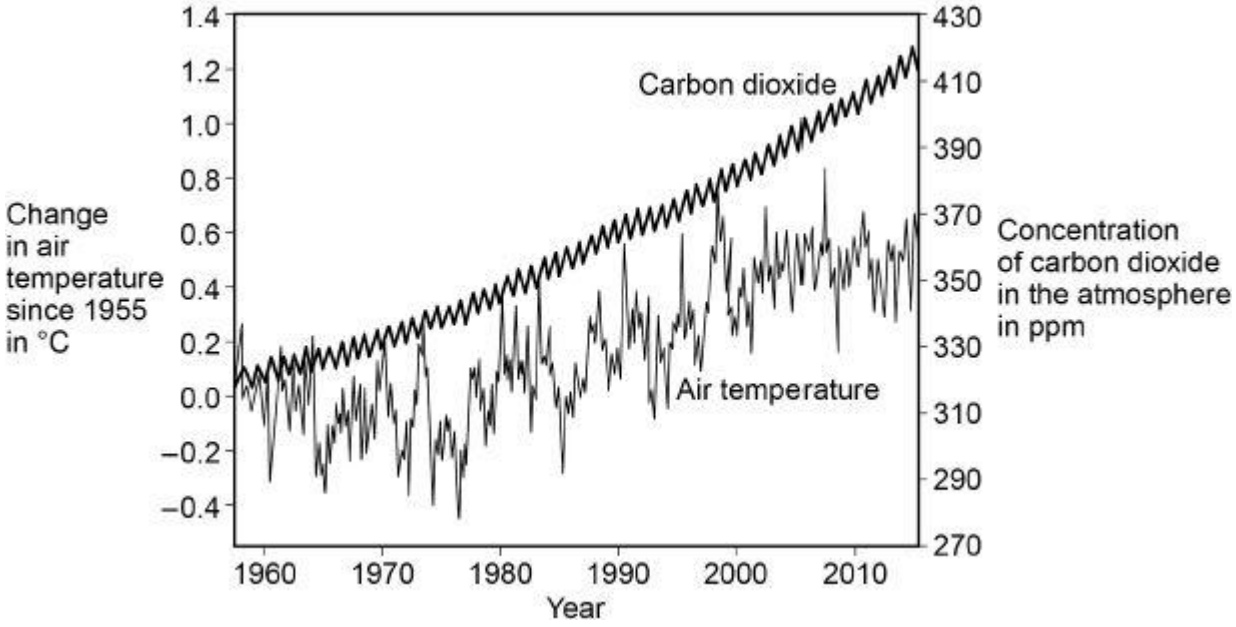
Q1.

Many scientists think that global air temperature is related to the concentration of carbon dioxide in the atmosphere.

The graph below shows changes in global air temperature and changes in the concentration of carbon dioxide in the atmosphere.



(a) Complete the table below.

Use information from the graph above.

Choose answers from the box.

You may use each answer once, more than once or not at all.

constant	decreasing	increasing

	1960 − 1977	1977 − 2003	2003 − 2015
Trend in carbon dioxide concentration	Increasing		
Trend in air temperature			

(2)

Many scientists think that an increase in carbon dioxide concentration in the atmosphere causes an increase in air temperature.

(b) How would an increase in the concentration of carbon dioxide in the atmosphere cause an increase in air temperature?

_____

_____

(1)

(c) Evaluate evidence for and against the theory that an increase in the concentration of carbon dioxide in the atmosphere causes an increase in air temperature.

Use data from the graph above and your own knowledge.

_____

_____

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(4)

In each year, the concentration of carbon dioxide in the atmosphere is higher in the winter than in the summer.

(d) Give **one** human activity that could cause the higher concentration of carbon dioxide in the winter.

_____

_____

(1)

(e) Give **one** biological process that could cause the lower concentration of carbon dioxide in the summer.

_____

_____

(1)

(f) Give **two** possible effects of an increase in global air temperature on living organisms.

1. _____

_____

2. _____

_____

(2)

(Total 11 marks)

Q2.

It is important that the concentration of glucose (sugar) in the blood is controlled.

(a) (i) Which hormone controls the concentration of glucose in the blood?

_____

(1)

(ii) Which organ produces this hormone?

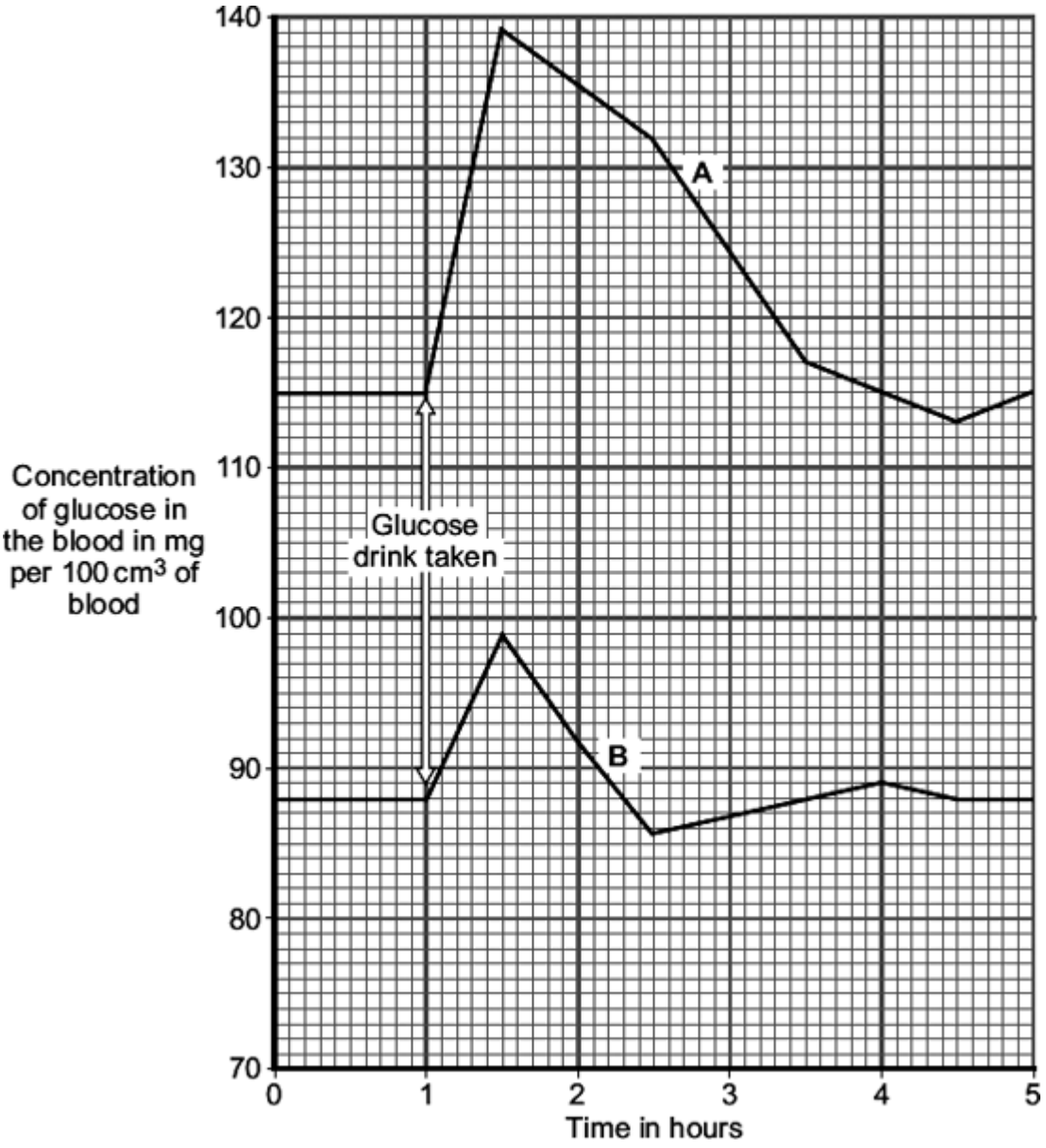
_____

(1)

(b) The concentration of glucose in the blood of two people, **A** and **B**, was measured every half an hour.

One hour after the start, both people drank a solution containing 50 g of glucose.

The graph shows the result.



(i) By how much did the blood glucose concentration in person **B** rise after drinking the glucose drink?

_____ mg per 100 cm^3 of blood

(1)

(ii) A doctor suggests that person **A** has diabetes.

Give **two** pieces of evidence from the graph to support this suggestion.

1. _____

_____

2. _____

_____

(2)

(iii) Give **one** reason for the fall in blood glucose concentration in person **B**, shown in the graph.

_____

(1)

(Total 6 marks)

Q3.

This question is about the nervous system.

(a) Describe the difference between the function of a receptor and the function of an effector.

In your answer you should give **one** example of a receptor and **one** example of an effector.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(b) Synapses are important in the nervous system.

(i) What is a synapse?

_____

_____

_____

_____

(2)

(ii) Describe how information passes across a synapse.

_____

_____

_____

_____

(2)

(c) Reflexes may be co-ordinated by the brain or by the spinal cord.

(i) The reflexes from sense organs in the head are co-ordinated by the brain.

Name a sense organ involved in a reflex co-ordinated by the spinal cord.

_____

(1)

(ii) The table shows information about reflexes co-ordinated by the brain and reflexes co-ordinated by the spinal cord.

Organ co-ordinating the reflex	**Mean length of neurones involved in cm**	**Mean time taken for reflex in milliseconds**	**Mean speed of impulse in cm per millisecond**
Brain	12	4	3
Spinal cord	80	50	

Calculate the mean speed of the impulse for the reflex co-ordinated by the spinal cord.

_____

_____

Mean speed = _____ cm per millisecond

(1)

(iii) In reflexes co-ordinated by the brain there are **no** relay neurones.

Suggest why there is a difference in the mean speed of the impulse for the two reflexes.

_____

_____

_____

_____

(2)

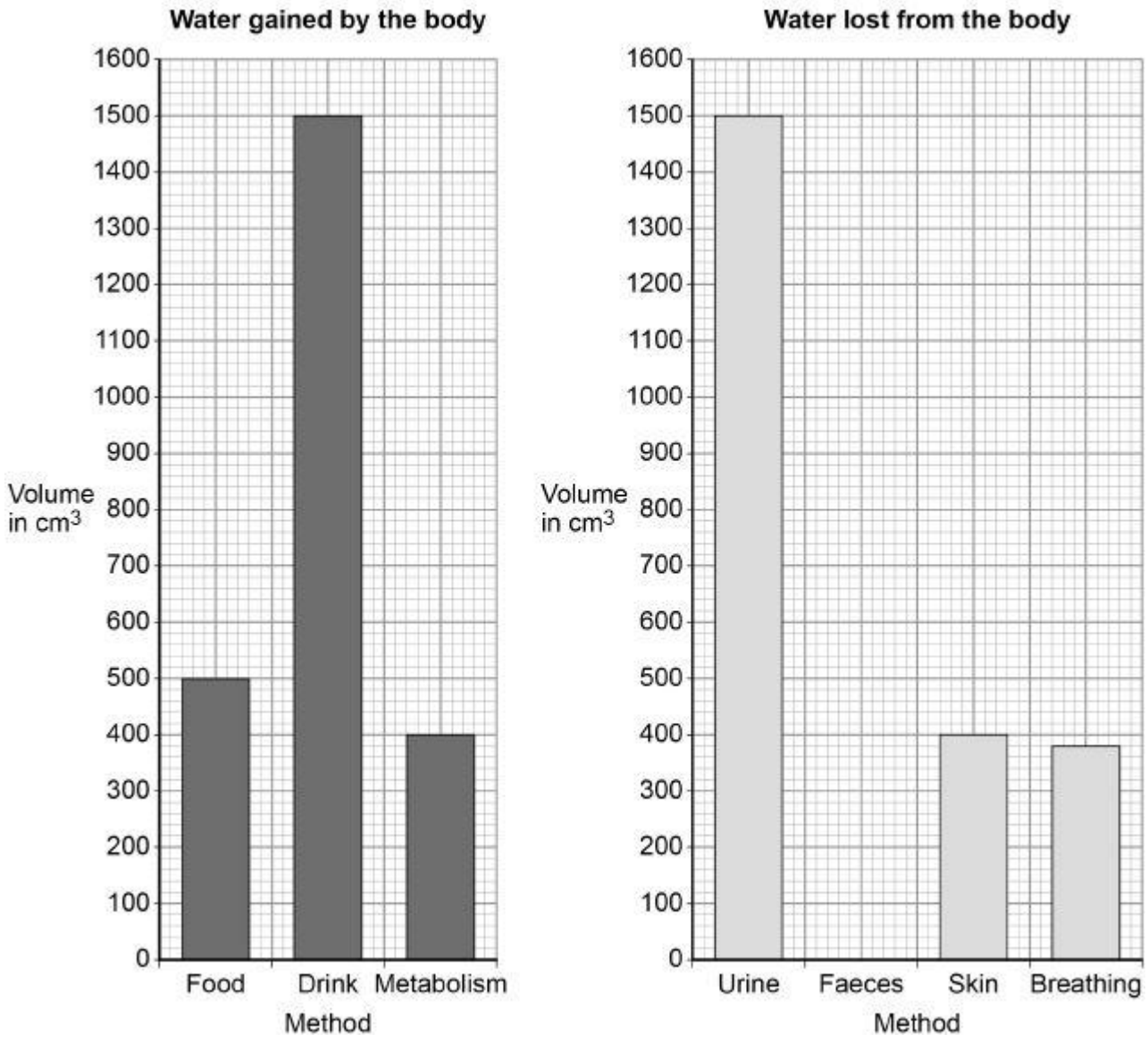
(Total 12 marks)

Q4.

It is important to maintain water balance in the body.

The graphs below show how much water a person gained and lost by different methods in

one day.



When water is balanced, the volume of water taken in by the body is equal to the volume of water lost from the body.

(a) Calculate the volume of water the person lost in one day in faeces.

Use information from the graphs above.

_____

_____

_____

_____

Volume lost in faeces = _____ cm^3

(2)

(b) The graphs above show that one method of gaining water is by metabolism.

Which metabolic process produces water?

Tick **one** box.

Breakdown of protein to amino acids	☐
Changing glycogen into glucose	☐
Digestion of fat	☐
Respiration of glucose	☐

(1)

The next day, the person ran a 10-kilometre race.

The volume of water lost from the body through the skin and by breathing increased.

(c) Explain why more water was lost through the skin during the race.

_____

_____

_____

_____

(2)

(d) Explain why more water was lost by breathing during the race.

_____

_____

_____

_____

_____

_____

(3)

(Total 8 marks)

Q5.

A gardener wants to add compost to the soil to increase his yield of strawberries.

The gardener wants to make his own compost.

(a) An airtight compost heap causes anaerobic decay.

Explain why the gardener might be against producing compost using this method.

_____

_____

_____

_____

(2)

(b) The gardener finds this research on the Internet:

'A carbon to nitrogen ratio of 25:1 will produce fertile compost.'

Look at the table below.

Type of material to compost	Mass of carbon in sample in g	Mass of nitrogen in sample in g	Carbon:nitrogen ratio
Chicken manure	8.75	1.25	7:1
Horse manure	10.00	0.50	20:1
Peat moss	9.80	0.20	**X**

Determine the ratio **X** in the table above.

_____

Ratio _____

(1)

(c) Which type of material in the table above would be **best** for the gardener to use to make his compost?

Justify your answer.

_____

_____

(1)

(d) Some of the leaves from the gardener's strawberry plant die.

The dead leaves fall off the strawberry plant onto the ground.

The carbon in the dead leaves is recycled through the carbon cycle.

Explain how the carbon is recycled into the growth of new leaves.

_____

_____

_____

_____

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_____

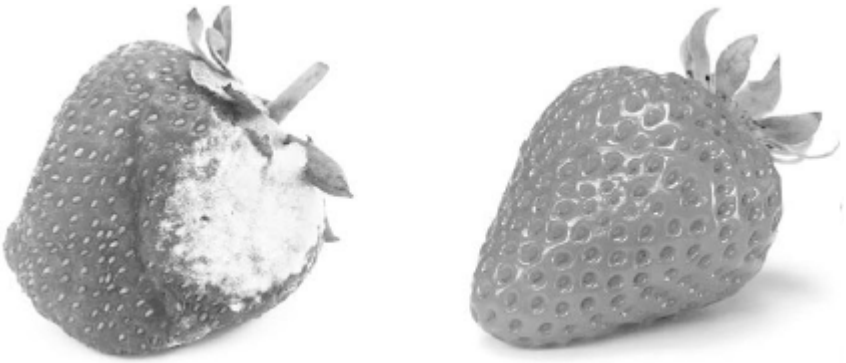
_____

(6)

(e) The diagram below shows two strawberries.

- Both strawberries were picked from the same strawberry plant.
- Both strawberries were picked 3 days ago.
- The strawberries were stored in different conditions.

Strawberry A **Strawberry B**



A © sarahdoow/iStock/Thinkstock, B © Mariusz Vlack/iStock/Thinkstock

Give **three** possible reasons that may have caused strawberry **A** to decay.

1. _____

_____

2. _____

_____

3. _____

_____

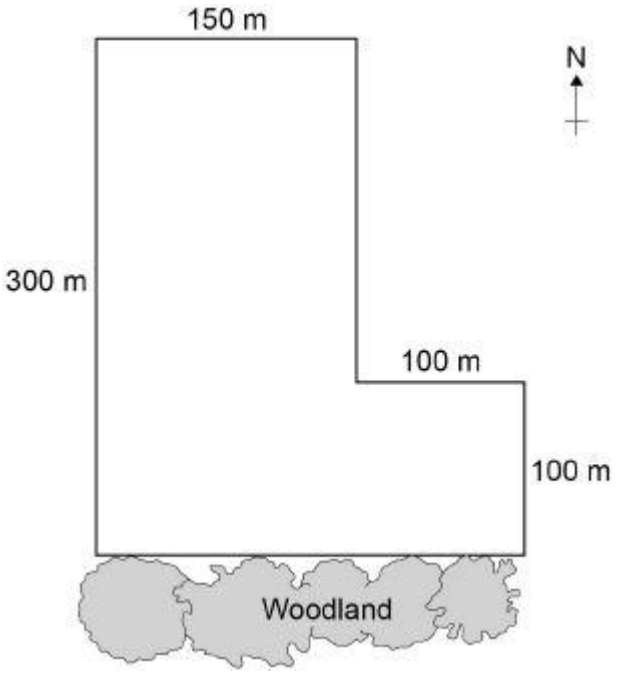
(3)

(Total 13 marks)

Q6.

Some students investigated the size of a population of dandelion plants in a field.

The diagram below shows the field.



The students:

- placed a 1 m × 1 m square quadrat at 10 random positions in the field
- counted the number of dandelion plants in each quadrat.

The table below shows the students' results.

Quadrat number	Number of dandelion plants
1	6
2	9
3	5
4	8
5	0
6	10
7	2

8	1
9	8
10	11

(a) Why did the students place the quadrats at random positions?

_____

_____

(1)

(b) Estimate the total number of dandelion plants in the field.

Calculate your answer using information from the diagram and the table above.

Give your answer in standard form.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Total number of dandelion plants = _____

(5)

Quadrats **5**, **7** and **8** were each placed less than 10 metres from the woodland.

These quadrats contained low numbers of dandelion plants.

The students made the hypothesis:

'Light intensity affects the number of dandelion plants that grow in an area.'

(c) Plan an investigation to test this hypothesis.

_____

_____

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(6)

(d) Light is an environmental factor that affects the growth of dandelion plants.

Give **two** other environmental factors that affect the growth of dandelion plants.

1. _____

2. _____

(2)

(Total 14 marks)

Q7.

Cell division is needed for growth and for reproduction.

(a) The table below contains three statements about cell division.

Complete the table.

Tick **one** box for each statement.

	Statement is true for		
Statement	**Mitosis only**	**Meiosis only**	**Both mitosis and meiosis**
All cells produced are genetically identical			
In humans, at the end of cell division each cell contains 23 chromosomes			
Involves DNA replication			

(2)

Bluebell plants grow in woodlands in the UK.

- Bluebells can reproduce sexually by producing seeds.
- Bluebells can also reproduce asexually by making new bulbs.

(b) One advantage of asexual reproduction for bluebells is that only **one** parent is needed.

Suggest **two** other advantages of asexual reproduction for bluebells.

1. _____

_____

2. _____

_____

(2)

(c) Explain why sexual reproduction is an advantage for bluebells.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

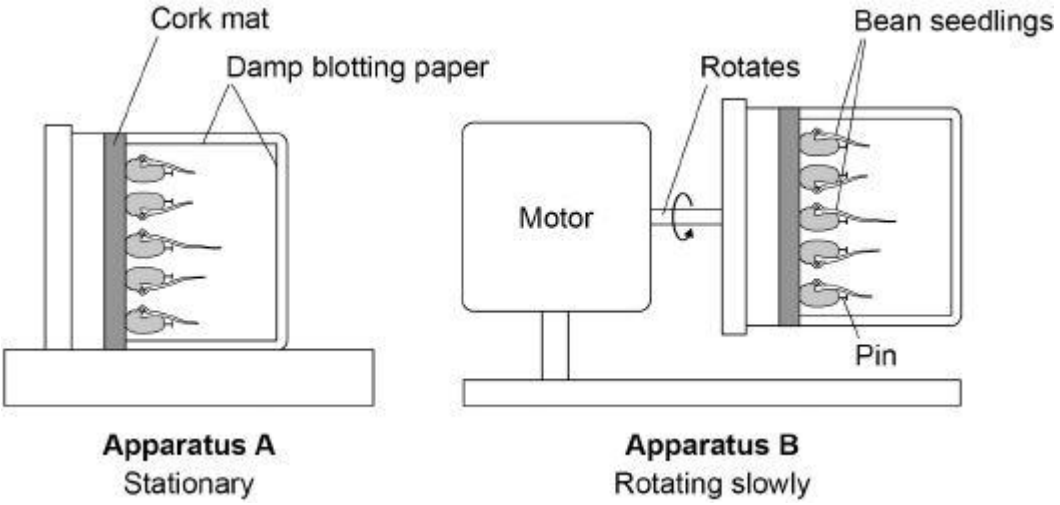
(Total 8 marks)

Q8.

Some students investigated geotropism in the roots of bean seedlings.

Figure 1 shows the apparatus used.

Figure 1



This is the method used.

1. Measure the length of the root of each of 10 bean seedlings.
2. Pin 5 seedlings to the cork mat in apparatus **A**.
3. Pin 5 seedlings to the cork mat in apparatus **B**.
4. Leave **A** and **B** in a dark cupboard for 2 days.
5. After the 2 days:
   - make a drawing to show the appearance of each seedling
   - measure the length of the root of each seedling.

(a) Why did the students surround the seedlings with damp blotting paper?

Tick **one** box.

To prevent light affecting the direction of root growth	☐

To prevent photosynthesis taking place in the roots	☐
To prevent the growth of mould on the roots	☐
To prevent water affecting the direction of root growth	☐

(1)

Apparatus **B** is a control.

Apparatus **B** rotates slowly.

(b) How does apparatus **B** act as a control?

_____

_____

(1)

The table below shows the students' results.

	Apparatus A					**Apparatus B**				
Seedling number	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Length at start in mm	35	41	32	33	39	30	33	29	28	31
Length after 2 days in mm	49	57	43	45	54	45	45	44	29	44
Length change in mm	14	16	11	12	15	15	12	15	1	13
Mean length change in mm	14					11				

(c) One student stated:

'The mean length change for the seedlings in apparatus **B** is **not** valid.'

Suggest the reason for the student's statement.

_____

_____

(1)

(d) Suggest **one** improvement the students could make to obtain a more valid mean

length change for the seedlings in apparatus **B**.

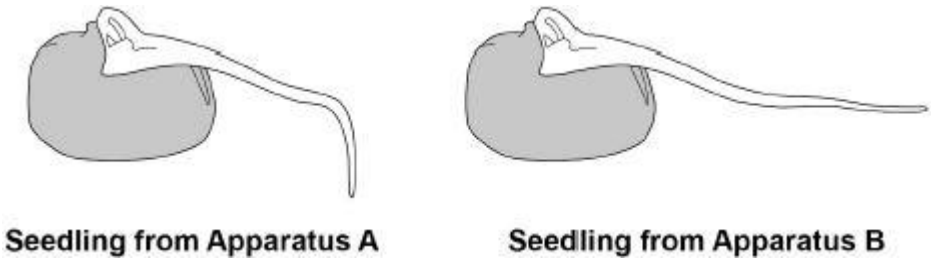
_____

_____

(1)

(e) **Figure 2** shows the students' drawings of two seedlings at the end of the 2 days.

Figure 2



Seedling from Apparatus A

Seedling from Apparatus B

A plant hormone is made in the root tip.

The hormone diffuses from the tip into the tissues of the root.

Explain how the hormone causes the appearance of the seedlings in **Figure 2** to be different.

You should refer to **both** seedlings in your answer.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(f) In horticulture plant hormones are used for controlling plant growth.

Draw **one** line from each plant hormone to the correct use of that hormone.

Plant hormone		Use of hormone

		To reduce the time taken for tomatoes to ripen
Auxin		
		To slow down the growth of plant stems
Ethene		
		To promote seed germination
Gibberellin		
		To stimulate root growth in plan cuttings

(3)

(Total 10 marks)

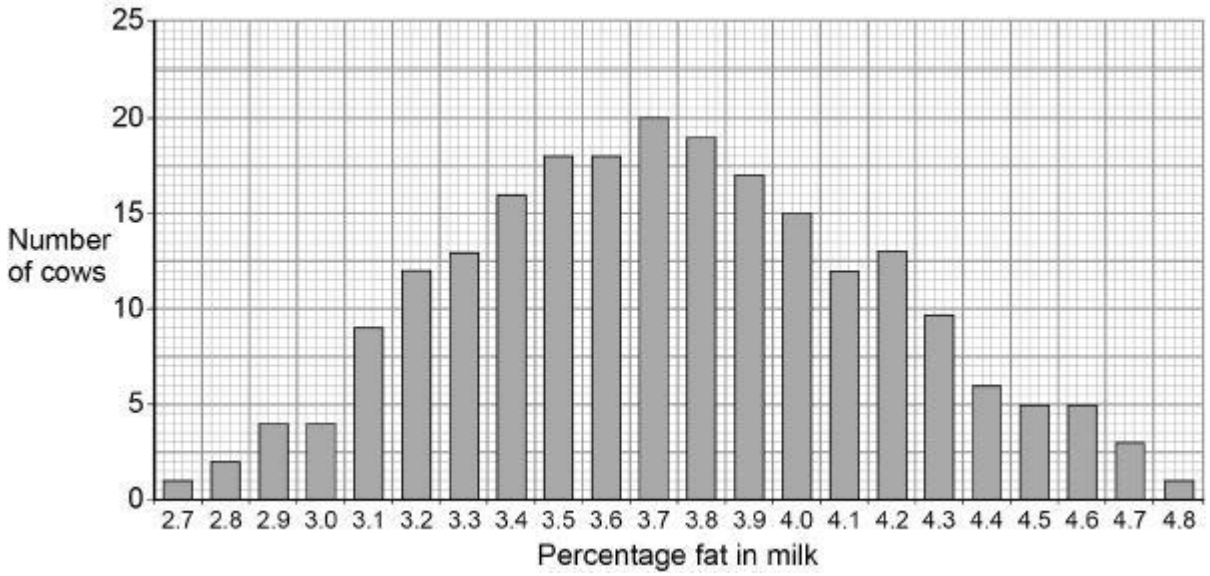
Q9.

Scientists want to breed cows that produce milk with a low concentration of fat.

Figure 1 shows information about the milk in one group of cows.

The cows were all the same type.

Figure 1



(a) In **Figure 1** the mean percentage of fat in the milk is equal to the modal value.

Give the mean percentage of fat in the milk of these cows.

Mean percentage = _____

(1)

(b) A student suggested:

'The percentage of fat in milk is controlled by one dominant allele and one recessive allele.'

How many different phenotypes would this produce?

Tick **one** box.

2		3		22		46	

(1)

(c) Give the evidence from **Figure 1** which shows the percentage of fat in the milk is controlled by several genes.

_____

_____

(1)

(d) One of the genes codes for an enzyme used in fat metabolism.

A mutation in this gene causes a reduction in milk fat.

The mutation changes one amino acid in the enzyme molecule.

Explain how a change in one amino acid in an enzyme molecule could stop the enzyme working.

_____

_____

_____

_____

_____

_____

(3)

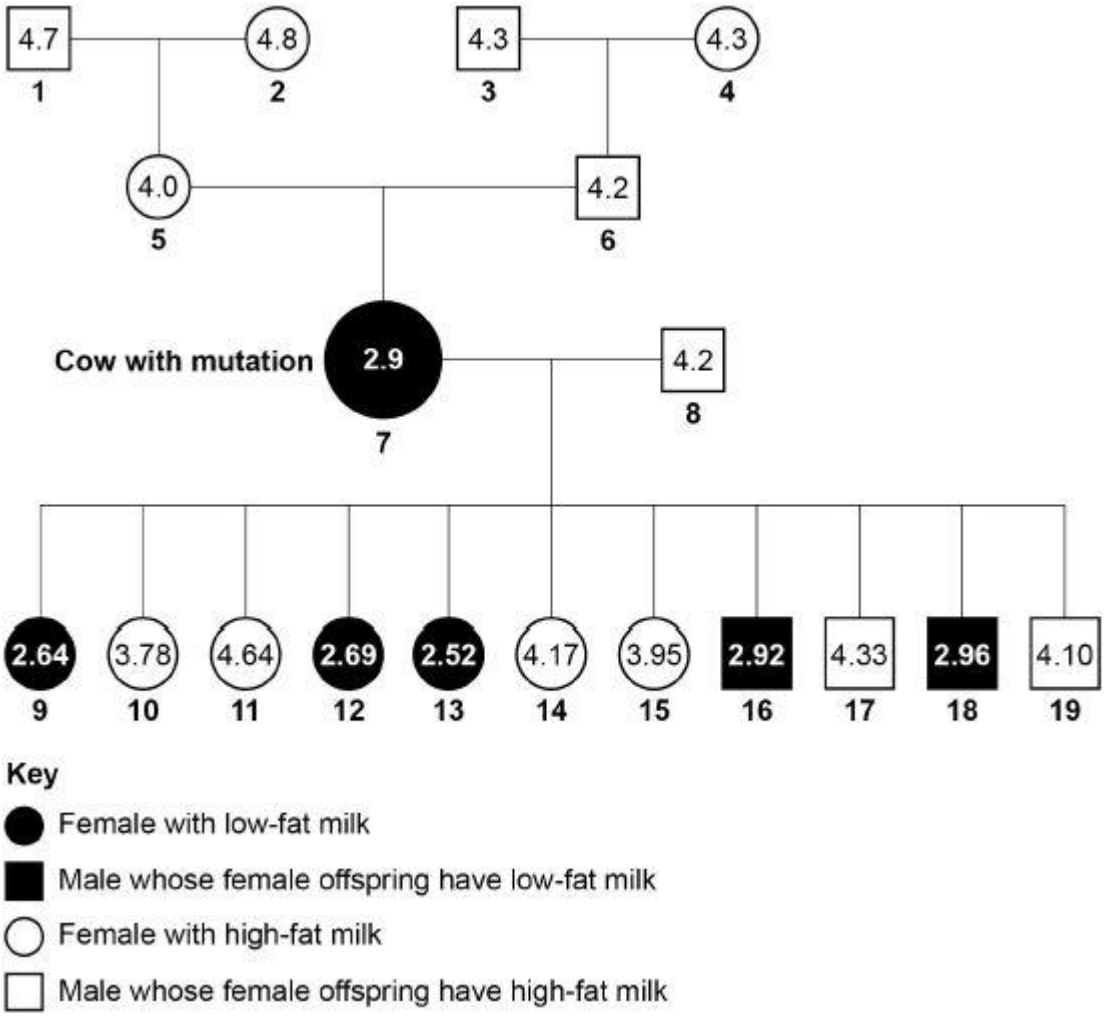
The scientists found one cow with a mutation.

The cow's milk contained only 2.9% fat.

Figure 2 shows the percentage of fat in the milk of cattle related to the cow with the mutation.

The values for male cattle are the mean values of their female offspring.

Figure 2



(e) Animal **8** is homozygous.

The mutation in animal **7** produced a dominant allele for making low-fat milk.

Give evidence from **Figure 2** that animal **7** is heterozygous.

_____

_____

(1)

(f) Animals **7** and **8** produced 11 offspring. These offspring were produced by in vitro fertilisation (IVF).

The embryos from IVF were transferred into 11 other cows.

Suggest why IVF and embryo transfer were used rather than allowing animals **7** and **8** to mate naturally.

_____

_____

(1)

(g) Draw a Punnett square diagram to show a cross between animals **7** and **8**.

Identify which offspring produce low-fat milk and which offspring produce high-fat milk.

Use the following symbols:

D = dominant allele for making low-fat milk

d = recessive allele for making high-fat milk

(4)

(h) The scientists want to produce a type of cattle that makes large volumes of low-fat milk.

The scientists will selectively breed some of the animals shown in **Figure 2**.

Describe how the scientists would do this.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 16 marks)