

**Marks**  
**3**

- You may recall from a lecture demonstration or your laboratory work that solid  $\text{CO}_2$  sublimates under ambient conditions while ice melts. Define the terms sublimation and melting.

**Sublimation is a phase change from solid to gas without passing through the liquid phase.**

**Melting is a phase change from solid to liquid.**

What is a triple point (*e.g.* in the phase diagram of  $\text{CO}_2$  or  $\text{H}_2\text{O}$ )?

**The triple point is the temperature and pressure at which all three phases (solid, liquid and gas) coexist in equilibrium.**

What does the different behaviour of ice and solid  $\text{CO}_2$  indicate about the relative positions of their respective triple points?

**The triple point of  $\text{CO}_2$  is above ambient pressure.**

**The triple point of  $\text{H}_2\text{O}$  is below ambient pressure.**

- Carbon has a number of allotropes, the two major ones being graphite and diamond. The phase diagram of carbon shows that diamond is not the stable allotrope under normal conditions. Why then does diamond exist under normal conditions?

**1**

**Graphite is more stable at room temperature and pressure. Diamond has a more compact structure than graphite and becomes more stable than graphite at very high pressures. Under very high pressures, graphite can be converted into diamond.**

**When the pressure is released, the reverse process is favourable. However, the structural rearrangement required is considerable and the activation energy is very high. Thus, at low temperatures, the diamond  $\rightarrow$  graphite conversion is extremely slow and diamonds can exist for many thousands of years.**