**Particle explanations**

The list below contains some statements about the particle model for the solid state. All the statements are correct.

A The particles are very closely packed together.

B The particles are tightly bound to their neighbours.

**C** The particles vibrate in their positions but cannot move around.

**D** The particles are arranged in a regular pattern.

Which of the statements above help to explain each of the following?

1. Materials in the solid state do not flow or pour.
2. Materials in the solid state cannot be compressed.

*Chemistry > Big idea CPS: Particles and structure > Topic CPS1: Substances and mixtures > Key concept CPS1.1 Particle model for the solid, liquid and gas states*

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| **Diagnostic question** |
| **Particle explanations** |

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| Learning focus: | Understand a basic particle model of matter that can explain the properties of substances in the solid and liquid states. |
| Observable learning outcome: | Use the particle model to explain the properties of substances in the solid and liquid states. |
| Question type: | simple multiple choice |
| Key words: | solid, state, particle |

**What does the research say?**

Johnson (1998) identifies three alternative models of matter held by students:

1. Substances are continuous (with no recognition of particle ideas)
2. Particles are located within a continuous substance (rather than being the substance)
3. Particles are the substance (but macroscopic properties are given to the particles)

These contradict the standard particle model in which the particles are the substance but where the macroscopic properties of the substances arise collectively from the particles. The standard particle model can successfully explain some properties of a substance in the solid state.

**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.

**Expected answers**

1 B and C

2 A

**How to respond - what next?**

If students indicate incorrect answers this suggests that they are not able to link the descriptions of the particles in the particle model to the bulk properties of the material.

If students have misunderstandings about how the particle model is able to explain properties of a substance in the solid state, then they may be supported by the use of a physical model, for example marbles in a tray. However, students will need to discuss whether this shows all aspects of the explanation required. The marbles in a tray (or a chocolate box insert to show fixed positions) does not help to visualise the forces of attraction between particles. An alternative model may be needed for this.

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Images: None

**References**

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