

More Latent Heat Questions

Summary questions

- 1
 - a Explain why energy is needed to melt a solid.
 - b Explain why the internal energy of the water in a beaker must be reduced to freeze the water.
- 2 Calculate the mass of water boiled away in a 3 kW electric kettle in 2 min.
The specific latent heat of vaporisation of water is 2.25 MJ kg^{-1} .
- 3 A plastic beaker containing 0.080 kg of water at 15°C was placed in a refrigerator and cooled to 0°C in 1200 s.
 - a Calculate how much energy each second was removed from the water in this process. The specific heat capacity of water = $4200 \text{ J kg}^{-1} \text{ K}^{-1}$.
 - b Calculate how long the refrigerator would take to freeze the water in a. The specific latent heat of fusion of water = $3.4 \times 10^5 \text{ J kg}^{-1}$.

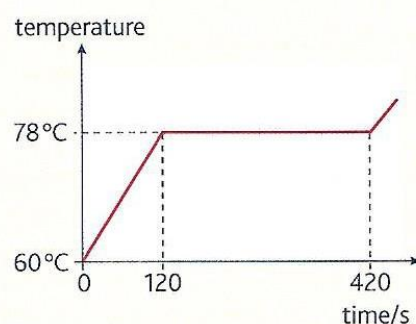


Figure 3

- 4 The temperature–time graph shown in Figure 3 was obtained by heating 0.12 kg of a substance in an insulated container. The specific heat capacity of the substance in the solid state is $1200 \text{ J kg}^{-1} \text{ K}^{-1}$.
Calculate:
 - a the energy per second supplied to the substance in the solid state if its temperature increased from 60°C to its melting point at 78°C in 120 s,
 - b the energy needed to melt the solid if it took 300 s to melt with energy supplied at the same rate as in a.

- 10.40** Two lumps of ice, at 0°C , each of mass 20 g, are added to a glass containing a mixture of alcohol and water at a temperature of 15°C . The heat capacity of the glass and its contents is 600 J K^{-1} . When the system has reached equilibrium how much ice is there? [Use data.]
- 10.41** The mass of liquid nitrogen in an open beaker is found to have decreased by 46.3 g in 10 minutes. If the s.l.h. of vaporisation of nitrogen at its boiling point is $1.99 \times 10^5 \text{ J kg}^{-1}$, at what rate were the surroundings heating the beaker? Why is the heat capacity of the beaker irrelevant?
- 10.42** A coffee machine in a café passes steam at 100°C into 0.18 kg of cold coffee (s.h.c. the same as that of water) to warm it. If the initial temperature of the coffee is 14°C , what mass of steam must be supplied to raise the temperature of the coffee to 85°C ?

For data, use the values given in the Breithaupt Summary questions. Assume that the presence of the alcohol does not change the ice water equilibrium temperature. Do not try this at home!!!