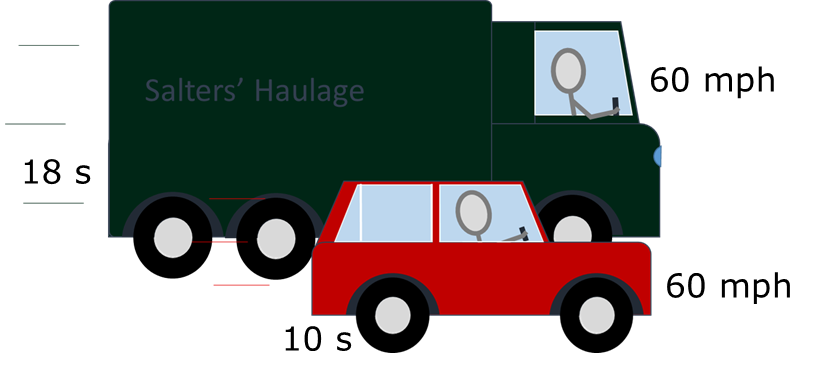
**Biggest acceleration**

1. On the motorway slip road a car and a lorry both speed up from 0 to 60 miles-per-hour.

The car reaches 60 mph in 10 seconds.

The lorry reaches 60 mph in 18 seconds.



**a.** Which has the biggest acceleration?

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

|  |  |  |
| --- | --- | --- |
| **A** | Car |  |
|  |  |  |
| **B** | Lorry |  |
|  |  |  |
| **C** | Both the same |  |

**b.** What is the **best** reason for your answer?

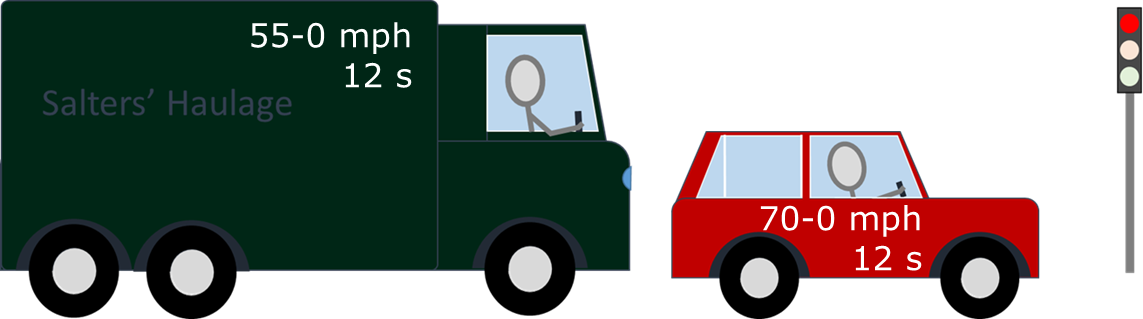
Put a tick (✓) in the box next to the best answer.

|  |  |  |
| --- | --- | --- |
| **A** | They both reach 60 mph |  |
|  |  |  |
| **B** | The car reaches 60 mph in a shorter time |  |
|  |  |  |
| **C** | The lorry weighs a lot more than the car |  |
|  |  |  |
| **D** | The car is designed to go fast |  |

2. Coming off the motorway a lorry slows from 55 mph to a stop in 12 seconds.

A car coming off the motorway is travelling at 70 mph.

The car also slows to a stop in 12 seconds.



**a.** Which has the biggest acceleration?

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

|  |  |  |
| --- | --- | --- |
| **A** | Car |  |
|  |  |  |
| **B** | Lorry |  |
|  |  |  |
| **C** | Both the same |  |
|  |  |  |
| **D** | They are not accelerating |  |

**b.** What is the **best** reason for your answer?

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

|  |  |  |
| --- | --- | --- |
| **A** | They both slow to a stop |  |
|  |  |  |
| **B** | The lorry weighs a lot more than the car |  |
|  |  |  |
| **C** | The speed of the car changes more in the same time |  |
|  |  |  |
| **D** | Before it slowed down the car was going faster than the lorry |  |

*Physics > Big idea PFM: Forces and motion > Topic PFM2: Moving by force > Key concept PFM2.1: Describing speed*

|  |
| --- |
| **Diagnostic question** |
| **Biggest acceleration** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Speed is a measure of how fast an object travels: how far it goes in a given time |
| Observable learning outcome: | Identify when speed is changing the most quickly and acceleration is biggest |
| Question type: | Diagnostic, two-tier multiple choice |
| Key words: | Acceleration, speed |

**What does the research say?**

Introducing and rehearsing vocabulary that allows students to describe observations accurately is an essential first step towards understanding motion. Students do not usually make a clear distinction between speed and acceleration. Often students do not use the word acceleration outside of their science lessons, and instead talk about speeding up or slowing down. Acceleration may be seen as ‘going fast’ (Driver et al., 1994).

These questions are designed to investigate students’ understanding of acceleration when objects are either speeding up or slowing down.

**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 follow on question will give you insights into how they are thinking and highlight specific misunderstandings that some may hold.

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**

1a. A 1b. B 2a. A 2b. C

**How to respond - what next?**

Q1. The car has the most acceleration because it reaches 60 mph in a shorter time. Some students may confuse acceleration for how fast the vehicles are going and choose answers C, A. If students choose the lorry, they are probably thinking of acceleration as a pushing force, which is confirmed with answer C for part b. Answer D for part b indicates students who are choosing an answer based on past experience rather than working it out from the evidence provided.

Q2. The car has the biggest acceleration because it slows down more in the same amount of time. Answer D for part b is correct, but is only a partial explanation. Answers B, B suggest students are thinking of the force needed to slow the lorry. Answers C, A shows that students are considering the end point only. It is quite common for students to ignore the time involved in speeding up and slowing down.

The correct reasons given in these answers define acceleration in two different and complementary ways.

If students have misunderstandings about identifying acceleration in different situations, it can help to discuss with the class what happens to a car when it accelerates. It is easy to find video clips of cars accelerating that describe acceleration in terms of the time it takes to speed up from 0-60 mph, say. Discussing what this means in pairs or small groups could encourage social construction of new ideas through dialogue. Giving students the opportunity to write a definition of acceleration in their own words can consolidate learning and check individual understanding. This can be extended to explain why slowing down is also acceleration.

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

* Response activity: Is it accelerating?

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: Peter Fairhurst (UYSEG).

**Reference**

Driver, R., et al. (1994). *Making Sense of Secondary Science: Support Materials for Teachers,* London: Routledge.