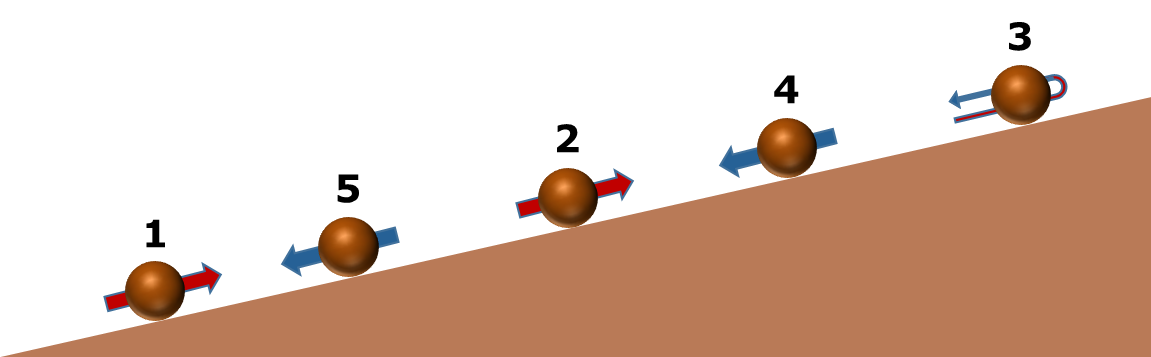
**To the top of the hill and down again**

A ball rolls up and down a slope.

It stops momentarily at the top.

The arrows show the direction of the ball as it moves (1 → 5).

**1.** Read the following passage. Fill in the gaps to describe what the ball is doing.

*You should only use the words* ***accelerating*** *or* ***not accelerating.***

1. The ball is moving quickly at the start. It is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ .

2. As it rolls up the slope it is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ .

3. It is at the top of the slope for just a moment as it turns around. At the top of the slope it is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

4. Rolling down the slope, the ball is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

5. As it moves quickly towards the bottom of the slope it is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**2.** Read the following passage. Fill in the gaps to describe what the ball is doing.

*You should only use the words* ***the same as****,* ***greater than****, or* ***smaller than.***

1. The ball is moving quickly up the slope.

2. Rolling up the slope its acceleration is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ at 1.

3. Turning around at the top its acceleration is \_\_\_\_\_\_\_\_\_\_\_\_\_ at 2.

4. Rolling down the slope its acceleration is \_\_\_\_\_\_\_\_\_\_\_\_\_\_ at 3.

5. Rolling towards the bottom its acceleration is \_\_\_\_\_\_\_\_\_\_\_\_ at 4.

*Physics > Big idea PFM: Forces and Motion > Topic PFM4: Measuring and calculating motion > Key concept PFM4.2: Acceleration*

|  |
| --- |
| **Response activity** |
| **To the top of the hill and down again** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Acceleration, like displacement and velocity, is a vector quantity. Acceleration measures by how much velocity changes in a given time interval. |
| Observable learning outcome: | Describe acceleration and differentiate between displacement, velocity and acceleration. |
| Question type: | Focused cloze |
| Key words: | Acceleration |

This activity can help develop students’ understanding by addressing the sticking-points revealed by the following diagnostic questions:

* Diagnostic question: Accelerating tortoise
* Diagnostic question: Accelerating cars

**What does the research say?**

Students may not differentiate clearly between distance, speed and acceleration when thinking about motion, merging different scientific concepts into a general idea of ‘motion’ (de Winter, 2021). They can find the concepts very difficult, partly because their prior ideas are established through experience, and partly because the formal scientific ideas are difficult to understand (Driver et al., 1994).

Students may conflate velocity and acceleration, so that an object that is moving fast is seen as having a greater acceleration than one which is moving more slowly, regardless of what the actual accelerations may be. They may not distinguish between velocity and change in velocity (Trowbridge and McDermott, 1981).

Deceleration is not always thought of as the same thing as acceleration, especially if students interpret acceleration as meaning ‘speeding up’. When thinking about the directions of velocity and acceleration, students tend to think that these must be in the same direction, in a similar way to thinking that any forces acting on an object must also be in the direction of motion (Lemmer, 2013), and that if velocity is zero, even if only instantaneously, then so must be acceleration (Rosenblatt and Heckler, 2011).

**Ways to use this question**

As a response activity, this task is intended for discussion in pairs or small groups. Students should complete the activity as a pencil and paper exercise.

How students fill in the gaps will show you whether they understand the concept of acceleration as distinct from velocity and as having a direction sufficiently well to apply it correctly. Listening in to the conversations of each group will often give you insights into how your students are thinking. Each member of a group should be able to report back to the class, giving reasons for their answers.

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. Feedback from each group can be used, with careful teacher questioning, to bring out a clear description or explanation of the science.

*Differentiation*

The quality of the discussions can be improved with a careful selection of groups; or by allocating specific roles to students in each group. For example, you may choose to select a student with strong prior knowledge as the scribe, and forbid them from contributing any of their own answers. They may question the others and only write down what they have been told. This strategy encourages contributions from more members of each group.

NB in any class, small group discussions typically improve over time and a persistence with this strategy is often very successful in the medium to long term.

**Expected answers**

*Question 1*

1. The ball is moving quickly at the start. It is **accelerating**.

2. As it rolls up the slope it is **accelerating**.

3. It is at the top of the slope for just a moment as it turns around. At the top of the slope it is **accelerating**.

4. Rolling down the slope, the ball is **accelerating**.

5. As it moves quickly towards the bottom of the slope it is **accelerating**.

*Question 2*

1. The ball is moving quickly up the slope.

2. Rolling up the slope its acceleration is **smaller than** at 1.

3. Turning around at the top its acceleration is **smaller than** at 2.

4. Rolling down the slope its acceleration is **smaller than** at 3.

5. Rolling towards the bottom its acceleration is **smaller than** at 4.

**Acknowledgments**

Developed by Simon Carson (UYSEG).

Images: Simon Carson (UYSEG).

**References**

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