P2 Questions

Name: _____

Class: _____

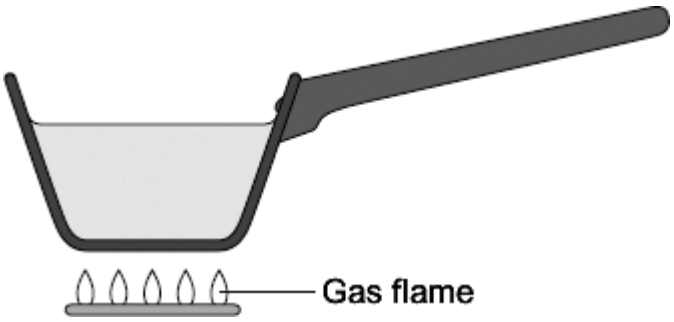
Date: _____

Time: **69 minutes**

Marks: **69 marks**

Comments:

Q1. The diagram shows a metal pan being used to heat water.



Energy from the gas flame is transferred through the metal pan by conduction.

Explain the process of conduction through metals.

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(4)
(Total 4 marks)

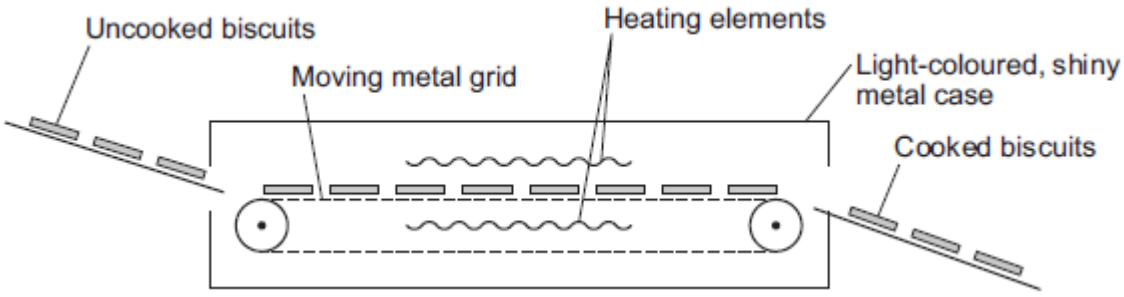
Q2.Figure 1 shows one way that biscuit manufacturers cook large quantities of biscuits.

The uncooked biscuits are placed on a moving metal grid.

The biscuits pass between two hot electrical heating elements inside an oven.

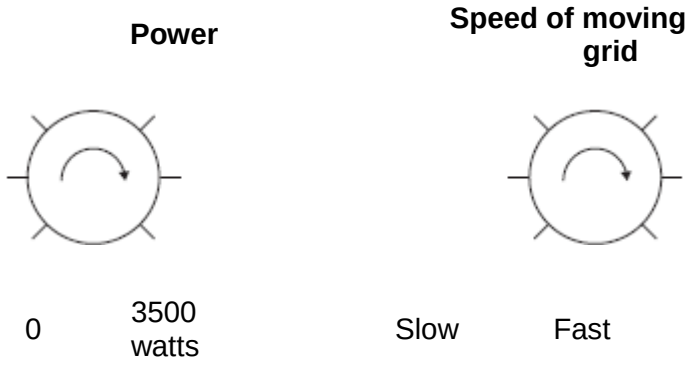
The biscuits turn brown as they cook.

Figure 1



The oven has two control knobs, as shown in **Figure 2**.

Figure 2



(a) Which type of electromagnetic radiation makes the biscuits turn brown?

.....

(1)

(b) Suggest **two** ways of cooking the biscuits in this oven, to make them turn browner.

1 .....

.....

2 .....

.....

(2)

(c) The inside and outside surfaces of the oven are light-coloured and shiny.

Explain why.

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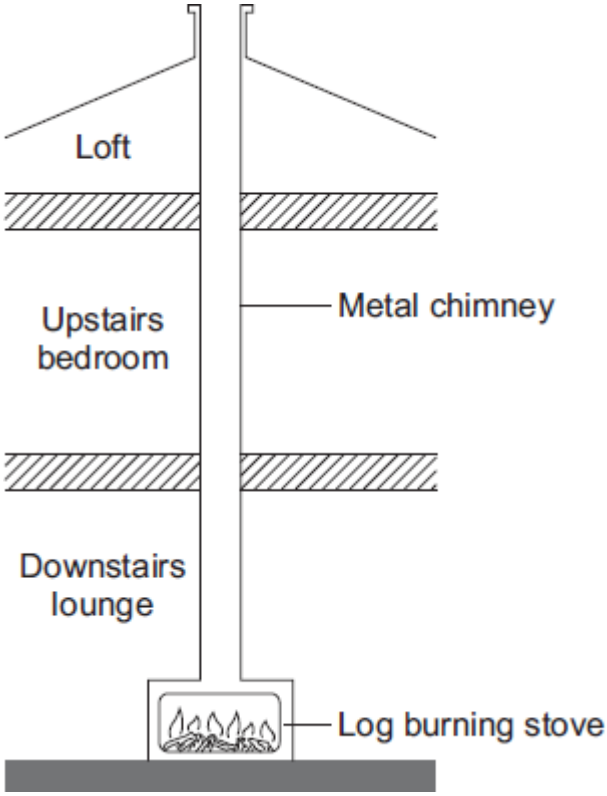
(3)
(Total 6 marks)

Q3. The diagram shows how the metal chimney from a log-burning stove passes through the inside of a house.



(a) Explain how heat is transferred by the process of convection from the inside of the stove to the top of the chimney.

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(2)

(b) Although the outside of the chimney becomes very hot, there is no insulating

material around the chimney.

(i) Explain, in terms of the particles in a metal, how heat is transferred by conduction from the inside to the outside of the metal chimney.

.....

.....

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.....

.....

(2)

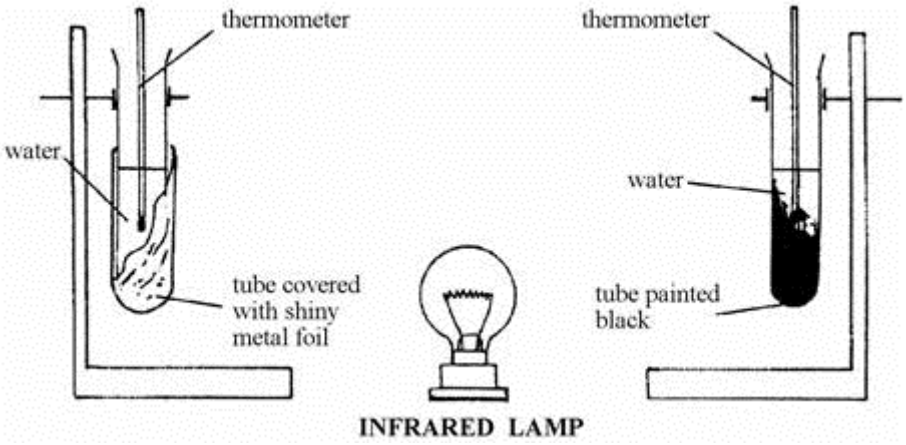
(ii) Suggest **one** advantage of having no insulation around the chimney.

.....

.....

(1)
(Total 5 marks)

Q4. The diagram shows an experiment to find out what happens to infrared waves when they strike different surfaces.



(a) The water in the black tube gets hotter than the water in the shiny tube.

Choose words from the list to complete the sentences below.

absorbs conducts convects radiates reflects

The infrared lamp ..... energy to the tubes of water.

The black surface ..... most of the energy that reaches it.

The shiny surface ..... most of the energy that reaches it.

(3)

(b) Put the sentences A- E below into the correct boxes on the flow diagram so that they tell you how to do the experiment

(You may use just the letters if you want to.)

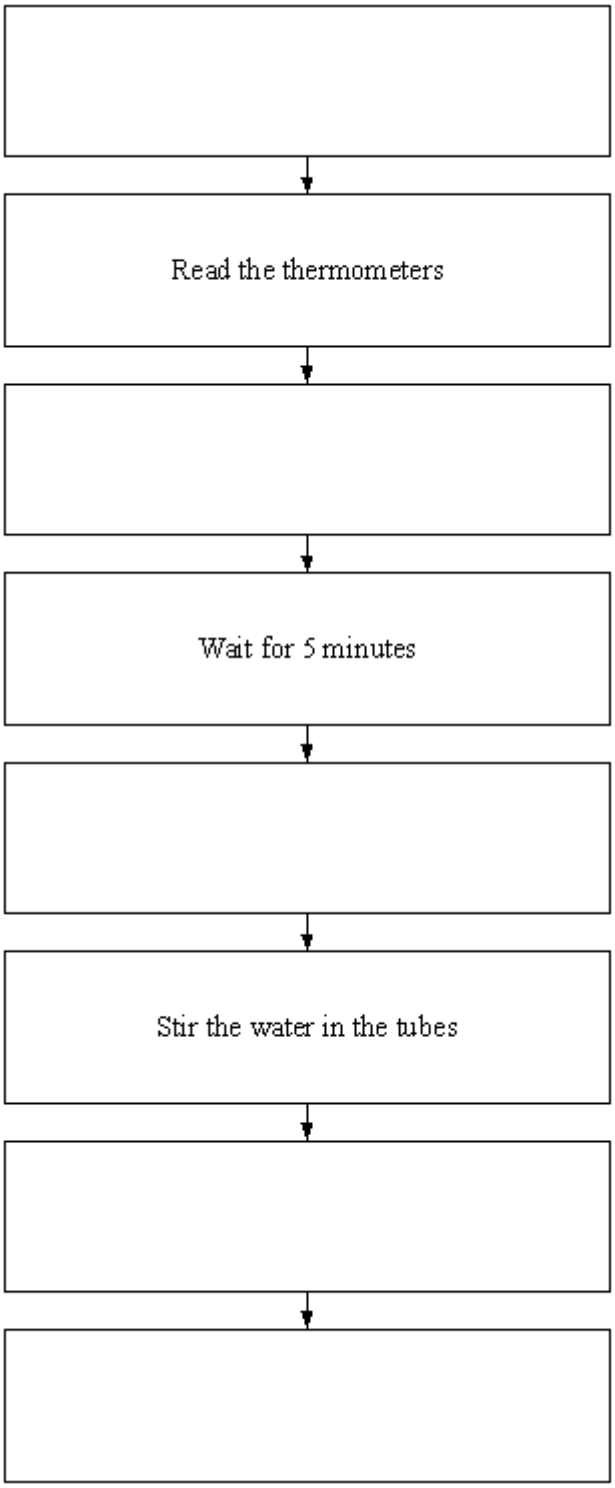
A Switch off the lamp

B Switch on the lamp

C Make sure the lamp is the same distance from both tubes

D Read the thermometers

E Wait for the temperature to stop rising



(5)
(Total 8 marks)

Q5. The electric kettle shown below is used to boil water.

©leeser87/iStock

(a) After the water has boiled, the temperature of the water decreases by 22 °C.
The mass of water in the kettle is 0.50 kg.
The specific heat capacity of water is 4200 J/kg °C.

Calculate the energy transferred to the surroundings from the water.

.....

.....

.....

Energy = ... joules

(2)

(b) Why is the total energy input to the kettle higher than the energy used to heat the water?

Tick (✓) **one** box.

	Tick (✓)
Energy is absorbed from the surroundings.	
Energy is used to heat the kettle.	
The kettle is more than 100% efficient.	

(1)
(Total 3 marks)

Q6. A wood burning stove is used to heat a room.

Photograph supplied by iStockphoto/Thinkstock

The fire in the stove uses wood as a fuel. The fire heats the matt black metal case of the stove.

(a) The air next to the stove is warmed by infrared radiation.

How does the design of the stove help to improve the rate of energy transfer by infrared radiation?

.....

.....

.....

.....

(2)

(b) Burning 1 kg of wood transfers 15 MJ of energy to the stove. The stove then transfers 13.5 MJ of energy to the room.

Calculate the efficiency of the stove.

Show clearly how you work out your answer.

.....

.....

.....

Efficiency = ...

(2)

(c) Some of the energy from the burning wood is wasted as the hot gases leave the chimney and warm the air outside the house.

Name **one** other way energy is wasted by the stove.

.....

(1)

(d) Some people heat their homes using electric heaters. Other people heat their homes using a wood burning stove.

Give **two** environmental advantages of using a wood burning stove to heat a home rather than heaters that use electricity generated from fossil fuels.

1 .....

.....

2 .....

.....

(2)

(e) The metal case of the stove gets hot when the fire is lit.

Here is some information about the stove.

Mass of metal case	100 kg
Starting temperature of metal case	20 °C
Final temperature of metal case	70 °C
Specific heat capacity of metal case	510 J/kg °C

Calculate the energy required to raise the temperature of the metal case to 70 °C.

Show clearly how you work out your answer and give the unit.

.....

.....

.....

.....

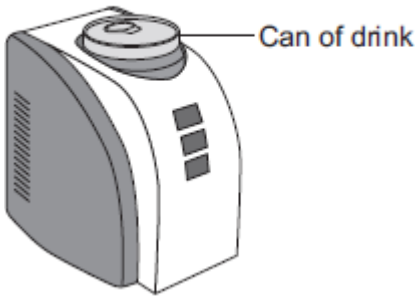
Energy required = ...

(3)
(Total 10 marks)

Q7.A 'can-chiller' is used to make a can of drink colder.

Figure 1 shows a can-chiller.

Figure 1



(a) The can-chiller decreases the temperature of the liquid in the can by 15 °C.
The mass of liquid is 0.33 kg.
The specific heat capacity of the liquid is 4200 J / kg °C.

Calculate the energy transferred from the liquid as it cools.

.....

.....

.....

Energy = ... J

(2)

(b) Complete the following sentence.

The specific heat capacity of a substance is the amount of energy required to change the ..... of one kilogram of the

substance by one degree Celsius.

(1)

(c) To calculate the specific heat capacity of a material, the mass of the material needs to be measured.

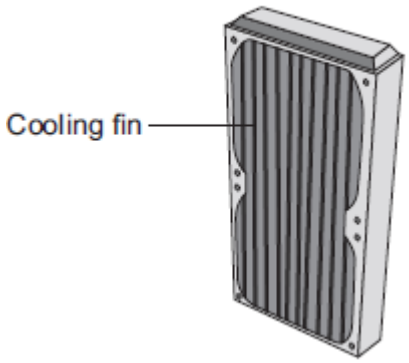
State the name of a measuring instrument used to measure mass.

.....

(1)

(d) The back of the can-chiller has cooling fins, as shown in **Figure 2**.

Figure 2



The cooling fins increase the rate of energy transfer from the can-chiller to the surroundings.

Complete the following sentences.

The cooling fins are a ..... colour because that makes them

good emitters of infrared radiation.

The large surface area of the cooling fins allows the air around the can-chiller

to gain energy quickly and rise, transferring energy by ..... .

(2)

(e) (i) The energy input to the can-chiller is the same as the energy output. This shows that energy is conserved.

Complete the following sentence.

Energy can be transferred usefully, stored or dissipated, but cannot be

..... or destroyed.

(1)

(ii) The temperature of the can of drink decreases while it is in the can-chiller.

What happens to the temperature of the air around the cooling fins?

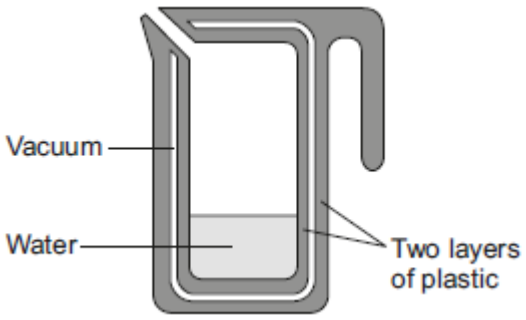
.....

(1)

(Total 8 marks)

Q8. 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 below.



(a) 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.

Calculate the temperature of the water in the kettle after 2 hours.

.....

.....

.....

.....

Temperature after 2 hours = ... °C

(3)

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

.....

.....

.....

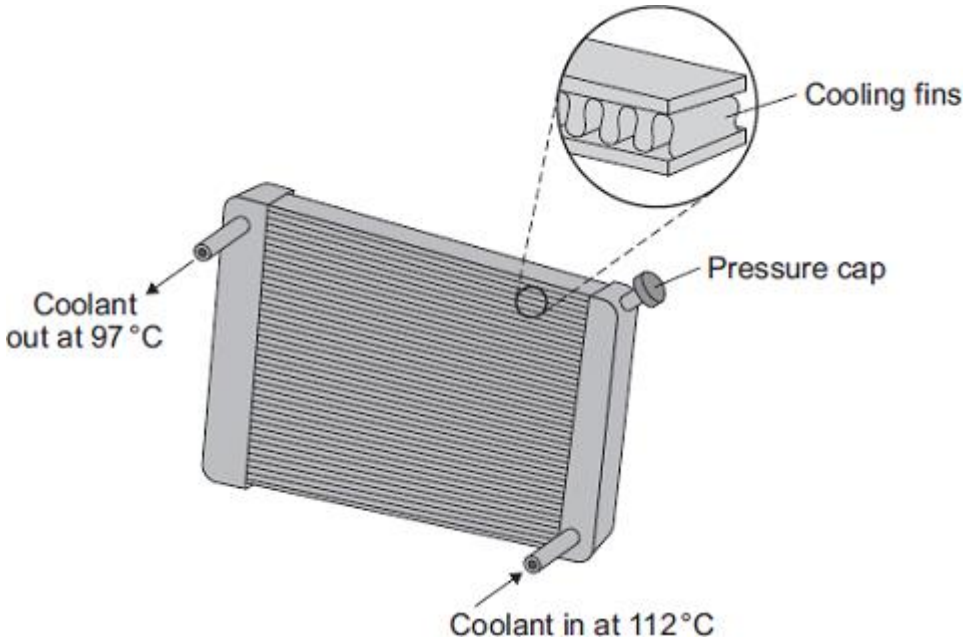
.....

Average power output = ... W

(2)

(Total 5 marks)

Q9. The diagram shows a car radiator. The radiator is part of the engine cooling system.



Liquid coolant, heated by the car engine, enters the radiator. As the coolant passes through the radiator, the radiator transfers energy to the surroundings and the temperature of the coolant falls.

(a) Why is the radiator painted black?

.....

.....

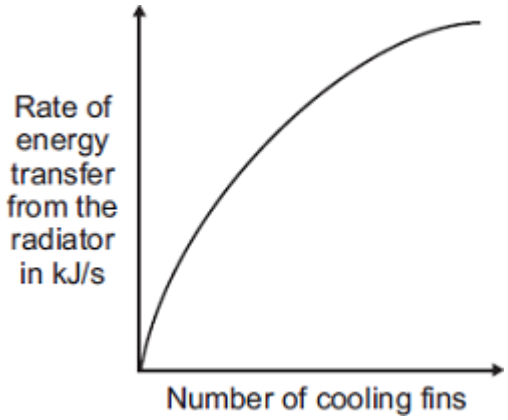
.....

.....

(2)

(b) Different radiators have different numbers of cooling fins along the length of the radiator.

The sketch graph shows how the number of cooling fins affects the rate of energy transfer from the radiator.



The number of cooling fins affects the rate of energy transfer from the radiator.

Explain how.

.....

.....

.....

.....

(2)

(c) When the car engine is working normally, 2 kg of coolant passes through the radiator each second. The temperature of the coolant falls from 112 °C to 97 °C.

Calculate the energy transferred each second from the coolant.

Specific heat capacity of the coolant = 3800 J/kg °C.

.....

.....

.....

.....

Energy transferred each second = ... J

(3)

(d) On cold days, some of the energy transferred from a hot car engine is used to warm the air inside the car. This is a useful energy transfer.

What effect, if any, does this energy transfer have on the overall efficiency of the car engine?

Draw a ring around the correct answer.

decreases the efficiency	does not change the efficiency	increases the efficiency

Give a reason for your answer.

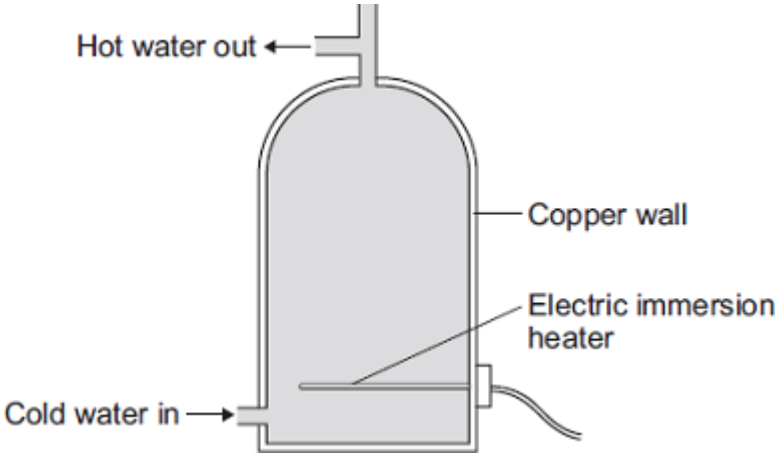
.....

.....

.....

(2)
(Total 9 marks)

Q10. An electric immersion heater is used to heat the water in a domestic hot water tank.
When the immersion heater is switched on the water at the bottom of the tank gets hot.



(a) Complete the following sentence.

The main way the energy is transferred through the copper wall of the water tank is by

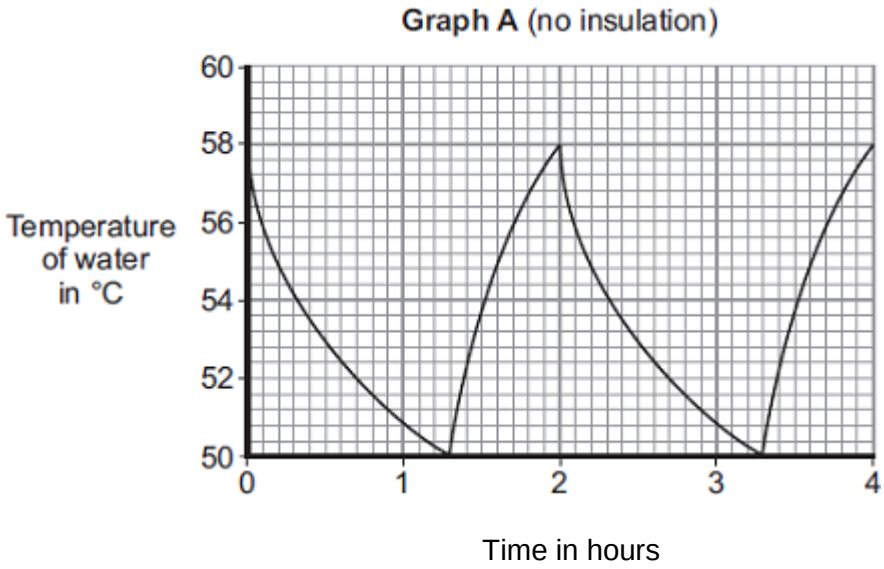
the process of ..... .

(1)

(b) The immersion heater has a thermostat to control the water temperature.

When the temperature of the water inside the tank reaches 58°C the thermostat switches the heater off. The thermostat switches the heater back on when the temperature of the water falls to 50°C.

Graph A shows how the temperature of the water inside a hot water tank changes with time. The tank is **not** insulated.



(i) The temperature of the water falls at the fastest rate just after the heater switches off.

Explain why.

.....

.....

.....

.....

(2)

(ii) To heat the water in the tank from 50°C to 58°C the immersion heater transfers 4032 kJ of energy to the water.

Calculate the mass of water in the tank.

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

.....

.....

.....

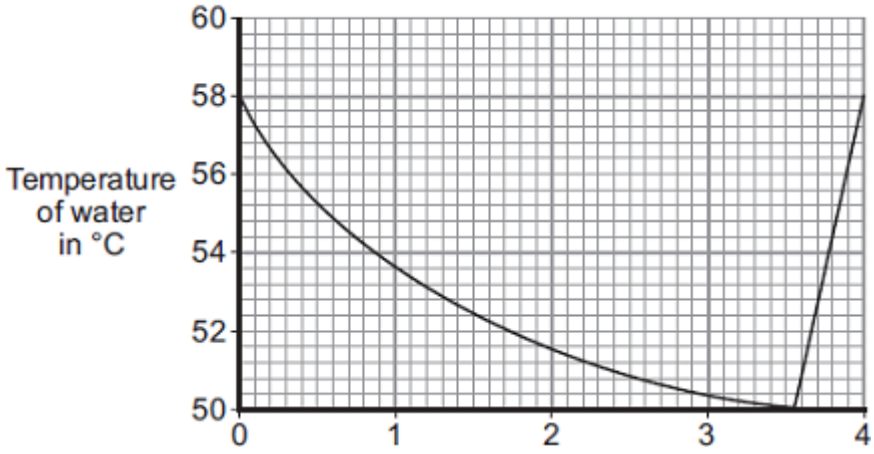
Mass = ... kg

(3)

(iii) An insulating jacket is fitted to the hot water tank.

Graph B shows how the temperature of the water inside the insulated hot water tank changes with time.

Graph B



An insulating jacket only costs £12.

By comparing **Graph A** with **Graph B**, explain why fitting an insulating jacket to a hot water tank saves money.

.....

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.....

.....

.....

.....

(3)
(Total 9 marks)

M1. *accept atoms / particles for ions throughout*

(a metal has) free <u>electrons</u>

accept mobile for free

1

(kinetic) energy of (free) electrons increases

accept energy of ions increases
accept ions vibrate with a bigger amplitude
accept ions vibrate more
*do **not** accept electrons vibrate more*

1

(free) <u>electrons</u> move faster

1

or

electrons move through metal

accept electrons collide with other electrons / ions

(so) electrons transfer energy to other electrons / ions

accept ions transfer energy to neighbouring ions

1

[4]

M2.(a) infrared / IR

correct answer only

1

(b) any **two** from:

- increase the power / watts
  allow increase the temperature of the oven or make the oven hotter
- decrease the speed
  allow leave the biscuits in for longer
- put biscuits through again
  increase radiation is insufficient

ignore changes to the design of the oven

2

(c) (inside) surface is a (good) reflector or poor absorber (of IR)

Ignore bounce for reflect

surface is a (good) reflector of light does not score

surface is a (good) reflector of light and infrared / heat does score

1

(and) outside surface is poor emitter (of IR)

1

(so) increases the energy reaching the biscuits

allow reduces energy loss or makes oven more efficient

*do **not** accept no energy losses*

keeps oven hotter is insufficient

1

[6]

M3. (a) any **two** from:

- (air) particles / molecules / atoms gain energy
- (air) particles / molecules / atoms move faster

  *do **not** accept move more*

  *do **not** accept move with a bigger amplitude / vibrate more*
- (air) particles / molecules / atoms move apart
- air expands

  ignore particles expand
- air becomes less dense

  ignore particles become less dense
- warm / hot air / gases / particles rise

  *do **not** accept heat rises*

  answers in terms of heat particles negates any of the mark points that includes particles

2

(b) (i) any **two** from

- free / mobile electrons gain (kinetic) energy
  accept free / mobile electrons move faster
  accept vibrate faster for gain energy
- free electrons collide with other (free) electrons / ions / atoms / particles
- atoms / ions / particles collide with other atoms / ions / particles
  answers in terms of heat particles negates this mark point

2

(ii) (faster) energy / heat transfer to room(s) / house
accept room(s) / house gets warm(er)
accept lounge / bedroom / loft for rooms

1

[5]

M4. (a) radiates
absorbs / conducts
reflects
for 1 mark each

3

(b) C make sure the lamp is the same distance from both tubes
B switch on the lamp
A switch off the lamp
E wait for the temperature to stop rising
D read the thermometers
for 1 mark each

5

[8]

M5.(a) 46 200
accept 46 000

*allow **1** mark for correct substitution*
ie 0.5 × 4200 × 22 provided no subsequent step

2

(b) Energy is used to heat the kettle.

1

[3]

M6. (a) any **two** from:

- black is a good emitter of (infrared radiation)
  accept heat for radiation
  ignore reference to absorbing radiation
- large surface (area)
- matt surfaces are better emitters (than shiny surfaces)
  accept matt surfaces are good emitters
  ignore reference to good conductor

2

(b) 90% or 0.9(0)

$$efficiency = \frac{useful\ energy\ out\ (\times 100\%)}{total\ energy\ in}$$

allow 1 mark for correct substitution, ie $\frac{13.5}{15}$
provided no subsequent step shown
*an answer of 90 scores **1** mark*
*an answer of 90 / 0.90 with a unit scores **1** mark*

2

(c) (producing) light
allow (producing) sound

1

(d) any **two** from:

- wood is renewable
  accept wood grows again / quickly
  accept wood can be replanted
- (using wood) conserves fossil fuels
  accept doesn't use fossil fuels

- wood is carbon neutral

  accept a description

  cheaper / saves money is insufficient

2

(e) $E = m \times c \times \theta$

2 550 000

*allow **1** mark for correct substitution*
ie 100 × 510 × 50
provided no subsequent step shown

*answers of 1 020 000, 3 570 000 gain **1** mark*

2

joules /J

accept kJ / MJ

*do **not** accept j*

for full credit the unit and numerical answer must be consistent

1

[10]

M7.(a) 20 790 (J)

*an answer of 21 000 (J) (2 s.f.) gains **2** marks*

*allow **1** mark for correct substitution:*
ie E = 0.33 × 4200 × 15 provided no subsequent step shown

2

(b) temperature

1

(c) (top pan) balance

accept scales

*do **not** accept a scale*
*do **not** accept weighing scales*
*do **not** accept newtonmeter*
*do **not** accept spring balance*

1

(d) dark / black / (dark) grey

1

convection

correct order only

1

(e) (i) created

accept made

1

(ii) increases

1

[8]

M8.(a) 78 (°C)

*allow **2** marks for correct temperature change ie 22 °C*

*allow **1** mark for correct substitution*

ie 46 200 = 0.5 × 4200 x θ

or

$$\frac{46200}{0.5 \times 4200} = \theta$$

3

(b) 6.4 (W)

*allow **2** marks for an answer that rounds to 6.4*

*allow **1** mark for correct substitution*

ie 46 200 = P × 7200

an answer of 23 000 or 23 100 or 385 gains 1 mark

2

[5]

M9.(a) (matt) black is a good emitter of infrared / radiation

accept heat for infrared / radiationignore reference to good absorberattracts heat negates this marking point

1

to give maximum (rate of) energy transfer (to surroundings)

accept temperature (of coolant) falls fast(er)

*accept black emits more radiation for **1** mark*

*black emits most radiation / black is the best emitter of radiation for **2** marks*

1

(b) the fins increase the surface area

accept heat for energy

1

so increasing the (rate of) energy transfer**or**so more fins greater (rate of) energy transfer

1

(c) 114 000

*allow **1** mark for correct temperature change, ie 15 (°C)*

or

*allow **2** marks for correct substitution, ie 2 × 3 800 × 15*

*answers of 851 200 **or** 737 200 gain **2** marks*

or

*substitution 2 × 3800 × 112 **or** 2 × 3800 × 97 gains **1** mark*

*an answer of 114 kJ gains **3** marks*

3

(d) increases the efficiency

1

less (input) energy is wasted

accept some of the energy that would have been wasted is (usefully) used

or

more (input) energy is usefully used

accept heat for energy

1

[9]

M10.(a) conduction

1

(b) (i) there is a bigger temperature difference between the water and the surrounding air

accept the water is hottest / hotter

1

so the transfer of energy (from hot water) is faster

accept heat for energy
ignore temperature falls the fastest

1

(ii) 120

*allow **1** mark for converting kJ to J correctly, ie 4 032 000*

or

correctly calculating temperature fall as 8°C

or

allow **2** marks for correct substitution, ie 4 032 000 = m × 4200 × 8

answers of 0.12, 19.2 **or** 16.6 gain **2** marks

answers of 0.019 **or** 0.017 gain **1** mark

3

(iii) water stays hot for longer

1

so heater is on for less time

accept so less energy needed to heat water

1

so cost of the jacket is soon recovered from) lower energy costs / bills

accept short payback time

1

[9]