Extension Worksheet – Topic 3, Worksheet 1

1 Distinguish between internal energy and heat. [2]

2 A 5 kg mass of copper at 600 K is placed in contact with 5 g of copper at 300 K.

a State and explain which body has the greater internal energy. [2]

b State the direction of energy transfer between the two bodies. [1]

3 One kg of aluminium at 400 K is brought into thermal contact with one kg of iron at 300 K. No energy transfers take place other than from aluminium to iron. Explain why, for each body,

a the magnitude of the change in internal energy will be the same. [1]

b the magnitude of the change in temperature will not be the same. [1]

4 A quantity of 300 g of water at 20 °C is mixed with 600 g of water at 80 °C. The mixture is stirred and its temperature measured. Determine the temperature of the mixture. [1]

5 An ice cube dropped into a glass of water of initial temperature 20 °C lowers the temperature of the water by 5 °C. An identical ice cube is dropped into the same quantity of water of temperature 40 °C. The drop in temperature of the water will be

A less than 5 °C

B 5 °C

C more than 5 °C

D more or less than 5 °C depending on the mass of the ice cube and the mass of the water. [1]

6 A glass contains 250 g of water at 20 °C. An ice cube of mass 30 g and temperature –10 °C is dropped into the glass.

a Determine the final temperature of the water after thermal equilibrium has been established. [2]

b A second identical ice cube is now dropped into the glass. Determine the new final temperature of the water. [2]

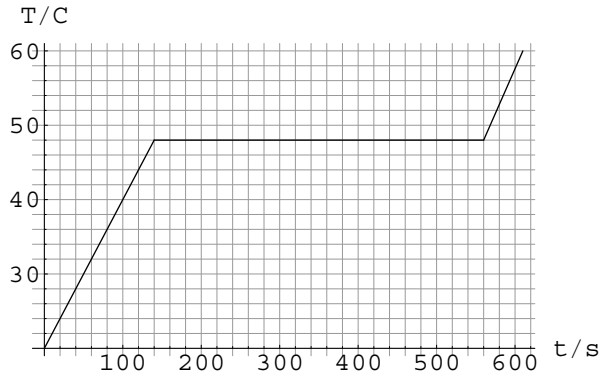
c Another glass contains 250 g of water at 20 °C. **Two** ice cubes, each of mass 30 g and temperature –10 °C are dropped into the glass at the same time. Determine the final temperature of the water. [2]

d Comment on your answers to **b** and **c**. Assume no heat losses and ignore the glass itself. You may use the following data: specific heat capacity of water 4.2×10^3 J kg^{-1} K^{-1}, specific heat capacity of ice 2.1×10^3 J kg^{-1} K^{-1}, specific latent heat of fusion of ice $L = 334$ kJ kg^{-1}. [1]

7 Energy is constantly being supplied to a liquid while it boils yet the temperature of the liquid remains constant. Explain this observation. [2]

8 Explain why the temperature of a liquid decreases during evaporation. [2]

9 A sample of 120 g of solid paraffin initially at 20 °C is being heated by a heater of constant power. The specific heat capacity of solid paraffin is 2500 J kg^{-1} K^{-1}. The temperature of paraffin varies with time as shown.



Use the graph to determine

a the power of the heater [2]

b the melting temperature of paraffin [1]

c the specific latent heat of fusion of paraffin [2]

d the specific heat capacity of paraffin in the liquid phase [2]

e Explain why the temperature of paraffin stays constant during melting. [2]

10 A piece of tungsten of mass 150 g is placed over a flame for some time. The metal is then quickly transferred to a well-insulated aluminium calorimeter of mass 120 g containing 300 g of water at 22 °C. After some time the temperature of the water reaches a maximum value of 52 °C.

a Calculate the temperature of the flame. You may use: specific heat capacity of water 4.2×10^3 J kg^{-1} K^{-1}, for tungsten 1.3×10^2 J kg^{-1} K^{-1} and for aluminium 9.1×10^2 J kg^{-1} K^{-1}. [3]

b State and explain whether the actual flame temperature is higher or lower than your answer to **a**. [2]