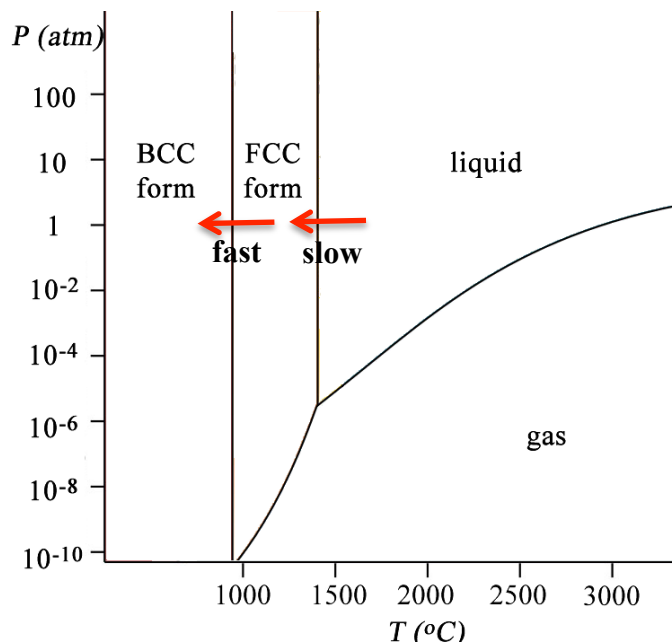


- A simplified phase diagram for iron is shown below, with the solid part divided into the body-centred cubic (BCC) and face-centred cubic (FCC) phases.

Marks
5



Which form of iron is stable at room temperature and pressure?

BCC form

If molten iron is cooled slowly to around 1200 °C and then cooled rapidly to room temperature, the FCC form is obtained. Draw arrows on the phase diagram to indicate this process and explain why it leads to the FCC form as a metastable phase.

The slow cooling leads to the most stable form at 1200 °C – the FCC form. Fast cooling to room temperature does not allow the atoms to re-arrange; they are stuck in the FCC form as considerable re-arrangement is needed to turn this in the BCC form.

The structure is stuck in the FCC arrangement even though BCC is more stable.

The line dividing the BCC and FCC forms is almost, but not quite vertical. Predict which way this line slopes and explain your answer.

BCC is less dense than FCC – the latter is a close packed structure so has the maximum possible density whereas the former is not closed packed.

Applying pressure will favour the more dense structure as it takes up less space. Increasing pressure therefore favours the FCC structure. The line between BCC and FCC has a negative slope (\searrow). If the system is on the line and the pressure is increased, the system moves into the FCC region.