Bio Factsheet

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Answering Questions: Growth of Organisms

Even if microbiology is not on your specification, you may still face a question about the growth of bacteria/yeast/algae etc in the exam! Why? Because the examiners aren't really testing your knowledge of microbiology – they are testing your:

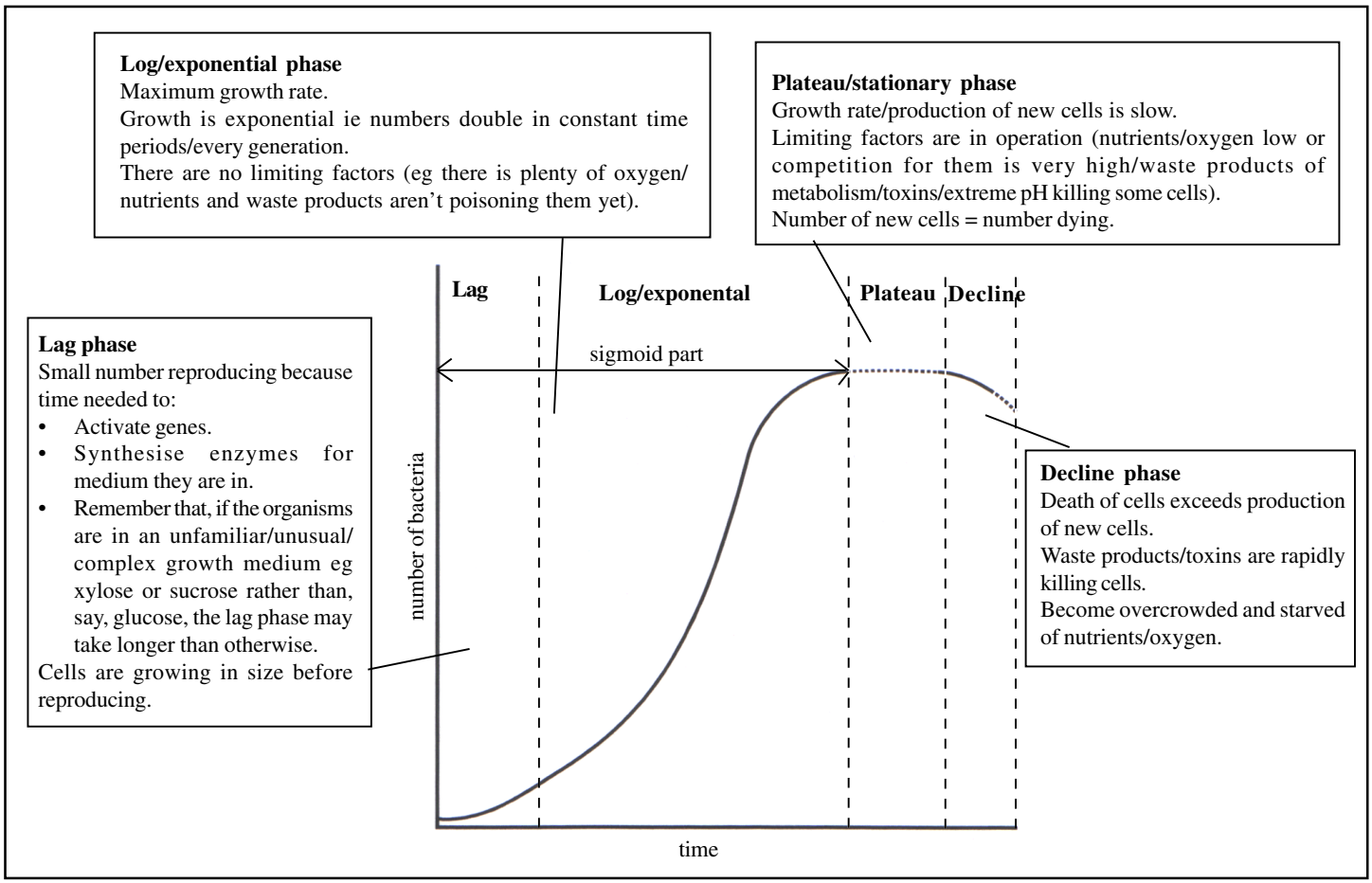
- Knowledge of limiting factors.
- Ability to ***apply*** scientific principles (fair tests, enzyme activity, technology etc).
- Ability to interpret data (tables, figures, graphs etc).
- Mathematical ability.

This Factsheet summarises the types of questions that have appeared on the exams of all the specs over the last 4 years.

1. Growth curves

This is a common and straightforward question. You usually get a graph of the growth of a microorganism.
The usual question is " Explain the shape of the curve". Often, you are asked to focus on the sigmoid part of the curve.
It really doesn't matter what the organism is – bacteria, fungi, algae, whatever, the underlying principles are the same (Fig 1).

Fig 1. Growth rate curve

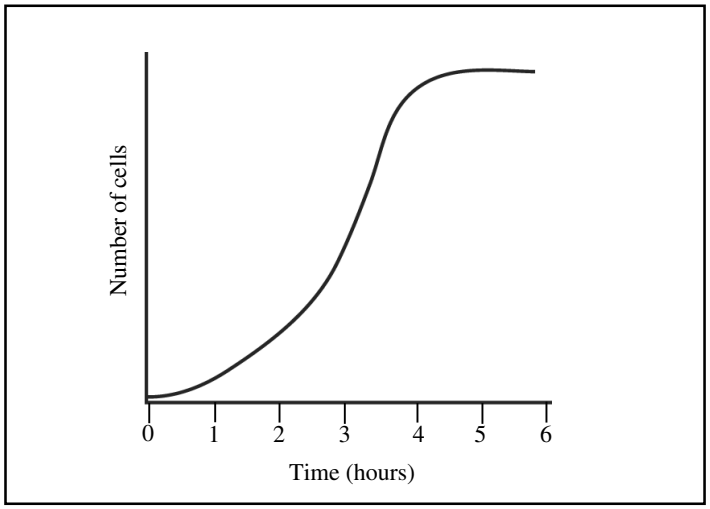


Exam Hints

1. Do not go into the exam without knowing every bit of this graph off by heart!
2. Use the technical terms (sigmoid/exponential/limiting factors etc. They will be on the markscheme and it stops you waffling. Avoid writing things like " In the log phase numbers increase" "In the decline phase disease spreads rapidly and they run out of space." This is too vague. Make your points with the precision shown in the annotations in Fig 1.
3. Don't be put off if the y axis doesn't show numbers/population. There are other ways of measuring microorganisms e.g. chlorophyll concentration for algae, turbidity (cloudiness) for almost any microorganisms

You might be asked to calculate the growth rate of the cells over a particular period, for example between 2 and 4 hours on Fig 2

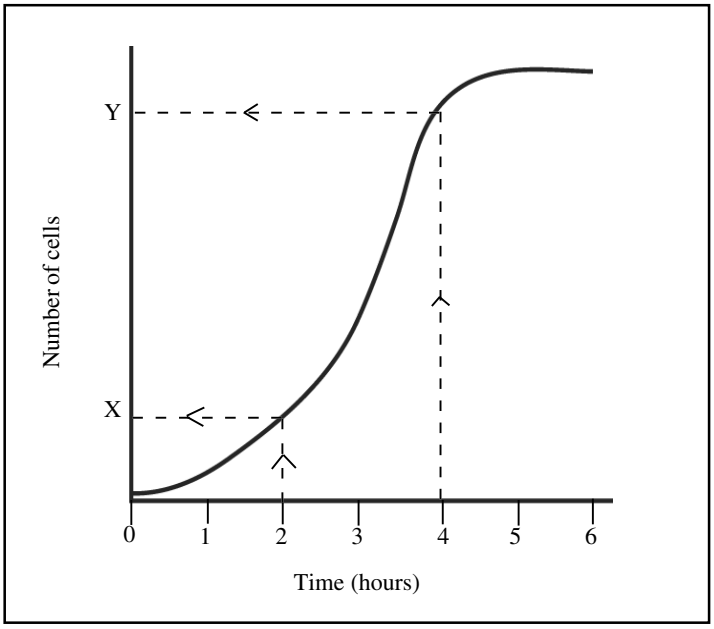
Fig 2.



To do this:

1. First work out how many new cells have been produced by drawing lines up to the curve and then across (Fig 2b)

Fig 2b.

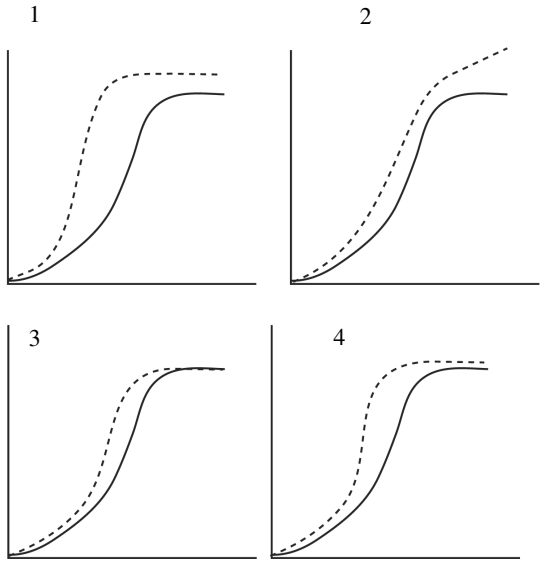


The number of new cells is given by: y-x
Then you simply divide by the number of hours (2) to give the growth rate per hour

So far, so good. You just have to learn the facts and practice drawing ruler lines on graphs. However, you may be asked to apply your knowledge of other areas to this graph.

Example: Question 1
"Sketch the growth curve you would expect if the temperature of the medium was increased/decreased from the optimum temperature".
You have to be very careful here!

Here are some typical sketches from students (dotted lines) who were asked to sketch the curve if the temperature of the medium had increased.



Which student(s) would get the mark?

Only student 3
Key points:
The origin must be identical
The log phase must be to the left and steeper
The plateau must be the same – we don't get more bacteria at a higher temperature, we just get the maximum population faster

Example: Question 2
"Why are bacteria most susceptible to antibiotics during the log/ exponential stage?"
When you get questions like this – questions that make you think I don't know/We haven't done it! - the key point is not to panic. You can work it out by thinking about what is happening.

In the log phase the number of cells is increasing rapidly
So think about what the bacteria are doing
They are replicating asexually and rapidly
New cells means (i) DNA replication (ii) protein synthesis (iii) new cell walls

So, the antibiotic could affect these processes
During the log phase the bacteria are doing all of these things very rapidly. They are absorbing substances from the medium very rapidly – including the antibiotic

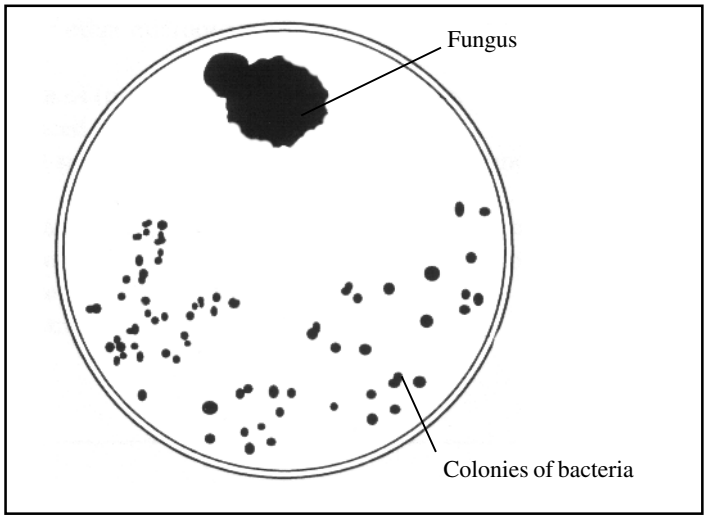
Questions like this are application questions and are used to differentiate between candidates ie sort out who gets the C grade, who gets the B etc. Don't be phased by them, they are usually straightforward if you stay calm.

2. Antibiotics

Examiners like to use historical material – it helps us to see that relatively simple investigations and good observation skills have been crucial in the development of our scientific knowledge. Antibiotics are a good example of this.

In 1928 Alexander Fleming was busy growing the bacterium *Staphylococcus aureus* on agar plates.
He noticed that some plates had been contaminated with the fungus *Penicillium* (Fig 3).

Fig 3



The question that you are asked depends on whether antibiotics are explicitly mentioned on your spec.

If they are, the question may be: " Explain why bacteria did not grow near the fungus".

If they aren't the question will be "Suggest why bacteria did not grow near the fungus".

Suggest always means " make something up that is biologically sensible and that relates to material that ***is*** on the spec".

The answer is the same to both questions: The fungus produced a chemical (an antibiotic, in this case, Penicillin) that kills or inhibits the growth of the bacteria.

Once you have understood this, most questions on the growth of bacteria on plates are straightforward.

The typical questions involve:

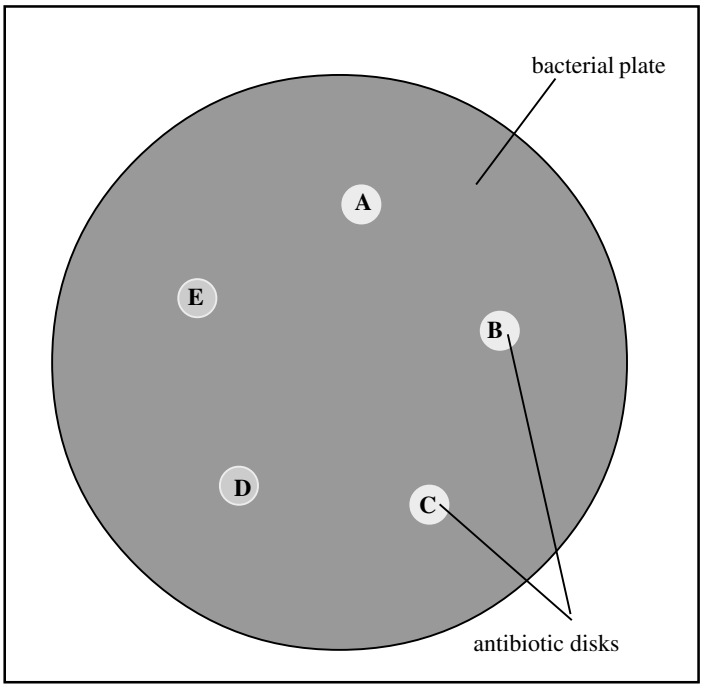
1. Adding different concentrations of an antibiotic to plates of bacteria.

Generally, the higher the concentration, the more bacteria will be killed. However, you may be asked why some bacteria survive even at the highest concentration. The answer is that these bacteria have a natural resistance to the antibiotic or that the antibiotic did not reach these bacteria. Never use or refer to the word ***immunity*** as in " the bacteria were naturally immune" – bacteria do not have an immune reaction, the word is ***resistance.***

2. The effect of different antibiotics on plates of bacteria

The usual technique is to add antibiotics to discs of filter paper and then to arrange the discs on to the bacterial plate (Fig 4).

Fig 4

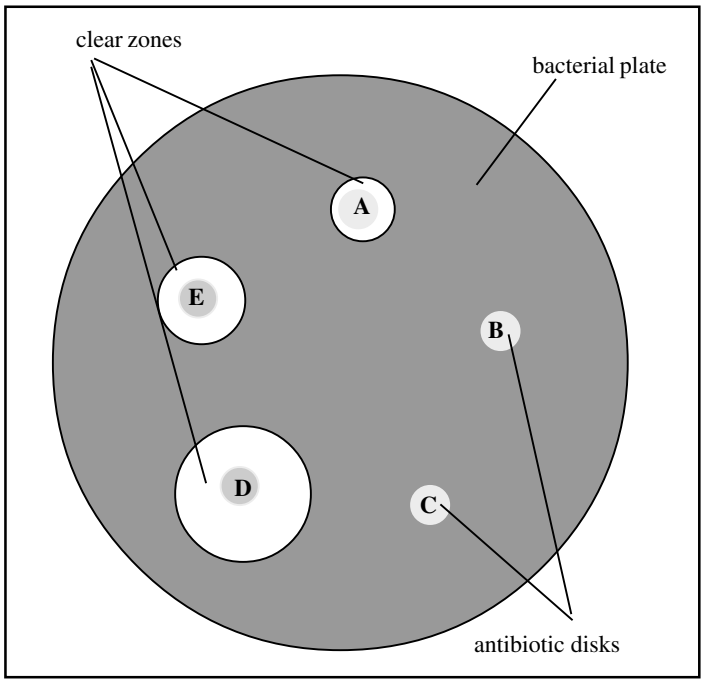


The antibiotics may inhibit the growth of the bacteria by:

- Preventing/interfering with cell wall synthesis
- Preventing/interfering with protein/nucleic acid synthesis
- Disrupting cell membrane function

The principle then is that, if the antibiotic does do this, a clear area will form in the agar. The bigger the clear area, the more bacteria have been killed/the more effective is the antibiotic (Fig 4b)

Fig 4b



Acknowledgements: *This Factsheet was researched and written by Kevin Byrne.* ***Curriculum Press, Bank House, 105 King Street, Wellington, Shropshire, TF1 1NU.***