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F

Wednesday 15 June 2022 – Morning

GCSE (9–1) Biology A (Gateway Science)

J247/02 Paper 2 (Foundation Tier)

Time allowed: 1 hour 45 minutes

You must have:
- a ruler (cm/mm)

You can use:
- a scientific or graphical calculator
- an HB pencil

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **28** pages.

ADVICE
- Read each question carefully before you start your answer.

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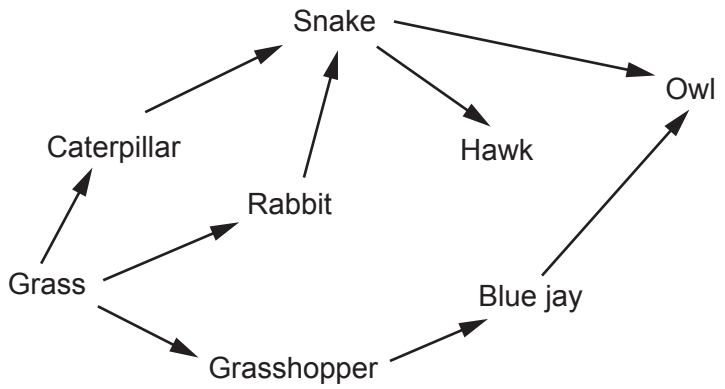
SECTION A

Answer **all** the questions.

You should spend a maximum of 30 minutes on this section.
Write your answer to each question in the box provided.

1 The diagram shows a food web.



Which organisms are secondary consumers?

A Blue jays and snakes

B Caterpillars and rabbits

C Hawks and owls

D Rabbits and hawks

Your answer ☐ **[1]**

2 Which of these factors affect the phenotype of an organism?

A Only the environment of the organism.

B Only the organism's genes.

C The organism's genes and its environment.

D The organism's habitat and the habitat of its parents.

Your answer ☐ **[1]**

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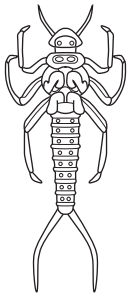
3 Which row in the table gives correct descriptions of physical and chemical plant defence responses to disease?

	Description of a physical response	**Description of a chemical response**
A	thickened leaf cuticle	thickened cell wall
B	thickened cell wall	thickened leaf cuticle
C	production of antimicrobial substances	thickened leaf cuticle
D	thickened cell wall	production of antimicrobial substances

Your answer ☐ **[1]**

4 A student finds this organism in a pond:



The student uses this key to identify the organism.

1 3 pairs of legs ..... go to 3
more than 3 pairs of legs ..... go to 2

2 curved body ..... freshwater shrimp
straight body ..... water-louse

3 tail parts ..... go to 4
no tail parts ..... water-boatman

4 2 tail parts ..... stonefly nymph
3 tail parts ..... mayfly nymph

What is the name of the organism?

A Freshwater shrimp

B Mayfly nymph

C Stonefly nymph

D Water-louse

Your answer ☐ **[1]**

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5 Which sperm would fertilise an egg to produce a female baby?

A A sperm with one X chromosome.

B A sperm with one Y chromosome.

C A sperm with two X chromosomes.

D A sperm with X and Y chromosomes.

Your answer ☐ **[1]**

6 The table gives some information about four types of strawberry.

Type	**Month when strawberries are ripe**	**Yield**
Calypso	September	medium
Cambridge Vigour	June	very high
Elvira	May	high
Pegasus	July	high

A farmer wants strawberry plants which produce very high yields of ripe strawberries as early as possible in the year.

Which two types of strawberry would a farmer use to produce these plants by selective breeding?

A Calypso and Cambridge Vigour

B Cambridge Vigour and Elvira

C Elvira and Pegasus

D Pegasus and Calypso

Your answer ☐ **[1]**

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7 Which of these is a **biotic** factor that can affect organisms?

A Light

B pH of soil

C Predators

D Temperature

Your answer ☐ **[1]**

8 Which disease is classed as a communicable disease?

A Cirrhosis of the liver

B Tuberculosis

C Type 1 diabetes

D Type 2 diabetes

Your answer ☐ **[1]**

9 Which process causes the loss of biomass from a food web?

A Growth

B Photosynthesis

C Predation

D Respiration

Your answer ☐ **[1]**

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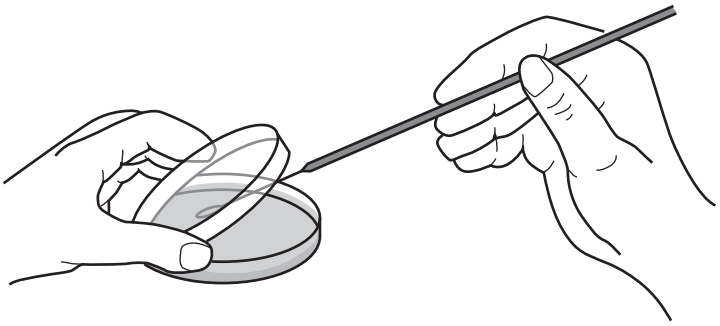
10 A student is inoculating a sterile agar plate with bacteria from a loop.



Why does the student keep the lid of the Petri dish at an angle?

A To prevent condensation collecting on the lid.

B To reduce the chance of bacteria from the agar escaping into the air.

C To reduce the number of microbes from the air landing on the agar.

D To stop alcohol from evaporating off the loop.

Your answer ☐ **[1]**

11 Which is a description of an antibiotic?

A A chemical group on the surface of a pathogen.

B A chemical that kills bacteria or stops them dividing.

C A drug that is used to kill viruses.

D A protein molecule made by white blood cells.

Your answer ☐ **[1]**

12 Which is the order for the levels of organisation in an ecosystem, starting with the **smallest**?

A community ⟶ population ⟶ organism ⟶ ecosystem

B ecosystem ⟶ population ⟶ community ⟶ organism

C organism ⟶ population ⟶ community ⟶ ecosystem

D population ⟶ organism ⟶ ecosystem ⟶ community

Your answer ☐ **[1]**

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13 The table shows the number of insects caught using a net on different days in a week.

Day	**M**	**Tu**	**W**	**Th**	**F**	**S**	**Su**
Number of insects	6	8	5	4	8	9	2

What is the median and mode of the number of insects caught in **one** day?

A Median = 6 Mode = 8

B Median = 6 Mode = 6

C Median = 8 Mode = 8

D Median = 8 Mode = 6

Your answer ☐ **[1]**

14 The diagram shows the energy trapped as biomass at each stage of a food chain.

grass ⟶ grasshopper ⟶ mouse ⟶ hawk
10 000 J 1000 J 200 J 40 J

What is the percentage efficiency in the transfer of energy between the grasshopper and the mouse?

A 0.2%

B 8%

C 10%

D 20%

Your answer ☐ **[1]**

15 What is the definition of a genome?

A All the genes present in a community of organisms.

B All the genes present in a gamete.

C The entire genetic material of an organism.

D The genes inherited by an offspring from their mother.

Your answer ☐ **[1]**

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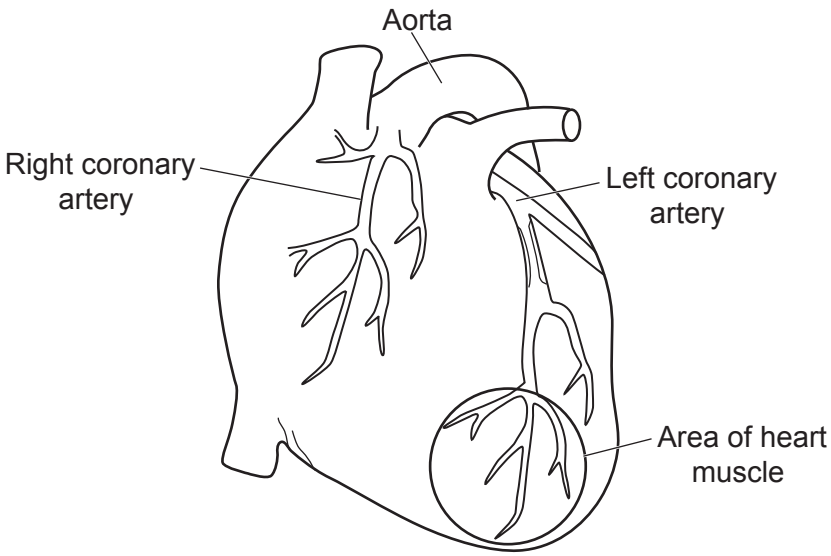
SECTION B

Answer **all** the questions.

16 The diagram shows the heart of a person who has heart disease.



(a) Complete each sentence below about the diagram. Use words from the list.

attack	**carbon dioxide**	**fat**	**fibre**
infection	**nitrogen**	**oxygen**	**water**

Heart disease is caused by ..... blocking the blood vessels that supply the heart muscle.

This means that the area of heart muscle circled in the diagram will not get enough glucose

or ..... for respiration.

This may cause it to stop beating. This is called a heart ..... .

[3]

(b) Which factors can **increase** the risk of a person getting heart disease?

Tick (✓) **two** boxes.

eating vegetables	
inheriting certain genes	
regular exercise	
smoking cigarettes	

[1]

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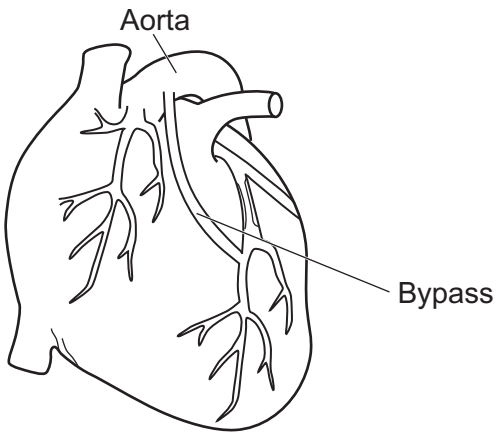
(c) This diagram shows the heart after a type of operation called a bypass.
A bypass is when a blood vessel from another part of the body is transplanted into the blood vessel of the heart.



Explain how the operation would help to reduce the risk of heart disease.

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..... **[2]**

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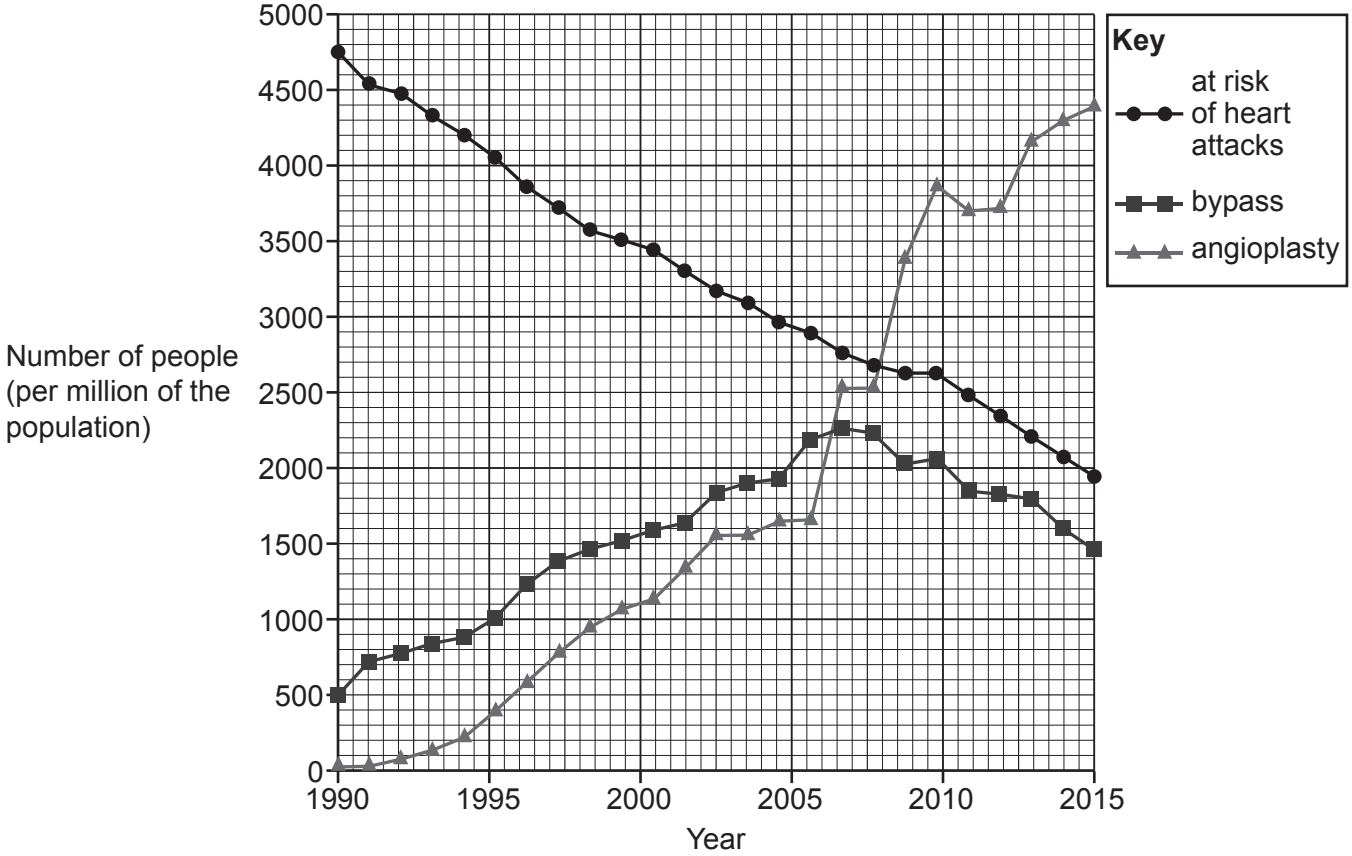
(d) An angioplasty can also be used to treat heart disease.

The graph shows the number of both types of operations performed in the USA from 1990 to 2015. It also shows the number of people considered to be at high risk of a heart attack.



(i) In 1990, the population of the USA was 250 million.

Calculate the number of people that had a bypass operation in the USA in 1990.

Number of people = ... **[2]**

(ii) Use the graph to suggest **two** reasons why the number of bypass operations decreased from 2006 to 2015.

1 .....

.....

2 .....

.....

[2]

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(e) Heart disease causes damage as muscle cells can be replaced with scar tissue.

This makes the heart less efficient at pumping blood, which affects all the cells of the body. Doctors can treat heart disease by injecting the heart muscle with stem cells.

Explain how this could improve the lives of people with heart disease.

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..... **[3]**

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17 Some farmers in Ireland want to start growing genetically modified (GM) wheat.

Growing GM wheat would mean that they need to spray less pesticides on their fields.

The table shows an estimate of the costs of growing non-GM wheat compared to GM wheat.

	Cost to farmer in euros per hectare (10 000 metres squared)	
Type of expense	**Non-GM wheat**	**GM wheat**
seeds	63	72
government charge	0	25
pesticide costs	165	113

(a) Use data from the table to suggest why the farmers want to start growing GM crops.

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..... **[2]**

(b) The wheat has been genetically modified.

Which type of chemical is inserted into the wheat cells to genetically modify them?

Put a (ring) around the correct answer.

DNA **fertiliser** **hormone** **pesticide**

[1]

(c) Some other farmers are concerned about growing GM wheat. They think that some people may not buy it.

Suggest **two** reasons why some people may **not** want to buy GM wheat.

1 .....

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2 .....

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[2]

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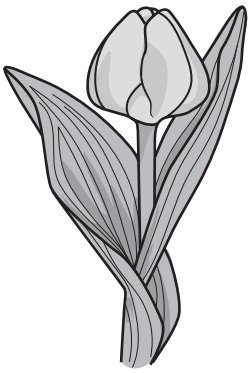
18 The diagram shows a tulip plant. Many gardeners like to grow tulip plants.



(a) Tulips can be grown from seeds produced from sexual reproduction.

They can also be grown from bulbs that are produced by asexual reproduction.

Which statements explain why gardeners usually choose to plant bulbs that were produced asexually?

Tick (✓) **two** boxes.

- Bulbs will grow much faster than seeds. ☐
- The gardener will know the colour of the flowers from bulbs. ☐
- Tulip plants grown from seed will not need to photosynthesise. ☐
- Tulips grown from seeds will not require water. ☐
- Tulips grown from seeds will all look exactly the same. ☐

[2]

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(b) In 1637, tulip growers found that a small number of their tulip plants produced flowers with different coloured stripes.

The growers did not know what was causing the colour changes.

Complete the sentences to show **two** possible explanations for the colour changes.
Use words from the list.

antibody	**gene**	**mutation**
pathogen	**phenotype**	**producer**

The tulips could be diseased because they have been infected by a ..... .

This has altered the production of a chemical that colours the flowers.

Another explanation is that a ..... has occurred in the DNA of the tulip.

This is a change in the ..... that codes for a coloured chemical.

[3]

(c) It was not until 1960 that scientists could show that the tulips were infected with a virus.

Viruses are much smaller than human cells.

Suggest why it took so long to identify the cause of the infection.

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..... **[1]**

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(d)* This virus is spread by insects that feed on the tulips.

Although infected bulbs produced attractive flowers, growers found that the bulbs became weaker every year until they died.

To stop the spread of the disease, growers can use two approaches:

- Dig up and burn any tulips as soon as they show signs of infection
- Spray their fields with insecticides.

Explain how these **two** different methods would control the disease.
Discuss the advantages and disadvantages of each method.

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..... **[6]**

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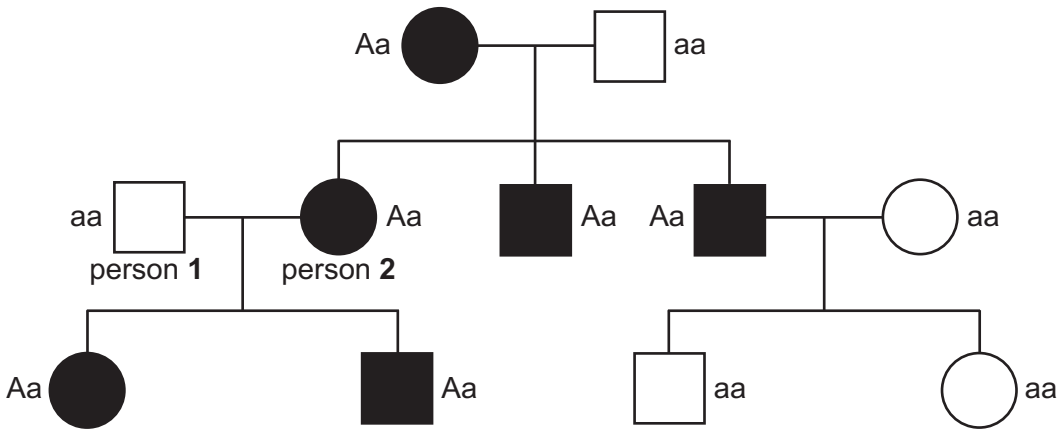
19 Amyloidosis is a group of inherited conditions that affect people's health.

The most common type of amyloidosis is caused by a dominant allele (**A**) of a gene.

The allele **A** codes for a harmful protein called amyloid.

(a) The diagram shows the inheritance of the allele in a family.



(i) Complete the table about the family tree.

The first row has been done for you.

	Number in the family
Number of males	**6**
Number of people who are homozygous recessive for the gene	
Number of people who have amyloidosis	

[2]

(ii) Person **1** and person **2** are expecting another baby.

Complete the genetic diagram to find the probability that the baby will have amyloidosis.

Person **1**

Person **2**	A		
	a		

Probability = ...

[2]

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(b) Amyloid protein is made by blood cells called plasma cells.
Amyloid can stop the pancreas releasing insulin.
It can also prevent sensory neurones from working.

Explain why person **2** starts to develop symptoms of amyloidosis **and** suggest what these symptoms might be.

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..... **[3]**

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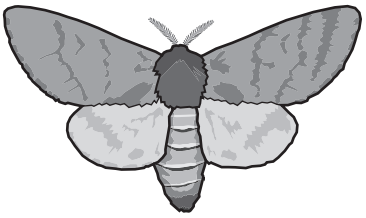
20 Pine processionary moths lay eggs that develop into caterpillars, as shown in the diagram.



Moth

Caterpillar

(a) The caterpillars eat pine trees.
The caterpillars are eaten by birds such as cuckoos. The caterpillars are also parasitised by fungi.

Draw a food web to show these feeding relationships.

[2]

(b) The caterpillars have hairs on their bodies that cause irritation to predators.

Cuckoos have a special sticky membrane lining their guts that traps these hairs.

This allows the cuckoos to eat the caterpillars.

(i) Cuckoos evolved this sticky membrane by the process of natural selection.

The statements **A–E** show steps in this process.
They are **not** in the correct order.

A The gene for sticky membranes increases in the population.

B Cuckoos with sticky membranes reproduce and pass on the gene.

C Cuckoos with sticky membranes are more likely to survive.

D A change in a gene in the cuckoo produces a sticky membrane.

E Over many generations the cuckoos all have sticky membranes.

Write a letter in each box to show the correct order.
One has been done for you.

				E

[3]

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(ii) Name the scientist who first published a book describing the theory of natural selection.

..... **[1]**

(c) Scientists use a fungus to kill the caterpillars to protect the pine trees.
The fungus is sprayed as spores which develop into the fungus.

Table 20.1 shows three treatments the scientists try.

Table 20.1

	Site of spraying	**Concentration of fungal spores used (million spores / ml)**	**How long the treatment lasts**
Treatment 1	on the tops of the pine trees	100	a few months
Treatment 2	on the soil around the pine trees	100 000	many years
Treatment 3	control (spraying with water)	0	

(i) Why is the use of the fungal spores an example of biological control?

..... **[1]**

(ii) How many times **more concentrated** are the spores in the spray used on the soil compared to the spray used on the tops of the pine trees?

Answer ..... **[1]**

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(iii) **Table 20.2** shows the results of the scientists' spraying in one year.

Table 20.2

Site of spraying	Caterpillars killed (%)
on the tops of the pine trees	86.9
on soil	80.0
control (spraying with water)	3.7

The scientists made this statement:

> The fungal spores are an effective way to kill the caterpillars.
> The fungal spores should be sprayed on the soil not in the trees.

Discuss why the scientists are correct.
Use data from **Table 20.1** and **Table 20.2**.

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..... **[3]**

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21 Measles is an infectious disease caused by a virus.

(a) Most people recover well from measles but often get other diseases afterwards. Doctors think that this is because the measles virus weakens the immune system.

Name **one** other virus that severely weakens the immune system.

..... **[1]**

(b) Measles spreads easily from one person to the next as it spreads through the air.

(i) Describe **one** way that a person who has measles can try and reduce the chance of passing it on to another person.

.....

..... **[1]**

(ii) Describe **one** way that the natural defence mechanisms of the human body may prevent the virus from entering the lungs.

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..... **[2]**

(c) A vaccine is available to protect people against measles.

What does the measles vaccine contain to provide this protection?

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..... **[1]**

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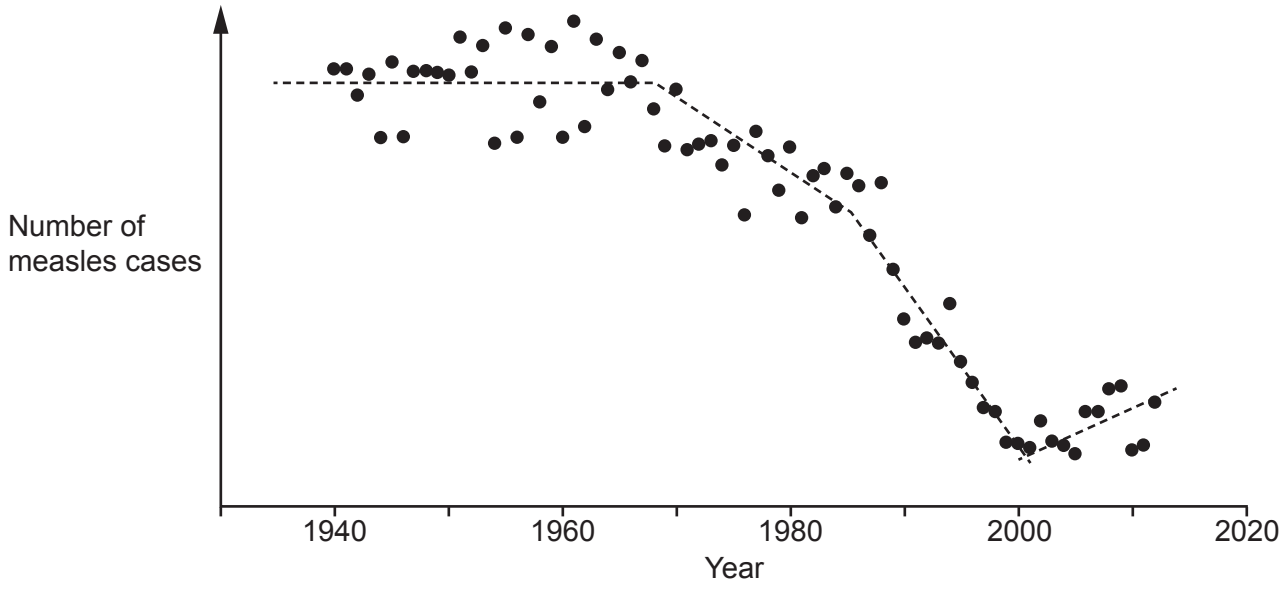
(d) The graph shows the number of cases of measles in the UK from 1940 to 2012.



During these years, two events have affected the number of measles cases.

(i) In 1968, vaccinations against measles started for children.

Explain the effect that this had on the number of measles cases.

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..... **[2]**

(ii) In 1998, a report claimed a link between the measles vaccine and an increased risk of a disorder called autism.

Explain the effect that this had on the number of measles cases.

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..... **[2]**

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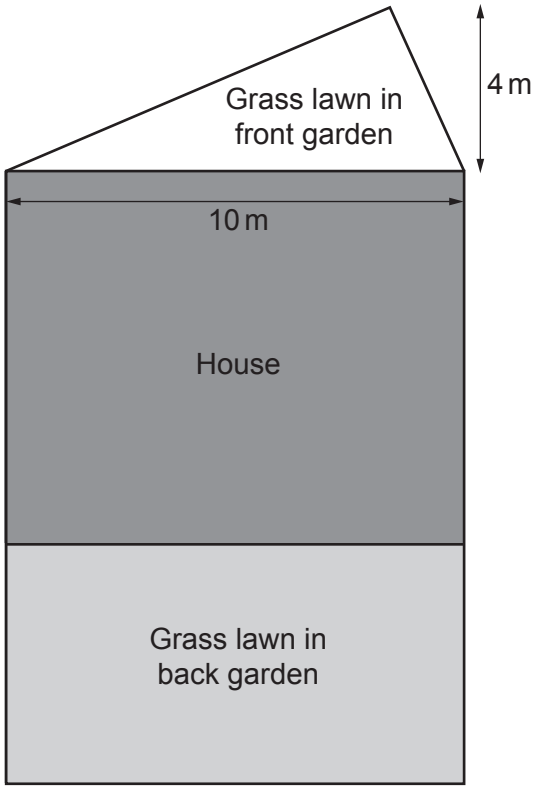
22 A gardener grows thistle plants as weeds in his grass lawns.
He wants to see if thistle plants grow better in the front garden than in the back garden.

The diagram shows a plan of the grass lawns in each garden.



(a) The gardener estimates the number of thistle plants in each metre squared of the **back** garden. He gets an estimate of 2.5 thistle plants / m^2.

Describe an experimental method the gardener uses to get this estimate.

Include the name of the piece of apparatus he uses.

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..... **[3]**

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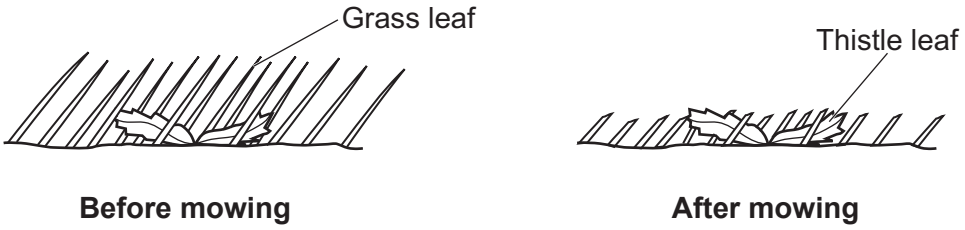
(b) The **front** garden is smaller so he counts all the thistle plants growing in the lawn.
He counts 36 plants.

Calculate the number of thistle plants per metre squared in the front garden.
Use the formula: area of a triangle = ½ × base × height

Number of thistles = ... / m^2 **[2]**

(c) The gardener cuts the grass more often in the back garden. He thinks thistles grow better when he mows the grass more often.

The diagram shows the grass lawns before and after he has mown them.



Explain how cutting the grass more often can affect how well the thistles grow.

Use ideas about competition and photosynthesis.

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..... **[3]**

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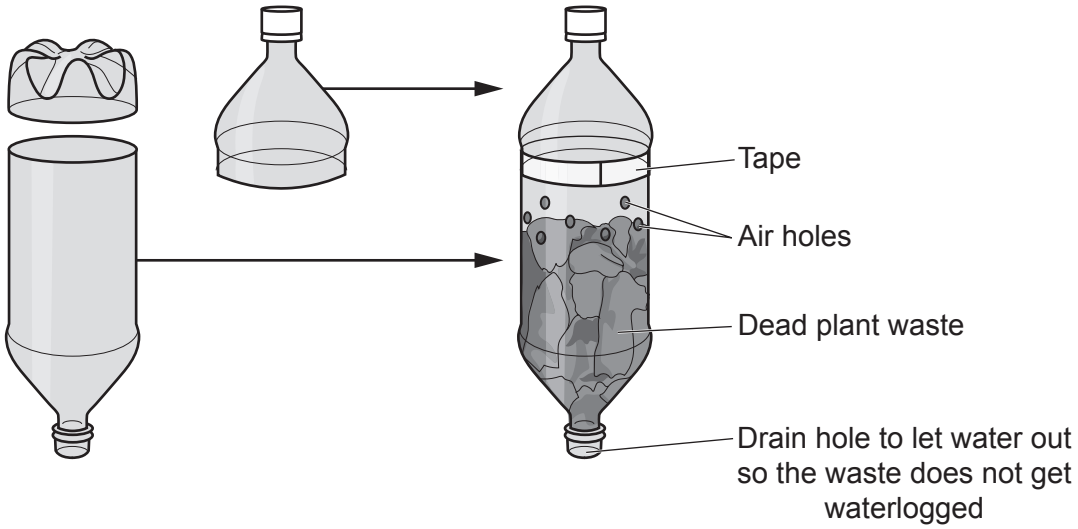
23 Some students investigate decomposition of dead plant waste.
They make a composter from two plastic bottles.



(a) Why do the students make air holes in the bottle?
Tick (✓) **one** box.

To allow heat into the bottle. ☐

To allow oxygen gas into the bottle. ☐

To prevent the build-up of nitrogen gas in the bottle. ☐

So that carbon dioxide gas can enter. ☐

[1]

(b) The students want to see if the number of air holes in the bottles affects the rate of decomposition.

- They set up bottles with different numbers of air holes.
- They then measure the mass of the bottle and compost at the start and after four weeks.

The table shows their results.

	Mass of bottles and plant waste (g)	
Number of air holes	**At the start**	**After 4 weeks**
2	300	270
4	300	250
8	300	240
16	300	235

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(i) Calculate the loss in mass **per week** of the bottle and plant waste with 16 air holes.

Give your answer to **3** significant figures.

Loss in mass = ... grams / week **[3]**

(ii) Describe the effect of the number of air holes on the rate of decomposition of the plant waste.

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..... **[2]**

(iii) The students checked that all the bottles and plant waste had a mass of 300 g at the start of the experiment.

Explain why this helps the students to analyse the results.

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..... **[1]**

(iv) What is the independent variable in the students' investigation?

..... **[1]**

(v) The students notice that during the experiment, water drips through the drain hole at the bottom of the apparatus on to the floor.

Explain why this can produce inaccurate results **and** how the students can change their method to correct this.

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..... **[2]**

END OF QUESTION PAPER

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