

PQ 9 Heat

Q

Q1

- A student immerses a 2.0kW electric heater in an insulated beaker of water. The heater is switched on and after 120 s the water reaches boiling point. The data collected during the experiment is given below.
- initial mass of beaker 25 g
- initial mass of beaker and water 750 g
- initial temperature of water 20 °C
- final temperature of water 100 °C

- Calculate the specific heat capacity of water if the thermal capacity of the beaker is negligible.

Q2

- The student in part Q1 continues to heat the water so that it boils for 105 s. When the mass of the beaker and water is measured again, it is found that it has decreased by 94 g.
- (i) Calculate a value for the specific latent heat of vaporisation of water.

Q2 continued

- State two assumptions made in your calculation.

Q3 continued

- (b) (i) Estimate the time taken for the water at 0 °C to turn completely into ice.

specific latent heat of fusion of water = $3.3 \times 10^5 \text{ J kg}^{-1}$

- (ii) State any assumptions you make

Q4 continued

- (b) State and explain one reason why the actual time taken to heat the room is longer than the value calculated in part (a)(ii).

Q5

- A bicycle and its rider have a total mass of 95 kg. The bicycle is travelling along a horizontal road at a constant speed of 8.0ms
- (a) Calculate the kinetic energy of the bicycle and rider

Q5 continued

- (b) The brakes are applied until the bicycle and rider come to rest. During braking, 60% of the kinetic energy of the bicycle and rider is converted to thermal energy in the brake blocks. The brake blocks have a total mass of 0.12 kg and the material from which they are made has a specific heat capacity of 1200 J kg K.
- (i) Calculate the maximum rise in temperature of the brake blocks

- (ii) State an assumption you have made in part (b)(i).

Q6

- A female runner of mass 60 kg generates thermal energy at a rate of 800W. Assuming that she loses no energy to the surroundings and that the average specific heat capacity of her body is 3900 J kg K calculate
- (i) the thermal energy generated in one minute,
- (ii) the temperature rise of her body in one minute.

Q6 continued

- (b) In practice it is desirable for a runner to maintain a constant temperature. This may be achieved partly by the evaporation of sweat. The runner in part (a) loses energy at a rate of 500W by this process. Calculate the mass of sweat evaporated in one minute.
- specific latent heat of vaporisation of water = $2.3 \times 10^6 \text{ J kg}^{-1}$

c) Explain why, when she stops running, her temperature is likely to fall.