

A Level Biology A
H420/02 Biological Diversity

Question Set 10

1

Two students investigated the growth of bacteria at different temperatures.

Three flasks containing identical solutions of nutrient broth were used.

- Flask 1: inoculated with 1cm³ of broth containing the bacterium *Bacillus subtilis* and incubated at 20 °C.
- Flask 2: inoculated with 1cm³ of broth containing *B. subtilis* and incubated at 30 °C.
- Flask 3: inoculated with 1cm³ of broth containing no bacteria and incubated at 30 °C.

Aseptic techniques were used throughout.

At set times over the next 3 days the students removed samples from each flask and measured the number of viable bacteria present.

- (a) State one further variable the students should have controlled in their investigation in order to produce **valid** results.

[1]

- (b) The students used the following procedure to determine the number of viable bacteria in each flask at a given time.

From each flask, 0.1 cm³ was removed and mixed with 9.9 cm³ of sterile water in a test tube. This was labelled **Tube A**. A serial dilution then proceeded, as shown in Table 19.1.

Tube	Contents	
B	1 cm ³ of Tube A mixture	9 cm ³ of sterile water
C	1 cm ³ of Tube B mixture	9 cm ³ of sterile water
D	1 cm ³ of Tube C mixture	9 cm ³ of sterile water
E	1 cm ³ of Tube D mixture	9 cm ³ of sterile water
F	1 cm ³ of Tube E mixture	9 cm ³ of sterile water

Table 19.1

From each tube, A–F, 0.1 cm³ of mixture was cultured on nutrient agar for 24 hours at 30 °C.

The results from Flask 2 after 7 hours of incubation are shown in Fig. 19.

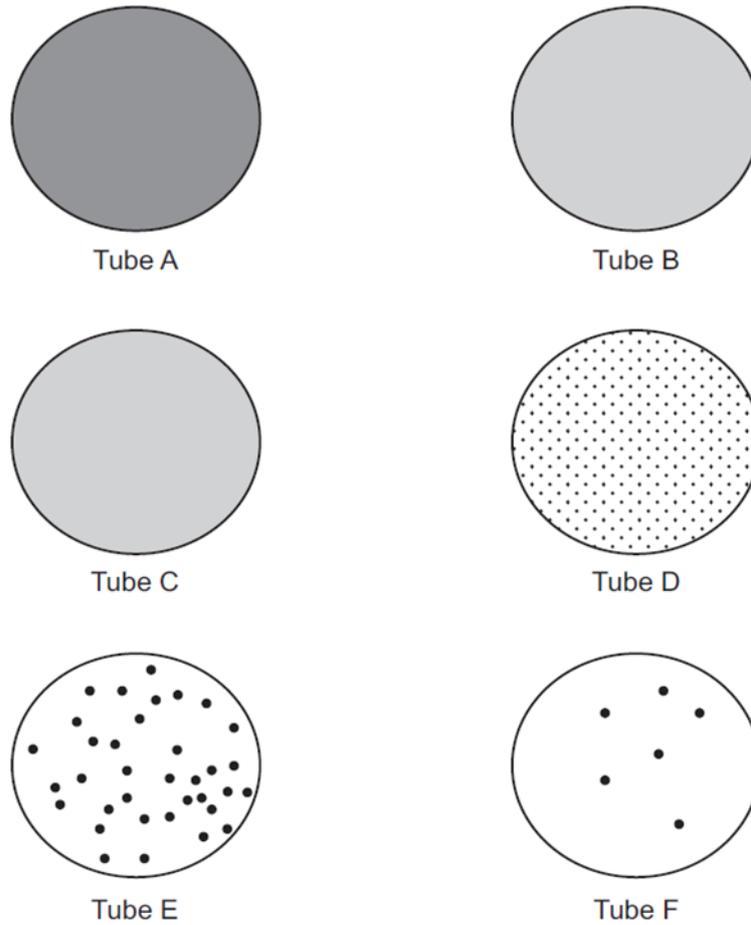


Fig. 19

The students used Tube F to calculate the number of viable bacteria present in the original sample.

- (i) Use Tube F to calculate the number of viable bacteria present in the original 0.1 cm^3 sample from Flask 2 after 7 hours of incubation.

Give your answer in standard form.

Answer..... [2]

- (ii) The students disagreed about which tube's result to use as a starting point for their calculation.

Discuss whether the petri dish resulting from Tube F was the most appropriate for them to use. [3]

- (c) The processed results from the students' investigation are shown in Table 19.2.

Time after incubation started (hours)	Number of viable bacteria present in Flask 1 at 20 °C	Number of viable bacteria present in Flask 2 at 30 °C
0	7.0×10^2	7.1×10^2
2	6.8×10^2	7.4×10^2
4	4.7×10^4	2.5×10^6
8	6.5×10^7	9.2×10^{10}
12	2.4×10^9	1.8×10^{11}
18	7.8×10^{10}	1.8×10^{11}
24	9.2×10^{10}	5.5×10^8
36	8.6×10^{10}	4.2×10^4
48	6.0×10^9	6.7×10^2
60	5.7×10^7	5.2×10^2
72	1.3×10^5	3.1×10^2

Table 19.2

- (i)* Using the information in Table 19.2, compare and explain the patterns of growth seen at 20 °C and at 30 °C. [6]
- (ii) No bacteria were detected at any time in the flask that was inoculated with nutrient broth that did not contain bacteria. [2]
- Explain the purpose of this flask.
- (iii) The teacher told the students they should not investigate the growth of bacteria at 35 °C. [1]
- Suggest why the teacher told them not to grow bacteria at 35 °C.
- (iv) The teacher also suggested that the students should have carried out the investigation using three flasks at each temperature. [3]
- Explain how this suggestion would have improved the students' investigation.

Total Marks for Question Set 10: 18

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