Surname		Centre Number	Candidate Number
Other Names			0

WJEC CBAC

GCSE

4461/02

SCIENCE A/BIOLOGY

BIOLOGY 1
HIGHER TIER

P.M. TUESDAY, 10 June 2014

1 hour

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

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 used in your answer to questions **4** and **10**.

SM*(S14-4461-02)

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*Answer **all** questions.*

1. Some organisms living in a large lake and their total biomass in kg are shown below.

    They are **not** drawn to scale.

    Snails
    4 500 kg

    Pike
    250 kg

    Aquatic plants
    45 000 kg

    Minnows
    500 kg

    Beetles
    800 kg

    (a) (i) Which of the organisms above are likely to be present in the least numbers? [1]

    ....

    (ii) The organisms above all form part of the same food chain.
    In the space below, draw a **labelled** diagram to show a pyramid of biomass containing **all** of these organisms. [2]

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only

(iii) The pike in the lake are affected by a parasite, called a fish louse, which lives on their skin. There would be many of these parasites on each pike but their biomass would be less than the biomass of the pike.

How would you add this information to the pyramid you drew in *(a)*(ii)?

Tick (✓) the correct answer. [1]

Place them at the tier above the pike ☐

Place them at the bottom of the pyramid ☐

Place them below the minnows ☐

Place them in the tier below the pike ☐

(b) Explain how a pyramid of numbers, for some organisms living on land, could look like the one shown below: [2]

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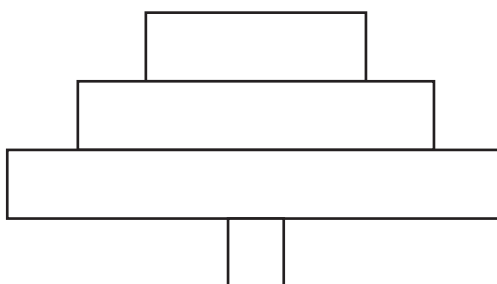
2. *(a)* The graph below shows the variation in the volume of milk produced by a herd of cows in one year. All the cows were the same breed.
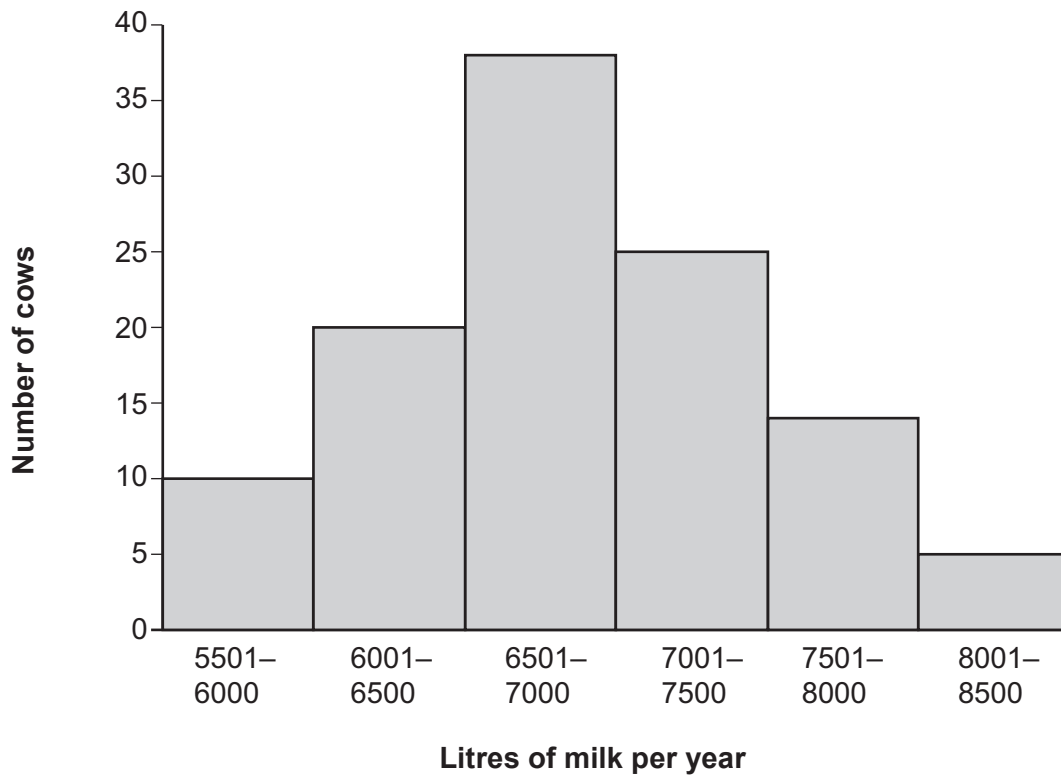
(i) During the winter months, the herd is kept indoors in large barns. All the cows in the herd are fed exactly the same quality and quantity of food. Suggest a reason why the volumes of milk produced by the cows varied during the winter months. [1]

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Examiner only

During the summer months, the farmer noticed that the volume of milk produced by the cows varied depending on which fields on the farm the cows were grazing on.

He divided the cows that produced 6501 – 7000 litres of milk per year into two groups. One of these groups grazed on a field by the river and the other on a field on the hill.

The graphs below show the results.

Hill field

River field
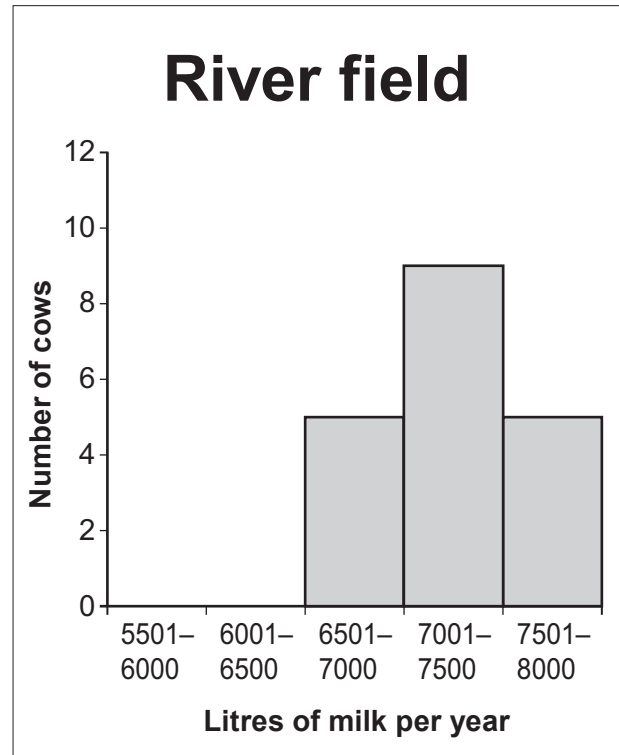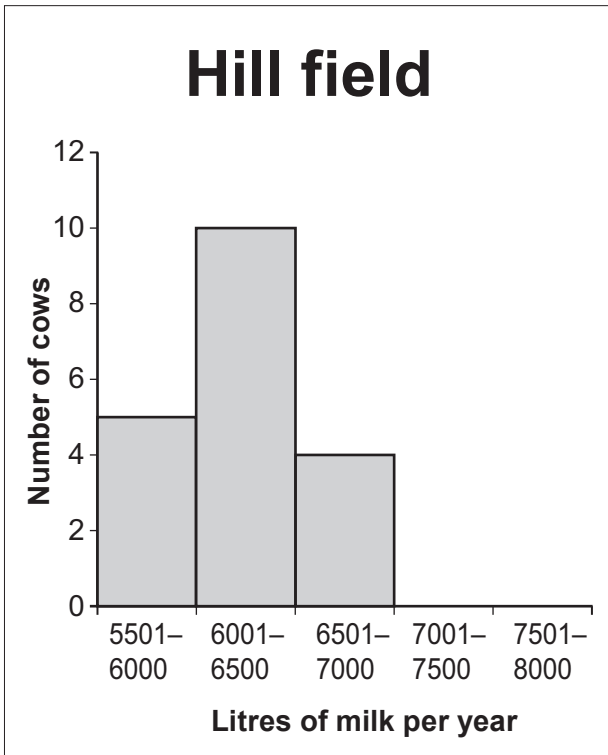
(ii) Explain the differences in the results shown in the graphs. [2]

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(iii) When the farmer breeds from his cows he uses a method called artificial insemination (AI). The sperm are introduced into the cows mechanically rather than by using a bull directly.
How does this information suggest that AI is a method of sexual reproduction? [1]

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(b)   The table below shows the milk composition of five breeds of dairy cattle.

breed	milk composition (g/l)		
	fat	protein	milk sugar
Ayrshire	3.97	3.26	4.63
Brown Swiss	3.80	3.18	4.80
Guernsey	4.58	3.49	4.78
Holstein	3.56	3.02	4.61
Jersey	4.97	3.03	4.70

Milk from which breed of cattle would you recommend to a person suffering from heart disease? Give a reason for your answer.   [2]

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3. The diagram below shows the hairs on the surface of the skin of a cat at different air temperatures.

Diagram A

Mean air temperature 6.4°C
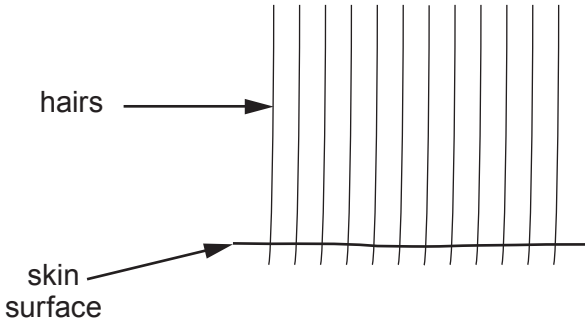
Diagram B

Mean air temperature 22.7°C

hairs →

skin surface →
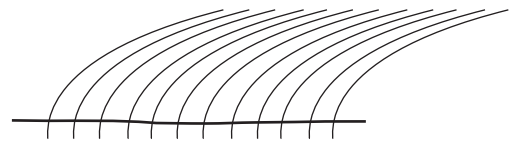
(a) Name the structures in the skin that raise each hair to the position shown in **Diagram A**. [1]

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(b) Explain why the skin in **Diagram A** loses less heat to the air than the skin in **Diagram B**. [3]

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(c) State **two** *other* ways in which the skin reduces heat loss from the body. [2]

I ....

II ....

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4. Describe an experiment you would set up to investigate the positive growth response (phototropism) of plant shoots to light coming from one side.
In your account you must explain the use of a control in your investigation. [6 QWC]

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5. In mice the allele for black eye colour (**B**) is dominant over the allele for red eye colour (**b**).

(a) What is the phenotype of each of the following mice? [1]

Mouse 1   **BB** ....

Mouse 2   **Bb** ....

Mouse 3   **bB** ....

Mouse 4   **bb** ....

(b) (i) If mouse 1 and mouse 4 were mated together and had 12 offspring, how many of these would you expect to have black eyes?

Number with black eyes .... [1]

(ii) Complete the Punnett square below to help explain your answer. [1]

Gametes		

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(c) (i) If mouse 2 and mouse 4 were mated together and had 50 offspring over several litters, how many of their offspring would you expect to have red eyes?

Number with red eyes .... [1]

(ii) Complete the Punnett square below to help explain your answer. [1]

Gametes		

(d) If mouse 2 and mouse 3 were mated together and had 48 offspring over several litters the expected Mendelian ratio is 3 black eyed mice : 1 red eyed mouse.
Suggest **one** reason why the expected ratio does not always occur in practice. [1]

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6. The drawing below shows a food chain in a river into which a pesticide has been washed.

Phytoplankton
88 000 kJ
(0.00005 ppm)

Zooplankton
14 000 kJ
(0.040 ppm)

Perch
1 600 kJ
(0.16 ppm)

Pike
88 kJ
(32.5 ppm)
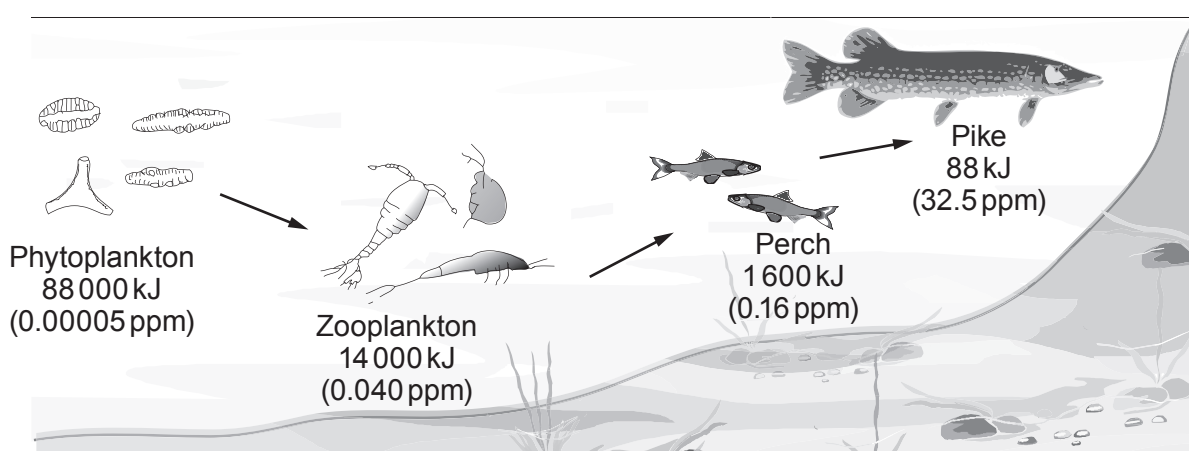
The organisms are not drawn to scale.

The unit, kJ, indicates the energy in organisms at each level of the food chain and represents kJ per m^3 of water per year.
The numbers in brackets show the pesticide concentration in parts per million (ppm).

(a) Calculate, the percentage of the energy in the producer that has reached the third stage consumer. **Show your working**.   [2]

Answer .... %

(b) Over a period of three years, the number of fertilised eggs per fish decreased in the river. Use the data shown in the drawing and your knowledge to explain a reason for this decrease.   [2]

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7. The principles of negative feedback can be summarised by the flow chart shown below.

(a) Fill in the blank spaces to show how the source of energy in the blood is maintained at a constant concentration. [5]

Increase in concentration of the hormone .... in the blood.

Decrease in concentration of the hormone .... in the blood.

Affects hormone production by the ....

Decrease in concentration of .... in the blood.

Increase in concentration of .... in the blood.
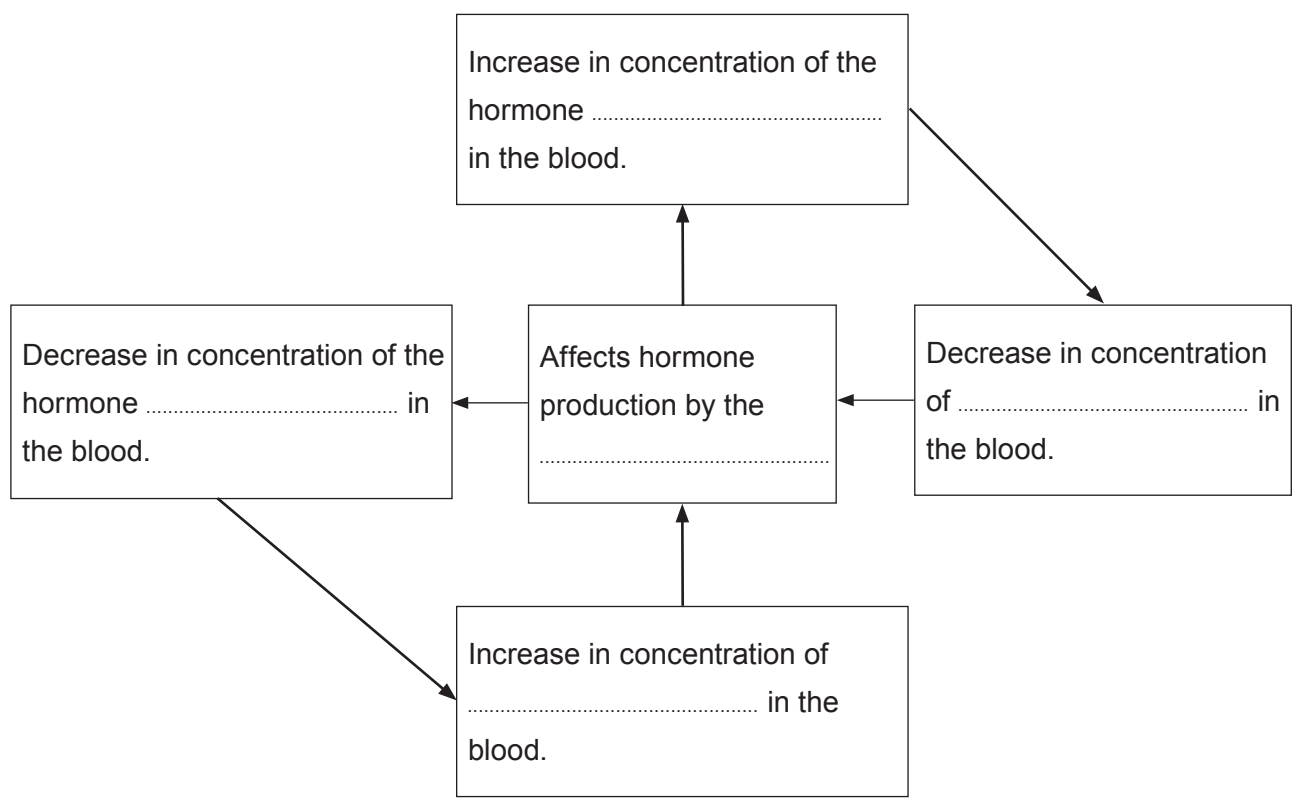
(b) State **two** features of hormones shown in the flow chart. [2]

I ....

II ....

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8. The patterns of inheritance of cystic fibrosis in two families is shown as a family tree below.
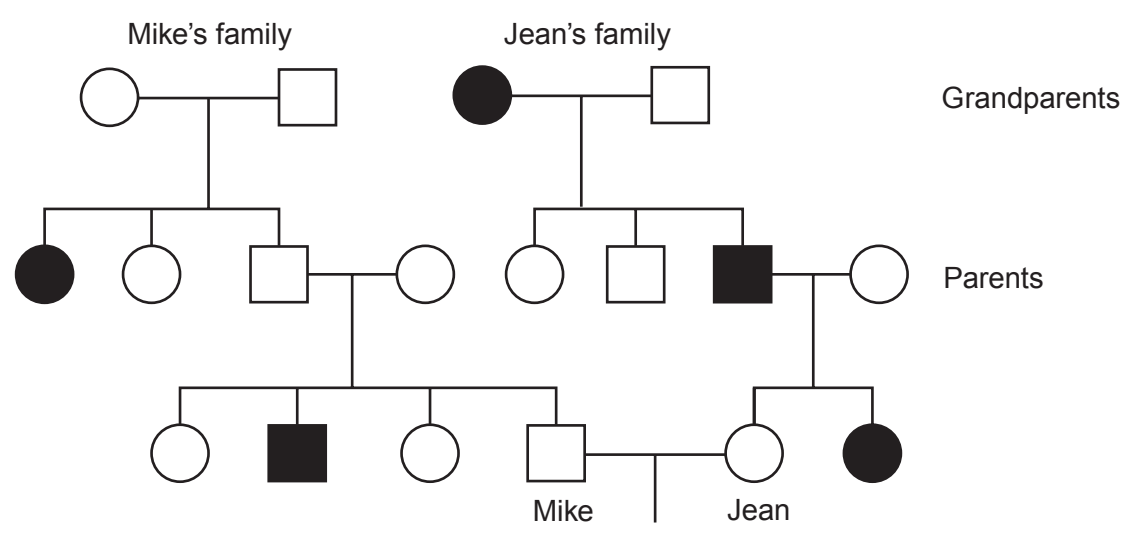
Cystic fibrosis results from a homozygous pair of recessive alleles. People who are heterozygous for cystic fibrosis have one normal allele and one cystic fibrosis allele. They are carriers of cystic fibrosis but do not suffer from it.

(a) In the family trees shown, if **N** = the normal allele and **n** = the allele for cystic fibrosis, what is the genotype of: [2]

   (i)   Mike's grandfather; ....

   (ii)   Jean? ....

(b) What is the percentage chance that Mike is a carrier of cystic fibrosis? [1]

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(c) Chromosomes from Mike and Jean's developing baby and from Mike were examined. A genetic analysis of the alleles present was carried out. The results are shown below as a sequence of bars.
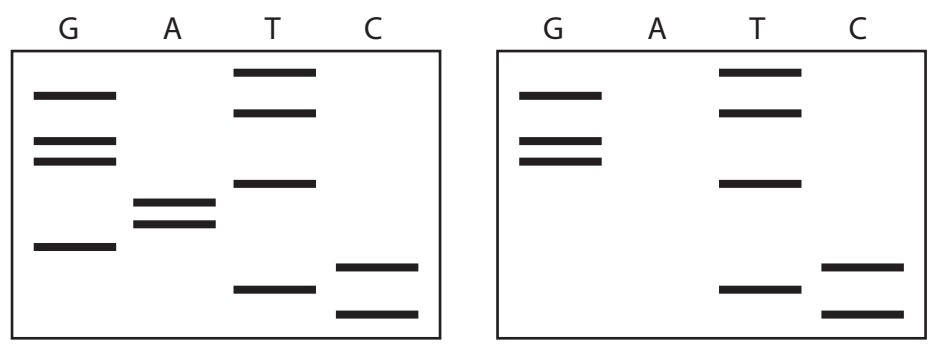
Genetic analysis of Mike's alleles

Genetic analysis of Mike and Jean's developing baby's alleles

(i) What term is used for this sequence of bars? [1]

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(ii) Cystic fibrosis is caused by a change in protein made in the cells.
Explain why the protein made in the cells of the developing baby is different from the protein being made in Mike's cells. [2]

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(d) Explain why genetic analysis is a more accurate method of predicting the inheritance of cystic fibrosis than using information from family trees. [2]

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9. The diagram below shows how some nitrates enter water in the soil and how some enter the roots of wheat.
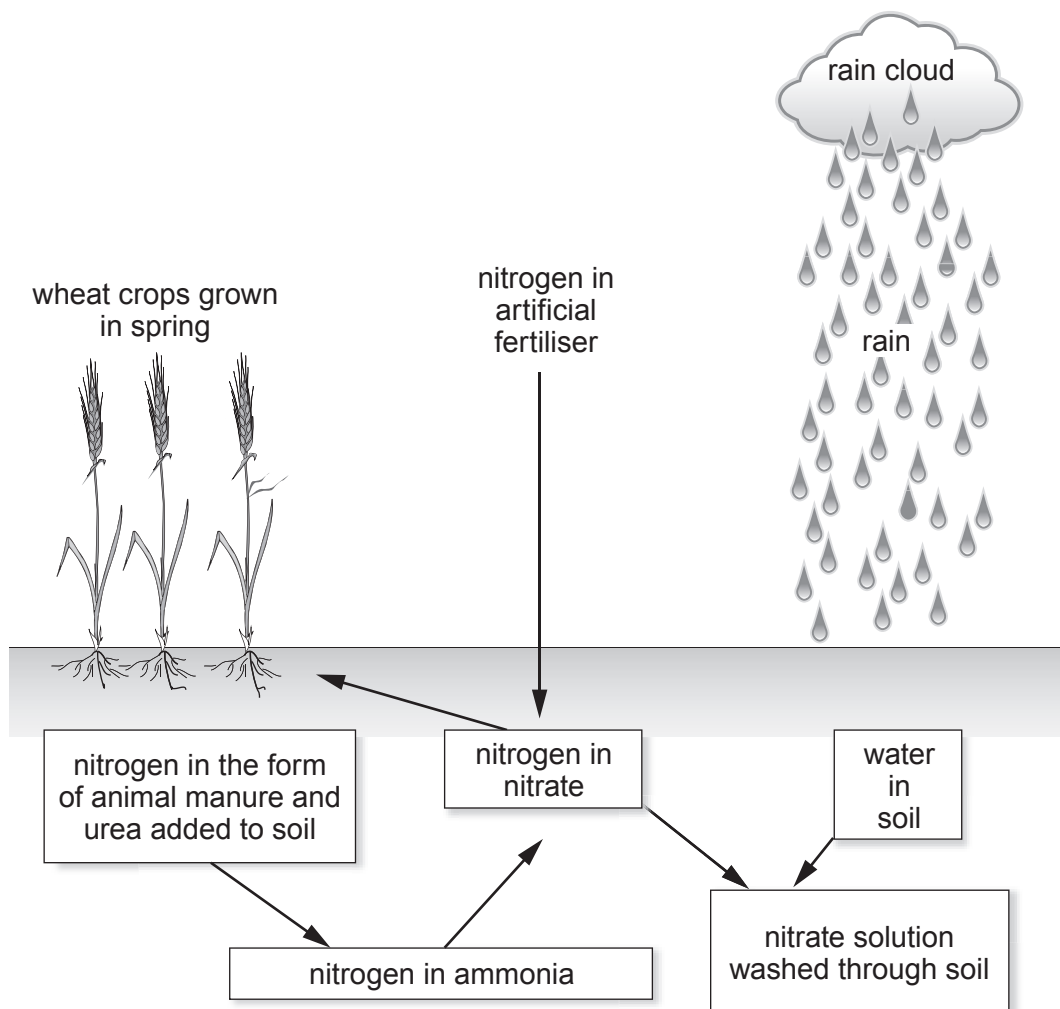
(a) Nitrate Vulnerable Zones (NVZs) are areas of land where nitrates in fertilisers are likely to enter water supplies.
Suggest why:

(i) the annual deadline for spreading animal manure (slurry) on NVZs in Wales is October 31st; [1]

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(ii) it is more environmentally friendly to add nitrate fertiliser to wheat crops in the Spring than in the Winter. [1]

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Examiner only

(b) Some genetically modified plants are able to absorb nitrates more rapidly than others so that they increase their yield.
State another way in which plants may be genetically modified as an economic advantage.
[1]

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(c) Suggest how ploughing dead plants back into the soil may lead to increased nitrate production in the long term. [2]

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Turn over.

Examiner only

10. There is a gene (FOXI 1) in humans which controls how much water is lost from the body in sweat and urine. Scientists found that 85% of a large sample of people who lived in the Sahara desert had a form of the FOXI 1 gene which had changed over time.

It has been estimated that climate change caused the Sahara desert to form between 10 000 and 20 000 years ago at the same time that the change in the FOXI 1 gene took place.

Explain how evolution has resulted in the changed FOXI 1 gene increasing in frequency in people living in the Sahara desert. [6 QWC]

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