Specific Heat Capacity and Specific Latent Heat

Edexcel IGCSE students require only Specific Heat Capacity (Exercise A). They may ignore the questions involving Specific Latent Heat (Exercise B). All other exam board students require both.

Exercise A

1.

100 g of glass is heated until its temperature rises from 19 °C to 33 °C. How much energy has it absorbed? The specific heat capacity of glass is 840 J/kg °C. **(2 marks)**

2.

250 g of the brick inside a storage heater (specific heat capacity = 910 J/kg °C) absorbs 5000 joules of energy. By how much will its temperature rise? **(2 marks)**

3.

Specific heat capacity of Aluminium is 900 J/kg^{0}C.
What does this mean? A 10 kg block of aluminium cools from 100 °C to 50 °C. How much thermal energy does it give out? What thermal energy would be given out by the same mass of water over the same temperature fall?
(Specific heat capacity of water is 4200 J/kg^{0}C)

4.

Specific heat capacity of water is 4200 J/kg^{0}C
A 210 W heater is placed in 2 kg of water. What temperature rise is produced if the heater is switched on for 200 s?

5.

Specific heat capacity of water is 4200 J/kg^{0}C

An electric kettle has a power rating of 2.1 kW. The kettle is filled with 1.5 kg of water at a temperature of 20 °C. How long after the kettle is switched on will the water start to boil?

6.

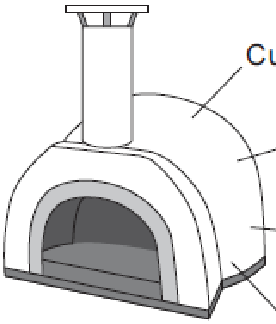
Specific heat capacity of water is 4200 J/kg^{0}C

A lump of metal of mass 0.2 kg and temperature 100 °C is placed in water of mass 0.4 kg and temperature 16 °C. If the final temperature of the metal and water is 20 °C, what is the specific heat capacity of the metal?

7.

Figure 5 shows an outdoor pizza oven.

Figure 5



The pizza oven is made of concrete. The mass of the concrete is 250 kg

Calculate the temperature increase when 8.36×10^7 J of energy are transferred to the concrete.

Concrete has a specific heat capacity of 880 J/kg °C

Use the correct equation from the Physics Equations Sheet.

[2 marks]

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___

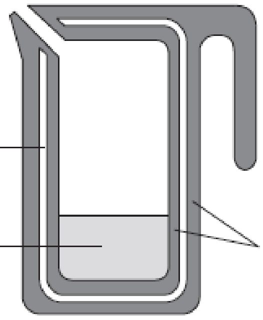
Temperature increase = __________ °C

8.

A new design for a kettle is made from two layers of plastic separated by a vacuum. After the water in the kettle has boiled, the water stays hot for at least 2 hours.

The new kettle is shown in **Figure 5**.

Figure 5



(a) Explain why the vacuum reduces energy transfer to the surroundings.

[2 marks]

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(b) The energy transferred from the water in the kettle to the surroundings in 2 hours is 46 200 J.

The mass of water in the kettle is 0.50 kg.

The specific heat capacity of water is 4200 J/kg °C.

The initial temperature of the water is 100 °C.

(b) (i) Calculate the temperature of the water in the kettle after 2 hours.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

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____

____

____

Temperature after 2 hours = ____________________ °C

(b) (ii) Calculate the average power output from the water in the kettle to the surroundings in 2 hours.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

____

____

____

____

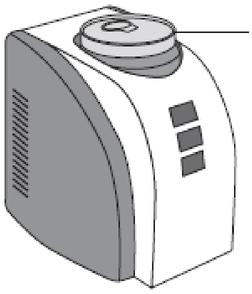
Average power output = ____________________ W

9.

A 'can-chiller' is used to make a can of drink colder.

Figure 7 shows a can-chiller.

Figure 7



The initial temperature of the liquid in the can was 25.0 °C.
The can-chiller decreased the temperature of the liquid to 20.0 °C.
The amount of energy transferred from the liquid was 6930 J.
The mass of liquid in the can was 0.330 kg.

Calculate the specific heat capacity of the liquid.

Give the unit.

Use the correct equation from the Physics Equations Sheet.

[4 marks]

....

....

....

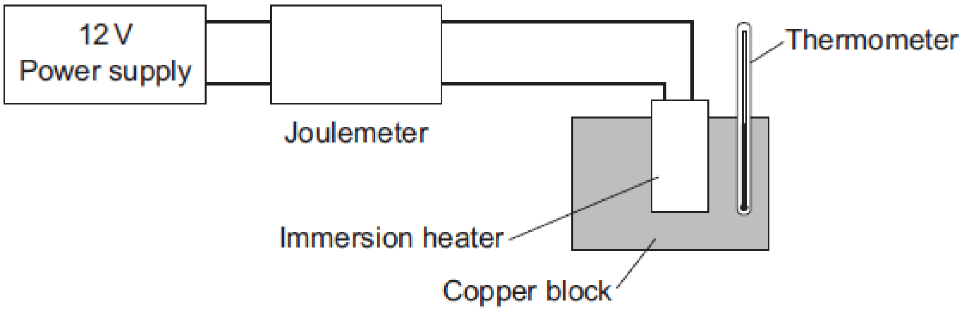
....

Specific heat capacity = ... unit ....

10.

A student used the apparatus in **Figure 7** to obtain the data needed to calculate the specific heat capacity of copper.

Figure 7



The initial temperature of the copper block was measured.

The power supply was switched on.

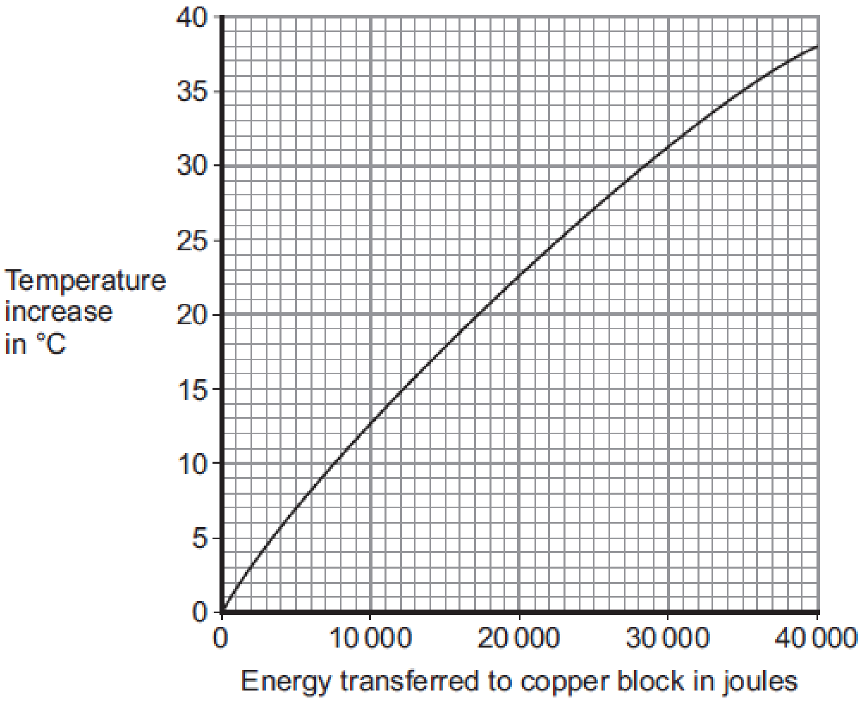
The energy transferred by the heater to the block was measured using the joulemeter.

The temperature of the block was recorded every minute.

The temperature increase was calculated.

Figure 8 shows the student's results.

Figure 8



(a) Energy is transferred through the copper block.

What is the name of the process by which the energy is transferred?

Tick (✓) **one** box.

[1 mark]

Conduction ☐

Convection ☐

Radiation ☐

(b) Use **Figure 8** to determine how much energy was needed to increase the temperature of the copper block by 35 °C.

[1 mark]

.... joules

(c) The copper block has a mass of 2 kg.

Use your answer to part **(b)** to calculate the value given by this experiment for the specific heat capacity of copper. Give the unit.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

....

....

....

....

Specific heat capacity = ...

(d) This experiment does **not** give the correct value for the specific heat of copper.

Suggest **one** reason why.

[1 mark]

....

....

Exercise B

1.

At 100 °C, water has a specific latent heat of vaporization of 2 260 000 J/kg. What does this mean? How much thermal energy would be needed to change 2 kg of water at 100 °C into steam at the same temperature? How much thermal energy would be needed to change 10 kg?

2.

Specific latent heat of vaporisation of water at 100^0C is 2 260 000 J/kg
The heating element of a kettle has a power rating of 2.26 kW. If the kettle contains boiling water, what mass of steam will be produced in 10 minutes?

3.
Specific heat capacity of water is 4200 J/kg^{0}C
Specific latent heat of vaporisation of water at 100^0C is 2 260 000 J/kg
How much thermal energy is needed to turn 3.0 kg of water at 50 °C into steam at 100 °C?

4.

Specific heat capacity of water is 4200 J/kg^{0}C
Specific latent heat of fusion of ice (water) is 334 000 J/kg
Calculate the total quantity of heat required to change 0.01 kg of ice at −10 °C completely into steam at 100 °C. (JMB)
Assume that Ice has the same specific heat capacity as water.

5.

(a) State what is meant by the *melting point* of a solid.

The melting point is ....

.... [2]

(b) Which two of the following quantities are the same? Tick **two** boxes.

boiling point of iron ☐

freezing (solidifying) point of iron ☐

melting point of iron ☐ [1]

(c) Some liquid in a beaker is kept boiling by heating the beaker, as shown in Fig. 6.1.

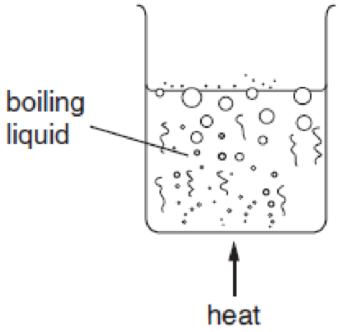


Fig. 6.1

(i) On the axes of Fig. 6.2, sketch a graph to show what happens to the temperature of the liquid whilst it is boiling.

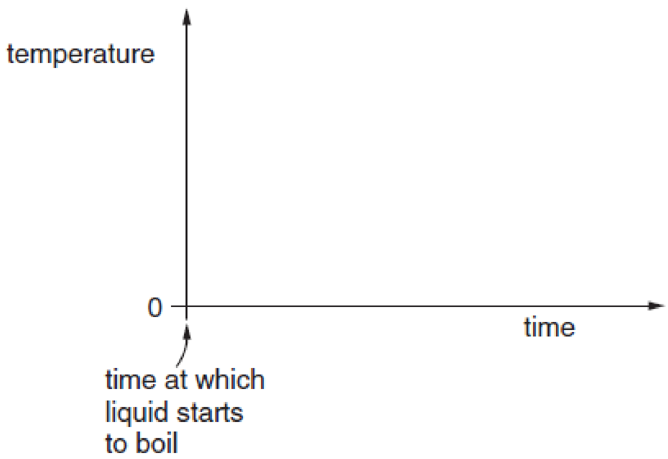


Fig. 6.2

(ii) On your graph, mark the boiling point of the liquid.

[2]

6.

(a) In an experiment to find the specific latent heat of water, the following readings were taken.

m_1	mass of water at 100 °C, before boiling starts	120 g
m_2	mass of water at 100 °C, after boiling finishes	80 g
V	voltage across the heater	12 V
I	current through the heater	2.0 A
t	time that the heater was supplying energy	3750 s

(i) Using the symbols above, write down the equation that must be used to find the value of the specific latent heat L of water.

(ii) Use the equation to calculate the specific latent heat of water from the readings above.

specific latent heat = ...
[4]

(b) Explain, in terms of the energy of molecules, why the specific latent heat of water has a high value.

....

....

....[2]

7.

Fig. 4.1 shows water being heated by an electrical heater.

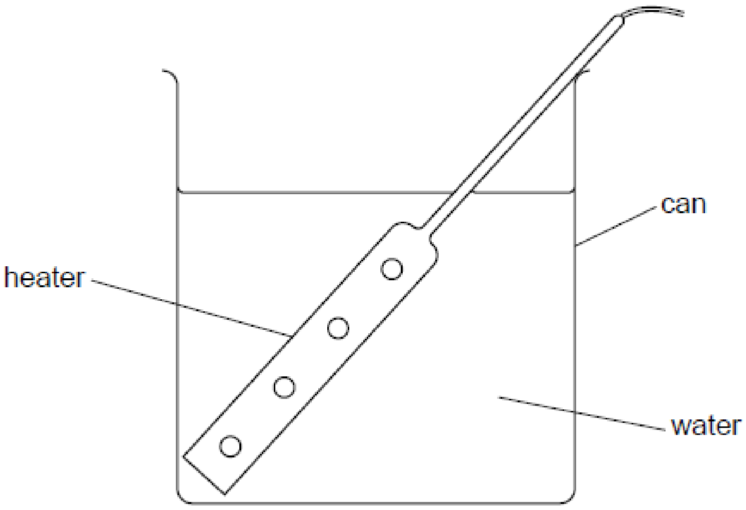


Fig. 4.1

After the water has reached its boiling point, the mass of water in the can is reduced by 3.2 g in 120 s. The heater supplies energy to the water at a rate of 60 W. Use this information to calculate the specific latent heat of vaporisation of water.

specific latent heat = ... [3]

8.

(a) Two identical open boxes originally contain the same volume of water.
One is kept at 15 °C and the other at 85 °C for the same length of time.

Fig. 4.1 shows the final water levels.

Fig. 4.1

With reference to the energies of the water molecules, explain why the levels are different.

....

....

....

....[3]

(b) In an experiment to find the specific latent heat of vaporisation of water, it took 34 500 J of energy to evaporate 15 g of water that was originally at 100 °C.

A second experiment showed that 600 J of energy was lost to the atmosphere from the apparatus during the time it took to evaporate 15 g of water.

Calculate the specific latent heat of vaporisation of water that would be obtained from this experiment.

specific latent heat = ...[3]

9.

A student measures the specific latent heat of fusion of ice in the following way. She knows that the specific heat capacity of water is 4.2 J/g °C.

She takes a polystyrene beaker of negligible mass, and puts 400 g of warm water into it. She stirs the water gently and measures its temperature with a thermocouple connected to a temperature display. The water temperature is 50 °C.

She then takes some wet ice that is at 0 °C, dries it on a tissue, drops it gently into the beaker and stirs until the ice has melted. The temperature is now 32 °C.

She checks the final weight of the beaker and finds that it is 460 g.

a) **i)** What was the temperature difference between the start and finish of the experiment? **(1 mark)**

ii) How many joules of heat did the warmed water give out as it cooled? **(2 marks)**

b) How many grams of ice did she add? **(2 marks)**

c) After the ice had melted, it consisted of cold water at 0 °C.

i) By how many degrees did this then heat up during the experiment? **(2 marks)**

ii) How many joules of heat did this cold water take in as it heated up? **(2 marks)**

d) How many joules of heat that were given out by the warmed water are still unaccounted for? **(2 marks)**

e) If all of these joules of heat were used to melt the ice, what answer does she get for the specific latent heat of the ice in J/g? **(2 marks)**