Microbiology (1.4): Eduqas A Level Biology Exam Questions by Topic

19 questions · 35 marks · about 42 minutes. Answer in the spaces, then check the mark schemes at the end.

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2. Bacteria can be distinguished from each other by their size, shape, staining characteristics and their metabolic features. **Image 2.1** shows three different types of bacteria. **Image 2.2** shows two different types of bacteria after Gram staining.

Image 2.1

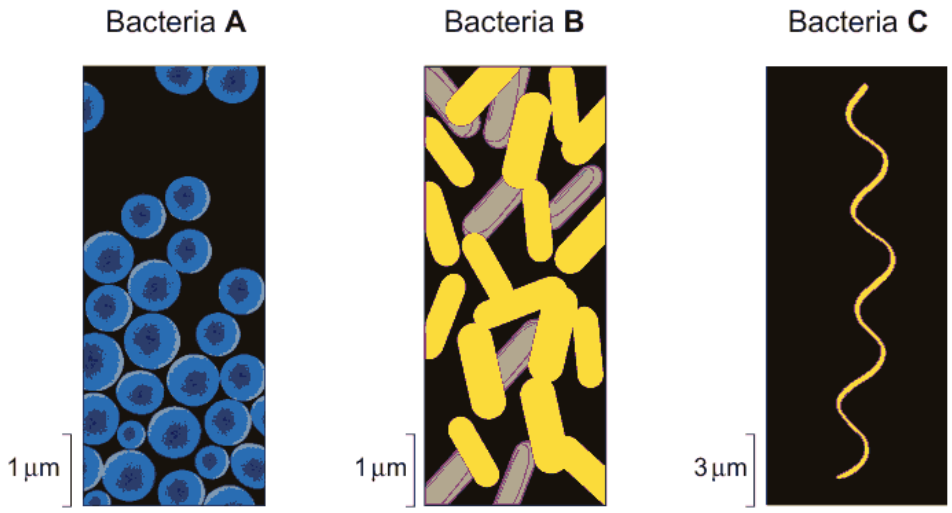
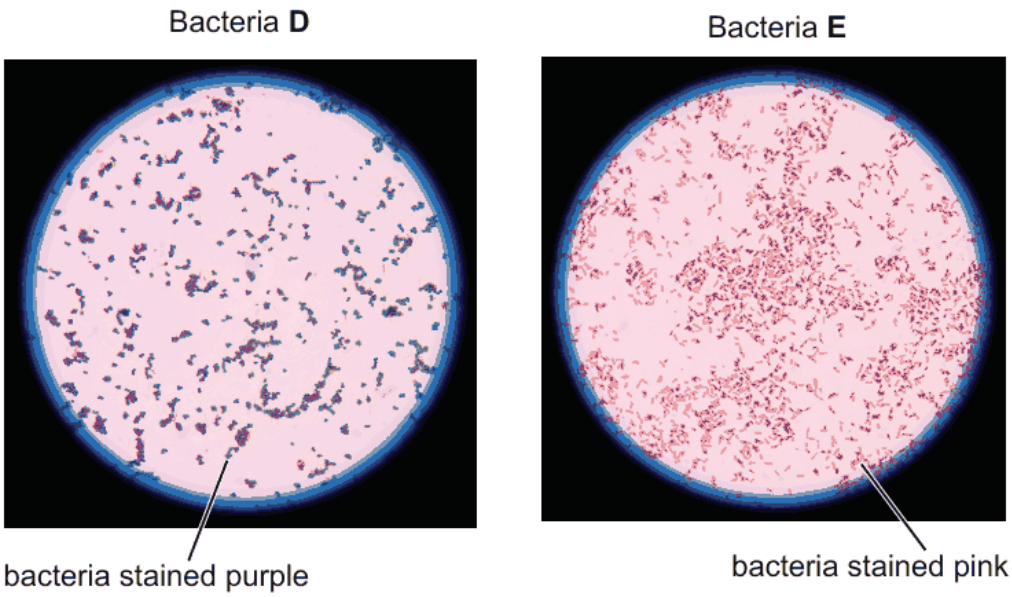


Image 2.2



(a) (i) State the names given to the shapes of bacteria, **A**, **B** and **C** shown in **image 2.1**. [1]

A .....

B .....

C .....

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Question 2 · A level Component 1 · Autumn 2021 · Q2(a)(ii) · 2 marks

(ii) State and explain what the results of the staining shown in **image 2.2** indicates about the structure of the cell walls of bacteria **D** and **E**. [2]

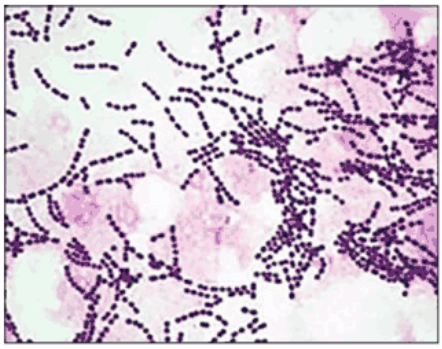
Question 3 · A level Component 3 · June 2022 · Q7(c)(i) · 2 marks

(c) A GP suspected that a patient suffering from a sore throat may have a bacterial infection.

Some bacteria from a throat swab taken from the patient were stained and viewed with an optical microscope. They appeared as purple spherical cells arranged in chains, shown in **Image 7.3**.

The bacteria were identified as *Streptococcus pyogenes*.

Image 7.3



(i) Name the type of bacterium indicated by the purple colour and describe what this indicates about the structure of the cell wall of *Streptococcus pyogenes*. [2]

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Question 4 · A level Component 1 · June 2018 · Q2(b)(iii) · 3 marks

(iii) *Enterococcus faecalis* is a Gram-positive bacterium which also inhabits the gastro-intestinal tracts of humans and other mammals.
Briefly describe **two** ways in which you could distinguish between *Enterococcus faecalis* and *Escherichia coli*. [3]

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Question 5 · A level Component 1 · June 2023 · Q5(b)(i) · 1 mark

(b) A sample of faeces from a patient with diarrhoea and vomiting was examined for the presence of *Salmonella* bacteria. Rod-shaped bacteria were observed which stained red using Gram-staining. These bacteria were cultured and were found to be facultative anaerobes.

(i) State the term used to describe rod-shaped bacteria. [1]

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Question 6 · A level Component 1 · June 2023 · Q5(b)(iii) · 1 mark

(iii) Explain what information about the **structure** of *Salmonella* bacteria is provided by the result of Gram-staining. [1]

.....

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Question 7 · A level Component 1 · June 2023 · Q5(b)(ii) · 1 mark

(ii) Explain what is meant by the term facultative anaerobe. [1]

.....

.....

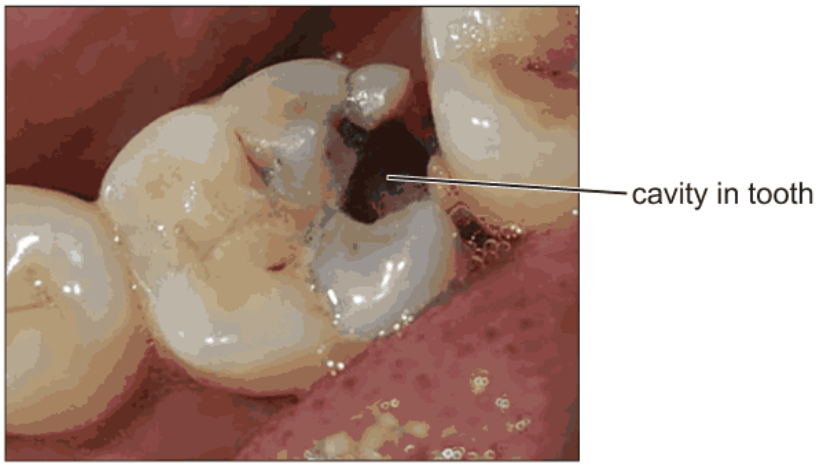
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(c) In humans, *S. mutans* is most prevalent on the surface of teeth and is one of the main organisms responsible for tooth decay.
S. mutans can convert sucrose into two main products:

- lactic acid
- dextran – a sticky polysaccharide

S. mutans can also metabolise other sugars, including glucose, fructose and lactose to produce lactic acid.
Image 2.3 shows a cavity in a human premolar caused by tooth decay.

Image 2.3



(i) With reference to the habitat of this species of bacteria and its metabolism of sugars, conclude whether *S. mutans* is an aerobe, an obligate anaerobe or a facultative anaerobe. Explain your answer. [3]

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Question 9 · A level Component 3 · June 2019 · Q8(d)(ii) · 2 marks

(ii) Describe **two** techniques that could have been used to maintain sterile conditions when inoculating the plates. [2]

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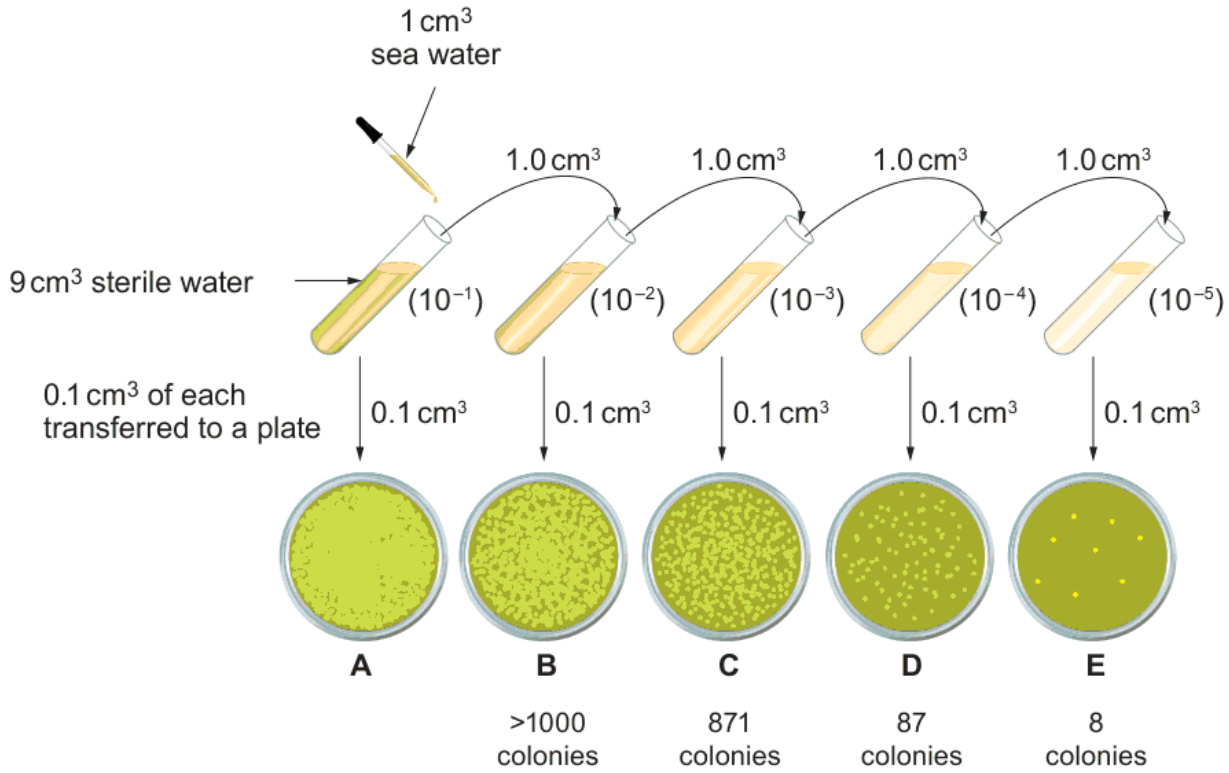
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Question 10 · A level Component 1 · Autumn 2020 · Q5(a)(i) · 1 mark

5. The quality of bathing water at designated coastal resorts is monitored. The number of bacteria present is assessed by using serial dilutions of sea water, plating, incubating and counting the colonies as shown in **image 5.1**.

Image 5.1



(a) (i) Use the number of colonies on plate **D** to calculate how many bacteria there are in 1 cm³ of the original sample of water. [1]

Number of colonies = ...

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Question 11 · A level Component 1 · Autumn 2020 · Q5(a)(ii) · 2 marks

(ii) Explain why the number of colonies on plates **C** and **E** would not be used to calculate the number of bacteria. [2]

C .....

.....

E .....

.....

Question 12 · A level Component 1 · Autumn 2020 · Q5(b) · 2 marks

(b) Explain why it is essential that the plates are all cultured using exactly the same culture medium and incubation period. [2]

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Question 13 · A level Component 1 · Autumn 2020 · Q5(c) · 1 mark

(c) At the end of the investigation all plates were autoclaved. State **one** condition produced by the autoclave which results in the sterilisation of the plates. [1]

.....

Question 14 · A level Component 1 · Autumn 2020 · Q5(d) · 2 marks

(d) Water quality can be determined by the number of human gut bacteria present. Suggest **two** suitable conditions for incubation in order to culture human gut bacteria. [2]

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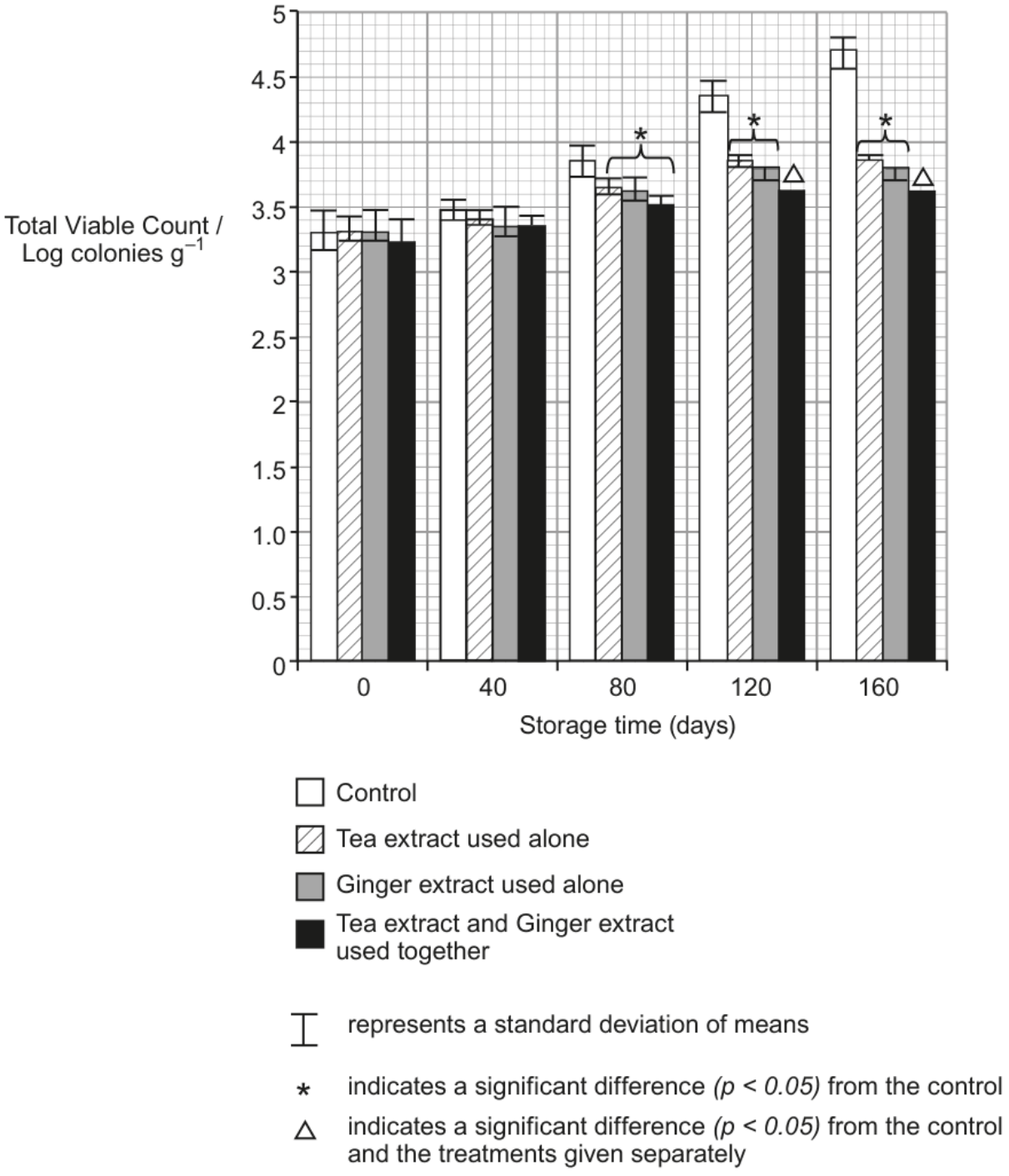
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5. An experiment was carried out to determine the effects of natural preservatives on shrimp paste, a common additive in Chinese food. These were tea extract and ginger extract. They were tested separately and then in combination.

Shrimp paste samples were stored at 25 °C for 160 days and samples were taken at regular intervals. Total viable counts (TVC) were determined on agar plates by counting the number of colonies after incubation at 35 °C for 48 hours. Three replicates were made for each sample.

The mean results were plotted as logarithms of the number of colonies (colonies g^{-1}). The standard deviations for each sample are also shown.



(a) What is meant by a total viable count? [2]

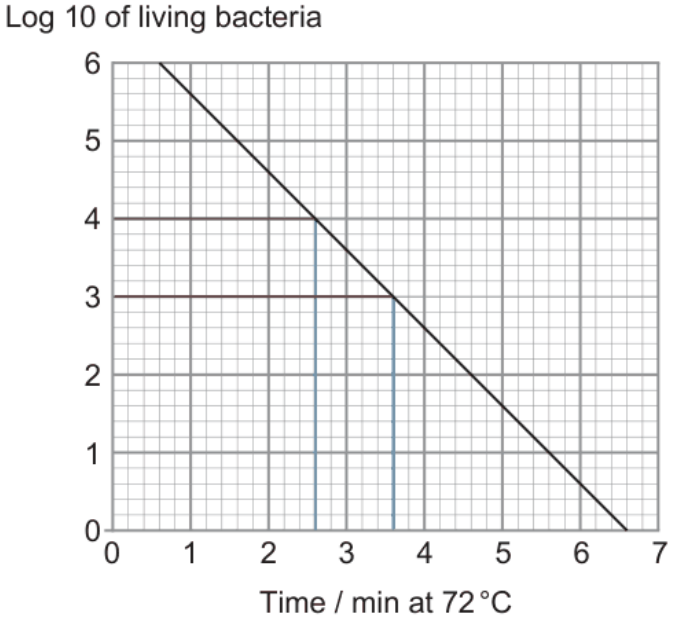
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Question 16 · information from earlier in the question

Each bacterial species has its own particular heat tolerance. During a process such as pasteurisation, the rate of cell destruction is logarithmic. Bacteria subjected to heat are killed at a rate that is proportional to the number of bacteria present. The process is dependent both on the temperature of exposure and the time required at this temperature to accomplish the desired rate of destruction.

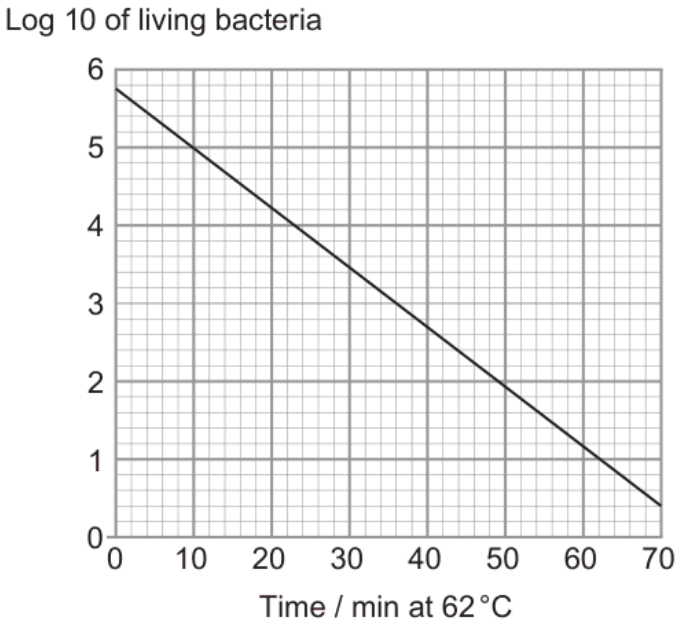
The D value is the time in minutes at a given temperature required to destroy 90% of the bacterial population.

Graph 1



In the example shown above at 72 °C, the D value = 1 minute. This means that for each minute of processing at 72 °C the bacterial population will be reduced by 90%.

Graph 2



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Question 16 · A level Component 1 · June 2019 · Q2(c) · 4 marks

(c) Describe a method that you could use to determine the number of living bacteria in the original sample prior to heat treatment. No reference to aseptic technique is required. [4]

Question 17 · information from earlier in the question

(c) Some strains of *E. coli* can cause food poisoning. Following an outbreak, samples were taken from suspected food sources and cultured on agar plates. Serial dilutions were carried out to determine the number of viable bacteria in the samples. 0.25 cm^3 was transferred to each agar plate and incubated at 37 °C. The number of colonies on each plate was then counted.

	Number of colonies per plate				
Dilution	Plate 1	Plate 2	Plate 3	Mean	SD
10^{-3}	426	503	521	483	50.5
10^{-5}	444	479	457	460	17.7
10^{-7}	275	293	310	293	
10^{-9}	66	71	78	72	6.0

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Question 17 · A level Component 1 · June 2018 · Q2(c)(ii) · 1 mark

The following table is given to help structure your calculation.

Plate number	Number of colonies per plate	$x - \bar{x}$	$(x - \bar{x})^2$
1	275		
2	293		
3	310		
Mean	293		Σ

Standard deviation = ...

(ii) Suggest why the **mean values** for the first two dilutions were so close despite there being a 100 times difference in the dilutions. [1]

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.....

Question 18 · A level Component 1 · June 2018 · Q2(c)(iv) · 3 marks

(iv) Calculate the number of bacteria in **1 cm^3** of the original sample using the 10^{-9} dilution. **Give your answer in standard form.** [3]

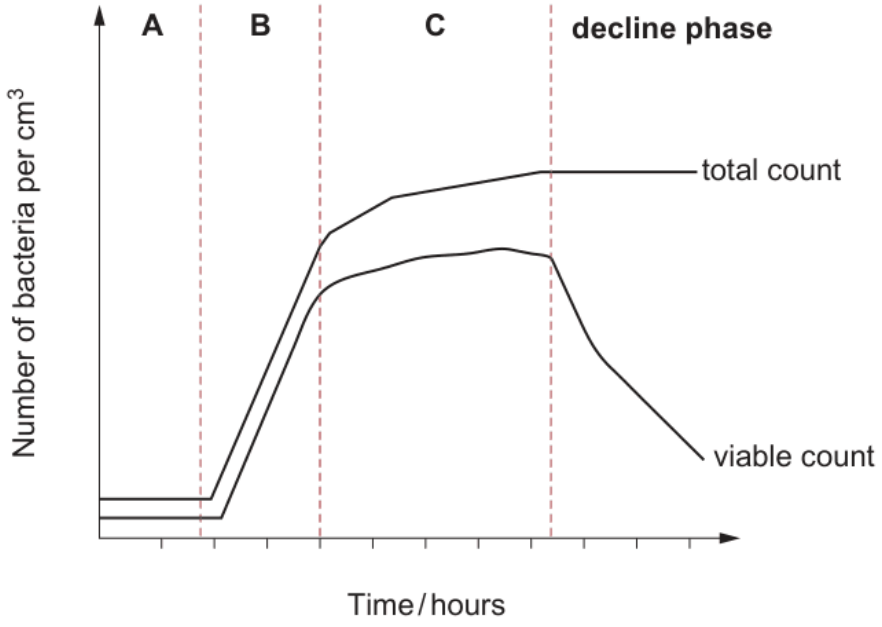
Number of bacteria = ...

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Question 19 · information from earlier in the question

1. A flask of sterile culture medium was inoculated with a small number of bacterial cells. The number of bacteria per cm^3 of culture medium was monitored at regular intervals using a total count and a viable count. The results were plotted as shown in **Image 1.1**.

Image 1.1



Question 19 · A level Component 1 · June 2022 · Q1(a)(ii) · 1 mark

(ii) Explain the difference between the shape of the decline phase obtained using a total count and a viable count. [1]

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.....

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Mark schemes

Question 1 · A level Component 1 · Autumn 2021 · Q2(a)(i) · 1 mark

2	(a)	(i)	A Coccus B Bacillus C spirillum **All correct for 1 mark**	1		1 1

Question 2 · A level Component 1 · Autumn 2021 · Q2(a)(ii) · 2 marks

	(ii)	D is Gram +ve + so has a {murein/ peptidoglycan} cell wall (1) E is Gram -ve + so has an additional outer layer of {lipoprotein/ lipopolysaccharide} (1)	2		2	2

Question 3 · A level Component 3 · June 2022 · Q7(c)(i) · 2 marks

(c)	(i)		Gram positive. (1) There is no lipopolysaccharide layer/there is a thick(er) layer of {murein/peptidoglycans} than gram negative bacteria)/ only peptidoglycan (1)	1	1	2	1

Question 4 · A level Component 1 · June 2018 · Q2(b)(iii) · 3 marks

	(iii)	Grams staining/ or description of(1) Accept reference to crystal violet only *Enterococcus faecalis/ Gram positive:* purple {spherical/spheres} (1) NOT round/ circle *Escherichia coli/ Gram negative:* red {rods/bacilli/us} (1) both correct colours = 1 mark both correct shapes for 1 mark Accept correct description of penicillin resistance	1	2	3	3

Question 5 · A level Component 1 · June 2023 · Q5(b)(i) · 1 mark

(b)	(i)	bacillus / bacilli	1	1	

Question 6 · A level Component 1 · June 2023 · Q5(b)(iii) · 1 mark

(iii)	Cell wall has an {extra / outer} layer of {lipopolysaccharide/ lipoprotein} (1)

1			1		1

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Question 7 · A level Component 1 · June 2023 · Q5(b)(ii) · 1 mark

(ii)	Can respire aerobically and anaerobically / can survive in aerobic and anaerobic conditions(1)	1	1	

Question 8 · A level Component 1 · June 2025 · Q2(c)(i) · 3 marks

(c)	(i)	Facultative anaerobe (1) Produces lactic acid so anaerobic respiration (1) Oxygen present in mouth (but bacteria survive) (1)	3	3

Question 9 · A level Component 3 · June 2019 · Q8(d)(ii) · 2 marks

(ii)	Any **two** (×1) from flame mouth of test tube/ flask work near updraft of Bunsen burner use sterile {pipette/ equipment}/ flame {loop/ spreader} tilt lid of Petri dish/ owtte	2	2

Question 10 · A level Component 1 · Autumn 2020 · Q5(a)(i) · 1 mark

5	*(a)*	(i)	8.7×10^6	1	1	1

Question 11 · A level Component 1 · Autumn 2020 · Q5(a)(ii) · 2 marks

(ii)	C Overlapping. (1) E Statistically unsound/error in count cause large % error/ count unreliable Owtte (1) NOT inaccurate/ not representative	2	2

Question 12 · A level Component 1 · Autumn 2020 · Q5(b) · 2 marks

(b)	Different nutrients would affect growth rate (1) Different incubation periods would result in different colony sizes/ risk of merging (1) Variation of controlled variables will affect DV (1)	2	2

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Question 13 · A level Component 1 · Autumn 2020 · Q5(c) · 1 mark

(c)	Temperature above boiling point	1	1	

Question 14 · A level Component 1 · Autumn 2020 · Q5(d) · 2 marks

(d)	37 ºC. (1) Accept range 35 - 38 ºC anaerobic (1)	1	1	2

Question 15 · A level Component 1 · June 2017 · Q5(a) · 2 marks

5 (a)	(Total) number of living {organisms/ bacteria/ cells} (1) in a known (mass/volume) of {substance/liquid} (1)	2	2	2

Question 16 · A level Component 1 · June 2019 · Q2(c) · 4 marks

(c)	**Any four (× 1) from:** A. 10×/100× series of dilutions/1+9/0.1+9.9cm^3(1) B. Volume 1cm^3 (or less) plated onto each plate (1) C. Incubated at 25-37^{o}C for 24-48 hours (1) D. Number of colonies counted (1) E. Use of dilution factor and calculation of numbers of bacteria (per cm^3 in original sample)/ or description of (1) F. Repeat (×3) and calculate a mean (1)	4	4	

Question 17 · A level Component 1 · June 2018 · Q2(c)(ii) · 1 mark

(ii)	Clumping of bacteria/ Overlapping colonies/ Difficult to count large colony numbers Ignore reference to anomalies/ not enough repeats	1	1	1

Question 18 · A level Component 1 · June 2018 · Q2(c)(iv) · 3 marks

(iv)	$72 \times 4 \times 10^9$ (1) 2 880 000 000 000 (2) $2.9 \times 10^{11}/2.88 \times 10^{11}$ bacteria in 1cm^3 (3) If do not use x 4 = 7.2×10^{10} = 1 mark	3	3	3

Question 19 · A level Component 1 · June 2022 · Q1(a)(ii) · 1 mark

(ii)	Total count (higher because) dead and living (cells) / Viable count (lower because) only living (cells)/ Total count will include dead cells	1	1	1

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