

3 Ice is less dense than liquid water due to the structure of the bonds between the molecules when it is in a solid state. Hence, when ice melts into water at 0°C, the density of water increases. As the liquid water increases in temperature, its density further increases to a maximum value at 4.0°C.

(a) Consider a 5.0 kg block of ice at 0°C that is melted into liquid water at the same temperature using a heat source supplying a constant power of 4180 W.

(i) The specific latent heat of fusion of ice is $3.34 \times 10^5 \text{ J kg}^{-1}$.

Determine the time taken to completely melt the block of ice into liquid water at 0°C.

time = s [3]

(ii) The density of ice at 0°C is 0.915 kg m^{-3} while the density of liquid water at 0°C is 0.999 kg m^{-3} .

Calculate the work done on the ice by a constant atmospheric pressure of $1.01 \times 10^5 \text{ Pa}$ as the ice melts completely into water at 0°C.

work done on the ice = J [3]

(b) The first law of thermodynamics for a system can be expressed as

$$\Delta U = q + w$$

where ΔU is the increase in internal energy of the system, q is the heat supplied to the system and w is the work done on the system.

Use the words **positive**, **negative** and **zero** to complete Table 3.1 for the three terms in the equation for each of the processes shown. You may use each word once, more than once, or not at all.

Table 3.1

Process	ΔU	q	w
Ice melting into liquid water at 0°C			
Liquid water warming up from 0°C to 4°C			

[2]

[Total: 8]

[Turn over