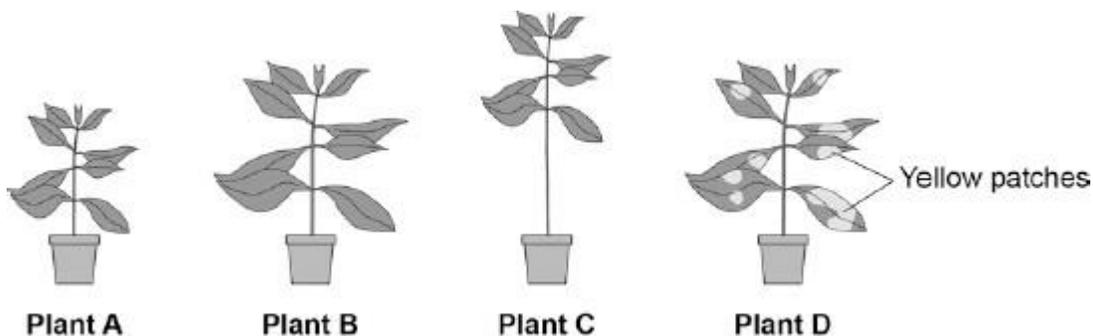


1 To be healthy, plants need the right amount of mineral ions from the soil.

The diagram below shows four plants.

The plants were grown in four different growing conditions:

- sunny area, with nitrate and magnesium added to the soil
- sunny area, with magnesium but **no** nitrate added to the soil
- sunny area, with nitrate but **no** magnesium added to the soil
- dark area, with nitrate and magnesium added to the soil.



(a) Which plant was grown with no **nitrate**?

Tick **one** box.

A  B  C  D

(1)

(b) Which plant was grown with no **magnesium**?

Tick **one** box.

A  B  C  D

(1)

(c) Give **one** variable that was kept constant in this experiment.

---

---

(1)

(d) Plants need other minerals for healthy growth such as potassium ions and phosphate ions.

A farmer wanted to compare the percentage of minerals in two types of manure.

- Cow manure from her own farm.
- Chicken manure pellets she could buy.

The table below shows data for each type of manure.

	Phosphate ions in %	Potassium ions in %
Cow manure	0.4	0.5
Chicken manure pellets	2.5	2.3

Suggest **one** advantage and **one** disadvantage of using the chicken manure pellets compared to the cow manure.

Advantage \_\_\_\_\_

\_\_\_\_\_

Disadvantage \_\_\_\_\_

\_\_\_\_\_

(2)

(Total 5 marks)

**2**

Rose black spot is a disease of roses.

(a) What type of microorganism causes rose black spot?

Tick **one** box.

A bacterium

A fungus

A protist

A virus

(1)

(b) Explain how different **types of organism** defend themselves against microorganisms.

---

---

---

---

---

---

---

---

---

---

(6)

(c) A student tried to grow some bacteria in the laboratory.

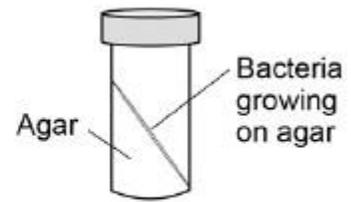
The diagram shows some of the apparatus used.



**Inoculating loop**



**Petri dish containing agar**



**Bottle containing the bacteria**

This is the method used.

1. Remove the lid of the Petri dish.
2. Remove the lid of the bottle containing the bacteria.
3. Use the inoculating loop to remove some of the bacteria from the bottle.
4. Spread the bacteria over the agar using the inoculating loop.
5. Put the lid back on the Petri dish.
6. Put the Petri dish into an incubator at 25 °C for 24 hours.

Steps 1–5 could cause the sample of the bacteria on the petri dish to be contaminated.

Give **three** improvements to the method to prevent contamination.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

3. \_\_\_\_\_

\_\_\_\_\_

**(3)**

(d) Why did the student grow the bacteria at 25 °C rather than at 40 °C?

Tick **one** box.

So the bacteria grew more quickly

So the bacteria grew more slowly

To prevent the growth of a harmful pathogen

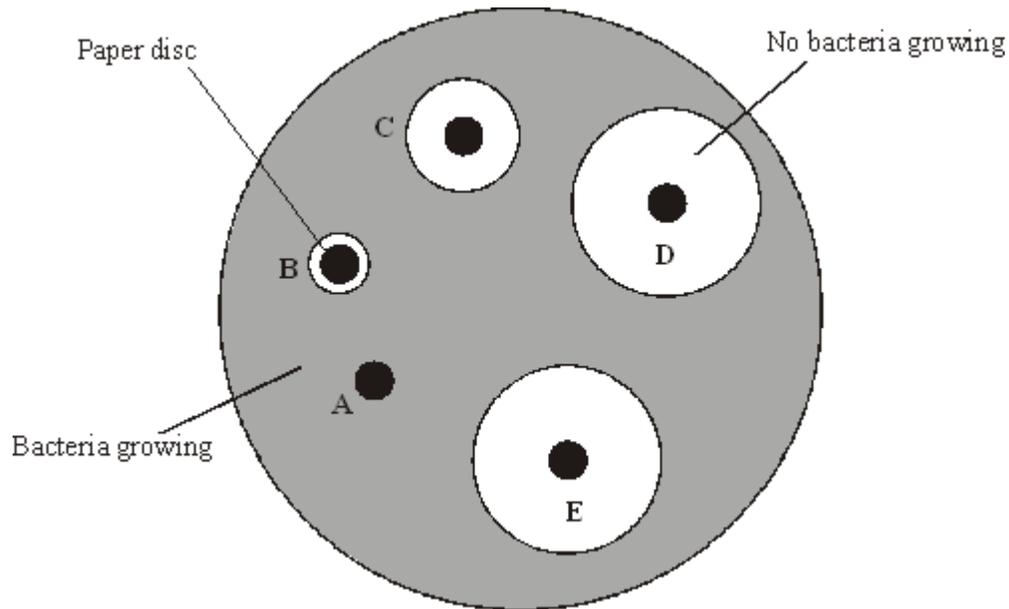
To save money

**(1)**

**(Total 11 marks)**

- 3 An investigator placed paper discs containing different concentrations of an antibiotic onto a culture of bacteria in a petri dish.

After an incubation period of two days, the dish looked like this.



- (a) Explain why there are areas around some of the paper discs where no bacteria are growing.

---

---

(2)

- (b) The concentration of the antibiotic on the paper discs is given in the table, along with the diameter of the circles where no bacteria are growing.

<b>Disc</b>	<b>Concentration of the antibiotic in units</b>	<b>Diameter of circle where no bacteria are growing, in mm</b>
<b>A</b>	0	0
<b>B</b>	2	8
<b>C</b>	4	14
<b>D</b>	6	26
<b>E</b>	10	26

What effect does an increase in the concentration of the antibiotic have on the growth of the bacteria?

---

---

---

(2)

(c) When students carry out this experiment, they need to take several safety precautions.

The precautions include:

- passing inoculating loops through a flame
- sealing the lid of the petri dish with tape
- incubating at a maximum temperature of 25 °C.

Explain why each of these precautions is necessary.

*To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific word.*

---

---

---

---

---

---

---

---

---

---

(5)

(d) Scientists are concerned that many bacteria are developing resistance to antibiotics.

Suggest **two** ways by which this problem could be limited.

---

---

---

---

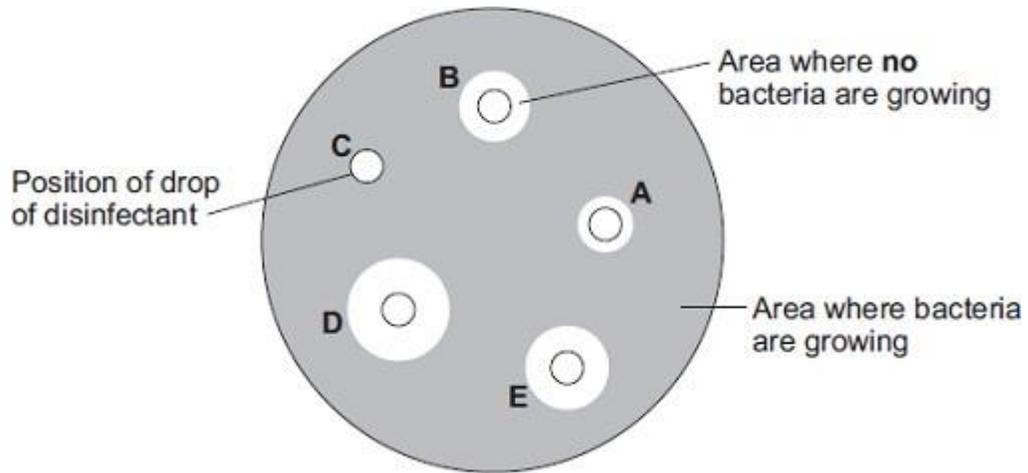
(2)

(Total 11 marks)



- (b) After the culture had been prepared, the student added one drop of each of five disinfectants, **A**, **B**, **C**, **D** and **E**, onto the culture.

The diagram shows the appearance of the Petri dish 3 days later.



- (i) There are areas on the agar jelly where **no** bacteria are growing.

Why?

---

---

(1)

- (ii) The student concluded that disinfectant **D** would be the best for using around the home.

Give **one** reason why the student might be correct.

---

---

---

Give **one** reason why the student might **not** be correct.

---

---

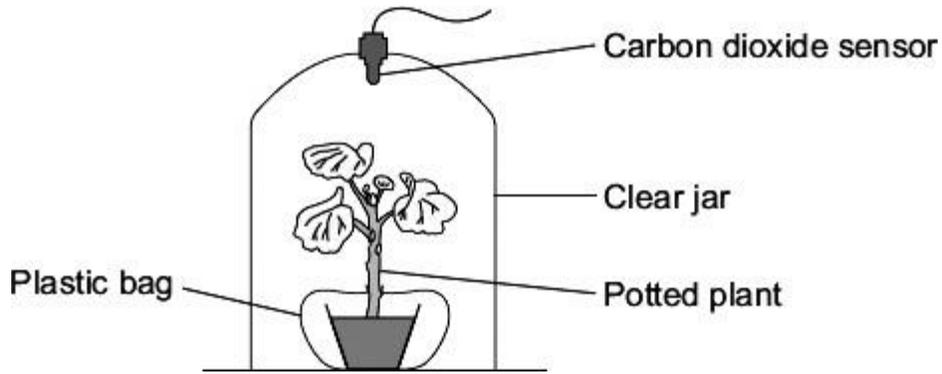
---

(2)

(Total 9 marks)

5 A student measured the concentration of carbon dioxide in the air around a potted plant on two different days.

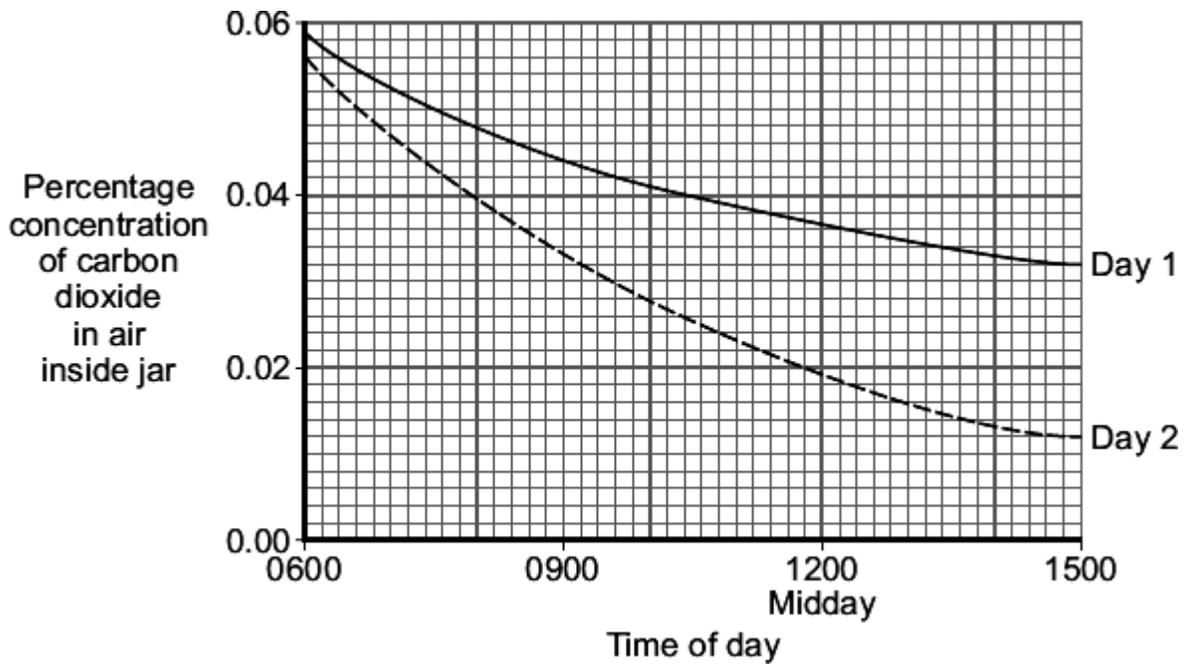
The diagram shows the student's apparatus.



There was a plastic bag round the plant pot to stop microorganisms in the soil affecting the concentration of gases in the air inside the jar.

The apparatus was put near a window.

The graph shows the results.



(a) **Day 1** was cloudier than **Day 2**.

What evidence from the graph shows that **Day 1** was cloudier?

Explain your answer.

---

---

---

---

**(2)**

(b) A potted plant sometimes develops yellow leaves.

The development of yellow leaves could be due to the lack of a mineral ion.

Suggest the mineral ion that could be lacking.

---

**(1)**

**(Total 3 marks)**

## Mark schemes

- 1**
- (a) **A** 1
- (b) **D** 1
- (c) use the same type of plant  
**or**  
give equal amount of water to each plant  
*ignore size of pot* 1
- (d) (advantage) more minerals 1
- (disadvantage) cost / not free 1
- [5]**
- 2**
- (a) a fungus 1
- (b) **Level 3 (5-6 marks):**  
Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.
- Level 2 (3-4 marks):**  
Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.
- Level 1 (1-2 marks):**  
Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.
- Level 0**  
No relevant content

## Indicative content

	defence	description of defence
<b>animals</b>	skin	sebum / oils to kill microbes dead layer difficult to penetrate
	nose	hairs keep out dust and microbes
	trachea / bronchi	mucus traps microbes cilia moves mucus
	stomach	(hydrochloric) acid kills bacteria
	white blood cells	produces antibodies produces antitoxins engulf microbes / phagocytosis
<b>plants</b>	cell wall	tough / difficult to penetrate
	waxy cuticle	tough / difficult to penetrate
	dead cells / bark	fall off, taking pathogens with them
	production of antibacterial chemicals	kill bacteria
<b>fungi</b>	antibiotic production	kill bacteria

6

(c) any **three** from:

- sterilise agar (before use)
- sterilise (Petri) dish before use
- disinfect bench (before use)
- pass inoculating loop (through flame)
- secure lid with (adhesive) tape
- minimise exposure of agar / culture to air / lift and replace lid as quickly as possible

*allow:*

- *dip loop into ethanol (after flaming)*
- *keep the lid on the plate for as long as possible*
- or**
- *minimise exposure of agar to air*
- or**
- *only tilt the lid off (rather than remove it)*
- *flame the neck of the bottle*

3

(d) to prevent the growth of a harmful pathogen

1

[11]

- 3 (a) antibiotics diffuse / pass (into agar)  
do **not** allow into dish 1
- kill / prevent growth of bacteria or destroy cell wall / bacteria  
accept bacteria are dead 1
- (b) it / higher concentration kills more bacteria **or** causes less growth  
do **not** accept anything referring to size of circle 1
- levels off (at 6 units)  
accept above 4 units 1
- (c) **Quality of written communication:**  
for correct sequencing or linking of ideas or points  
*this mark can only be awarded for a plausible attempt (not necessarily biologically correct) to link a precaution to a purpose*  
Q ✓ or Q ✗ 1
- Loop flamed
- to sterilise it / kill unwanted microorganisms  
accept so no bacteria present do **not** accept to clean it 1
- Lid taped
- prevent bacteria getting in / out **or** prevent someone touching bacteria  
accept microorganisms/fungi for bacteria  
do **not** accept viruses or germs 1
- 25°C
- prevents / reduces growth of / reproduction 1
- harmful bacteria / microorganisms or pathogens 1

(d) any **two** from:

- to avoid over-use of antibiotics **or** use no / less / low concentration antibiotics
- select antibiotic that is most effective
- finish the course
- don't give or use for animals
- develop new antibiotics **or** alternatives

2

[11]

**4**

(a) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the [Marking guidance](#), and apply a 'best-fit' approach to the marking.

**0 marks**

No relevant content.

**Level 1 (1-2 marks)**

There is a brief description of at least one of the stages (pre-inoculation, inoculation, post-inoculation).

**Level 2 (3-4 marks)**

There is a simple description of at least two stages and an explanation of at least one of them.

**Level 3 (5-6 marks)**

There is a clear description of all three stages and an explanation of at least two of them.

**Examples of Biology points made in the response:**

***Pre-inoculation***

- Petri dish and agar sterilised before use
- to kill unwanted bacteria
- inoculating loop passed through flame / sterile swab
- to sterilise / kill (other) bacteria

***Inoculation***

- loop/swab used to spread/streak bacterium onto agar

*Allow other correct methods, eg bacterial lawns*

- lid of Petri dish opened as little as possible
- to prevent microbes from air entering

***Post-inoculation***

- sealed with tape
- to prevent microbes from air entering
- incubate
- to allow growth of bacteria

6

- (b) (i) bacteria killed / destroyed  
*ignore fights / attacks / stops growth / got rid of*

1

- (ii) *Might be correct*

largest area / space where no bacteria are growing  
*allow most bacteria killed*

1

*Might not be correct*

(need more evidence as) D may be harmful to people / animals / surfaces  
*ignore ref to cost / dangerous or harmful unqualified*

1

**or** may work differently with different bacteria

**or** disinfectants may be different concentrations

*ignore different amounts of disinfectant unless reference to different drop size*

**or** may not last as long

*ignore take longer to work*

*allow reference to anomalous result or not repeated*

[9]

5

(a) less carbon dioxide used

**or** higher carbon dioxide (concentration) in jar

*do **not** allow no carbon dioxide used or no change in carbon dioxide*

1

because less photosynthesis **or** light was a limiting factor

*do **not** allow no photosynthesis*

1

(b) magnesium / Mg

*do **not** allow manganese / Mn*

*allow iron / Fe*

*ignore nitrates*

1

[3]