Name:

1. This question is about an experiment to measure the temperature of a flame.

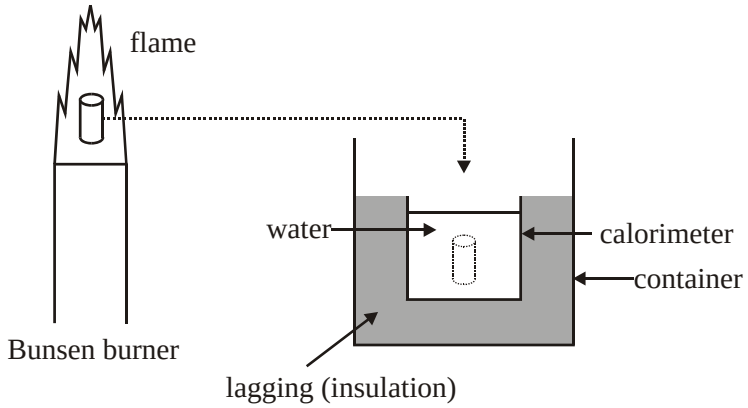
(a) Define *heat (thermal) capacity*.

.....

.....

(1)

A piece of metal is held in the flame of a Bunsen burner for several minutes. The metal is then quickly transferred to a known mass of water contained in a calorimeter.



The water into which the metal has been placed is stirred until it reaches a steady temperature.

(b) Explain why

(i) the metal is transferred as quickly as possible from the flame to the water.

.....

.....

(1)

(ii) the water is stirred.

.....

.....

(1)

The following data are available:

heat capacity of metal	= 82.7 J K^{-1}
heat capacity of the water in the calorimeter	= 5.46 × 10^2 J K^{-1}
heat capacity of the calorimeter	= 54.6 J K^{-1}
initial temperature of the water	= 288 K
final temperature of the water	= 353 K

(c) Assuming negligible energy losses in the processes involved, use the data to calculate the temperature T of the Bunsen flame.

.....

.....

.....

.....

.....

.....

(4)

(Total 7 marks)

2. This question is about specific heat capacity and specific latent heat.

(a) Define *specific heat capacity*.

.....

.....

(1)

(b) Explain briefly why the specific heat capacity of different substances such as aluminium and water are not equal in value.

.....

.....

.....

.....

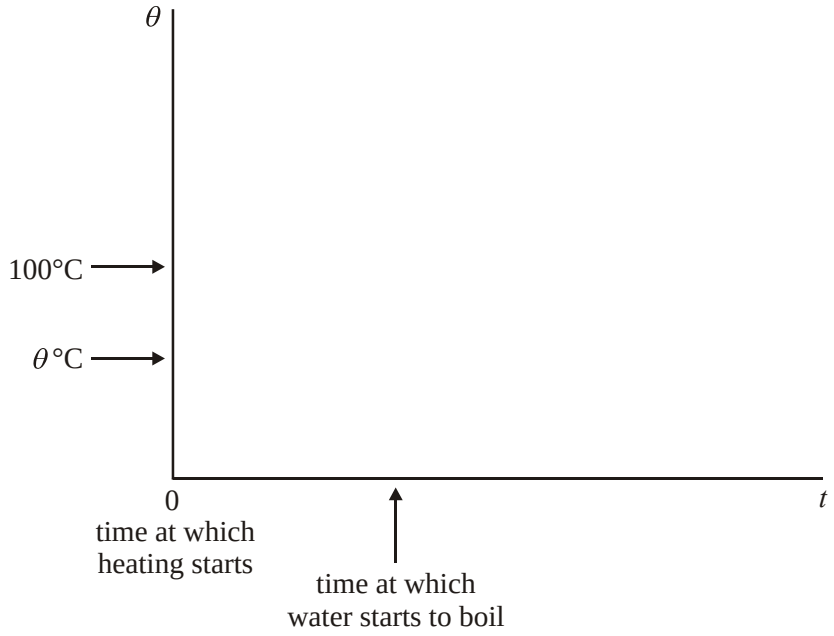
(2)

Name:

A quantity of water at temperature θ h is placed in a pan and heated at a constant rate until some of the water has turned into steam. The boiling point of the water is 100 °C.

(c) (i) Using the axes below, draw a sketch-graph to show the variation with time θ of the temperature θ of the water. *(**Note**: this is a sketch-graph; you do not need to add any values to the axes.)*

(1)



(ii) Describe in terms of energy changes, the molecular behaviour of water and steam during the heating process.

.....

.....

.....

.....

.....

.....

(5)

Thermal energy is supplied to the water in the pan for 10 minutes at a constant rate of 400 W. The thermal capacity of the pan is negligible.

(d) (i) Deduce that the total energy supplied in 10 minutes is 2.4×10^5 J.

.....

(1)

(ii) Using the data below, estimate the mass of water turned into steam as a result of this heating process.

initial mass of water = 0.30 kg

initial temperature of the water θ = 20 °C

specific heat capacity of water = 4.2×10^3 J kg^{-1} K^{-1}

specific latent heat of vaporization of water = 2.3×10^6 Jkg^{-1}

.....

.....

.....

.....

.....

.....

(3)

(iii) Suggest **one** reason why this mass is an estimate.

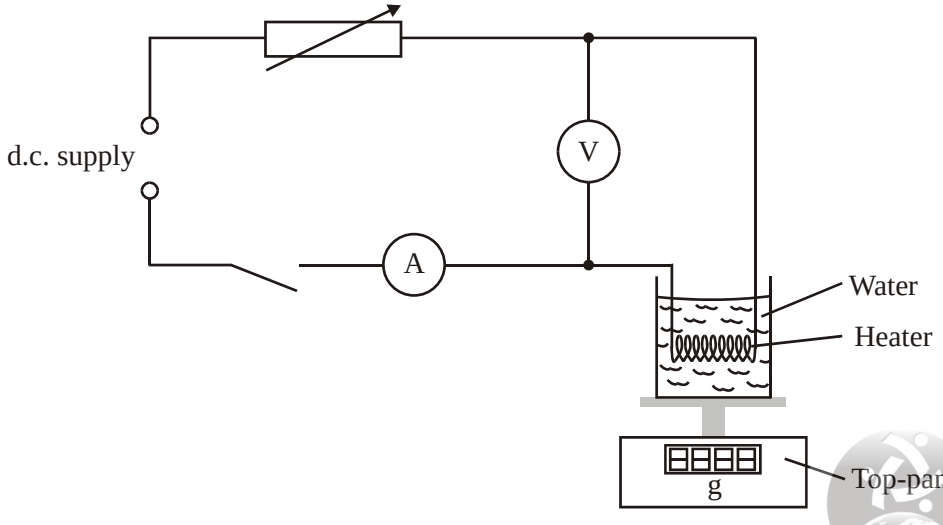
.....

.....

(1)

(Total 14 marks)

3. Some students were asked to design and carry out an experiment to determine the specific latent heat of vaporization of water. They set up the apparatus shown below.



Name:

The current was switched on and maintained constant using the variable resistor. The readings of the voltmeter and the ammeter were noted. When the water was boiling steadily, the reading of the top-pan balance was taken and, simultaneously, a stopwatch was started. The reading of the top-pan balance was taken again after 200 seconds and then after a further 200 seconds.

The change in reading of the top-pan balance during each 200 second interval was calculated and an average found. The power of the heater was calculated by multiplying together the readings of the voltmeter and the ammeter.

(a) Suggest how the students would know when the water was boiling steadily.

.....

.....

(1)

(b) Explain why a reading of the mass lost in the first 200 seconds and then a reading of the mass lost in the next 200 second interval were taken, rather than one single reading of the mass lost in 400 seconds.

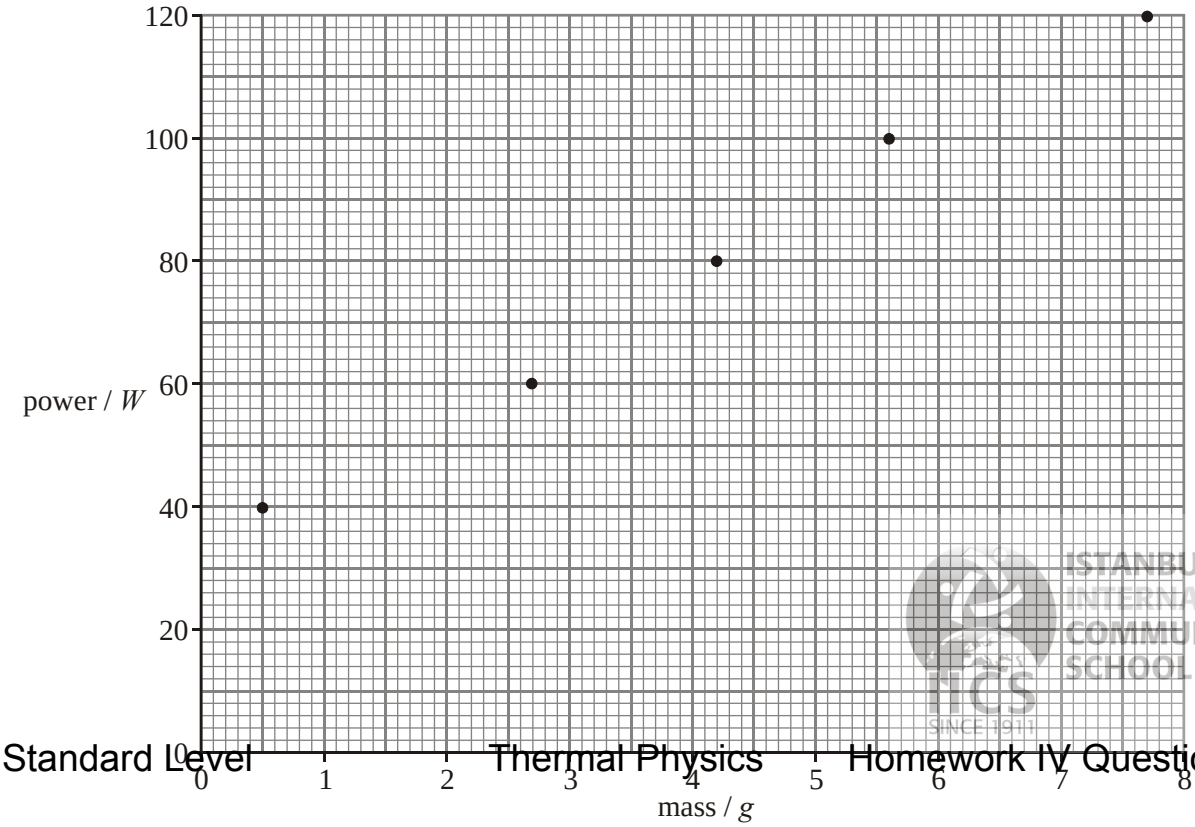
(2)

.....

.....

.....

The students repeated the experiment for different powers supplied to the heater. A graph of the power of the heater against the mass of water lost (the change in balance reading) in 200 seconds was plotted. The results are shown below. *(Error bars showing the uncertainties in the measurements are not shown.)*



Name:

(c) (i) On the graph above, draw the best-fit straight line for the data points.

(1)

(ii) Determine the gradient of the line you have drawn.

.....

.....

.....

.....

(3)

In order to find a value for the specific latent heat of vaporization L, the students used the equation

$$P = mL,$$

where P is the power of the heater and m is the mass of water evaporated **per second**.

(d) Use your answer for the gradient of the graph to determine a value for the specific latent heat of vaporization of water.

.....

.....

.....

.....

(3)

(e) The theory of the experiment would suggest that the graph line should pass through the origin. Explain briefly why the graph does not pass through the origin.

.....

.....

(2)

(Total 12 marks)