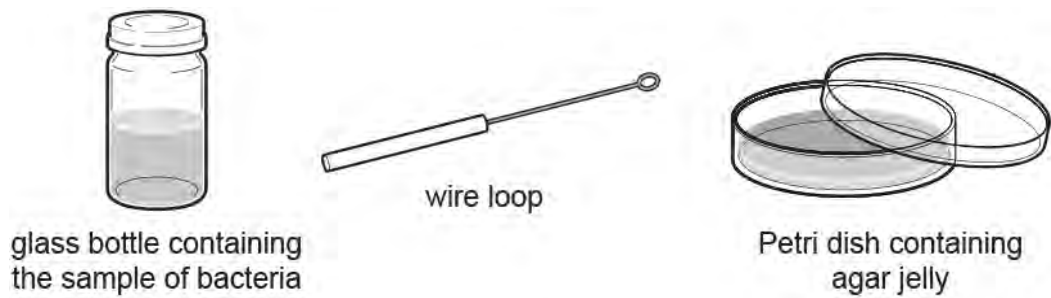


1. Amir works in a laboratory. His job is to identify the pathogens that cause plant diseases.

Amir has a sample of bacteria from an infected plant.

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

Amir writes a method for transferring bacteria from the sample onto a Petri dish.



Method:

1. Pick up the wire loop from the bench.
2. Open the glass bottle containing the sample of bacteria.
3. Dip the loop in the sample of bacteria
4. Take the lid off the Petri dish.
5. Wipe the loop over the agar jelly in the Petri dish to spread bacteria.
6. Put the lid back on the Petri dish.

- (i) Suggest **three** improvements Amir could make to his method to reduce the risk of contaminating the Petri dish with unwanted bacteria.

1 -----

2 -----

3

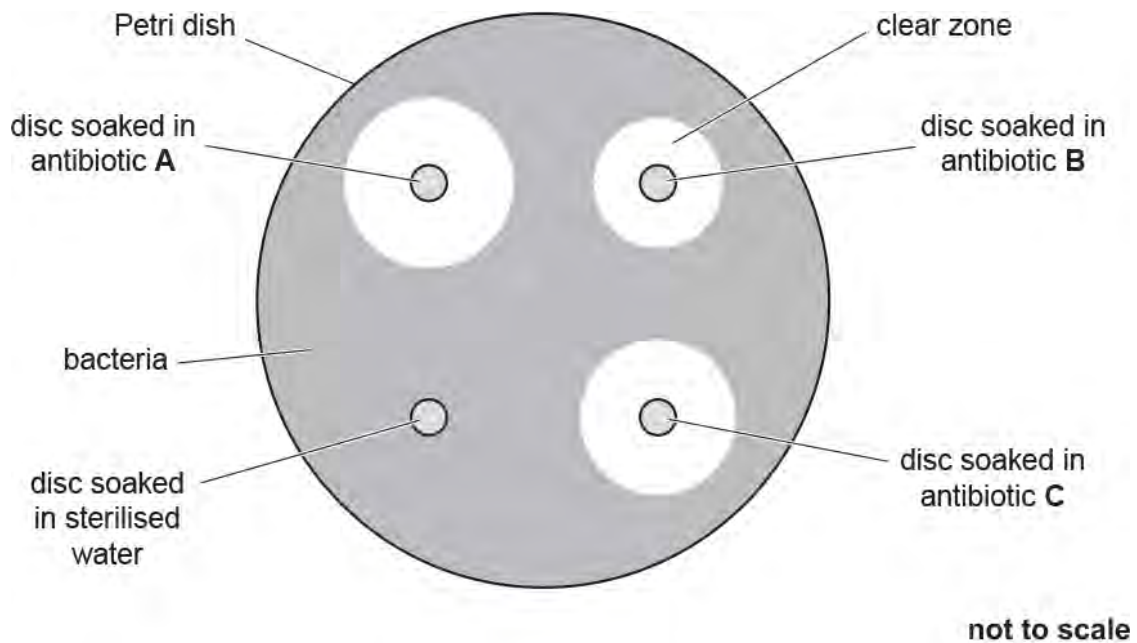
[3]

(ii) After transferring bacteria from the sample onto a Petri dish, Amir adds four different paper discs to the agar.

Three of the discs have been soaked in solutions of different antibiotics, A, B and C. One disc has been soaked in sterilised water.

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

The diagram shows what he sees after the dish has been incubated.



The radius (r) of the clear zone around the disc soaked in antibiotic A is 11 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 = mm²[3]

(iii) Amir sets up three more Petri dishes in the same way as the first.

The table shows his 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
1	Antibiotic A		363	346	346
2	Antibiotic B	227	363	227	214
3	Antibiotic C	314	283	298	314
4	Sterilised water	0	0	0	0

Amir thinks one of the discs was soaked in the wrong solution.

Suggest which disc may have been soaked in the wrong solution.

Give a reason for your answer.

Disc in Petri dish

Reason

.....

..... [2]

2. Jane's dog has arthritis in its hip joint. This makes the joint stiff and painful.

Jane reads an article in a magazine. Here is the article's headline:

Stem cell therapy to help dogs with arthritis

(i) Explain what a stem cell is and why they are used in medicine.

[2]

(ii) The article explains that stem cells were removed from a dog's fat tissues and were then grown in a laboratory.

Explain why a vet would have used aseptic techniques when growing the stem cells.

[1]

(iii) Which of the following are also sources of stem cells?

Tick (✓) **two** boxes.

Bone marrow

Embryos


Hair

Nerve cells

Red blood cells

[2]

END OF QUESTION PAPER

Question	Answer/Indicative content	Marks	Guidance
1	<p>i</p> <p>Any three from: use aseptic technique(s) ✓ put on gloves before starting ✓ disinfect/sterilise the bench with alcohol before starting ✓ work next to a Bunsen burner (to create an updraft) ✓ pass the neck of the jar through a flame before dipping wire loop in ✓ pass the wire loop through a flame (and allow to cool) / sterilise the loop before dipping into sample jar ✓ idea of not taking lid fully off Petri dish / putting it back on quickly ✓ secure the Petri dish lid with Sello/sticky tape (following the inoculum spread) ✓</p>	3 (AO 3.3b × 3)	<p>DO NOT ALLOW “clean”, as this may not be sterile</p> <p>DO NOT ALLOW “seal the Petri dish”</p> <p><u>Examiner’s Comments</u></p> <p>Responses to this question suggested that most candidates were familiar with this kind of practical procedure, most likely through having done it themselves in a hands-on practical activity. Many candidates were able to give two or three correct examples of aseptic techniques. Some candidates needed to use scientific language such as ‘disinfect’ or ‘sterilise’ to score marks, rather than imprecise and everyday terms such as ‘wipe’, ‘wash’ and ‘clean’.</p> <p> AfL The word ‘clean’ (as in “clean the wire loop”) was not sufficient to score a mark. When learning about aseptic techniques and about the spread of diseases, there is an important distinction to make between ‘clean’ and ‘sterile’, because apparatus, surfaces, water, food, cooking utensils and hands can all look clean but be contaminated with pathogens, as most pathogens are too small to see.</p>

Question	Answer/Indicative content	Marks	Guidance
	ii FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 380 (mm²) award 3 marks 3.14×11^2 OR 3.14×121 OR $\pi \times 11^2$ ✓ $= 379.94$ ✓ $= 380 \text{ (mm}^2\text{)}$ ✓	3 (AO 2.2 × 3)	<p>Award 2 marks for correct answer not given to 3 s.f. (i.e. 379.94)</p> <p><u>Examiner's Comments</u></p> <p>This calculation was generally well answered, but some candidates did not score the third mark because they did not give their (otherwise correct) answer to three significant figures.</p>

Question		Answer/Indicative content	Marks	Guidance
	iii	<p>Disc 2 in Petri dish 2 ✓</p> <p>Plus any one from:</p> <p>the area of the clear zone is much higher / outside the range of results for this disc in the other dishes / it is an outlier ✓</p> <p>the area of the clear zone is in the range of results for disc 1 in the other dishes ✓</p> <p>the area of the clear zone suggests it was soaked in antibiotic A ✓</p>	<p>2 (AO 3.2b)</p> <p>(AO 3.1b)</p>	<p>ALLOW Disc B in Petri dish 2</p> <p>ALLOW same as disc 1 in dish 2</p> <p>Examiner's Comments</p> <p>Many candidates needed to make clear which specific parts of the data they were referring to in order to score the reason mark.</p> <p>Exemplar 3</p> <p>Amir thinks one of the discs was soaked in the wrong solution. Suggest which disc may have been soaked in the wrong solution. Give a reason for your answer.</p> <p>Disc 2 in Petri dish 2 ✓</p> <p>Reason: Because the result is significantly bigger than the other results. [2]</p> <p>This candidate has identified the correct disc and dish for 1 mark, but does not get the mark for their reason. The candidate needed to refer to the other results 'for this disc' or 'for this antibiotic', or even 'in this row', rather than referring non-specifically to "the other results".</p>
		Total	8	

Question		Answer/Indicative content	Marks	Guidance
2	i	<p>Any two from</p> <p>stem cells are unspecialised/undifferentiated ✓</p> <p>(in the right conditions) stem cells can specialise / differentiate into cells that are needed ✓</p> <p>stem cells can be used to replace damaged cells or tissues ✓</p>	2 (AO 1.1 × 2)	<p>ALLOW stem cells can develop into many different or any type of cell that is needed</p> <p>ALLOW specific examples of when stem cells are needed e.g. when a patient with leukaemia is given stem cells, they can specialise to grow new bone marrow</p> <p>IGNORE produce new body parts</p> <p>Examiner's Comments</p> <p>After correctly saying that stem cells are unspecialised many candidates did not get the second mark as they did not fully answer the question and explain why the cells are used in medicine. Although the term unspecialised was widely used, candidates did not seem to realise that this means that stem cells are able to specialise into cells that are needed. Some candidates were able to illustrate their answers with excellent examples of when stem cells are used in medicine and therefore did score the second mark. This question assessed objective AO1.</p>
	ii	to reduce risk of contamination ✓	1 (AO 1.2)	<p>IGNORE to keep it clean</p> <p>Examiner's Comments</p> <p>Less than half of candidates scored the mark here, mainly because they did not know what aseptic meant. Incorrect responses commonly suggested aseptic techniques are faster, safer or cleaner. This question assessed objective AO1.</p>

Question			Answer/Indicative content	Marks	Guidance
		iii	Bone marrow ✓ Embryos ✓	2 (AO 1.1 × 2)	Examiner's Comments This AO1 question was very well answered with almost all candidates at least one mark (for embryos mainly). A common incorrect response was red blood cells.
		iv	results are looked at by other scientists or experts working in the field ✓ gives you greater confidence in or confirms the findings ✓	2 (AO 1.1 × 3)	IGNORE results are looked at by other people in the same field ALLOW to obtain more evidence / to ensure the data is accurate or repeatable or reproducible / to evaluate the work Examiner's Comments This AO1 question was answered correctly by around a third of candidates. Some candidates scored one mark, for being able to explain the purpose of peer review but few were able to describe the process of peer review, often re-wording the question for example "peer review is when a scientist's work is reviewed by a peer".
			Total	7	