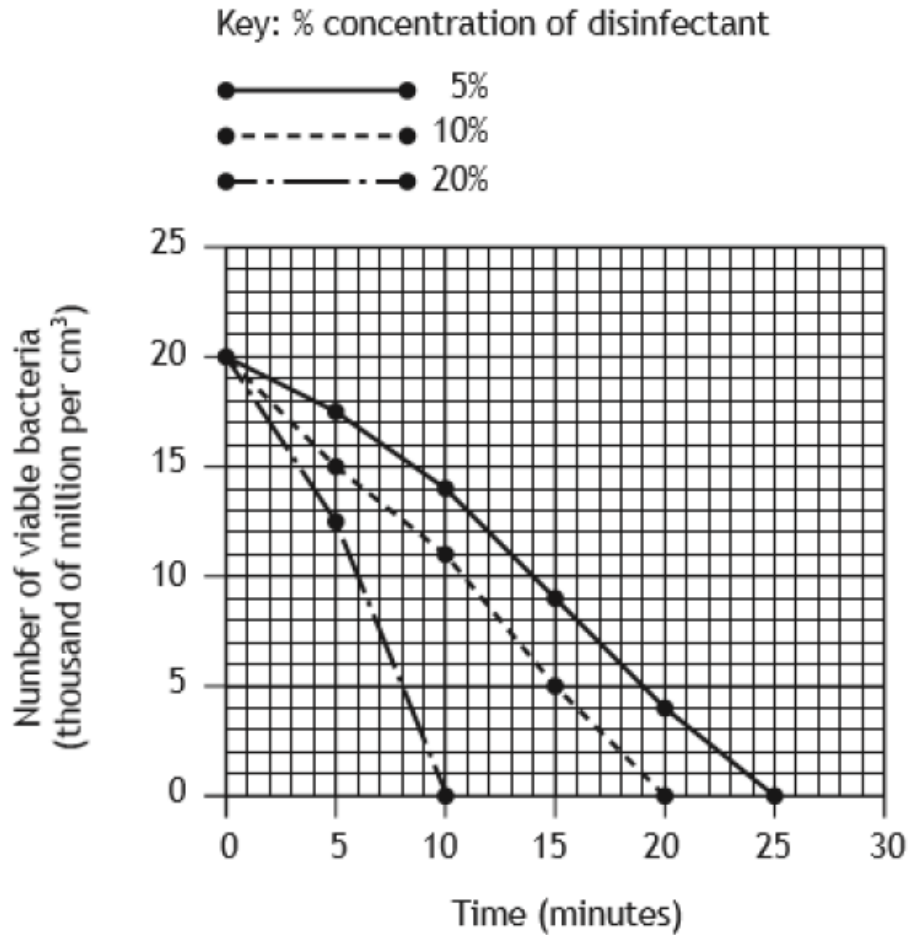


Unit 2 Key Area 6 Environmental control of metabolism

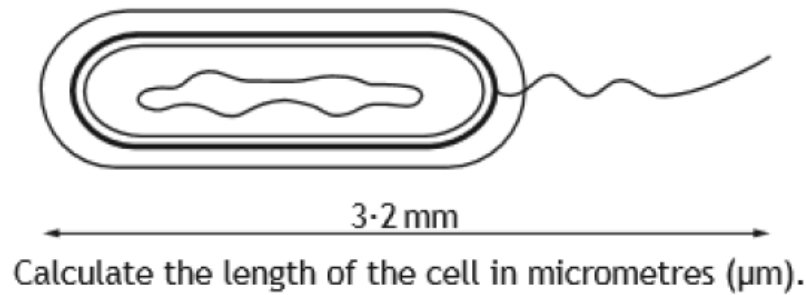
1. The graph below shows the effect of different concentrations of a disinfectant on the number of viable bacteria in liquid culture.



What percentage of bacteria was killed by 20% disinfectant after 5 minutes?

- A 25
- B 37.5
- C 62.5
- D 75

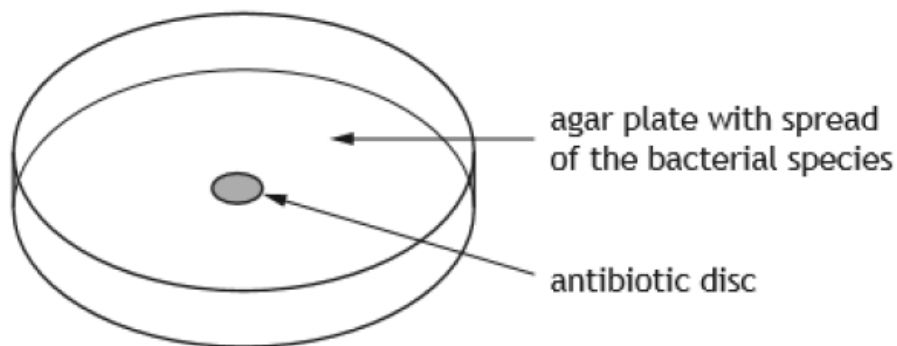
2. The diagram below shows a bacterial cell that has been magnified 800 times.



- A** 0.004
- B** 0.04
- C** 0.4
- D** 4.0

**1**

3. The effect of an antibiotic on a bacterial species was tested by spreading a culture of each of the bacterial species on agar plates and adding a disc of absorbent paper soaked in the antibiotic, as shown in the diagram below.



The plate was incubated for 24 hours at  $30^{\circ}\text{C}$  and the growth was examined.

Which of the following would be a suitable control for this experiment?

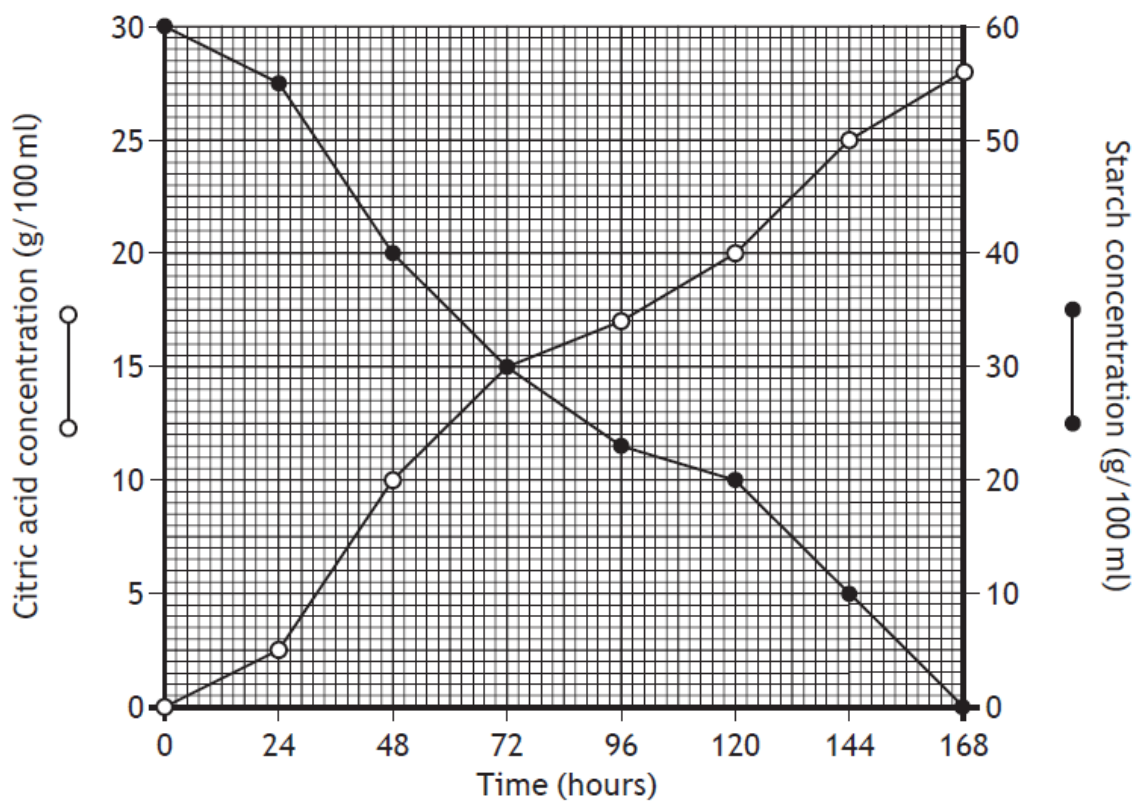
Repeat the experiment exactly but

- A** With no bacteria
- B** Incubate at human body temperature
- C** Use a disc with no antibiotic
- D** Use a disc with a different antibiotic

**1**

4. The fungus *Aspergillus niger* is grown in large fermenters to produce citric acid using starch as a substrate.

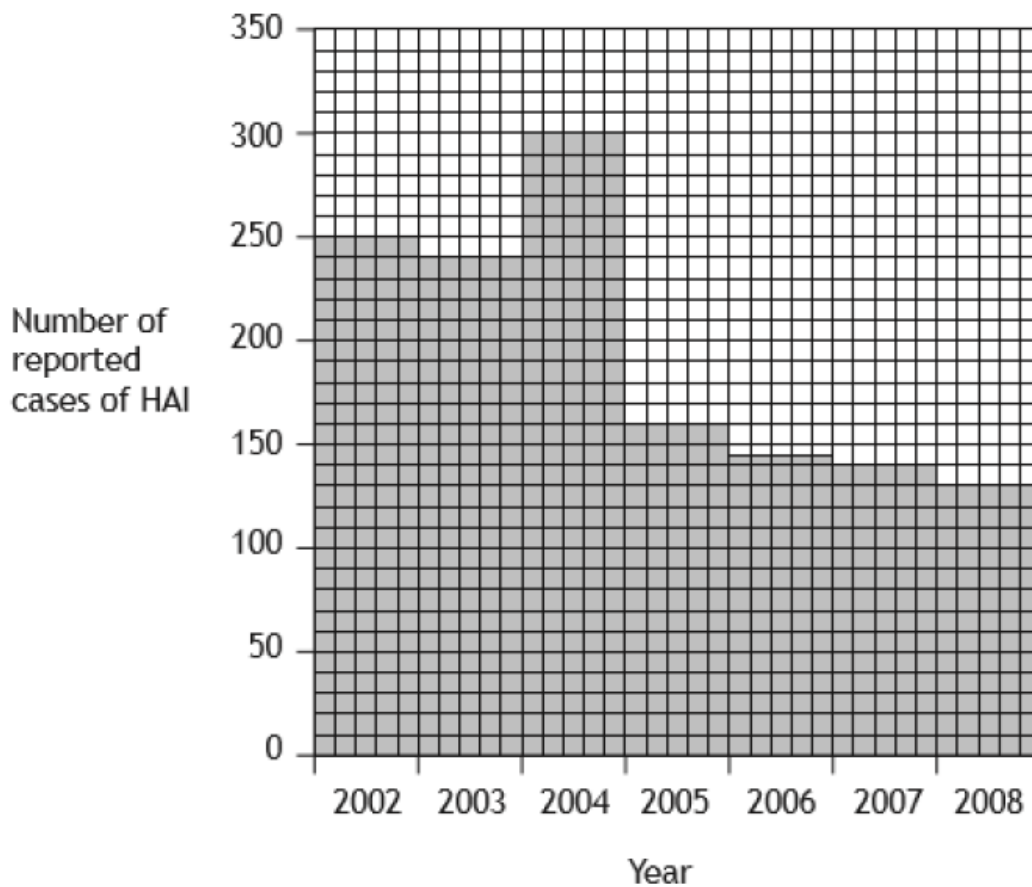
The graph shows the changes in the citric acid and starch concentrations in a fermenter over 168 hours.



The citric acid concentration equals the starch concentration at

- A 0 hours
- B 48 hours
- C 72 hours
- D 120 hours.

5. The graph below shows the number of reported cases of hospital acquired infections (HAI) in one hospital between 2002 and 2008. The overall number of patients remained constant during this time.



- (a) Using information from the graph, calculate the average decrease per year in reported cases of HAI between 2002 and 2008.

*Space for calculation*

\_\_\_\_\_ cases per year **1**

- (b) The decrease in the number of cases in 2005 was due to introduction of a new hand washing procedure at the hospital.

Predict what would happen to the number of reported cases of HAI in 2009. Circle **one** answer and give a reason for your choice.

increase

decrease

stay the same

Reason

\_\_\_\_\_  
\_\_\_\_\_

- (c) The table below shows the percentage of cases of HAI in the hospital attributed to two types of bacteria, Clostridium and Staphylococcus, between 2002 and 2008.

<i>Percentage of cases of HAI in each year attributed to bacterial types</i>							
Bacterial types	2002	2003	2004	2005	2006	2007	2008
<i>Clostridium</i>	32	30	30	51	54	57	59
<i>Staphylococcus</i>	34	32	33	30	31	33	33

Using information in the table, compare the overall trend in the percentage of Clostridium cases with that of Staphylococcus cases.

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**2**

- (d) Using information from the graph and the table, draw a conclusion about the effectiveness of the hand washing procedure against Staphylococcus. Justify your answer.

Conclusion

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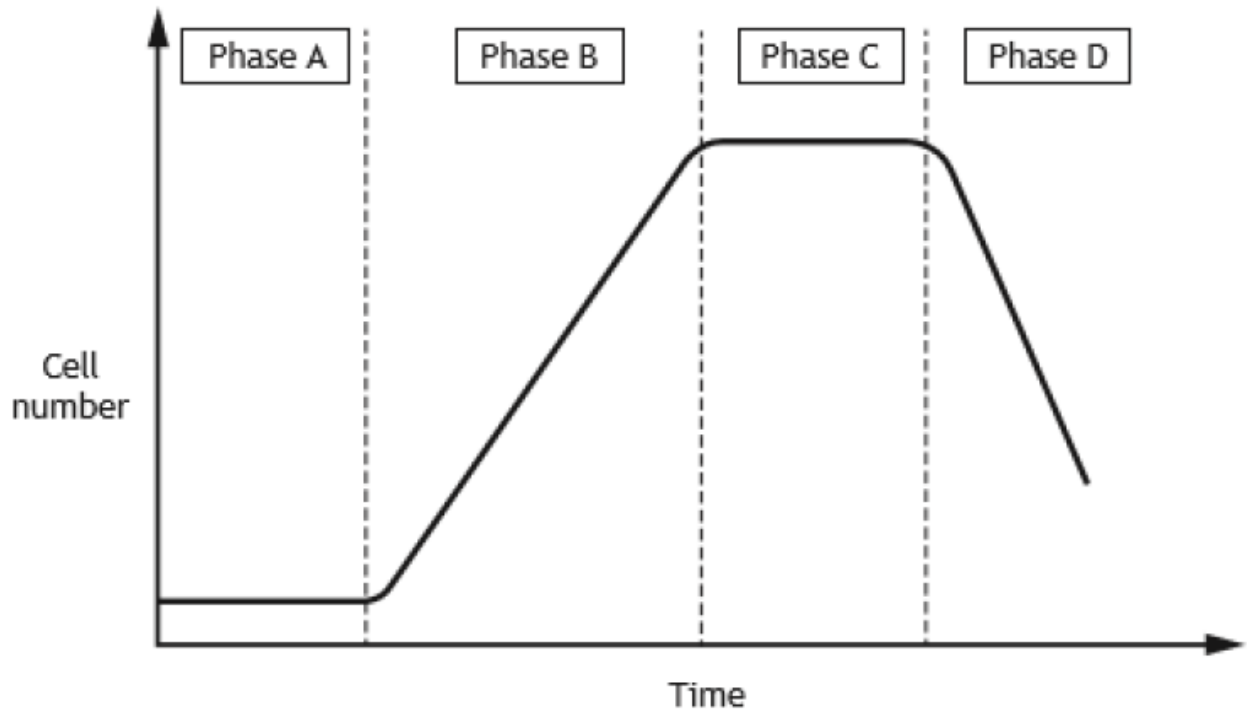
Justification

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**2**

6. The antibiotic bacitracin is produced by the bacterial species *B.subtilis*. The graph below shows the growth curve of a population of *B.subtilis* cultured to produce the antibiotic.



- (a) Name Phase A and explain why cells do not divide during this phase.

Name \_\_\_\_\_

Explanation

\_\_\_\_\_  
\_\_\_\_\_

**2**

- (b) (i) Name the phase in which the bacteria produce the secondary metabolite bacitracin.

\_\_\_\_\_  
\_\_\_\_\_

**1**

- (ii) Explain why this secondary metabolite gives an ecological advantage to *B.subtilis*.

\_\_\_\_\_  
\_\_\_\_\_

**1**

- (c) This growth curve shows viable cell numbers of *B.subtilis*.  
Give evidence from the graph to justify this statement.

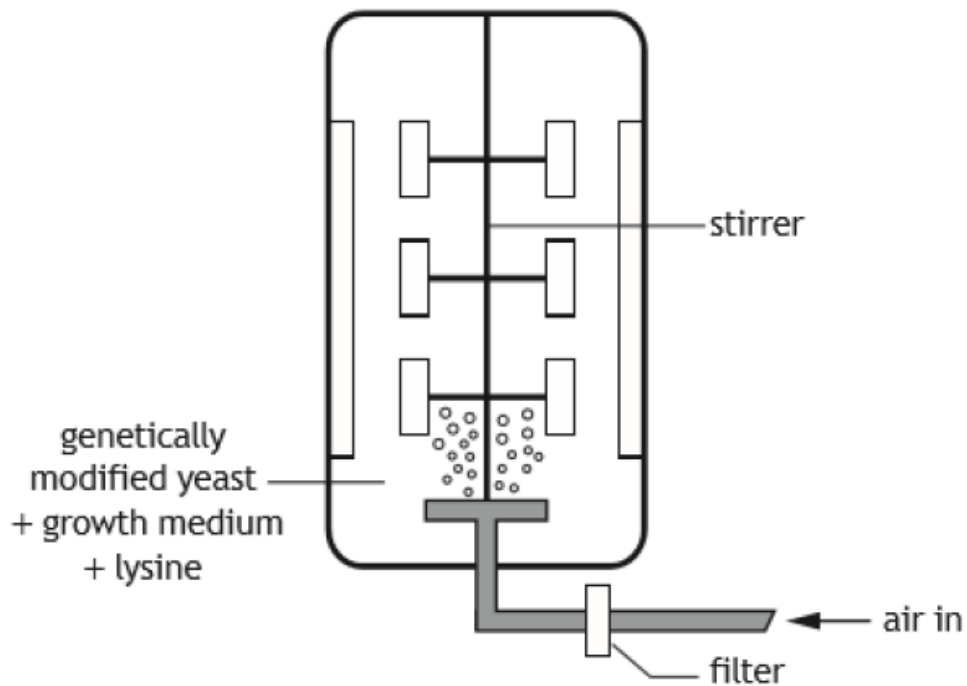
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**1**

7. The diagram shows genetically modified yeast growing in a fermenter in a medium to which the amino acid lysine has been added.



- (a) (i) Name the process for which the yeast cells need the amino acid lysine.

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**1**

- (ii) The fermenter contains 5.5 litres of growth medium.  
Calculate the mass of lysine which should be added to the medium to give a concentration of 300 mg/l.

*Space for calculation*

\_\_\_\_\_ mg **1**

- (iii) The air entering the fermenter passes through a filter to prevent contamination.

Explain why it is necessary to prevent contamination of the culture.

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**1**

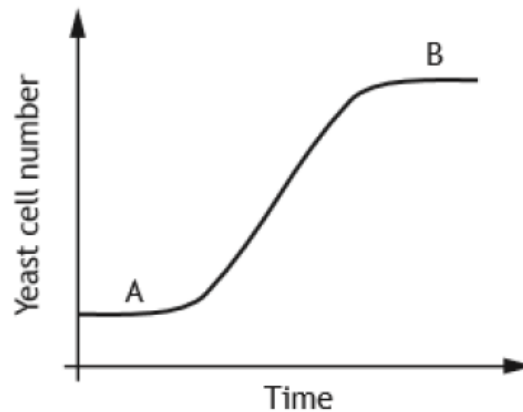
- (iv) The optimum pH for yeast growth is 4.5.

Suggest how this pH could be maintained in the fermenter.

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**1**

- (b)** Some phases of a growth curve of yeast culture are shown.



Complete the table by selecting growth phase A or B. Name the chosen phase and describe an event which occurs during that phase of growth.

<i>Letter</i>	<i>Phase of growth</i>	<i>Description</i>

**2**



- (c) Describe a safety mechanism used to prevent the survival of genetically modified microorganisms in the external environment.

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1

8. The bacteria *Streptomyces* is a microorganism found in soil. It produces a secondary metabolite, the antibiotic streptomycin, which kills other microorganisms. *Streptomyces* live in close association with plant roots. These plants produce soluble carbohydrates which are released into the soil through their roots.

- (a) (i) Name the growth phase during which streptomycin is produced.

1

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- (ii) Explain the advantage to *Streptomyces* of producing an antibiotic such as streptomycin.

1

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- (b)

An investigation was set up to compare the effectiveness of streptomycin with other antibiotics by measuring the survival of bacteria. A species of bacteria was grown in the presence of different concentrations of antibiotics and the percentage which survived was calculated. The results are shown in the table.

<i>Antibiotic</i>	<i>Concentration of antibiotic (<math>\mu\text{g}/\text{cm}^3</math>)</i>	<i>Survival of bacteria (%)</i>
Fusidic acid	10	6
Chloramphenicol	25	42
Erythromycin	5	49
Gentamycin	10	5
Tetracycline	25	35
Streptomycin	10	35

(i) Name one antibiotic with which streptomycin could be validly compared. 1

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(ii) Give a conclusion which can be drawn from the results. 1

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