Approaches to data-based questions

Germán Tenorio explains how to tackle data-based exam questions

Paper 2 of the IB biology external assessment is characterised by the data-based question, which is worth around 20% of the marks. So how should you approach this vital question?

The marks achieved by any SL candidate in paper 2 will be decisive for their final grade, as it is worth twice as much as any other assessment component. At higher level (HL), paper 2 accounts for 36% of the final grade. It is therefore worth taking a look at this assessment in more detail.

There is one data-based question in paper 2, in section (a), and it is worth around 20–25% of the total grade for this paper. Obviously, the more confident you are with data-based questions, the higher probability there is of you obtaining a higher grade in paper 2, which is the paper with the heaviest weight.

In my experience as a paper 2 examiner and IB teacher, many students tend to struggle with data-based questions, affecting their performance on paper 2 and consequently their overall grade in biology. As there are also a couple of short-answer questions on paper 3 that use data, it is definitely worth having a good understanding of how to approach this kind of question.

Practice question

There are a few tips that you should keep in mind when tackling data-based questions. Some of them are related to command terms, while others are more focused on mathematical skills etc. but all of them are equally important for your success.

Imagine that you run into the following data-based question in paper 2:

Hypertension is a disease of the circulatory system that is becoming more and more frequent in Europe. A study was carried out in rats with hypertension to examine the effects of a new drug on it.

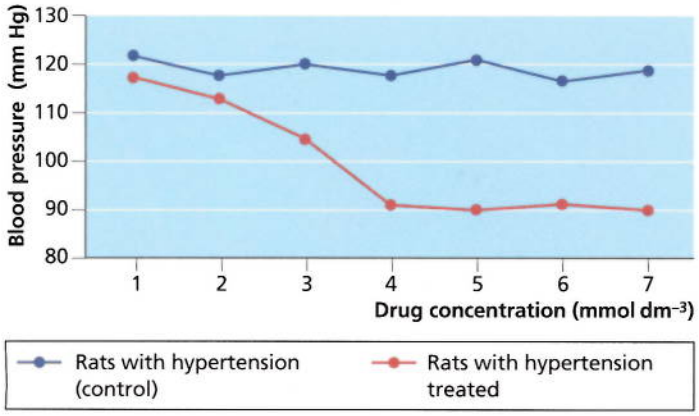


Figure 1 Effect of a new drug on the blood pressure of rats

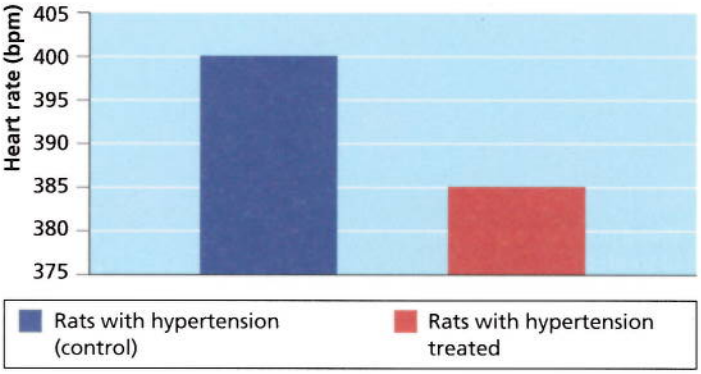


Figure 2 Effect of a new drug on the heart rate of rats

A group of adult male rats with hypertension were treated with different concentrations of a new drug. Similarly, another group of adult male rats with hypertension were treated with a placebo as a control.

Figure 1 shows the blood pressure in rats depending on the concentration of drug used.

a **Suggest one benefit of using rats as models instead of other organisms in this experiment.** (1 marks)

b **Outline the effect of the new drug on rats.** (2 marks)

c **Distinguish between the control group and the treated rats.** (3 marks)

In addition, scientists also wanted to find out the effect of the drug on heart rate. Figure 2 shows the heart rate for both groups of rats with a concentration of 4 mmol dm^{-3}.

d **Calculate the percentage decrease in heart rate between both groups of rats.** (2 marks)

Let's take into account the following advice in order to answer the above questions.

Marks in brackets

In data-based questions, the number of marks usually varies from 1 to 3 for each question, which tells you how many pieces of different information you have to give in your answer. One mark does not mean that there is only one correct answer, but it does mean that you only have to give one correct piece of information.

There are several correct answers for question (a), such as: 'small size', 'short life cycle', 'better than higher mammals due to ethical issues'. You only need to write one of these to get the mark.

Questions and activities

Use the data from Figures 1 and 2 to create the other types of graph listed in the article.

Two marks means that you have to give at least two different pieces of information in your answer. A common mistake that students make is to say the same thing in two different ways. For example, in answer to question (b):

> I can see from the graph that there is a negative relationship between blood pressure and drug concentration. In addition, the higher the concentration of the drug, the lower the blood pressure.

Apparently, this student is saying two things in order to meet the number of marks in the brackets. However, this student is really just saying the same thing twice. They are not coming up with two different conclusions from the graph, just one, and for this reason they would only be awarded 1 mark.

An example of an answer that provides two different pieces of information from the graph and would have received 2 marks for question (b) is:

> I can see from the graph that there is a negative relationship between blood pressure and drug concentration. Nevertheless, this relationship occurs up to a concentration of 4 mmol dm^{-3}, as a plateau can be seen at higher concentrations.

Similarly, you must provide three different pieces of information in order to obtain all the marks for a 3-mark question.

Command terms

The **command terms** are the key terms and phrases used in examination questions. You can find the IB glossary of command terms for biology at **www.tinyurl.com/ybshje6c**

You need to know these command terms in depth, especially those related to data-based questions. You can't afford to waste marks because you do not know what the question is asking. Most students tend to describe what they can see in a graph step by step instead of saying what they can conclude from it. Let's suppose a student answers the following for question (c):

> First, blood pressure decreases in treated rats from around 118 to 90 and then stays around 90 mm Hg. Second, blood pressure in control rats always keeps between 115 and 120.

Theory of knowledge

1 What are the consequences of various ways of illustrating data?
2 What is the role of the mathematical skills in scientific experimentation?
3 To what extent are graphs the best way of communication in science?

In data-based questions, you must find trends or patterns in graphs, avoiding numerical descriptions of the graph. In this case, the command term 'distinguish' involves pointing out differences between both groups of rats, but remember that these should be differences in patterns rather than in specific numbers. A much better answer for question (c) would be:

> First, blood pressure decreases in treated rats up to a concentration of 4 mmol dm^{-3}, but it keeps constant at higher concentrations. Second, blood pressure in control rats does not change, staying more or less steady. Overall, blood pressure in control rats is always higher than in treated rats throughout the experiment.

As you can see, three different pieces of information have been given in order to meet the number of marks for the question. Additionally, instead of describing the graph, the differences between the pattern for each group of rats have been drawn.

Different types of graphs

Many difficulties that students experience when answering data-based questions are related to the type of graph they have to understand. Although line graphs and bar charts appear the most frequently in exams, students must also know how to read or interpret information from other types of graphs.

You need to be confident with all of the following types of graphs:

- line graphs
- bar charts
- histograms
- pie charts
- box and whiskers
- scattergraphs

The more you work on these graphs, the higher the probability of improving your grade in paper 2.

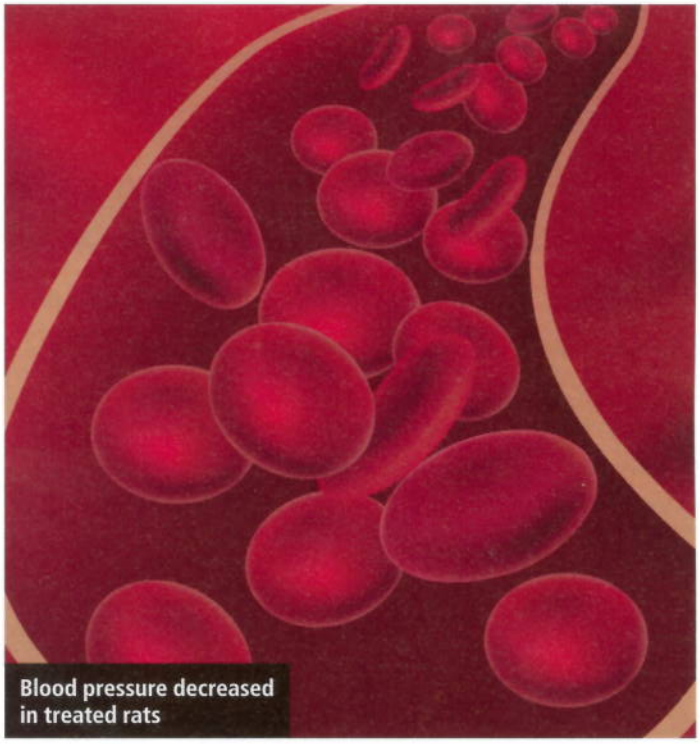
Mathematical skills

Data-based questions usually include a couple of questions where you have to apply some kind of mathematical skills. Although these skills are based on basic calculations, you still need to work on them in order to avoid losing marks from these questions. For example, students commonly struggle with questions that require them to calculate the percentage of an increase or decrease.

There is a basic formula that can be used for calculating percentage decreases:

$$\% \text{ change} = \frac{\text{Difference between original value and new value}}{\text{Original value} \times 100}$$

Note that this formula is used for calculating a decrease, as the new value is lower than the original one. If the new value were higher than the original, then we would calculate the percentage increase with this formula:



Blood pressure decreased in treated rats

$$\% \text{ change} = \frac{\text{Difference between new value and original value}}{\text{Original value} \times 100}$$

For our example, question (d) is an increase, so we can say that:

$$\% \text{ change} = \frac{\text{Difference between control value and treated group value}}{\text{Original value} \times 100}$$

The calculation for question (d) would be:

$$\frac{(400 - 385)}{400} \times 100 = \frac{1500}{400} = 3.75\%$$

A useful tip is to check if the result makes sense to you. We can see from the graph that the decrease is from 400 to 385, which is quite small. From 400 to 300 would be 25% and from 400 to 350 would be a decrease of 6.25%, so it makes sense that our result is lower than that value.

Final consideration

Over the past few years, the IB biology examiners' report has said many students have had difficulties in answering the data-based questions in section (a) of paper 2. Although you do not know what questions are coming up in the rest of the exam, you do know in advance that the first question in section (a) of paper 2 is always a data-based question — so get ready for it. You can't afford to lose marks because you are not familiar with this type of question.

Hopefully you now have a better insight into how to answer data-based questions. If you make the most of the tips given here, you will have a better chance to succeed in paper 2, the paper with the highest impact on your overall grade in biology. As you prepare for your exams, make sure you are familiar with and feel confident when approaching data-based questions.

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