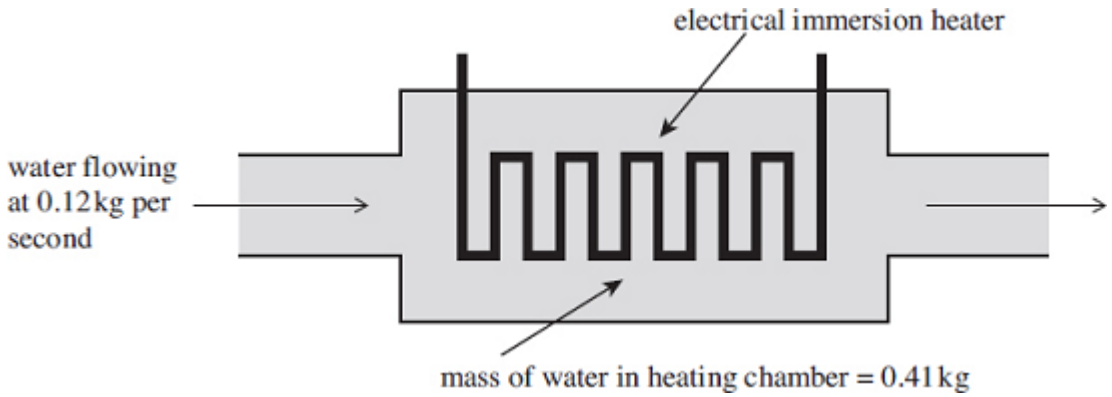
1 An electrical immersion heater supplies 8.5 kJ of energy every second. Water flows through the heater at a rate of 0.12 kg s^{-1} as shown in the figure below.



(a) Assuming all the energy is transferred to the water, calculate the rise in temperature of the water as it flows through the heater.

specific heat capacity of water = 4200 J kg^{-1} K^{-1}

answer = ... K

(2)

(b) The water suddenly stops flowing at the instant when its average temperature is 26 °C. The mass of water trapped in the heater is 0.41 kg.
Calculate the time taken for the water to reach 100 °C if the immersion heater continues supplying energy at the same rate.

answer = ... s

(2)
(Total 4 marks)

2 In an experiment to measure the temperature of the flame of a Bunsen burner, a lump of copper of mass 0.12 kg is heated in the flame for several minutes. The copper is then transferred quickly to a beaker, of negligible heat capacity, containing 0.45 kg of water, and the temperature rise of the water measured.

specific heat capacity of water = 4200 J kg^{-1} K^{-1}
specific heat capacity of copper = 390 J kg^{-1} K^{-1}

(a) If the temperature of the water rises from 15 °C to 35 °C, calculate the thermal energy gained by the water.

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(2)

(b) (i) State the thermal energy lost by the copper, assuming no heat is lost during its transfer.

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(ii) Calculate the fall in temperature of the copper.

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.....

(iii) Hence calculate the temperature reached by the copper while in the flame.

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(4)
(Total 6 marks)

3 A cola drink of mass 0.200 kg at a temperature of 3.0 °C is poured into a glass beaker. The beaker has a mass of 0.250 kg and is initially at a temperature of 30.0 °C.

specific heat capacity of glass = 840 J $kg^{-1}K^{-1}$
specific heat capacity of cola = 4190 J $kg^{-1}K^{-1}$

(i) Show that the final temperature, T_f, of the cola drink is about 8 °C when it reaches thermal equilibrium with the beaker.
Assume no heat is gained from or lost to the surroundings.

(2)

(ii) The cola drink and beaker are cooled from T_f to a temperature of 3.0 °C by adding ice at a temperature of 0 °C.
Calculate the mass of ice added.
Assume no heat is gained from or lost to the surroundings.

specific heat capacity of water = 4190 J kg^{-1} K^{-1}
specific latent heat of fusion of ice = 3.34×10^5 J kg^{-1}

mass ..... kg

(3)
(Total 5 marks)

4 (a) Define the specific latent heat of vaporisation of water.

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.....

.....

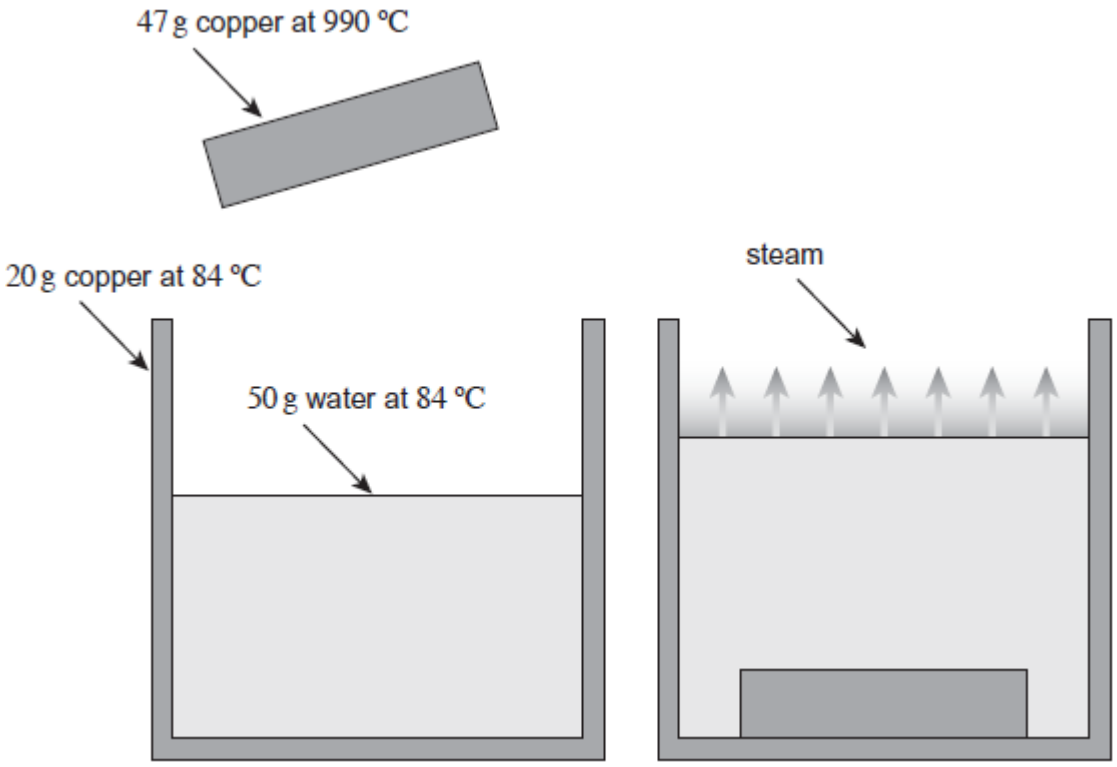
(2)

(b) An insulated copper can of mass 20 g contains 50 g of water both at a temperature of 84 °C. A block of copper of mass 47 g at a temperature of 990 °C is lowered into the water as shown in the figure below. As a result, the temperature of the can and its contents reaches 100 °C and some of the water turns to steam.

specific heat capacity of copper = 390 J kgsup class="xsmall">–1 Ksup class="xsmall">–1

specific heat capacity of water = 4200 J kgsup class="xsmall">–1 Ksup class="xsmall">–1

specific latent heat of vaporisation of water = 2.3×10^6 J kgsup class="xsmall">–1



(i) Calculate how much thermal energy is transferred from the copper block as it cools to 100 °C.
Give your answer to an appropriate number of significant figures.

thermal energy transferred ..... J

(2)

(ii) Calculate how much of this thermal energy is available to make steam.
Assume no heat is lost to the surroundings.

available thermal energy ..... J

(2)

(iii) Calculate the maximum mass of steam that may be produced.

mass ..... kg

(1)
(Total 7 marks)