PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



EXAM QUESTION PACK

TOPIC 6: MICROBIOLOGY AND PATHOGENS

MICROBIAL TECHNIQUES

SCORE	PERCENTAGE
/82	%

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Q1.

Bacteria were cultured in two different types of medium.

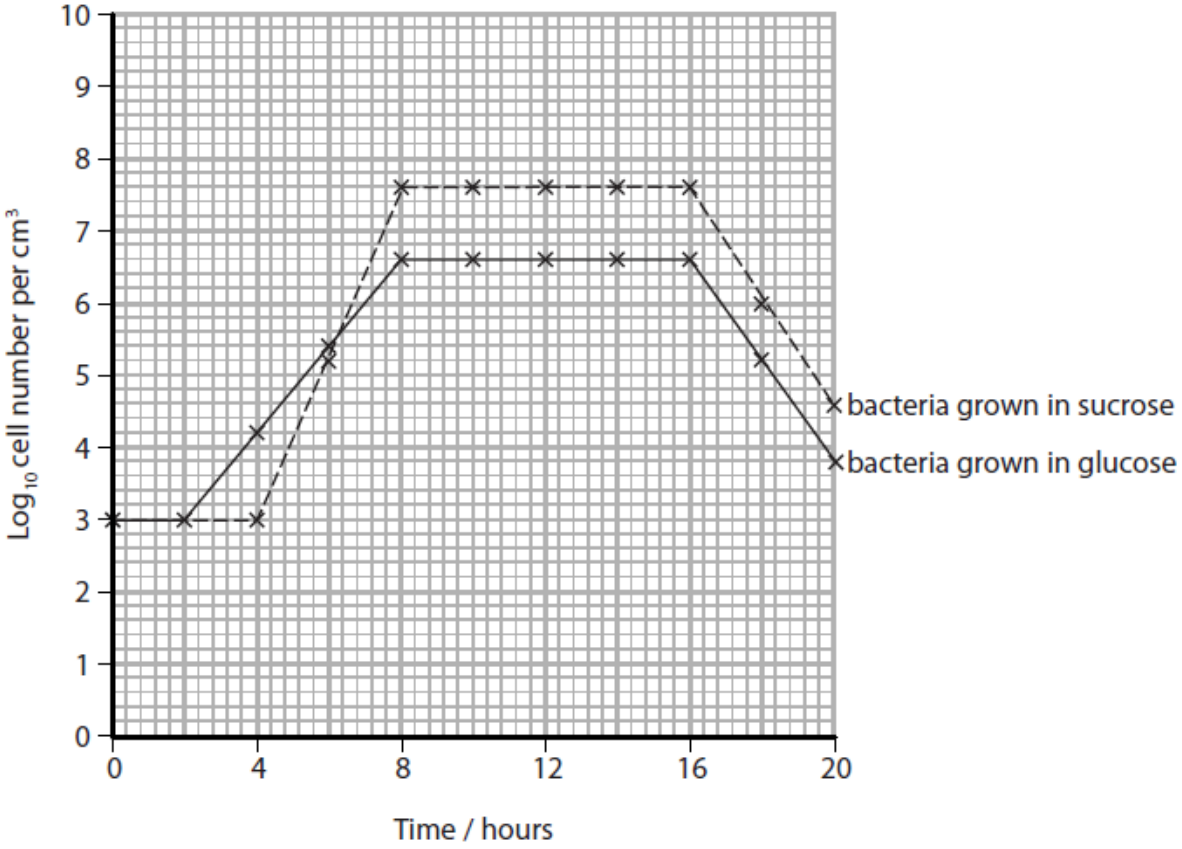
One medium contained glucose as the energy source and the other contained sucrose.

The same molar concentrations of glucose and sucrose were used.

Bacteria were grown in each medium for 20 hours.

Every two hours, the numbers of bacteria were determined using dilution plating and an optical method (turbidity).

The graph shows the results from the dilution plating.



(i) Calculate how many times faster the bacteria in sucrose reproduce than the bacteria in glucose, during the log phase.

(2)

Answer .....

(ii) Analyse the data to explain why the growth curve for sucrose is different from the growth curve for glucose.

(2)

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(iii) On the graph, draw a curve to show the number of bacteria grown in glucose as determined by the optical method.

(1)

(Total for question = 5 marks)

Q2.

Antibiotics are widely used to treat infections.

Some antibiotics are bactericidal.

Describe how you would use aseptic techniques to transfer bacterial cells growing on an agar plate to a tube containing a sterile broth.

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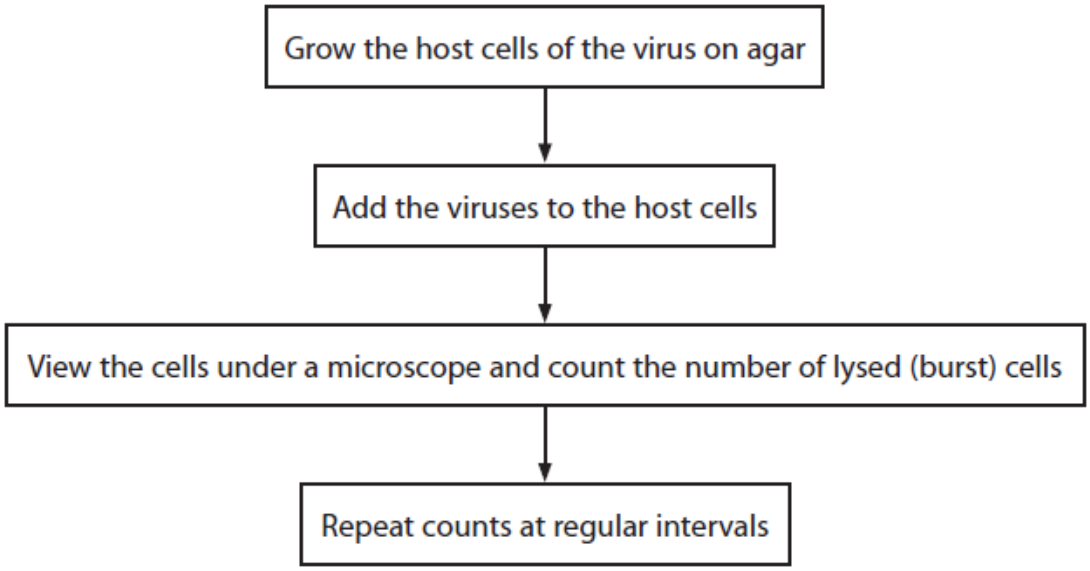
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Q3.

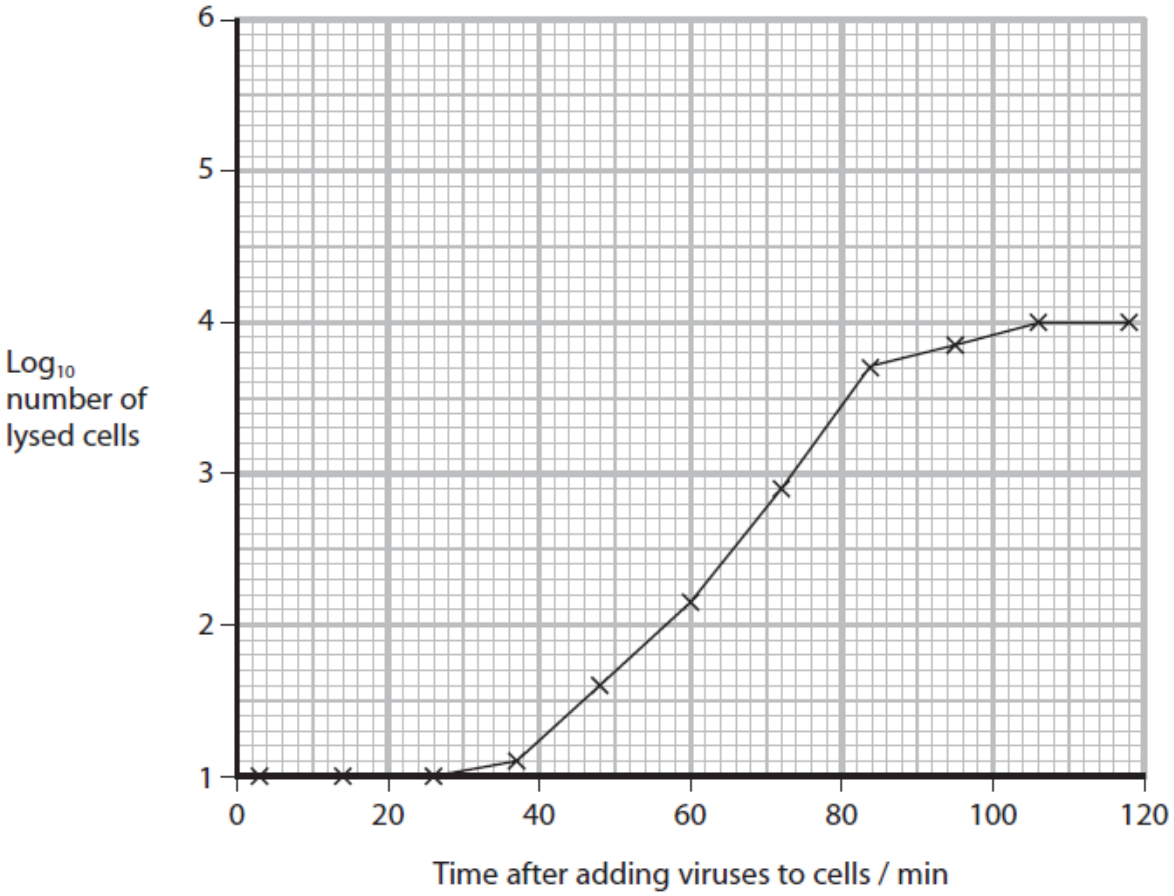
Bacteria are the host cells for λ (lambda) phage viruses.

Viruses can be cultured and a growth curve can be produced.

The flow chart shows how this can be done.



The graph shows a growth curve for viruses.



(i) Explain why there was a delay before the number of lysed cells started to increase.

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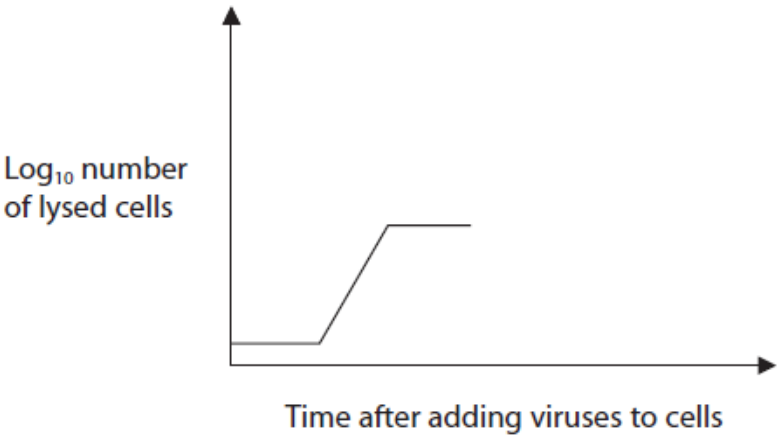
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(ii) Calculate the mean rate of increase in the actual number of lysed cells between 50 minutes and 90 minutes.

(2)

Answer ..... cells min $^{-1}$

(iii) A sketch has been made of this growth curve.



Complete this sketch to predict the shape of the growth curve after 120 minutes, assuming there is an excess of host cells.

(2)

(Total for question = 7 marks)

Q4.

Skin flora include bacteria that live on the skin.

Different parts of the body have different types of bacteria present.

Skin flora are beneficial as they inhibit the growth of pathogenic bacteria on the skin.

Skin flora compete for nutrients and space or secrete toxic chemicals.

The following are types of bacteria found in the female genital tract:

- *Escherichia coli*
- *Klebsiella species*
- *Lactobacillus species*
- *Staphylococcus species.*

(i) Describe how these types of bacteria present in the female genital tract could be identified.

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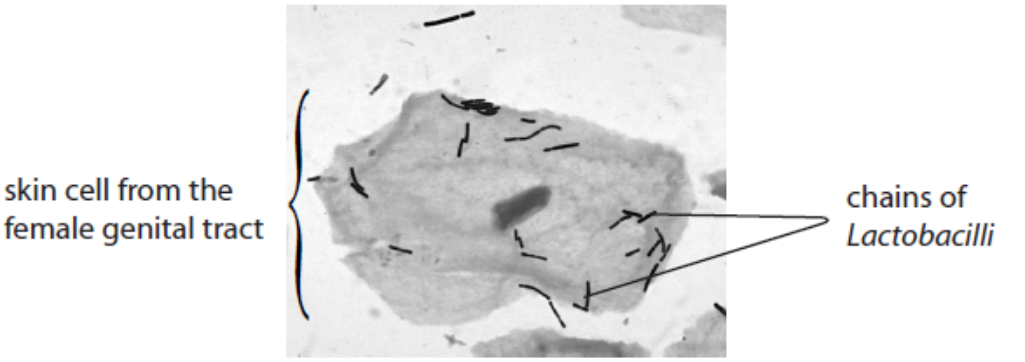
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(ii) The photograph shows *Lactobacilli* on a skin cell from the female genital tract.



Source: © Janice Carr Content Providers (s): CDC/Dr. Mike Miller

Lactobacilli metabolise glycogen into lactic acid.

Explain how *Lactobacilli* inhibit the growth of pathogenic bacteria in the female genital tract.

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(Total for question = 7 marks)

Q5.

An investigation was carried out to compare the aerobic respiration of different sugars by yeast.

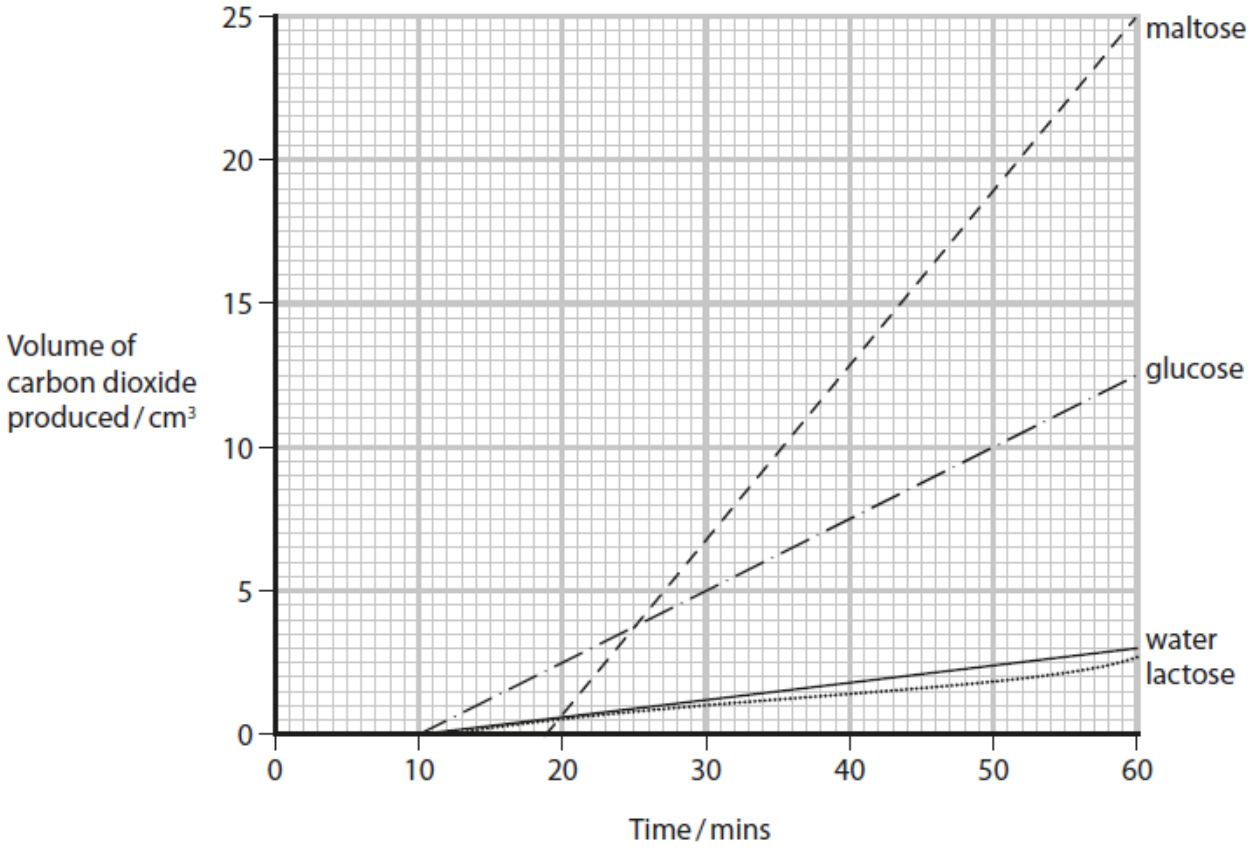
A suspension of yeast was used to produce three cultures, each one with a different sugar.

A control was set up that had a suspension of yeast cultured with water only.

The volume of carbon dioxide produced was measured.

The mass of yeast and the concentration of each sugar were controlled.

The graph shows the results of this investigation.



(i) Give one difference between the structure of glucose and the structure of maltose.

(1)

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(ii) Explain the results for the yeast cultured with glucose and the yeast cultured with maltose.

(2)

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(Total for question = 3 marks)

Q6.

An investigation was carried out to compare the aerobic respiration of different sugars by yeast.

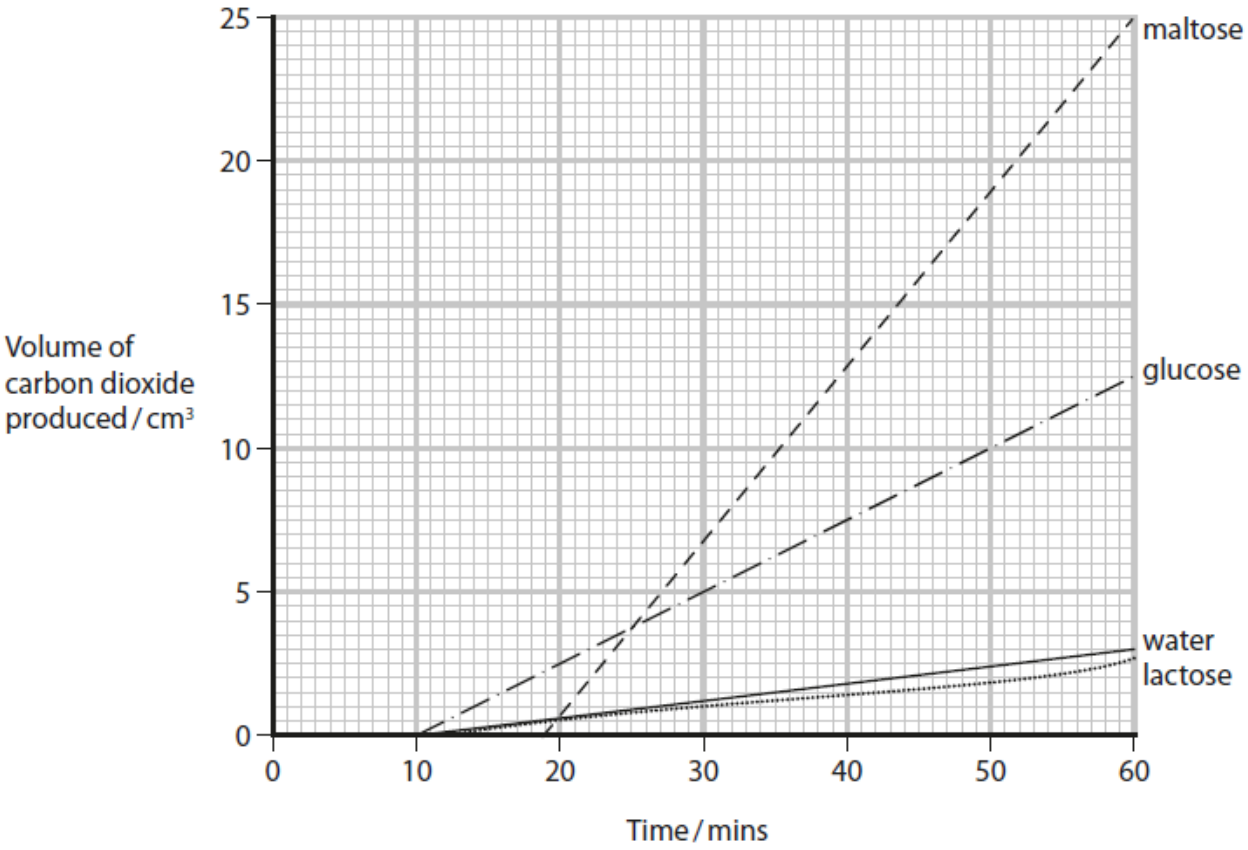
A suspension of yeast was used to produce three cultures, each one with a different sugar.

A control was set up that had a suspension of yeast cultured with water only.

The volume of carbon dioxide produced was measured.

The mass of yeast and the concentration of each sugar were controlled.

The graph shows the results of this investigation.



Explain the results for the yeast cultured with lactose.

(2)

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(Total for question = 2 marks)

Q7.

Ultraviolet (UV) radiation damages DNA and is used in microbiology to produce aseptic conditions.

The effectiveness of UV radiation was investigated, using three species of pathogenic bacteria.

The table provides information about the bacteria used in this investigation.

Bacteria	Gram staining	Infected part of body
P. aeruginosa	negative	blood
S. aureus	positive	lung
E. coli	negative	intestine

(i) Compare and contrast the structure of the wall of Gram positive bacteria and Gram negative bacteria.

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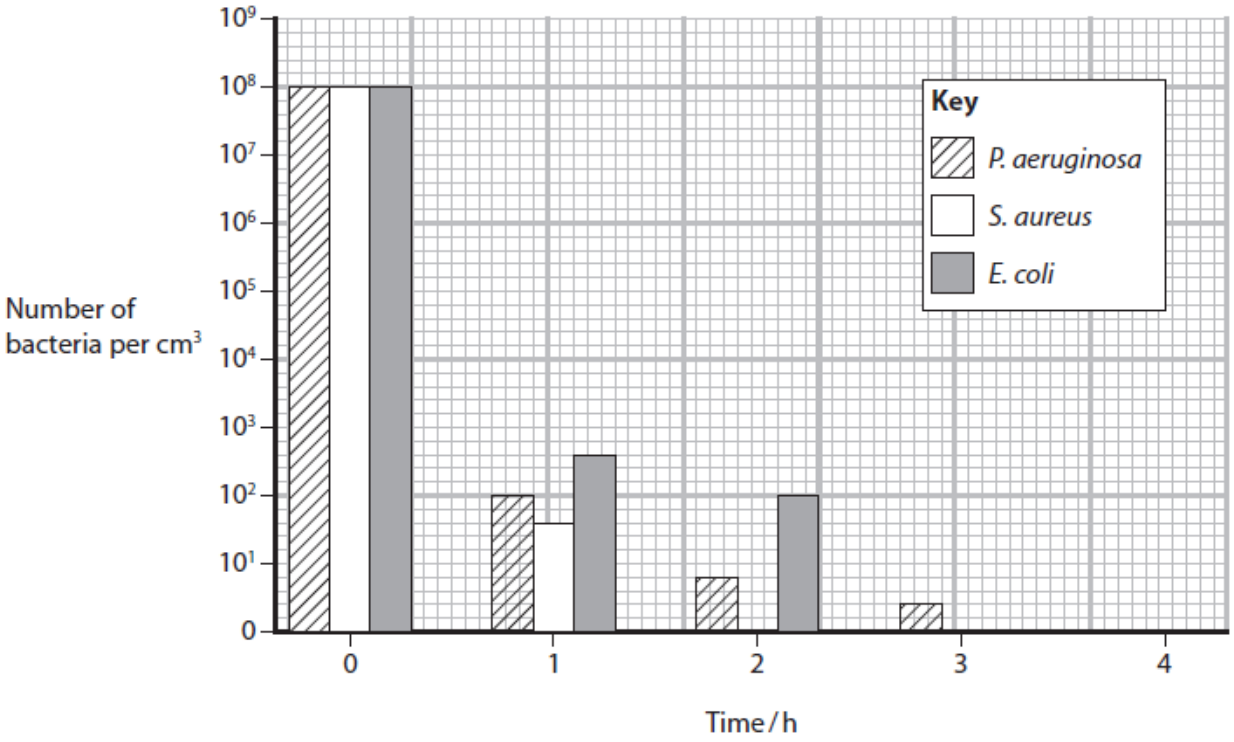
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(ii) In this investigation, living bacteria of each species were exposed to UV radiation for four hours.

The numbers of living bacteria were counted each hour during the four-hour period.

The graph shows the results of this investigation.



Calculate the percentage change in numbers of living *E. coli* after two hours of exposure to UV radiation.

(2)

Answer ..... %

(iii) A student concluded from this investigation that if food is exposed to UV radiation, it would remove all risk of food poisoning.

Criticise the validity of this conclusion.

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(Total for question = 9 marks)

Q8.

Antibiotics can affect bacteria.

The table describes the mode of action of four antibiotics.

Antibiotic	Mode of action
benzylpenicillin	disrupts peptidoglycan structure
streptomycin	binds to 70S ribosomes
ciprofloxacin	inhibits enzymes involved in prokaryotic DNA replication
rifamycin	inhibits prokaryotic RNA polymerase

A student compared the effectiveness of these four antibiotics on the growth of bacteria.

Devise a method that the student could use to obtain valid results.

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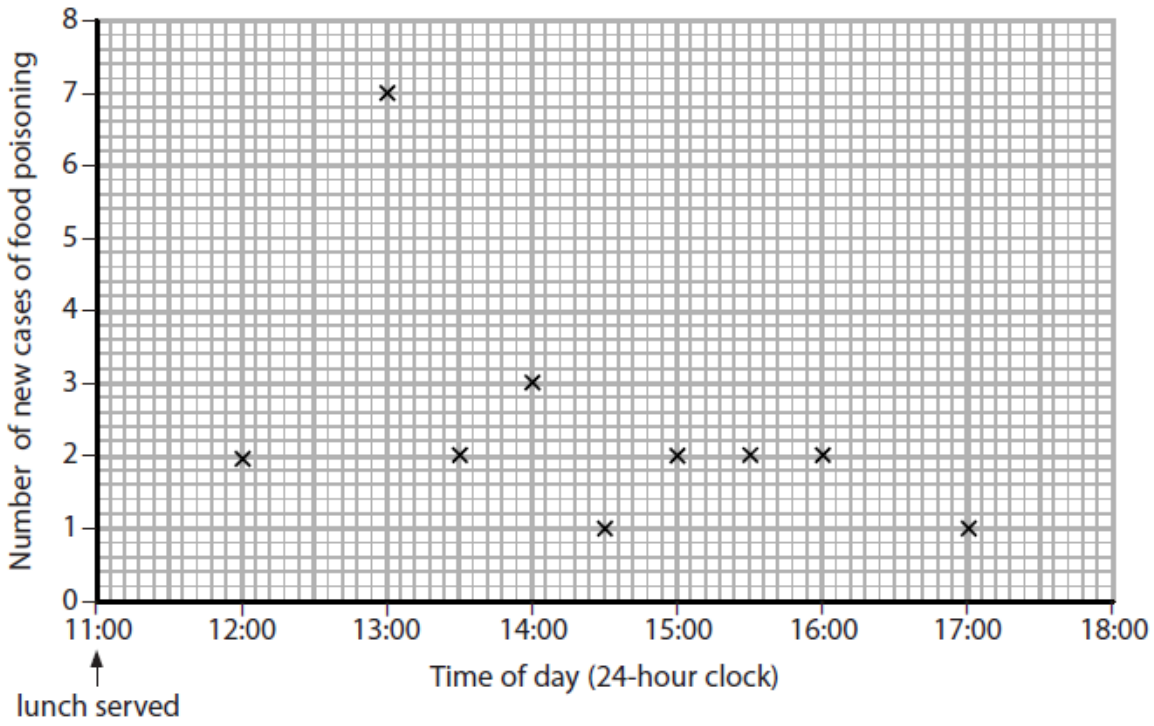
(Total for question = 5 marks)

Q9.

Food poisoning can be caused by food that is contaminated with pathogenic microorganisms.

A number of different bacteria can cause food poisoning.

The graph shows the number of new cases of food poisoning after a lunch party.



(i) Explain why it is likely that this food poisoning resulted from food contaminated with *Staphylococcus* rather than with *Salmonella*.

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(ii) Describe the techniques microbiologists could use to confirm that this food poisoning was caused by *Staphylococcus*.

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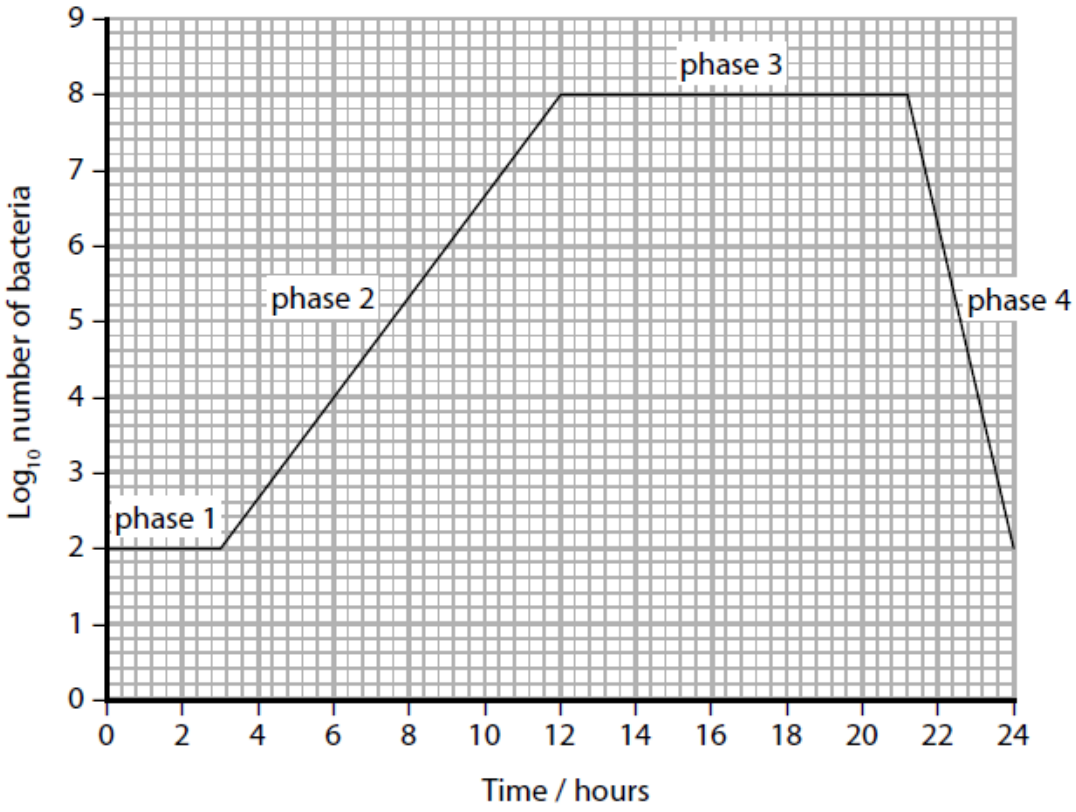
(Total for question = 7 marks)

Q10.

A broth culture for growing bacteria was set up.

Dilution plating was used to determine the number of live bacteria in the culture over a period of 24 hours.

The graph below shows the number of live bacteria in the culture during this 24-hour period.



(a) Which is the correct order of the phases 1 to 4 shown on the graph?

(1)

☒ **A** lag, log, death, stationary

☒ **B** lag, log, stationary, death

☒ **C** log, lag, death, stationary

☒ **D** log, lag, stationary, death

*(b) Evaluate the use of dilution plating and optical methods for determining the number of bacterial cells in a culture.

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(c) Calculate the growth rate constant (k) for phase 2 of this culture, using the formula:

$$k = \frac{\log_{10} N_t - \log_{10} N_0}{0.301 \times t}$$

(4)

Answer .....

(Total for question = 11 marks)

Q11.

Salmonella are Gram negative bacteria found in the large intestine of humans.

A scientist studied the growth of *Salmonella*.

(i) *Salmonella* was isolated from a mixed culture of bacteria, using streak plating onto selective media.

Explain why this is a suitable method for isolating the *Salmonella*.

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(ii) The scientist made a broth culture of *Salmonella* at a concentration of 5×10^3 cells per cm^3.

Ten hours later the concentration of *Salmonella* was 4×10^6 per cm^3.

Calculate the exponential growth rate constant (k) for this culture of *Salmonella* using the formula

(3)

$$k = \frac{\log_{10} N_t - \log_{10} N_0}{0.301 \times t}$$

Answer .....

(iii) In this calculation, the scientist did not allow for the time that the *Salmonella* spent in the lag phase.

Explain the effect that this will have on the calculated value for the growth rate constant.

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(Total for question = 10 marks)

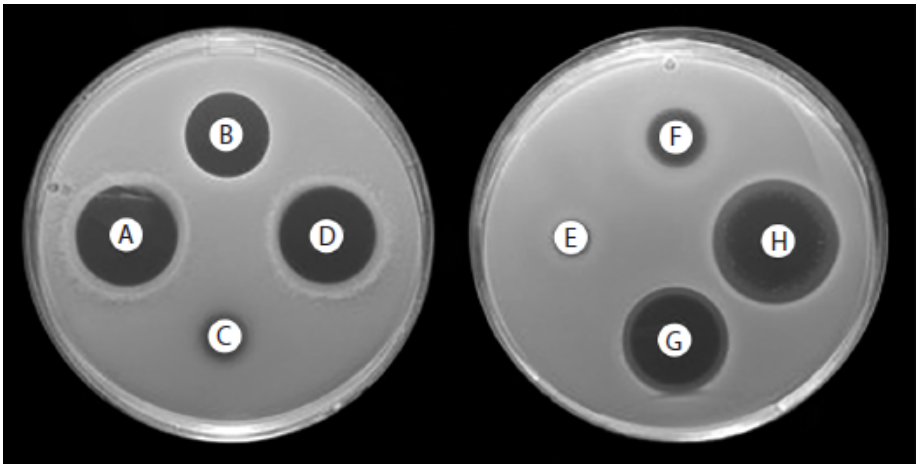
Q12.

A student read that more than half of raw chickens on sale in supermarkets are contaminated with bacteria from the genus *Campylobacter*.

Some species of *Campylobacter* cause food poisoning in humans.

The student carried out an experiment to test the effectiveness of various antibiotics against *Campylobacter*.

The photograph shows the student's agar plates at the end of the experiment.



The white circles labelled A–H are filter paper discs. These discs were soaked in different antibiotics then placed on the surface of the agar.

Explain how the student's method could ensure that the results from the two agar plates can be compared.

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Q13.

Salmonella can cause severe vomiting and diarrhoea.

Public health laboratories use the Salmonella Rapid Culture technique to confirm a *Salmonella* infection.

This can accurately identify *Salmonella* as purple stained colonies within 48 hours.

Previous methods for the identification of *Salmonella* infections took four days.



Explain why it is important that aseptic technique is used when carrying out the Salmonella Rapid Culture technique.

(2)

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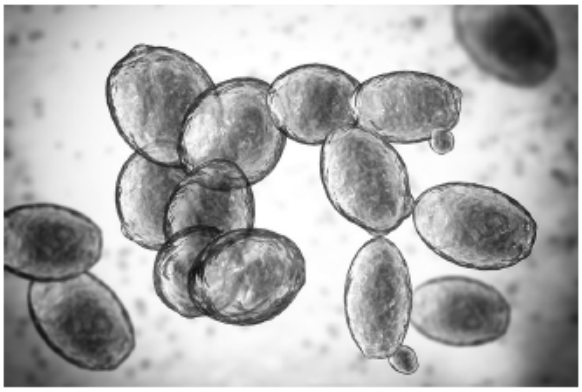
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Q14.

Yeast, *Saccharomyces cerevisiae*, is a single-celled organism used in brewing and baking.

The photograph shows yeast cells seen using a light microscope.



(Source: © Kateryna Kon/Shutterstock)

A student counted the number of yeast cells, at 90-minute intervals, growing in a liquid culture at 30°C.

Describe two precautions that would prevent the yeast culture becoming contaminated with bacteria.

(2)

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(Total for question = 2 marks)

Q15.

Yeast, *Saccharomyces cerevisiae*, is a single-celled organism used in brewing and baking.

The photograph shows yeast cells seen using a light microscope.



(Source: © Kateryna Kon/Shutterstock)

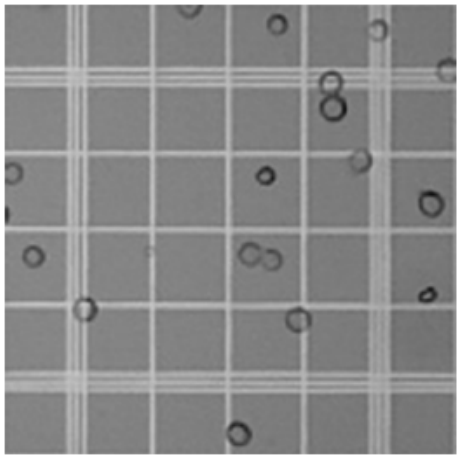
A student counted the number of yeast cells, at 90-minute intervals, growing in a liquid culture at 30°C.

The student counted the yeast cells using a haemocytometer.

This is a slide with chambers containing a known volume of liquid. The yeast cells are counted when viewed using a light microscope.

Any yeast cells totally within the counting square should be counted, along with those which overlap the top or left-hand side of the square.

(i) The volume of liquid in the counting square shown is 0.004 mm^3 .



(Source: © Joseph Elsbernd/Flickr)

Calculate the number of yeast cells per mm^3.

Give your answer in standard form.

(2)

Answer ..... per mm^3

(ii) Identify two causes of inaccuracy in this method of counting cells.

(2)

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(Total for question = 4 marks)