Exchanging Substances

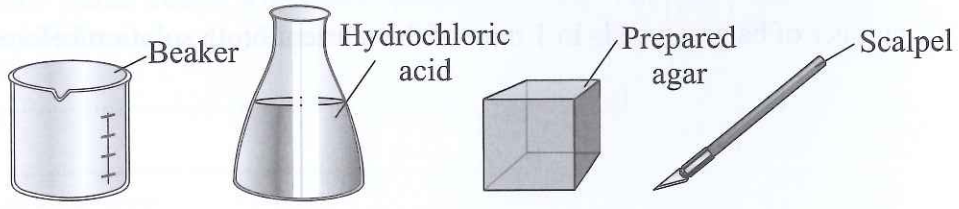
1 All organisms need to exchange substances with their environment in order to survive. Single-celled organisms such as bacteria exchange substances with their environment directly across their outer surface. The rate at which they exchange substances is affected by their surface area to volume ratio.

A student carried out an experiment to model the relationship between the surface area to volume ratio of a bacterial cell and the rate of exchange of substances.

To model bacterial cells, agar was used — agar is a material that absorbs substances from its surroundings. The agar contained an indicator dye and sodium hydroxide solution (an alkali). The indicator dye is pink at a pH greater than 8, but becomes colourless when pH falls below 8.

Figure 1 shows an agar block as well as some of the other equipment used in the experiment.

Figure 1



1.1* Describe a method that the student could have used in her experiment.
Include details of:
- what she should have measured,
- the variables she should have controlled.

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[6]

1.2 Describe **two** ways in which the agar in this experiment did not accurately model a bacterial cell and how it exchanges substances with its environment.

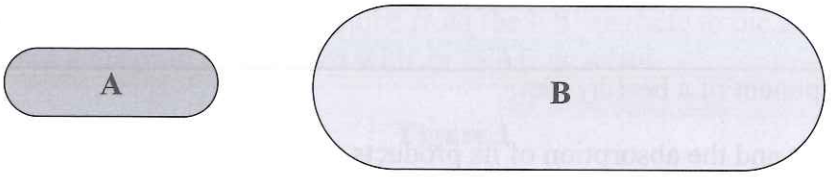
1. .....

2. .....

[2]

Figure 2 shows two rod-shaped bacterial cells, drawn to scale.

Figure 2



1.3 The height of cell **A** is 0.4 μm.
Which of the following is the most realistic estimate of the height of cell **B**? Tick **one** box.

1×10^{-3} mm	☐	1×10^{2} μm	☐
8×10^{-3} mm	☐	8×10^{-1} μm	☐

[1]

1.4 Both cells need to absorb substances from their environment in order to carry out metabolic reactions. Based on this information, which cell (**A** or **B**) do you think will have a faster metabolic rate? Explain your answer.

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[2]

[Total 11 marks]

2 Samples of plant and animal tissue were each placed into separate beakers containing a sugar solution. **Table 1** shows the starting sugar concentrations of the cells and of the solutions in the beakers. Due to differences in their structures, the plant and animal cells responded differently to being placed in the solutions. The animal cells burst, but the plant cells did not.

Table 1

	Sugar concentration inside cell (M)	Sugar concentration in beaker (M)
Plant	0.3	0.1
Animal	0.4	0.2

Suggest an explanation for why the animal cells burst but the plant cells did not when placed in the sugar solutions.

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[Total 3 marks]

Score: ☐ / **14**

Exam Practice Tip

As well as learning the required practicals, you should make sure you're prepared to answer questions about experiments you've never seen before. You need to be able to apply the practical skills and techniques you've learnt to new situations.