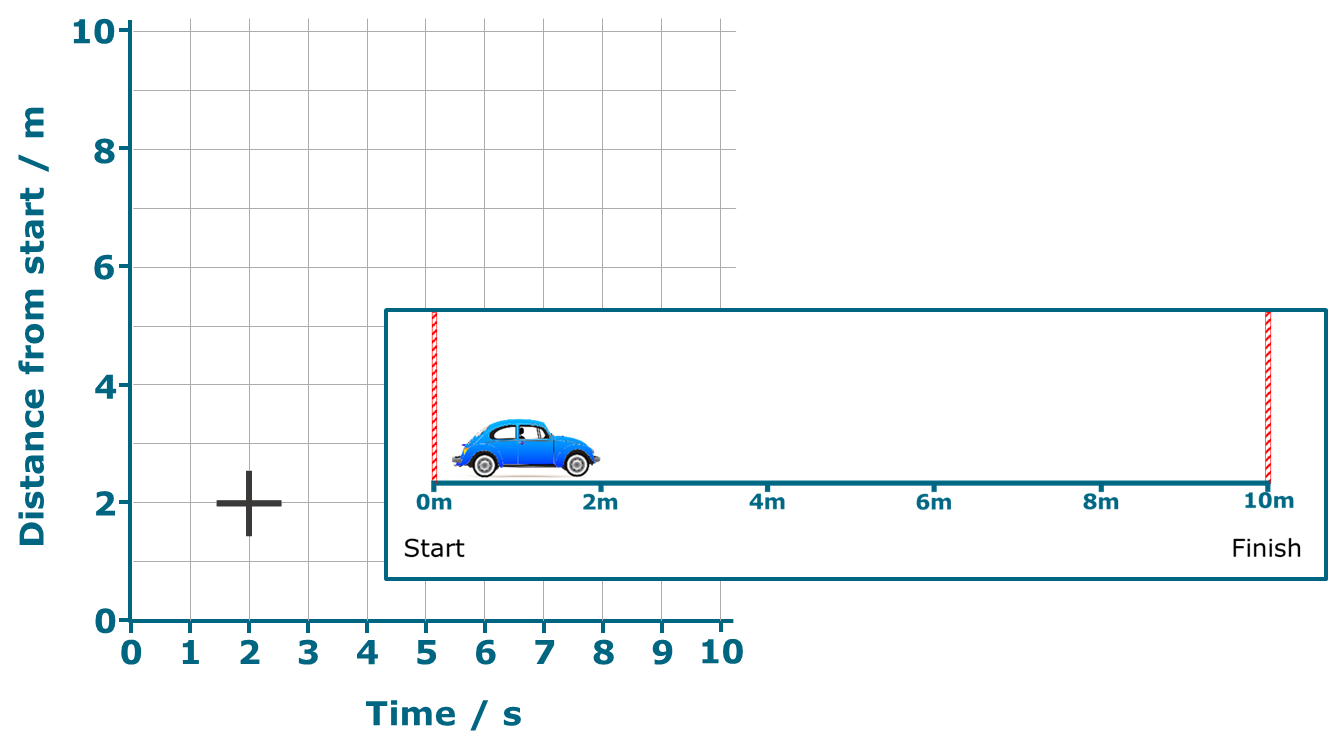
**Plot story**

A car moves along a line.

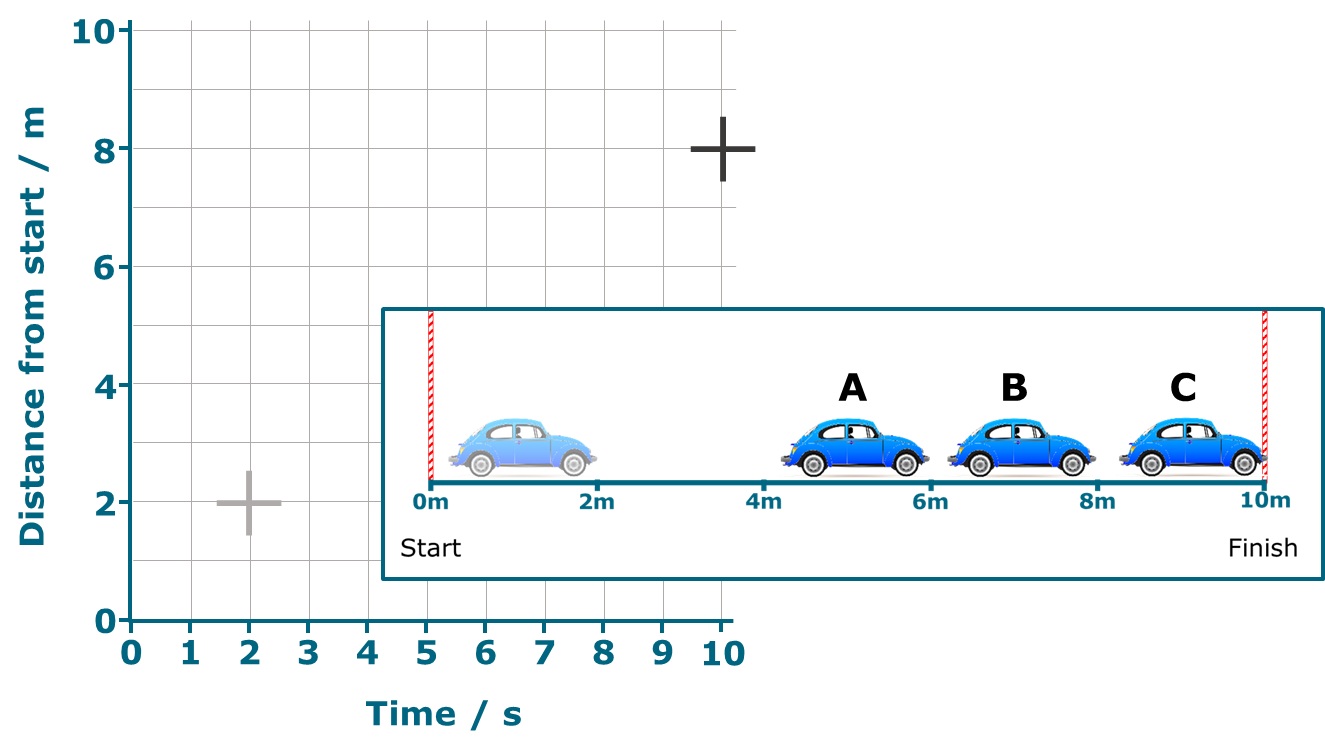
A graph is plotted to represent its motion.

The picture of the car shows what this plot represents.



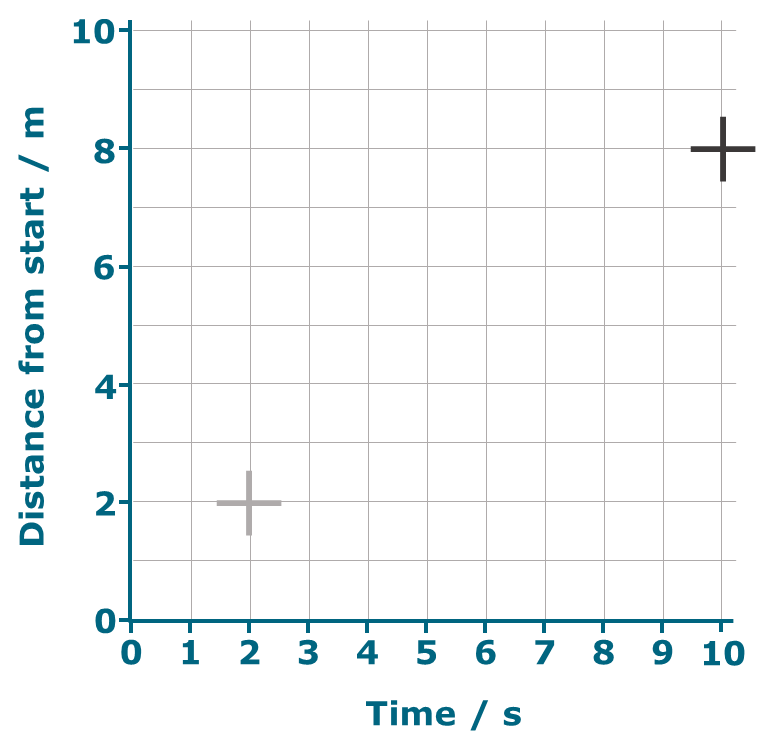
**1.** Which car does the **new** plot represent?

Put a tick (✓) in the box next to the best answer.



**2.** The plots on the graph represent a change.

Which statement best describes the change?



Put a tick (✓) in the box next to the best answer.

|  |  |  |
| --- | --- | --- |
| **A** | Car moves forward 8m in 10s |  |
|  |  |  |
| **B** | Car moves forward 8m in 8s |  |
|  |  |  |
| **C** | Car moves forward 6m in 10s |  |
|  |  |  |
| **D** | Car moves forward 6m in 8s |  |

*Physics > Big idea PFM: Forces and motion > Topic PFM2: Moving by force > Key concept PFM2.2: Motion graphs*

|  |
| --- |
| **Diagnostic question** |
| **Plot story** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Information about the motion of an object can be summarised on a distance-time graph: the plot shows the object’s distance from the start at a given time and the slope (gradient) at that point shows its speed. |
| Observable learning outcome: | Describe the changes to an object represented by a move from one point on a distance-time graph to another |
| Question type: | Simple multiple choice |
| Key words: | Distance, time, graph |

**What does the research say?**

Often text books (and teachers) put great attention on the procedures for plotting graphs and calculating gradients, rather than developing understanding of relationships that a graph shows (Stump, 1999). It can be more constructive to concentrate on the latter, which involves teaching:

* understanding of how to read information directly from a graph, interpreting each axis individually
* how to describe simple relationships between the axes such as those represented by straight lines
* how to interpret a graph, linking what it represents to a real situation (Friel, Curcio and Bright, 2001; Lingefjard and Farahani, 2018)

This question investigates students’ understanding of how plots on a graph represent the physical position of a moving object and how a line on a graph represents its motion.

**Ways to use this question**

Students should complete the questions individually. This could be a pencil and paper exercise, or you could use an electronic ‘voting system’ or mini white boards and the PowerPoint presentation.

The answers to the questions will show you whether students understood the concept sufficiently well to apply it correctly.

If there is a range of answers, you may choose to respond through structured class discussion. Ask one student to explain why they gave the answer they did; ask another student to explain why they agree with them; ask another to explain why they disagree, and so on. This sort of discussion gives students the opportunity to explore their thinking and for you to really understand their learning needs.

*Differentiation*

You may choose to read the questions to the class, so that everyone can focus on the science. In some situations it may be more appropriate for a teaching assistant to read for one or two students.

**Expected answers**

1. B 2. D

**How to respond - what next?**

Question *1* investigates students’ understanding of how the axes of a graph relate to a physical situation and their ability to read values accurately from an axis. It is common for students to use intuition to interpret a graph, rather than a methodical reading and interpretation of axes. Car C indicates students who have read the wrong scale, and car A those who have interpreted the picture as showing the change from the first plot, rather than absolute values of position.

Question *2* investigates students’ understanding of how a graph represents change. Answer A indicates students who have read values for the position of the second plot without reference to the initial plot. Students selecting answers B or C have done this for one of the axis, and worked out the correct change for the other one.

If students have misunderstandings about describing the changes to an object represented by a move from one point on a distance-time graph to another, it can help to rehearse the strategy, when interpreting a graph, of always reading the labels on each axis first. On the graph used in this question, the second plot should be read as ‘at a time of 10 seconds, the distance from the start is 8m’.

This strategy can be consolidated by giving students practice at describing plots on a range of graphs, each with different variables shown on their axes. Using some graphs that are identical to each other except for the labels on the axes, can reinforce the idea that it is essential to read the labels on the axes in order to interpret a graph.

The following BEST ‘response activity’ could also be used in follow-up to this diagnostic question:

* Response activity: speedy graphs

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: Peter Fairhurst (UYSEG), car: https://pixabay.com/en/car-vehicle-make-blue-little-953357/

**References**

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