

Surname	Centre Number	Candidate Number
Other Names		0



**GCSE**

4461/02



S16-4461-02-R1

**SCIENCE A/BIOLOGY**

**BIOLOGY 1  
HIGHER TIER**

P.M. WEDNESDAY, 15 June 2016

1 hour

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	6	
2.	7	
3.	5	
4.	6	
5.	6	
6.	5	
7.	7	
8.	5	
9.	7	
10.	6	
<b>Total</b>	<b>60</b>	

**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.

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.

**INFORMATION FOR CANDIDATES**

The number of marks is given in brackets at the end of each question or part-question.

You are reminded that assessment will take into account the quality of written communication (QWC) used in your answer to questions **4** and **10**.

Answer all questions.

1. (a) (i) Gregor Mendel crossed purple flowered pea plants with white flowered pea plants. All the **F1** generation were purple flowered. Show this cross by completing the Punnett square below. Use the letter **D** to represent the purple allele and the letter **d** to represent the white allele. [2]

	Gametes		
<b>F1</b>			

- (ii) When Mendel selfed the **F1** generation he obtained a ratio of 3 purple:1 white flowered pea plants in the **F2** generation. In the space below construct and complete a Punnett square to show this cross. [2]

- (b) Mendel's experiments on genetics were carried out with garden peas (*Pisum sativum*). In each of his experiments he used thousands of pea plants. State the importance of the use of such a large number of plants. [1]
- .....

- (c) Mendel published his work on the genetics of pea plants in 1866. The significance of his work was not recognised until it was replicated in the early 1900s. Why is it important for scientists to replicate the work of other scientists? [1]
- .....

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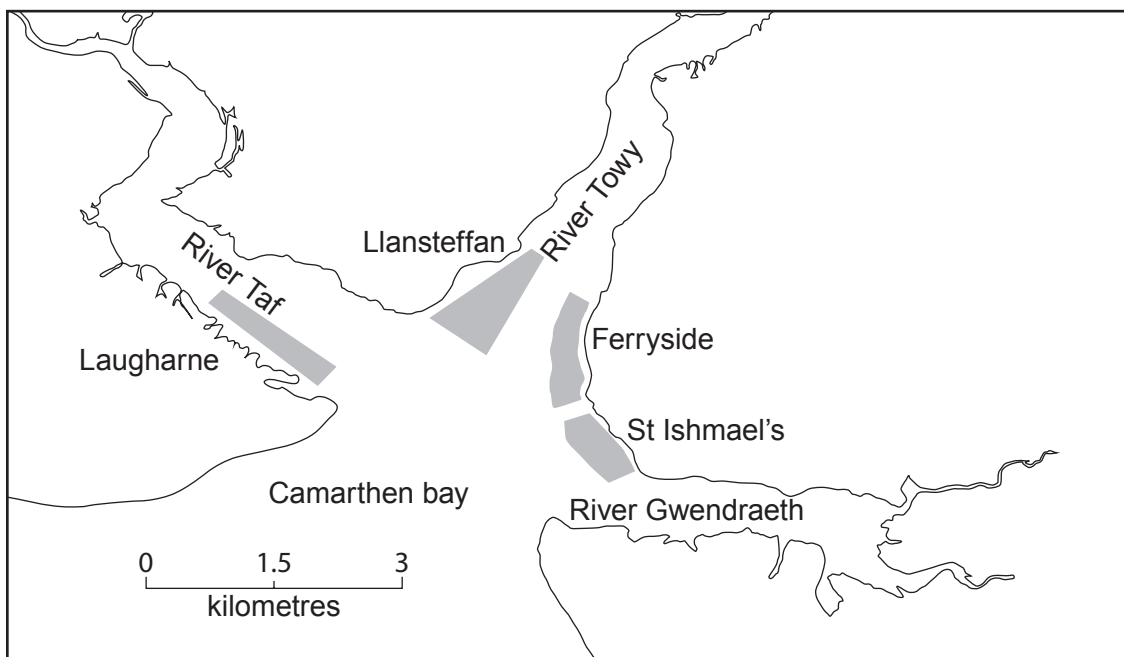
2. There is an increasing demand for food to feed the growing human population. This has both worldwide and local effects on wildlife and on the environment.


Cockles (*Cerastoderma edule*)



In 1984 a survey found that there was a small cockle fishery in the Three Rivers area of Carmarthenshire, South Wales with a few people harvesting the cockles. By 2014 the Three Rivers Cockle Fishery had become an important industry in South Wales with many fishermen harvesting the cockles for human consumption. The cockles are harvested from sandy mudflats at low tide.

Map showing the Three Rivers Cockle Fishery



 cockle beds

The table shows the number of fishermen that harvested cockles from the Llansteffan cockle bed on 4 days in the summer of 2007.

Date	Number of fishermen	Mass of cockles harvested (tonnes)
Tuesday 26 June	292	129
Tuesday 3 July	257	102
Tuesday 10 July	330	142
Tuesday 17 July	100*	37

\*Tide not suitable for harvesting cockles

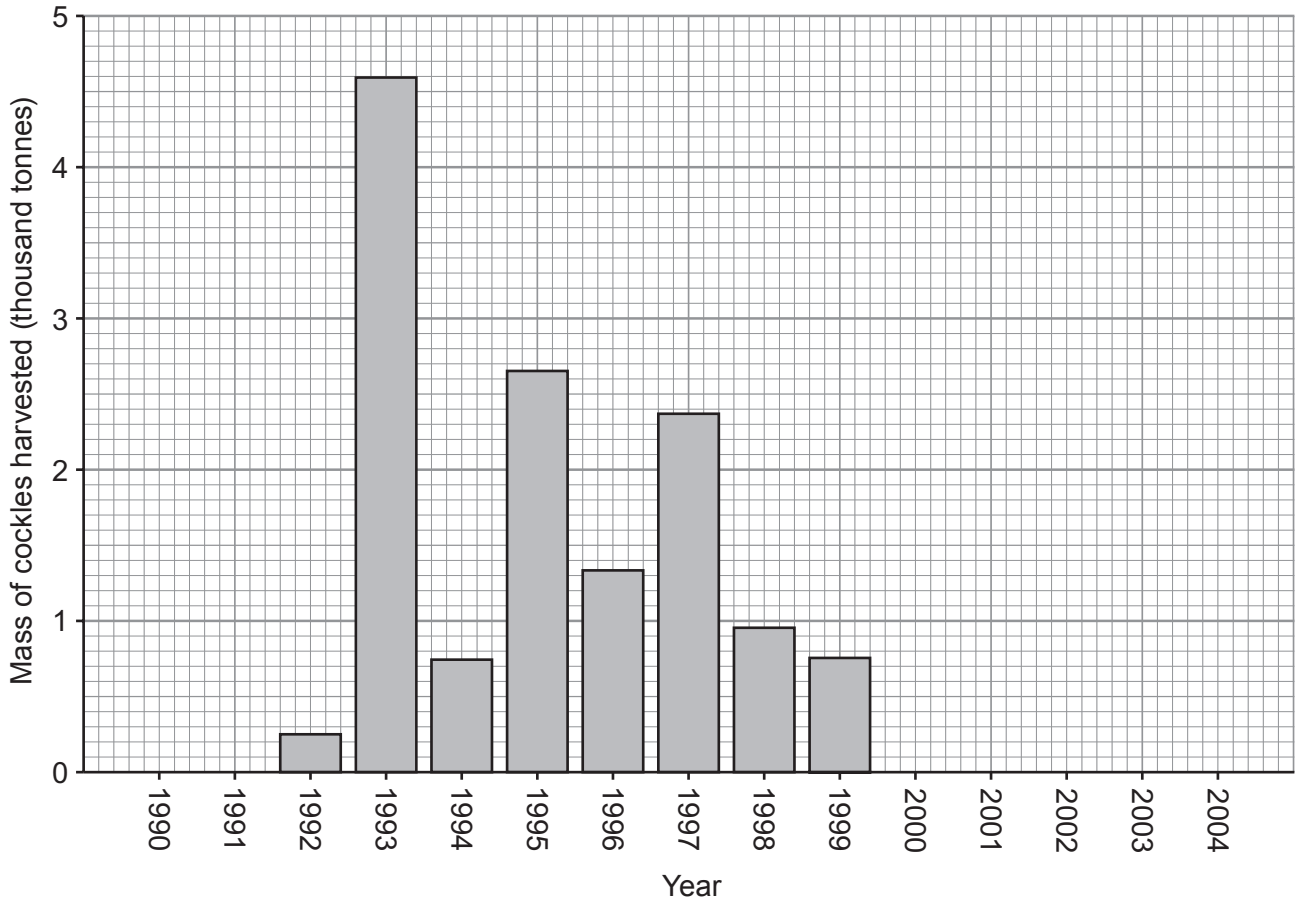
- (a) Calculate the mean mass of cockles harvested per fisherman on Tuesday 26 June. Use the space below for your calculation. [2]

mean mass = ..... tonnes

- (b) (i) Cockles can only be harvested if there is a minimum of 50 cockles per  $m^2$  of mud flats. If the number falls below this level then the Welsh Government closes the fishery. Suggest a reason why the fishery is closed if the number of cockles is less than 50 cockles per  $m^2$ . [1]
- .....

- (ii) Suggest a way in which the mass of cockles harvested could be managed effectively. [1]
- .....

- (c) The graph below shows the mass of cockles harvested in the Three Rivers Fishery between 1990 – 2004.



*Adapted from South Wales Sea Fisheries Committee*

Suggest **two** possible reasons why no cockles were harvested from 2000 to 2004. [2]

I. ....

II. ....

- (d) Oystercatchers (*Haematopus ostralegus*) are birds which often feed on cockles.



In recent years there has been an increase in the number of oystercatchers (*Haematopus ostralegus*) moving into the Three Rivers area. Cockles are a major source of food for oystercatchers.

Suggest **one** possible reason for this increase.

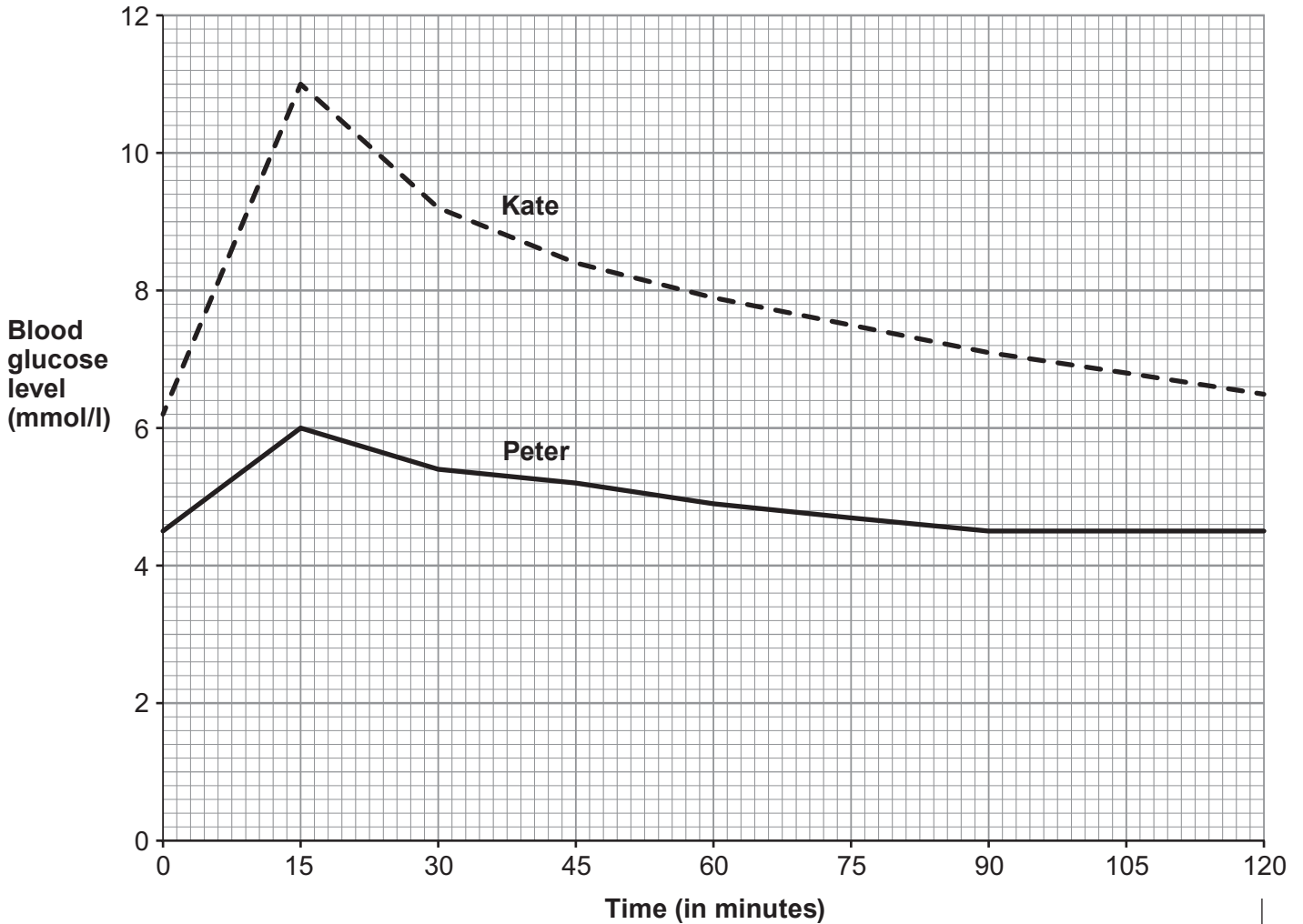
[1]

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3. The graph below shows the blood glucose levels of Kate and Peter, after eating the same mass of sugary cereal at breakfast time. The normal blood glucose range before meals is 4.0 – 5.9 mmol/l.



- (a) Explain why Peter's blood glucose level rises then falls. [3]

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- (b) State **two** pieces of evidence, shown in the graph, which indicate that Kate has diabetes. [2]

I. ....

II. ....



4. Explain how the leakage of untreated sewage into an unpolluted pond can result in the death of fish living in the pond. [6 QWC]

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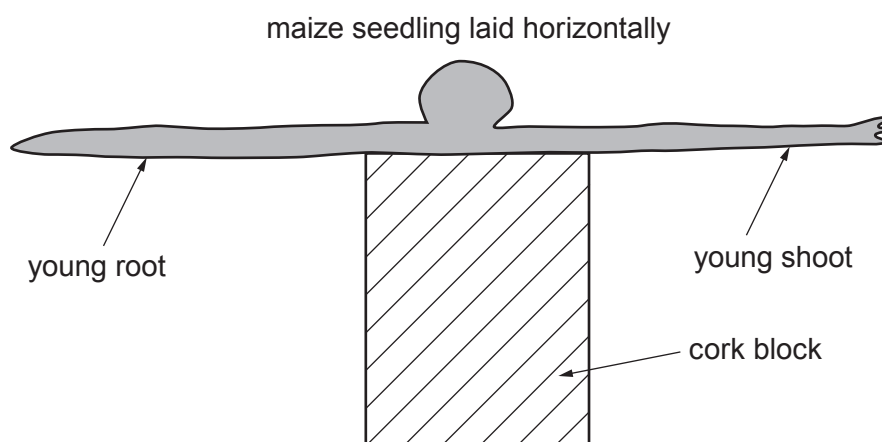
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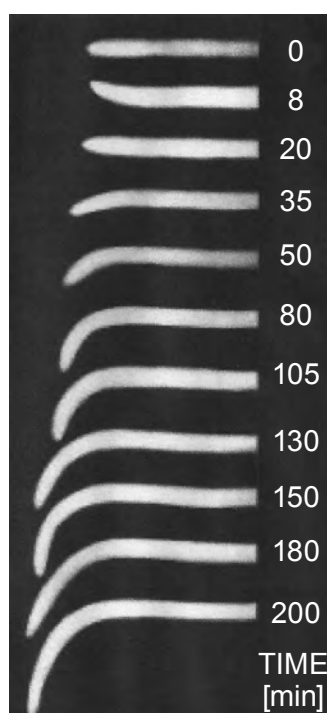
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5. A young maize seedling was laid horizontally in a dark room.



A series of time-lapse photographs was taken of the **young root**, at various time intervals, over a 200 minute period.

The series of photographs is shown below.



- (a) (i) State three observations, **shown in the photographs**, about the young root over the time of the investigation. [3]

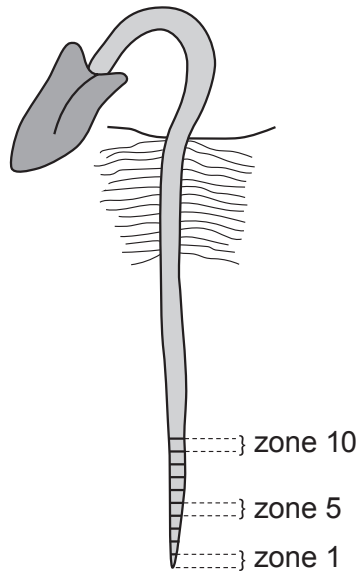
- I. ....
- II. ....
- III. ....

- (ii) Name the response shown by the young root between 35 and 200 minutes. [1]

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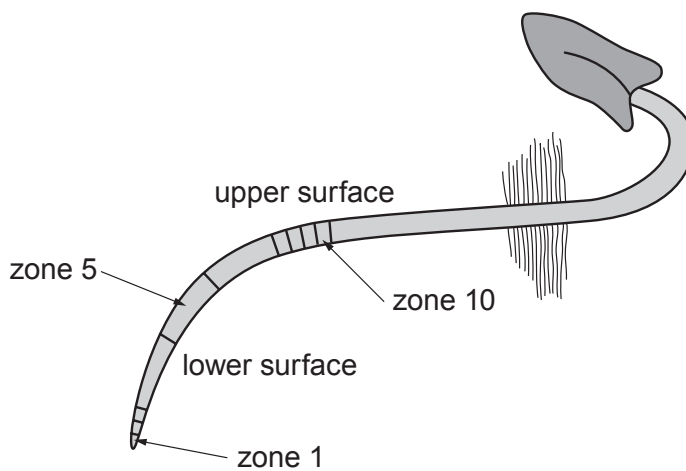
- (b) The root tip of a young seedling was marked with ink at 2 mm intervals. Each of the 2 mm divisions is known as a zone and three zones are labelled in the drawing.

Drawing 1



The seedling was laid horizontally for 180 minutes after which time a drawing was made. This is shown below.

Drawing 2



- (i) **Using Drawing 2 only** compare the growth rate of the upper and lower surfaces of the young root. [1]

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.....

- (ii) Name the type of chemical responsible for the curvature of the young root. [1]

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6. The following is part of a code of good farming practice concerning the use of nitrate-based fertiliser:

- do not apply nitrate fertiliser in autumn
- do not leave the soil bare during winter
- sow winter crops early in autumn
- do not spread slurry (animal manure) near lakes or rivers
- aerate soils (allow air to enter the soils) before spreading slurry
- plough straw into the soil to increase nitrate production in the long term

(a) Explain why nitrate-based fertiliser, used when the crop is actively growing, will cause less nitrate loss from the soil than if it is used on bare soil in autumn. [2]

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(b) Give the reason why air in the soil helps the nitrogen cycle to take place. [1]

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(c) Explain why ploughing straw into the soil leads to increased nitrate production in the long term. [2]

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7. Bananas that are cultivated commercially do not produce gametes. They are all grown as clones by asexual reproduction.

(a) What is meant by the term clone? [1]

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(b) Explain why populations of cloned bananas grown without the use of pesticides have very little chance of surviving outbreaks of diseases caused by fungi. [2]

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(c) In 1963, a fungus infected bananas grown in Costa Rica in Central America and spread throughout all of the banana crops there. A pesticide was sprayed on the banana crops to kill the fungus. In recent years, more than 70 different pesticides have been sprayed on the banana crops in Costa Rica.



Caiman (*Caiman crocodilus*) are similar to alligators and are fourth stage consumers.

Explain why the excessive use of pesticide sprays has led to the decrease in populations of caiman in the rivers of Costa Rica. [4]

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8. In 2013 specimens of sea snails (molluscs) were collected from a deep sea trench near the north of Scotland. They were sent to a scientist at the National Museum of Wales, Cardiff, for identification.

Most of the specimens were known as *Volutopsius norwegicus* but one showed some differences in appearance to the known specimens and also showed some similarities.

It was concluded that the unknown specimen belonged to the same genus as the known specimens. The scientist reported that the differences might be due to:

**EITHER**

A – the sea snail's development under different environmental conditions

**OR**

B – natural selection from a group of snails showing continuous variation

- (a) Give the letter A or B which suggests that the known and unknown snails have: [2]

(i) different genotypes; .....

(ii) the same genotype .....

- (b) Name the technique that could be used to confirm the scientist's conclusions. [1]

.....

- (c) It was decided that the unknown specimen was of the genus *Volutopsius* but it was given the second name *scotia*. What term, used in classification, does this second name represent? [1]

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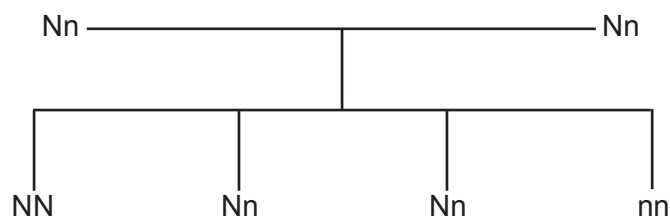
- (d) Underline the correct statement from the list below. [1]

The scientific name of all newly discovered organisms is decided by:

- (i) the person who discovered the organism;
- (ii) the name of the place where it was discovered;
- (iii) an international committee;
- (iv) the National Museum of Wales;
- (v) a committee from the United Kingdom.

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9. The family tree shows how two parents, heterozygous for the cystic fibrosis allele, have a 1 in 4 chance of having a child who has cystic fibrosis.



Key:

N = the normal allele

n = the cystic fibrosis allele

nn = child with cystic fibrosis

- (a) It is estimated, that one person in 25 in the population of the United Kingdom is heterozygous for the cystic fibrosis allele. Therefore the probability of both parents being heterozygous for the cystic fibrosis allele in the population of the United Kingdom is:

$$\frac{1}{25} \times \frac{1}{25}$$

(1 in 25 × 1 in 25)

If one in 4 of their children is nn, calculate the probability of a person having cystic fibrosis in the population of the United Kingdom.

Show your working:

[2]

probability = .....

- (b) State how cystic fibrosis affects the lungs.

[1]

- (c) People with cystic fibrosis may be given a lung transplant. Give a reason why the transplanted lungs would not produce the symptoms of cystic fibrosis.

[1]



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(d) (i) Gene therapy has been used to treat the symptoms of cystic fibrosis. State how lung cells are targeted with normal alleles. [1]

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(ii) Suggest why this type of gene therapy would have to be regularly repeated. [1]

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(e) It took more than 20 years between the first research into this type of gene therapy and its final approval by the European Union. Suggest why this time was needed for detailed testing. [1]

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- 10. Cockroaches are pests which spoil food and spread disease. They have a gene which makes them attracted to sugar. In the 1980s pest controllers used a mixture of insecticide and sugar as a means of pest control. The sugar attracted the cockroaches and the insecticide killed them. In the 1990s certain populations of cockroaches had changed so that they were no longer attracted to sugar. The insecticide was still lethal but the cockroaches avoided eating it when it was mixed with sugar.



Explain how the cockroaches evolved to survive the pest control that was used in the 1980s.  
[6 QWC]

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