

GCSE Biology

Worksheet: Culturing microorganisms

TIME 35 min	TOTAL 32 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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Topics: Culturing microorganisms

NAME	CLASS	DATE
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- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer all questions in the spaces provided.
- In all calculations, show clearly how you work out your answer.
- The marks for questions are shown in brackets.

0 1

A student placed a paper disc soaked in mouthwash on an agar plate spread with bacteria. After incubation there was a clear zone around the disc with a diameter of 20 mm.

0 1 . 1

Calculate the area of the clear zone.

Use the equation: $\text{area} = \pi r^2$

Give your answer to 3 significant figures.

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Area = mm²

[2 marks]

0 1 . 2

Explain why there is a clear zone around the disc.

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[1 mark]

0 2

Bacteria can be grown in the laboratory.

0 2 . 1

Bacteria multiply by simple cell division.

What is the name of this type of cell division?

Tick (✓) **one** box.

Binary fission

☐

Differentiation

☐

Fertilisation

☐

Meiosis

☐

[1 mark]

0 2 . 2

Give **two** ways that bacteria can be grown in the laboratory.

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[2 marks]

0 2 . 3

Give the reason why an inoculating loop is passed through a flame before it is used.

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[1 mark]

0 2 . 4

At what temperature should cultures of bacteria generally be incubated in a school laboratory?

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Temperature = °C

[1 mark]

0 3

A student investigated the effect of three antiseptics, **A**, **B** and **C**, on the growth of bacteria.
The student:

- spread bacteria over the surface of an agar plate
- placed paper discs soaked in each antiseptic, and one disc soaked in water, on the agar
- incubated the plate and then measured the diameter of the clear zone around each disc.

Table 1 shows the results.

Table 1

Disc soaked in	Diameter of clear zone in mm
Antiseptic A	12
Antiseptic B	18
Antiseptic C	8
Water	0

0 3 . 1

Calculate the area of the clear zone around the disc soaked in antiseptic **B**.

Use the equation: $\text{area} = \pi r^2$

Give your answer to 3 significant figures.

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Area = mm²

[3 marks]

0 3 . 2

Which antiseptic was the most effective against these bacteria?

Give a reason for your answer.

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[1 mark]

0 3 . 3

Explain why the student included a disc soaked in water.

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[1 mark]

0 3 . 4

Give **two** variables the student should have kept the same.

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[2 marks]

0 4

20 bacteria were added to a flask of sterile milk. Under these conditions, the bacteria divide by binary fission with a mean division time of 20 minutes.

0 4 . 1

How many times will the bacteria divide in 2 hours?

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[1 mark]

0 4 . 2

Calculate the number of bacteria after 2 hours.
Give your answer in standard form.

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Number of bacteria =

[2 marks]

0 5

A student investigated the effect of the concentration of a disinfectant on the growth of bacteria. Paper discs soaked in the disinfectant were placed on agar plates spread with the bacteria. The student tested four concentrations of disinfectant (0%, 5%, 10% and 20%), using three discs at each concentration on separate agar plates. After 48 hours' incubation at 25 °C, the diameter of the clear zone around each disc was measured with a ruler marked in millimetres. Table 2 shows the results.

Table 2

Concentration of disinfectant in %	Zone diameter in mm: plate 1	Plate 2	Plate 3	Mean zone diameter in mm
0	0	0	0	0
5	12	14	13	13
10	18	17	19	18
20	24	23	25	24

0 5 . 1

State one advantage of testing three discs at each concentration, rather than just one.

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[1 mark]

0 5 . 2

The ruler used has a resolution of 1 mm. Suggest why measuring with digital callipers, which have a resolution of 0.1 mm, would **not** necessarily make these measurements more accurate.

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[2 marks]

0 5 . 3

A different class, using a different supplier's agar plates and a different bottle of the same disinfectant, tested the same four concentrations and obtained a similar pattern of results. Does this show that the results are repeatable or reproducible? Explain your answer.

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[2 marks]

0 6

500 bacteria were added to a tube of nutrient broth. Under these conditions, the bacteria divide by binary fission with a mean division time of 25 minutes.

0 6 . 1

How many times will the bacteria divide in 2 hours 5 minutes?

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[1 mark]

0 6 . 2

Calculate the number of bacteria after 2 hours 5 minutes.
Give your answer in standard form.

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Number of bacteria =

[2 marks]

0 7

A student measured the diameter of the clear zone around paper discs soaked in a disinfectant, on agar plates spread with bacteria. At the 10% disinfectant concentration, the three zone diameters recorded were 18 mm, 17 mm and 19 mm. The student later realised that, for every zone, they had lined up the 1 mm mark of the ruler (not the 0 mark) with one edge of the zone, and recorded the reading at the other edge.

0 7 . 1

Calculate the mean zone diameter and its uncertainty for the 10% concentration, using the recorded values.

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[2 marks]

0 7 . 2

What type of error did lining up the 1 mm mark cause? Explain how it affected the mean you calculated.

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[2 marks]

0 7 . 3

Give **one** example of a random error that could occur when measuring the zone diameters, and explain how using the mean of three plates reduces its effect on the result.

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[2 marks]

END OF QUESTIONS

Mark scheme

GCSE Biology · Worksheet: Culturing microorganisms · 32 marks

Question 1 (3 marks)

01.1 [2 marks]

Answer: 314 mm²

- radius = 10 (mm) (1)
- ($\pi \times 10^2 =$) 314 (mm²) (1)

Notes: Using the diameter as the radius (1260) scores 1 mark.

01.2 [1 mark]

- the mouthwash diffused into the agar and killed the bacteria / stopped them growing (1)
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Question 2 (5 marks)

02.1 [1 mark]

Correct: Binary fission

02.2 [2 marks]

- in a nutrient broth (solution) (1)
 - as colonies on an agar gel plate (1)
-

02.3 [1 mark]

- to kill microorganisms on the loop / to sterilise it (1)

Notes: Allow 'to kill bacteria'. Ignore 'to clean it'.

02.4 [1 mark]

Answer: 25 °C

- 25 (°C) (1)
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Question 3 (7 marks)

03.1 [3 marks]

Answer: 254 mm²

- radius = 9 (mm) (1)
- $\pi \times 9^2$ (1)
- 254 (mm²) (1)

Notes: An answer of 254 scores 3 marks. An answer of 254.5 (not given to 3 significant figures) scores 2 marks. An answer of 1020 (diameter used as the radius) scores 1 mark.

03.2 [1 mark]

- B, because it produced the largest clear zone (1)

Notes: Both the letter and the reason are needed for the mark.

03.3 [1 mark]

- as a control, to show that the clear zones are caused by the antiseptics (not the paper disc) (1)

03.4 [2 marks]

- concentration of each antiseptic (1)
- size / type of paper disc (1)
- time the discs were soaked / volume of antiseptic (1)
- incubation temperature / incubation time (1)
- type of bacteria / volume of bacterial culture spread on the plate (1)
- type / depth of agar (1)

Any 2 of the points above.

Question 4 (3 marks)

04.1 [1 mark]

Answer: 6

- $(120 \div 20 =) 6$ (1)

04.2 [2 marks]

Answer: 1.28×10^3

- $20 \times 2^6 (= 1280)$ (1)
- 1.28×10^3 (1)

Notes: 1280 (not in standard form) scores 1 mark. Allow ECF from the number of divisions.

Question 5 (5 marks)

05.1 [1 mark]

- a mean can be calculated, which reduces the effect of random errors / any anomalous result can be identified (1)

05.2 [2 marks]

- the edge of a clear zone is often slightly fuzzy / uneven, so it is difficult to judge exactly where it ends, whatever the resolution of the instrument (1)
- the uncertainty from judging the edge is likely to be much bigger than 0.1 mm, so a finer resolution would not make the measurements much closer to the true values (1)

05.3 [2 marks]

- reproducible (1)
 - because different equipment and materials (a different supplier's plates, a different bottle) were used and still gave a similar pattern, not just a repeat using the same equipment (1)
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Question 6 (3 marks)

06.1 [1 mark]

Answer: 5

- $(125 \div 25 =) 5$ (1)

06.2 [2 marks]

Answer: 1.6×10^4

- $500 \times 2^5 (= 16\,000)$ (1)
- 1.6×10^4 (1)

Notes: 16 000 (not in standard form) scores 1 mark. Allow ECF from the number of divisions.

Question 7 (6 marks)

07.1 [2 marks]

Answer: 18 ± 1 mm

- mean = $(18 + 17 + 19) \div 3 = 18$ (mm) (1)
- uncertainty = $\pm$ half the range = $\pm (19 - 17) \div 2 = \pm 1$ (mm) (1)

07.2 [2 marks]

- systematic error (allow zero error) (1)
- every diameter recorded, and so the mean, is 1 mm too large: the true mean is 17 mm (the trend between concentrations would be unaffected if every zone was measured this way) (1)

Notes: Do not accept 'random error' or 'anomalous result'. For the second mark, the mean must be stated to be too large / the true mean given as 17 mm.

07.3 [2 marks]

- random error, e.g. judging where the slightly fuzzy edge of a zone is, or not placing the ruler exactly across the centre (the widest part) of the zone (1)
 - random errors make readings vary above and below the true value, so they tend to cancel out when a mean is calculated, giving a value closer to the true value (1)
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