .....

(b) State **three** assumptions that must be made when using capture/recapture data. [3]

1. .....

2. .....

3. .....

8

END OF PAPER

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

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