21 Worksheet (A2)

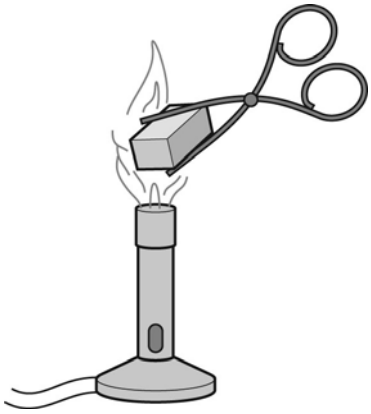
Specific heat capacity of water = 4200 J kg^{-1} K^{-1}
Specific latent heat of fusion of water = 3.4×10^5 J kg^{-1}

1 Describe the arrangement of atoms, the forces between the atoms and the motion of the atoms in:

a a solid [3]
b a liquid [3]
c a gas. [3]

2 A small amount of gas is trapped inside a container. Describe the motion of the gas atoms as the temperature of the gas within the container is increased. [3]

3 **a** Define the **internal energy** of a substance. [1]
b The temperature of an aluminium block increases when it is placed in the flame of a Bunsen burner. Explain why this causes an increase in its internal energy. [3]

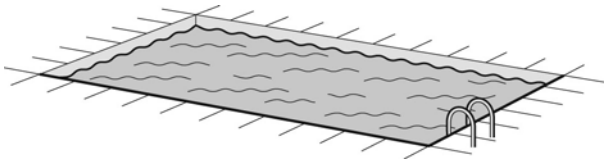


c A lump of metal is melting in a hot oven at a temperature of 600 °C.
Explain whether its internal energy is increasing or decreasing as it melts. [4]

4 Write a word equation for the change in the thermal energy of a substance in terms of its mass, the specific heat capacity of the substance and its change of temperature. [1]

5 The specific heat capacity of a substance is measured in the units J kg^{-1} K^{-1}, whereas its specific latent heat of fusion is measured in J kg^{-1}. Explain why the units are different. [2]

6 During a hot summer's day, the temperature of 6.0×10^5 kg of water in a swimming pool increases from 21 °C to 24 °C. Calculate the change in the internal energy of the water. [3]



7 A 300 g block of iron cools from 300 °C to room temperature at 20 °C. The specific heat capacity of iron is 490 J kg^{-1} K^{-1}. Calculate the heat released by the block of iron. [3]

8 Calculate the energy that must be removed from 200 g of water at 0 °C to convert it all into ice at 0 °C. [2]

9 a Change the following temperatures from degrees Celsius into kelvin.

i 0 °C

ii 80 °C

iii −120 °C [3]

b Change the following temperatures from kelvin into degrees Celsius.

i 400 K

ii 272 K

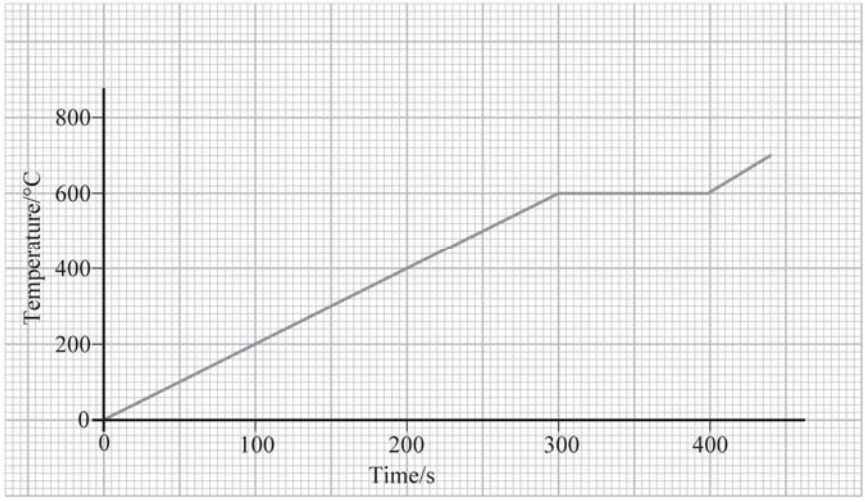
iii 3 K [3]

10 An electrical heater is used to heat 100 g of water in a well-insulated container at a steady rate. The temperature of the water increases by 15 °C when the heater is operated for a period of 5.0 minutes. Determine the change of temperature of the water when the same heater and container are individually used to heat:

a 300 g of water for the same period of time [3]

b 100 g of water for a time of 2.5 minutes. [3]

11 The graph below shows the variation of the temperature of 200 g of lead as it is heated at a steady rate.



a Use the graph to state the melting point of lead. [1]

b Explain why the graph is a straight line at the start. [1]

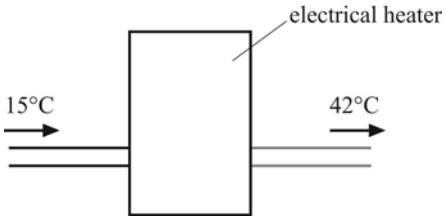
c Explain what happens to the energy supplied to the lead as it melts at a constant temperature. [1]

d The initial temperature of the lead is 0 °C. Use the graph to determine the total energy supplied to the lead before it starts to melt. [3]
(The specific heat capacity of lead is 130 J kg^{-1} K^{-1}.)

e Use your answer to **d** to determine the rate of heating of the lead. [2]

f Assuming that energy continues to be supplied at the same rate, calculate the specific latent heat of fusion of lead. [3]

12 The diagram shows piped water being heated by an electrical heater.

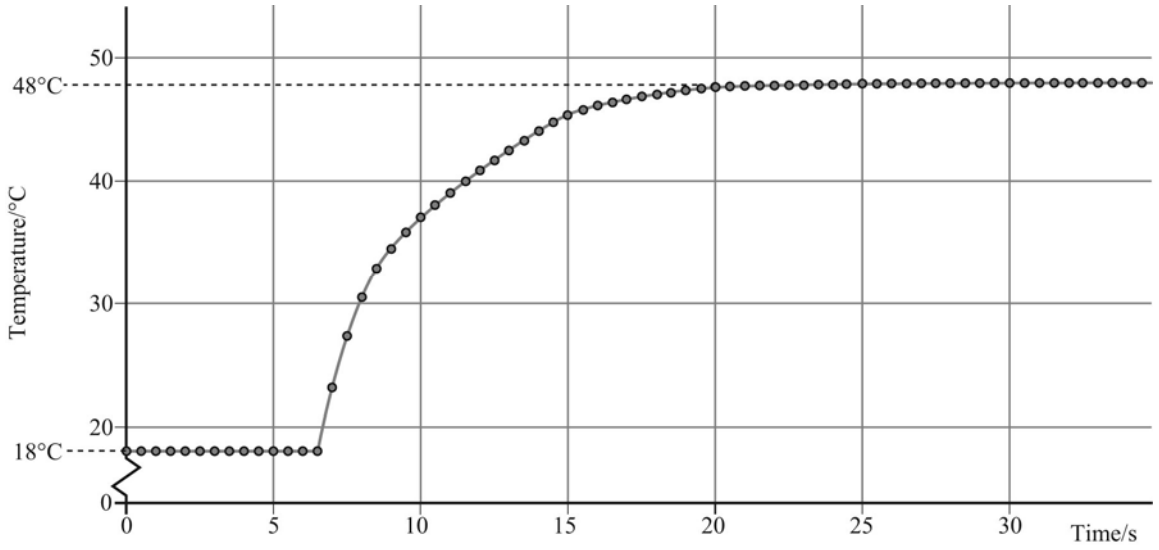


The water flows through the heater at a rate of 0.015 kg s^{-1}. The heater warms the water from 15 °C to 42 °C. Assuming that all the energy from the heater is transferred to heating the water, calculate the power of the heater. [5]

13 A gas is held in a cylinder by a friction-free piston. When the force holding the piston in place is removed, the gas expands and pushes the piston outwards.
Explain why the temperature of the gas falls. [2]

14 Hot water of mass 300 g and at a temperature of 90 °C is added to 200 g of cold water at 10 °C. What is the final temperature of the mixture? You may assume there are no losses to the environment and all heat transfer takes place between the hot water and the cold water. [5]

15 A metal cube of mass 75 g is heated in a naked flame until it is red hot. The metal block is quickly transferred to 200 g of cold water. The water is well stirred. The graph shows the variation of the temperature of the water recorded by a datalogger during the experiment.



The metal has a specific heat capacity of 500 J kg^{-1} K^{-1}. Use the additional information provided in the graph to determine the initial temperature of the metal cube. You may assume there are no losses to the environment and all heat transfer takes place between the metal block and the water. [5]

Total: ——— Score: %
71

