AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



EXAM QUESTION PACK

4.3.2.2 TEMPERATURE CHANGES IN A SYSTEM AND SPECIFIC HEAT CAPACITY (PACK 2)

SCORE	PERCENTAGE
/90	%

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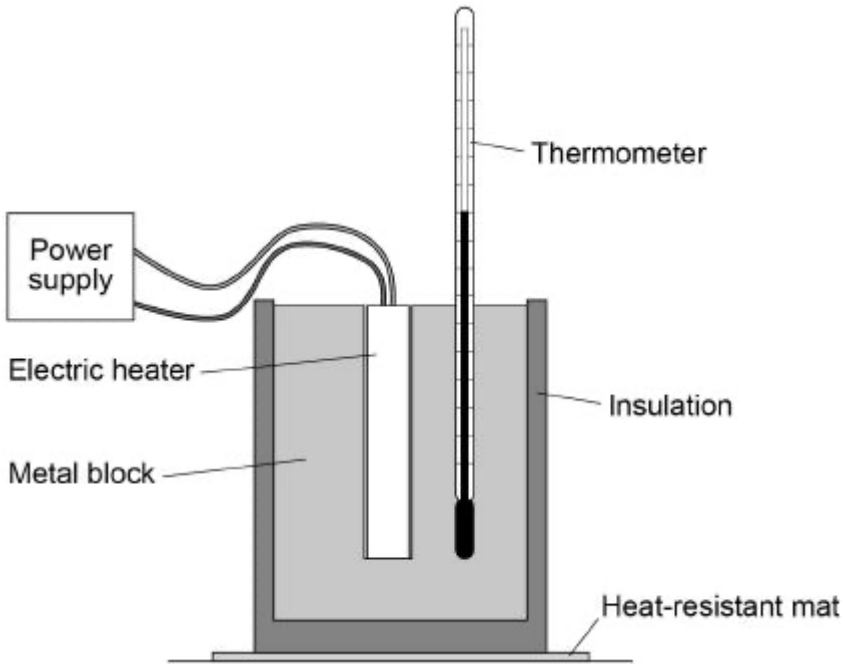
Q1.

A student investigated how the temperature of a metal block changed with time.

An electric heater was used to increase the temperature of the block.

The heater was placed in a hole drilled in the block as shown in **Figure 1**.

Figure 1



The student measured the temperature of the metal block every 60 seconds.
The table below shows the student's results.

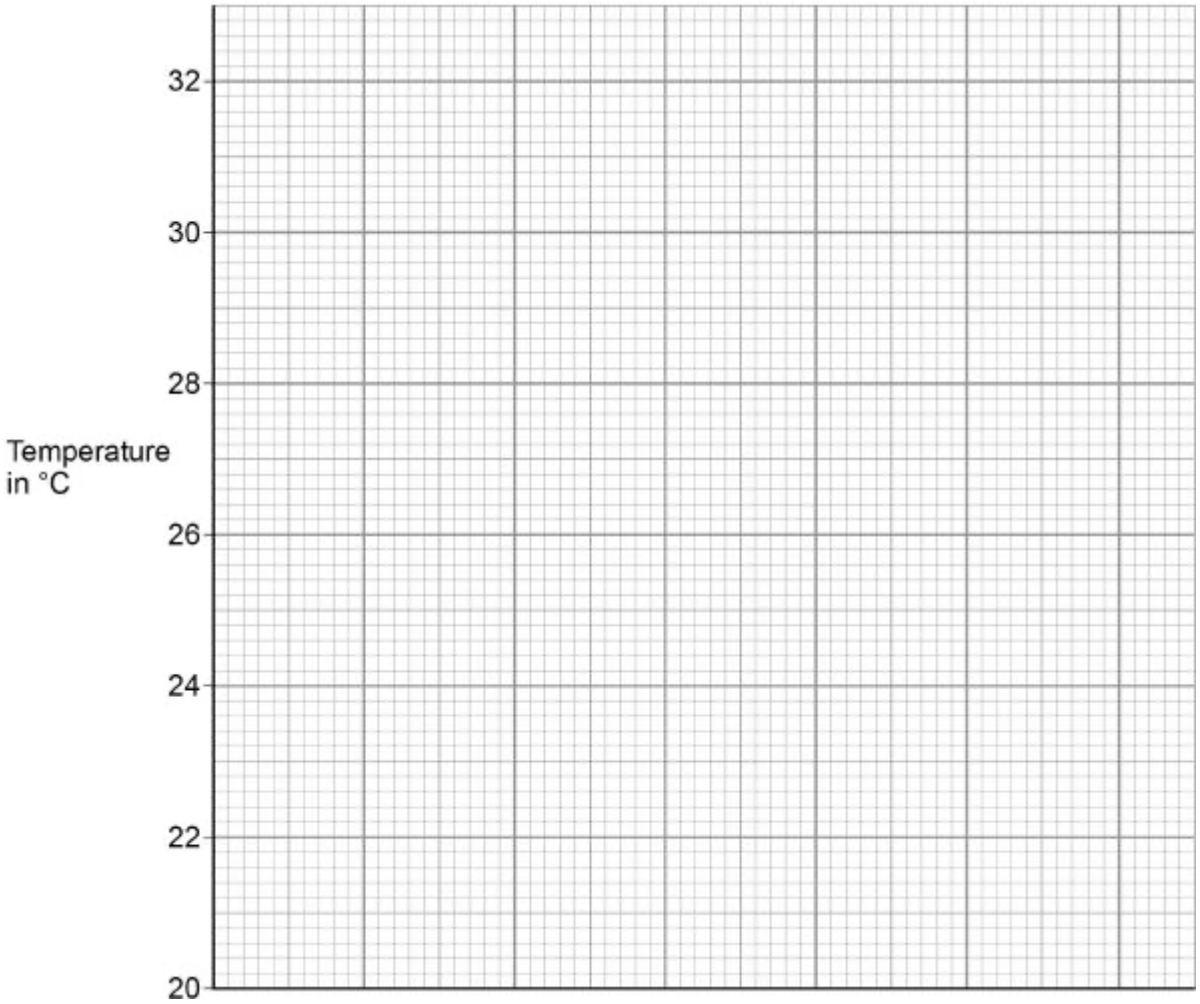
Time in s	Temperature in °C
0	20.0
60	24.5
120	29.0
180	31.0
240	31.5

(a) Complete the graph of the data from the table above on the graph below.

- Choose a suitable scale for the x-axis.
- Label the x-axis.
- Plot the student's results.
- Draw a line of best fit.

Figure 2

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(4)

(b) The rate of change of temperature of the block is given by the gradient of the graph.

Determine the gradient of the graph over the first 60 seconds.

_____

_____

_____

_____

Gradient = _____

(2)

(c) The metal block had a mass of 1.50 kg

The specific heat capacity of the metal was 900 J/kg °C

Calculate the change in thermal energy of the metal during 240 seconds.

Use the Physics Equations Sheet.

Give your answer in kilojoules.

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Change in thermal energy = _____ kJ

(4)

(d) Another student repeated the investigation.

Give **two** variables this student would need to control to be able to compare their results with the results in the table above.

1. _____

2. _____

(2)

(Total 12 marks)

Q2.

Figure 1 shows a student making potato soup.

Figure 1



(a) The student places 0.5 kg of potato into a pan of water.

During cooking, the temperature of the potato increases from 20 °C to 100 °C

The specific heat capacity of the potato is 3400 J/kg °C

Calculate the change in thermal energy of the potato.

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Use the equation:

change in thermal energy = mass × specific heat capacity × temperature change

Change in thermal energy = _____ J

(3)

(b) Why is the energy supplied by the cooker greater than that calculated in part (a)?

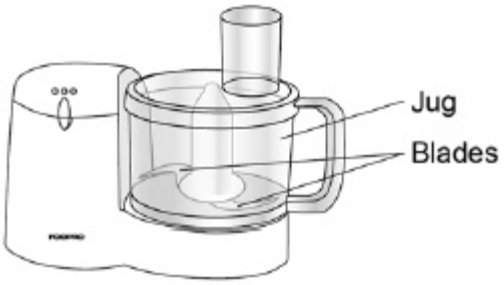
(1)

(c) Suggest **one** way that the student could reduce the time to heat the potato to 100 °C

(1)

Figure 2 shows a food processor.

Figure 2



(d) The student places the cooked potato into the jug of the food processor.

The food processor contains a motor that spins blades to chop the potato.

The total power input to the motor is 500 W

The useful power output from the motor is 300 W

Calculate the efficiency of the motor in the food processor.

Use the equation:

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$$\text{efficiency} = \frac{\text{useful power output}}{\text{total power input}}$$

Efficiency = _____

(2)

(e) The jug is made of plastic with a low thermal conductivity.

Explain why this is an advantage.

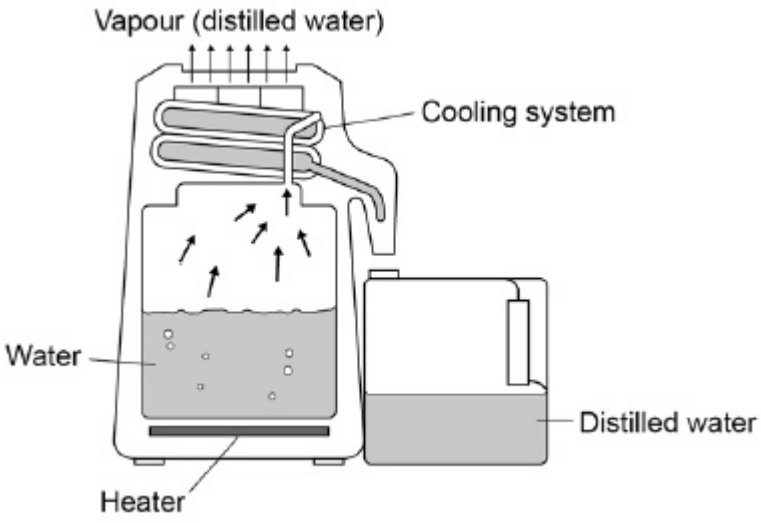
(2)

(Total 9 marks)

Q3.

Figure 1 shows a water distiller which is used to purify water.

Figure 1



The distiller boils water and then condenses most of the water vapour back to water.

(a) The water distiller is filled with 5.0 kg of water at 20 °C

The specific heat capacity of water = 4 200 J/Kg °C

Calculate the energy needed to raise the temperature of the water to 100 °C

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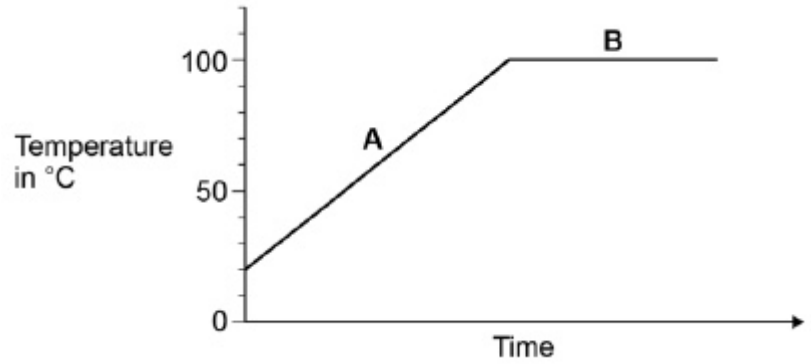
Use the Physics Equations sheet.

Energy = _____ J

(3)

Figure 2 shows how the temperature of the water in the distiller changes with time.

Figure 2



(b) Energy is transferred to the water at a constant rate.

Explain why the graph is a different shape in parts **A** and **B**.

(3)

(c) When the water drops to a low level, the heater automatically switches off.

Explain what problem would be caused if the heater did **not** automatically switch off.

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_____

_____

_____

(3)

(d) The distiller is connected to the mains by a three-core cable.

The wires are covered by different coloured insulation.

What colour is the insulation covering each of the wires?

Live wire _____

Neutral wire _____

Earth wire _____

(2)

(e) Which statement gives the purpose of the earth wire?

Tick **one** box.

It carries an alternating potential difference.	☐
It melts if the current in the circuit is too high.	☐
It provides a connection to complete the circuit.	☐
It stops the casing of the appliance becoming live.	☐

(1)

(f) The heating element has a power of 2.5 kW

The resistance of the heating element is 17 Ω

Calculate the current in the heating element.

Give your answer to 2 significant figures.

Write any equations that you use.

_____

_____

_____

_____

_____

_____

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_____

_____

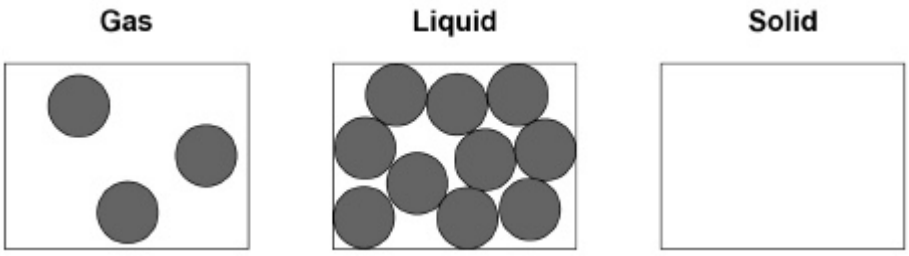
Current = _____ A

(5)

(Total 17 marks)

Q4.

The diagram shows a model of the particles in a gas and in a liquid.



(a) Complete the diagram to show the arrangement of particles of the same substance as a solid.

(2)

(b) What is the name of the process when a substance changes from a gas to a liquid?

Tick **one** box.

Condensing ☐

Evaporating ☐

Freezing ☐

Melting ☐

(1)

(c) The substance in the diagram has a:

- melting point of 98 °C
- boiling point of 883 °C

What is the state of the substance at 20 °C?

Tick **one** box.

Gas ☐ Liquid ☐ Solid ☐

(1)

(d) What type of change is a change of state?

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Tick **one** box.

- Chemical ☐
- Kinetic ☐
- Permanent ☐
- Physical ☐

(1)

(e) Which **two** statements are correct about the particles when a liquid turns into a gas?

Tick **two** boxes.

- Particles are bigger ☐
- Particles are lighter ☐
- Particles have more chemical energy ☐
- Particles have more kinetic energy ☐
- Particles move faster ☐

(2)

(f) Which **two** quantities are needed to calculate the energy required to turn a liquid into a gas with no change in temperature?

Tick **two** boxes.

- Mass of the liquid ☐
- Specific heat capacity of the gas ☐
- Specific latent heat of vaporisation ☐
- Time the liquid is heated ☐

(2)

(g) A mass of 2.0 kg of water is heated.

The temperature increase of the water is 80 °C

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

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Calculate the change in thermal energy when the water is heated.

Use the equation:

change in thermal energy = mass × specific heat capacity × temperature change

_____

_____

_____

Change in thermal energy = _____ J

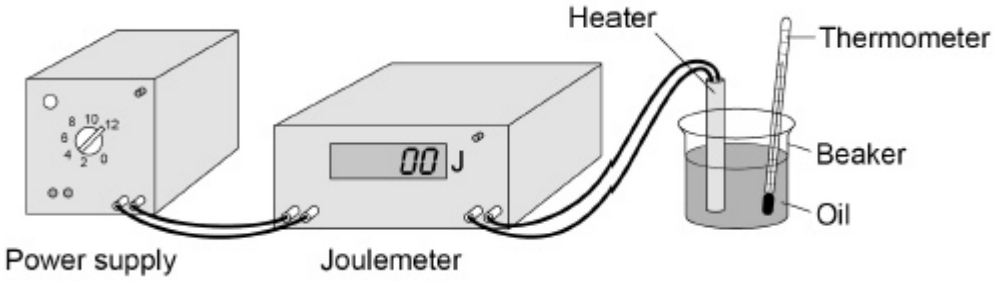
(2)

(Total 11 marks)

Q5.

Students investigated the specific heat capacity of different oils.

The diagram shows the equipment used.



This is the method used.

1. Put 200 g of an oil in a beaker.
2. Record the temperature of the oil.
3. Switch on the heater.
4. After 5 minutes, record the temperature of the oil and the reading on the joulemeter.
5. Repeat steps 1–4 with different oils.

(a) Give **one** variable the students controlled in the investigation.

_____

(1)

The table shows the students' results for one oil.

Temperature at start in °C	Temperature after 5 minutes in °C
21	68

(b) What is the resolution of the thermometer used in the investigation?

Resolution = _____ °C

(1)

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The students calculated the specific heat capacity of the oil as 2100 J/kg °C

The correct value for the specific heat capacity of the oil is 1630 J/kg °C

(c) Calculate the percentage difference between the two values.

_____

_____

_____

_____

Percentage difference = _____ %

(2)

(d) Suggest **two** improvements the students could make to obtain a more accurate value for the specific heat capacity.

1. _____

_____

2. _____

_____

(2)

(e) A company is considering what metal to use to make saucepans.

They use data about the:

- cost of each metal
- specific heat capacity of each metal.

Suggest **two** other properties the company needs to consider when deciding which metal to use.

1. _____

_____

2. _____

_____

(2)

(Total 8 marks)

Q6.

The particle model can be used to explain the properties of gases.

(a) Describe the direction of motion of the particles in a gas.

_____

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(1)

(b) Explain why heating a gas increases the average speed of the gas particles.

(3)

(c) Water can exist as either a liquid or a gas at 100 °C.

Explain why a mass of gaseous water at 100 °C contains more energy than an equal mass of liquid water at 100 °C.

(2)

(d) Water vapour is a gas. Gases change state when they cool.

The figure below shows condensation on a cold bathroom mirror.



© Dwight Eschliman/Getty Images

A volume of 2.5×10^{-5} m^3 of condensation forms on the mirror.

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Density of water = 1000 kg / m^3

Specific latent heat of vaporisation of water = 2.26×10^6 J / kg.

Calculate the energy released when the condensation forms.

Energy released = _____ J

(5)

(e) Central heating boilers burn gas and use the energy released to heat water.

Modern condensing central heating boilers take advantage of the energy that is released when water condenses.

Waste water vapour produced when the water is heated in the boiler is used to preheat the cold water entering the boiler.

Give some of the arguments in favour of condensing boilers compared to older non-condensing boilers.

(4)

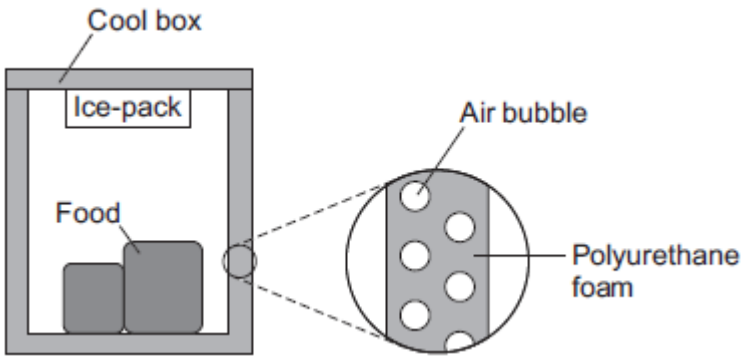
(Total 15 marks)

Q29.

The figure below shows a cool box.

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A cool box is used to keep food colder than the surroundings. The cool box consists of plastic walls with a layer of polyurethane foam between them.



(a) The polyurethane foam has a low U-value.

Why does the polyurethane foam need to have a low U-value?

_____

_____

(1)

(b) The polyurethane foam contains air bubbles.

Explain how the air bubbles reduce energy transfer through the walls of the cool box.

You should refer to the processes of energy transfer in your answer.

_____

_____

_____

_____

_____

_____

(3)

(c) An ice-pack can be placed inside the cool box. An ice-pack contains a material with a very high specific heat capacity. The ice-pack is frozen in a freezer and cooled to –18 °C before being put in the cool box.

The ice-pack keeps the contents of the cool box cooler than the surroundings for a long time.

Describe how.

_____

_____

_____

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_____

_____

_____

(3)

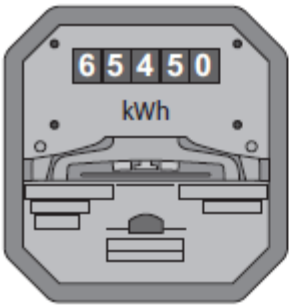
(Total 7 marks)

Q30.

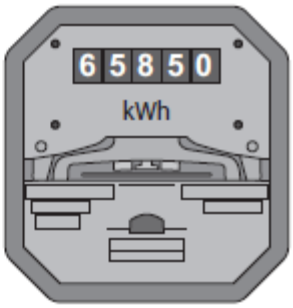
A householder wants to reduce her electricity bills.
The householder takes readings from her electricity meter to see how much electricity she is using.

The pictures show the electricity meter readings at the start and end of April in 2013.

At the start of April



At the end of April



(a) How many kilowatt-hours of electricity did she use in April?

_____

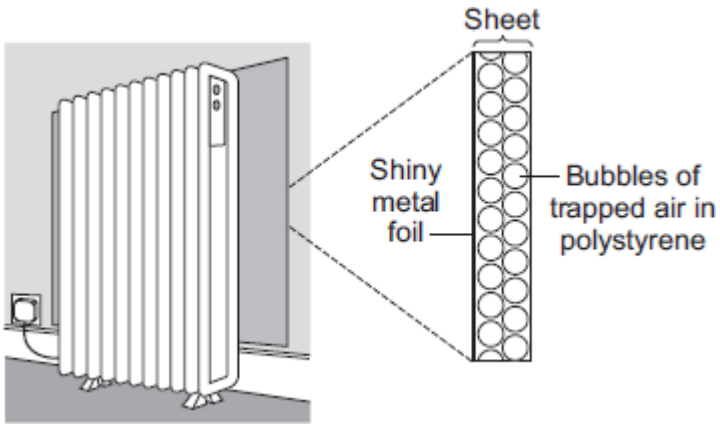
_____

Number of kilowatt-hours = _____

(2)

(b) The householder wants to reduce energy transfer from a room so she puts a special sheet between a heater and the wall.

The side of the sheet facing the heater is shiny metal foil.
The side of the sheet facing the wall is polystyrene.
The polystyrene contains bubbles of trapped air.



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What properties of the sheet make it good for reducing energy transfer from the room?

Draw a ring around each correct answer to complete the sentences.

(i) Shiny surfaces are good | absorbers / emitters / reflectors | of infrared radiation.

(1)

(ii) The air in the polystyrene is a good | conductor. / insulator. / emitter.

(1)

(c) The householder turns her heater thermostat down by 2°C so the temperature of the room is lower.

The specific heat capacity of air is 1000 J/kg°C.

The mass of air in the room is 50 kg.

Calculate the energy needed to change the temperature of 50 kg of air by 2°C.

Use the correct equation from the Physics Equations Sheet.

_____

_____

_____

_____

Energy = _____ J

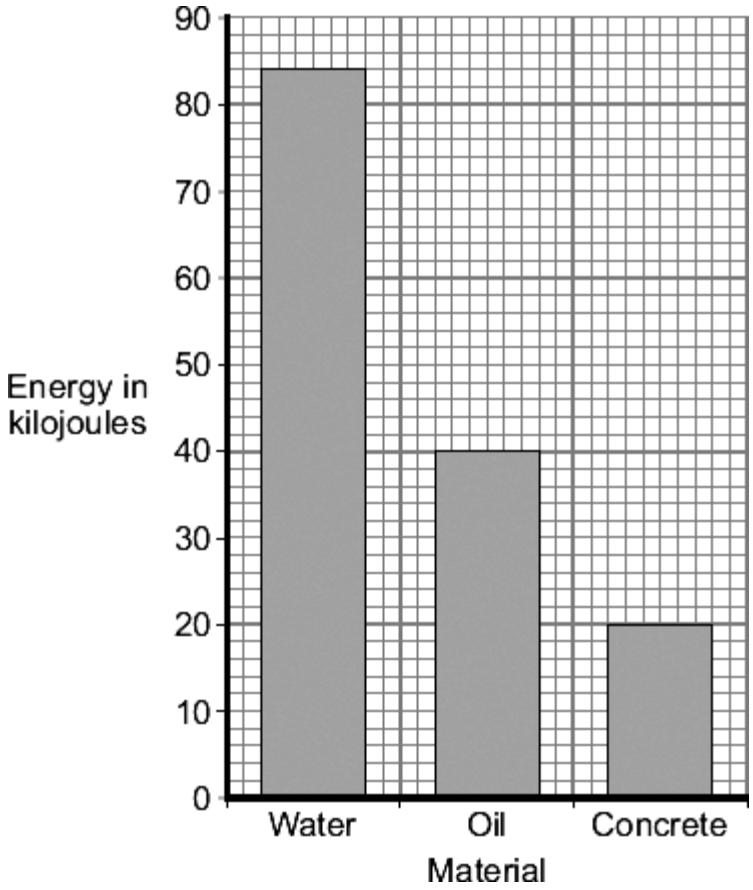
(2)

(Total 6 marks)

Q31.

The bar chart shows the amount of energy needed to raise the temperature of 1 kg of three materials by 20 °C. The materials are used inside heaters.

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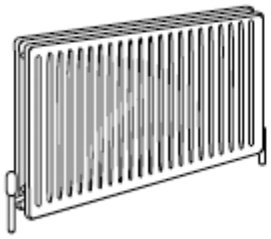
(a) Which material stores most energy?

_____

(1)

(b) The heaters that use the different materials are shown below. The power output when the heaters are being used is shown below each picture.

Water-filled heater



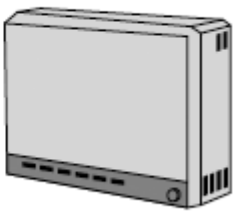
3 kW

Oil-filled heater



1.5 kW

Storage heater
(has concrete blocks inside)



1.7 kW

Each heater is put in one of three identical rooms. Each room's temperature is 10 °C and the heaters are switched on for 5 hours.

Which heater would cause the biggest temperature rise in the room?

Give a reason for your answer.

Heater _____

Reason _____

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(2)

(c) Aluminium has a specific heat capacity of 900 J/kg °C.

Calculate how much energy is needed to raise the temperature of 2 kg of aluminium by 15 °C.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

_____

_____

_____

_____

Energy = _____ J

(2)

(Total 5 marks)

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