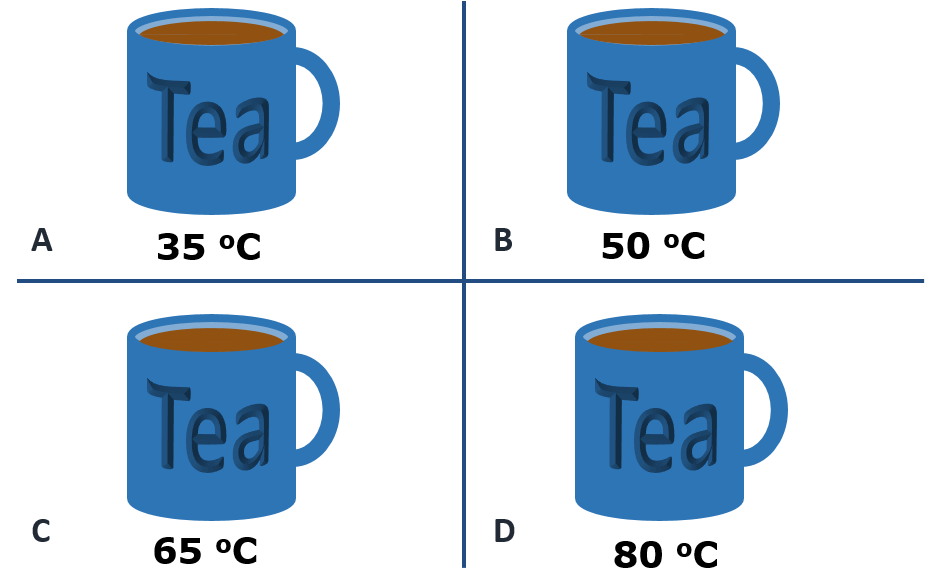
**Thermal store of energy**

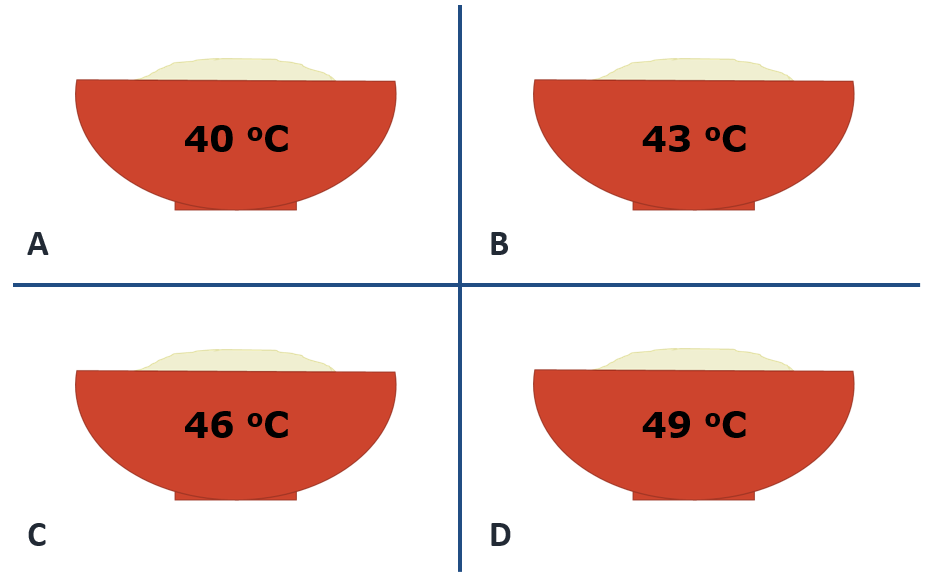
Lola has been outside building a snowman.

She is very cold.

1. Which drink will warm up Lola the most?
2. Which drink has most energy in its thermal store?



1. Which bowl of porridge has most energy in its thermal store?

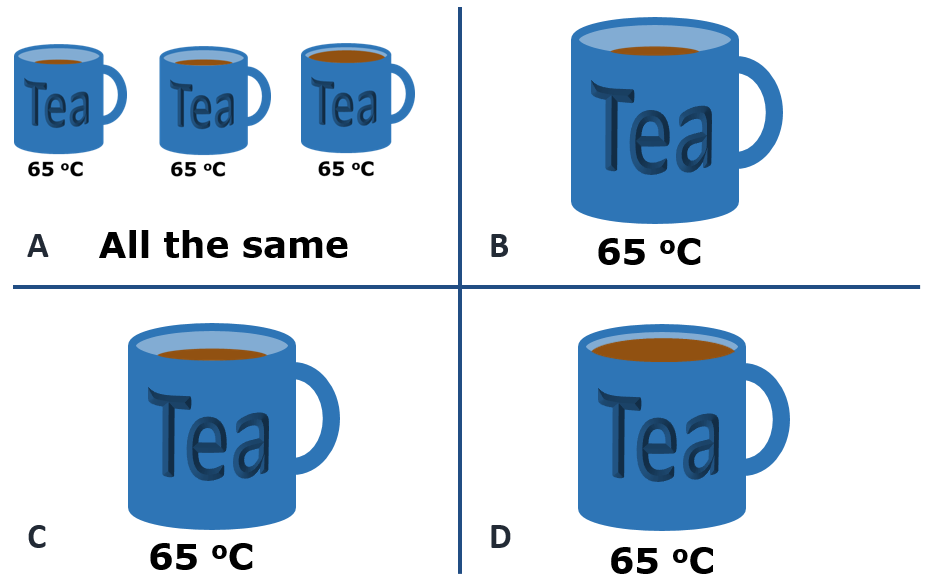




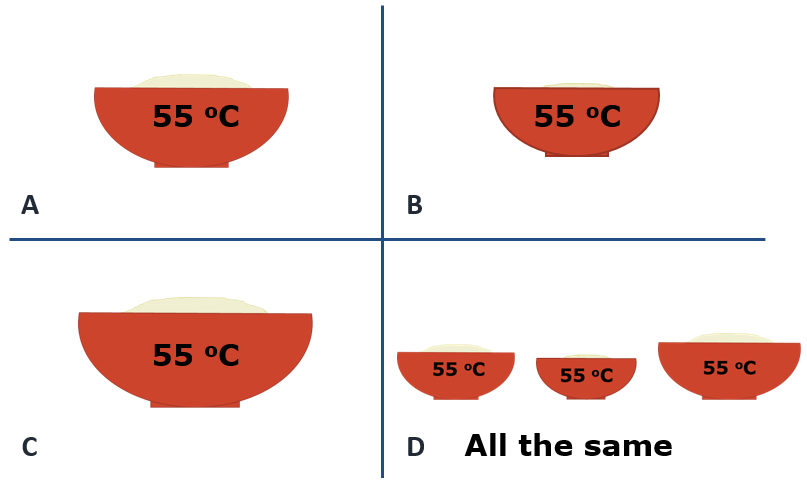
Finley has been outside helping Lola build a snowman.

He is very cold as well.

1. Which drink will warm up Finley the most?
2. Which drink has most energy in its thermal store?



1. Which bowl of porridge has most energy in its thermal store?



*Physics > Big idea PMA: Matter > Topic PMA1: Heating and cooling > Key concept PMA1.4: Thermal store of energy*

|  |
| --- |
| **Diagnostic question** |
| **Thermal store of energy** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Each different material will have more energy in its thermal store if either its temperature or mass is increased |
| Observable learning outcome: | Identify which of two objects or substances has the most energy in its thermal store when the only difference between them is temperature  Identify which of two objects or substances has the most energy in its thermal store when the only difference between them is their mass |
| Question type: | Simple multiple choice |
| Key words: | Thermal store of energy, temperature |

**What does the research say?**

The difference between temperature and a thermal store of energy is a crucial idea in the understanding of thermal concepts. When an object is warmed up its temperature rises, the amount of energy in its thermal store increases and the particles in the object move or vibrate more. All of these changes are interconnected and happen at the same time. Heating an object makes its particles move around more; temperature is a measure of the average kinetic energy of the particles; and the extra kinetic energy of all the particles adds to the energy in the thermal store (Institute of Physics).

It has been found that about a quarter of students aged 10-16 do not distinguish between temperature and energy in a thermal store. They often have the misunderstanding that temperature is a means of measuring energy in a thermal store. (Driver et al., 1994; Tiberghien, 1983)

Most students correctly understand that raising the temperature of a particular object also increases the energy in its thermal store. However, fewer than half of 11- to 14-year-olds understand that, when they are at the same temperature, a larger mass of a material contains more energy in its thermal store than a smaller mass of the same material. (Gonen and Kocakaya, 2010)

**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**

1. D
2. D
3. D
4. D
5. D
6. C

**How to respond - what next?**

In questions 1-3 the mass is constant so the highest temperature matches the most energy.

In questions 4 and 5 the temperature is the same, so the one with the most energy is the one with the most mass. Likewise for Q6. Any answers of ‘all the same’ show that students are wrongly thinking that temperature is directly measuring the energy in each thermal store. This is a common misunderstanding.

If students have misunderstandings about which substance has the most energy in its thermal store, it can help to talk students through simple thought experiments in which either the temperature or the mass of a substance is changed. The starting point should be that an energy store is necessary for something to happen. Holding a steel rod at 20oC and then imagining holding the same rod at 200oC should make it obvious that the hotter rod causes more changes to the hand, and so contains more energy in its thermal store. To compare different masses, students could be asked to imagine a drop of water on their hand at 100oC, and then plunging their hand into a bath of water at the same temperature!

Students usually find the latter of these ideas the most challenging. The following BEST ‘response activity’ could be used in follow-up to this diagnostic question:

* Response activity: The same Bunsen

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: Peter Fairhurst (UYSEG).

**References**

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