1. Aseptic techniques must be used when culturing organisms.

Give an example of an aseptic technique and explain why it is used.

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[2]

2. To confirm that a female is pregnant a pregnancy test will be done. This test uses monoclonal antibodies.

(i) Describe how monoclonal antibodies are produced.

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[3]

(ii) Antibodies are proteins.

The statements below describe protein synthesis.

A The mRNA travels to a ribosome in the cytoplasm.

B A copy of the gene is made from messenger RNA.

C The ribosome joins the amino acids together in the correct order.

D The gene that codes for the protein is found in the DNA.

Put the statements in the correct order.

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[1]

3. Amir works in a laboratory. His job is to identify pathogens that cause plant diseases.

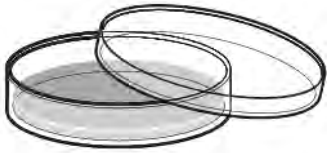
Amir has a sample of one species of bacteria from an infected plant.

He wants to test the effectiveness of different antibiotics against this species of bacteria.

Amir must start by transferring bacteria from the sample bottle into four Petri dishes containing agar jelly.

He needs to set up four identical dishes of this species of bacteria.

glass bottle containing the sample of bacteria



Petri dish containing agar jelly

He intends to pour some of the liquid from the glass bottle into each Petri dish.

(i) Write down **two** ways he could improve his method and explain why each is an improvement.

Improvement 1 ----------

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Explanation ----------

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Improvement 2 ----------

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Explanation ----------

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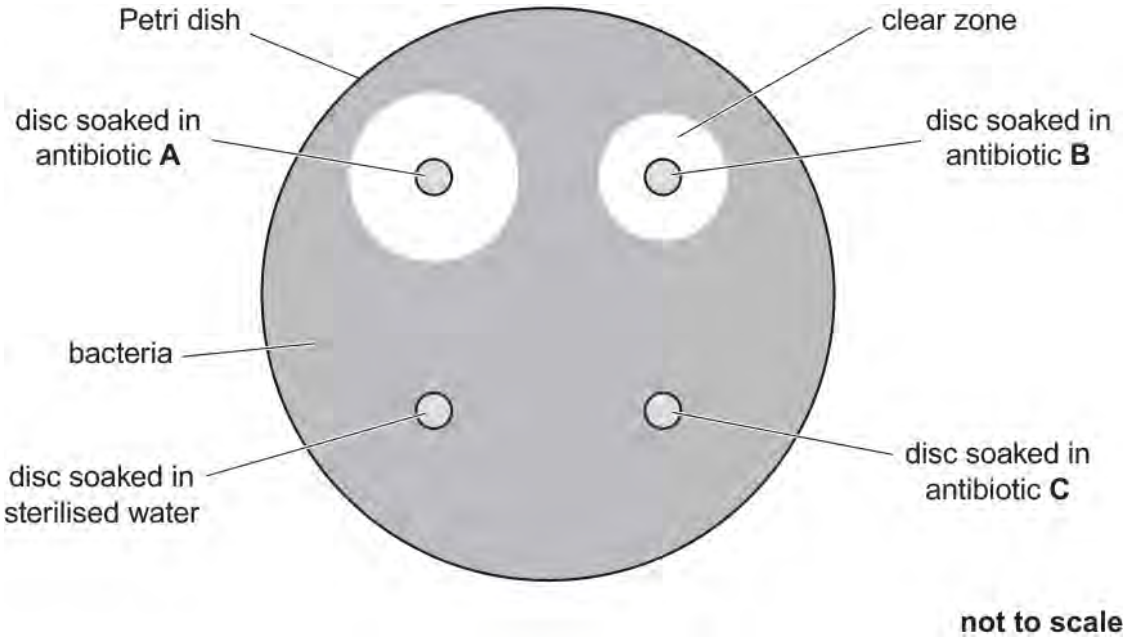
**[4]**

After transferring bacteria from the sample to the four Petri dishes, Amir adds four different paper discs to each dish.

The paper discs have been soaked in different solutions.

Amir places the dishes in an incubator overnight.
The bacteria grow to cover the surface of the agar jelly.

The diagram shows what Amir sees on one of the dishes after it has been incubated.




(ii) The diameter of the clear zone around the disc soaked in antibiotic **A** is 23 mm.

Calculate the area of this clear zone.

Use the equation: area of clear zone = $3.14 \times r^2$.

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

Area of clear zone = ..... $mm^2$**[3]**

(iii) **Table 4.1** shows Amir's results for all four dishes.

| Disc soaked in | Area of clear zone ($mm^2$) | | | |
|---|---|---|---|---|
| | Petri dish 1 | Petri dish 2 | Petri dish 3 | Petri dish 4 |
| Antibiotic **A** | | 363 | 346 | 346 |
| Antibiotic **B** | 227 | 254 | 227 | 214 |
| Antibiotic **C** | 0 | 0 | 0 | 0 |
| Sterilised water | 0 | 0 | 0 | 0 |

**Table 4.1**

Suggest **two** possible explanations for the results for antibiotic **C**.

1 ----------

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2 ----------

---------- [2]

END OF QUESTION PAPER

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 1 | | | *Technique*<br>Working under flame ✓<br>Use of alcohol / flame ✓<br>*For explanation*<br>Prevents other bacteria colonising agar plate ✓<br>Kills other microorganisms ✓ | 2 | ALLOW any correct technique<br><br>Technique and explanation required for 2 marks<br><br>DO NOT ALLOW two techniques for 2 marks |
| | | | **Total** | **2** | |
| 2 | | i | Antigen is injected into the animal ✓<br>The antibody producing cells are taken from the animal ✓<br>The cells producing the correct antibody are then<br>Selected and cultured ✓ | 3 | All three stages needed for three marks |
| | | ii | D B A C | 1 | |
| | | | **Total** | **4** | |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 3 | | i | **Any two pairs of improvement + explanation from:**<br>*improvement:* put on gloves before starting / disinfect the bench (with alcohol) before starting ✓<br>*explanation:* prevent/reduce risk of contaminating **sample/dish** ✓<br><br>*improvement:* use a wire loop to transfer bacteria from sample jar to dish ✓<br>*explanation:* can be flamed to prevent/reduce risk of contaminating **sample/dish** / regulates the amount of bacteria transferred to each **sample/dish** ✓<br><br>*improvement:* pass the neck of the jar through a flame before dipping wire loop in / pass wire loop through a flame (and allow to cool) before dipping into sample jar ✓<br>*explanation:* prevent/reduce risk of contaminating **sample/dish** ✓<br><br>*improvement:* idea of not taking lid fully off Petri dish ✓<br>*explanation:* prevent/reduce risk of contaminating **sample/dish** ✓<br><br>*improvement:* idea of working close to a (roaring) Bunsen flame ✓<br>*explanation:* prevent/reduce risk of aerial contamination of **sample/dish** ✓ | 4<br>(AO 3.3b × 4) | If only improvements given with no explanation, only a max. of 2 marks can be awarded'<br>Explanation can only be credited if it relates to the improvement<br><br>**ALLOW** suitable improvement if regulates the amount of bacteria transferred e.g. pipette/syringe<br><br>**ALLOW** 'sets up a convection current' for explanation<br><br><u>Examiner's Comments</u><br><br>Aseptic techniques are a key element to one of the practical activities in section B2.4 of the specification and it was evident that many candidates were aware of methods involved. However, the explanations were not always linked to the improvements. |
| | | ii | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 415 award 3 marks**<br><br>$3.14 \times (23 \div 2)^2$✓<br>= 415.265 ✓<br>= 415 (to 3 s.f.)✓ | 3<br>(AO 2.2 ×3) | <u>Examiner's Comments</u><br><br>Most candidates were able to calculate the area of the clear zone. There were a number of common mistakes including the use of the diameter instead of the radius and giving the answer to 3 decimal places and not to 3 significant figures. |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | | iii | Any two from:<br>the bacteria are resistant to antibiotic **C** ✓<br><br>is not effective/does not kill the bacteria ✓<br><br>the solution of antibiotic **C** was too dilute ✓<br><br>the discs were soaked in only water by mistake ✓ | 2<br>(AO 3.2a × 2) | **DO NOT ALLOW** bacteria are tolerant or immune to antibiotic C<br><br>**ALLOW** no antibiotic on disc / not enough antibiotic on disc<br><br><u>Examiner's Comments</u><br><br>Common mistakes involved the use of the word 'immune' when 'resistance' was required as well as the use of 'antibodies/antigens' instead of 'antibiotic'. Also some candidates wrongly referred to disc A as a placebo. |
| | | | Total | 9 | |