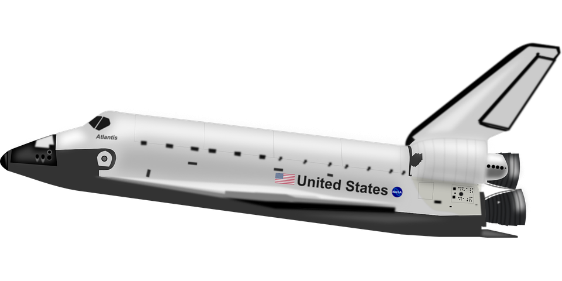
**Moving things**



All of these things are moving.





Which statement is the odd one out?

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

|  |  |  |
| --- | --- | --- |
| **A** | Miles a car travels in one hour |  |
|  |  |  |
| **B** | Kilometres a space craft travels in one second |  |
|  |  |  |
| **C** | Metres an athlete runs each second |  |
|  |  |  |
| **D** | Hours a minibus takes to complete a journey |  |
|  |  |  |
| **E** | Centimetres a snail crawls each minute |  |

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

|  |
| --- |
| **Diagnostic question** |
| **Moving things** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Speed is a measure of how fast an object travels: how far it goes in a given time |
| Observable learning outcome: | Calculate the average speed of an object using speed = distance ÷ time |
| Question type: | Simple multiple choice |
| Key words: | Speed |

**What does the research say?**

Making sure that students have a clear qualitative understanding of speed is necessary before introducing quantitative approaches (Driver et al., 1994a). ‘[Students] need more than a routine manipulation of numbers. They need to think of an object at a greater speed both getting to a particular point in a shorter time and going further in the same time, so as to have an understanding of the practical implications of speed as distance covered in a unit time.’ (Driver et al., 1994b)

When dividing distance by time to calculate average speed different units are involved that combine to form a *compound measure*. For example, if a ball rolls 8 metres along the ground in 2 seconds, its average speed can be calculated. Here, the division has been done in two steps for emphasis – first the units and then the numbers.

In science, it is good practice always to include units as part of the calculation, in order to keep track of what the numbers mean. (Boohan, 2016)

This question checks students’ qualitative understanding of speed as a measure of distance per unit time, in order to make sure they are ready for calculating averaged speeds.

**Ways to use this question**

Students should complete the question 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 question 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**

Answer **D**

**How to respond - what next?**

Statement D is the odd one out because it describes time rather than speed. Some students may think it does describe speed, because in everyday language they may say a journey is ‘fast’ if it does not take very long.

Some students may select either the snail (about 1 cm/s) or the space shuttle (up to 7.8km/s) because they are at the extremes of the speeds of the objects in the list.

If students have misunderstandings about why four statements describe speed and one does not, it can help to discuss, for each statement in turn, how the speed can be worked out from the information given. For D there is no distance – so the minibus could be travelling very quickly over a long distance, or slowly over a short distance.

This is a good point to introduce students to the equation: average speed = distance ÷ time and the units of speed as m/s (the SI unit for speed). Practical work to measure distance and time in order to calculate speeds can help to consolidate understanding, and opportunity to practise calculations is also helpful. For many students it may not be appropriate at this stage to include problems that need the equation to be rearranged. It is worth checking with maths teachers what is appropriate.

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

* Response activity: Measuring top speed

**Acknowledgments**

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