Energy is transferred from hot water in the cups to the surroundings.

(a) Use the correct answer from the box to complete each sentence.

| condensation | conduction | convection |

Energy is transferred through the walls of the cup by .........................................

In the air around the cup, energy is transferred by ........................................... .
(b) Some students investigated how the rate of cooling of water in a cup depends on the surface area of the water in contact with the air.

They used cups A, B and C. They poured the same volume of hot water into each cup and recorded the temperature of the water at regular time intervals.

The results are shown on the graph.

(i) What was the starting temperature of the water for each cup?

Starting temperature = ........................................ °C

(ii) Calculate the temperature fall of the water in cup B in the first 9 minutes.

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Temperature fall = ........................................ °C

(iii) Which cup, A, B or C, has the greatest rate of cooling?

Using the graph, give a reason for your answer.

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(iv) The investigation was repeated using the bowl shown in the diagram. The same starting temperature and volume of water were used.

![Diagram of the bowl](image)

Draw on the graph in part (b) another line to show the expected result.

(1)

(v) After 4 hours, the temperature of the water in each of the cups and the bowl was 20°C.

Suggest why the temperature does not fall below 20°C.

................................................................................................................

(1)

(c) (i) The mass of water in each cup is 200 g.

Calculate the energy, in joules, transferred from the water in a cup when the temperature of the water falls by 8°C.

Specific heat capacity of water = 4200 J / kg°C.

Use the correct equation from Section B of the Physics Equations Sheet.

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Energy transferred = ........................................ J

(3)

(ii) Explain, in terms of particles, how evaporation causes the cooling of water.

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(4)

(Total 16 marks)
M1. (a) conduction

must be in correct order

convection

(b) (i) 70

accept ± half a square
(69.8 to 70.2)

(ii) 15

accept 14.6 to 15.4 for 2 marks
allow for 1 mark 70 – 55
ecf from (b)(i) ± half a square

(iii) C

biggest drop in temperature during a given time
accept it has the steepest gradient this is a dependent

(iv) starting at 70 °C and below graph for C
must be a curve up to at least 8 minutes

(v) because 20 °C is room temperature
accept same temperature as surroundings

(c) (i) 6720

correct answer with or without working gains 3 marks
6 720 000 gains 2 marks
correct substitution of $E = 0.2 \times 4200 \times 8$ gains 2 marks
correct substitution of $E = 200 \times 4200 \times 8$ gains 1 mark

(ii) the fastest particles have enough energy
accept molecules for particles

to escape from the surface of the water

therefore the mean energy of the remaining particles decreases
accept speed for energy
the lower the mean energy of particles the lower the temperature (of the water)

accept speed for energy