Q1. (a) Use the words from the box to complete the following sentences.

conduction	convection	radiation

(i) The transfer of thermal energy (heat) by the movement of hot liquids

is called ....**(1)**

(ii) The transfer of thermal energy (heat) from one particle to another

is called ....**(1)**

(b) A student set up the following equipment. The 3 metal plates are the same distance from the heater. The surfaces of each of the 3 metal plates are different colours.
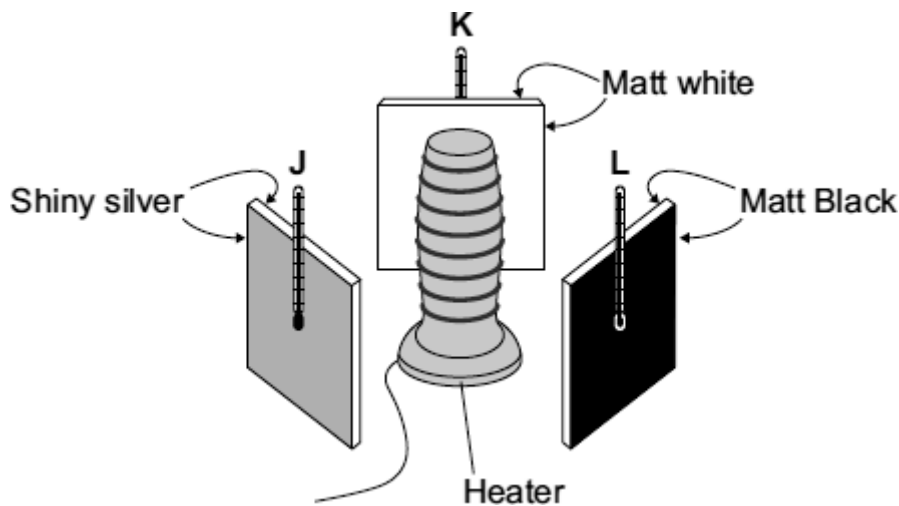
The student switched the heater on for 10 minutes. The thermometers were read before the heater was switched on. The thermometers were read again just after the heaters were switched off.
The readings are shown in the table.

	Temperature before switching on in °C	Temperature after switching on in °C
1	19	21
2	19	29
3	19	23

(i) Which set of readings, **1**, **2** or **3**, is most likely to have been taken from the thermometer labelled **L**?

....

Give a reason for your answer.

....

....**(2)**

(iii) Suggest **one** advantage of using a temperature sensor, data logger and computer, rather than a thermometer to carry out this experiment.

....

....**(1)**

(c) The picture shows a fire fighter putting out a forest fire. The fire fighter's clothing has thick thermal padding inside and a light coloured, fire proof, shiny layer outside.

(i) What is the main way that heat is transferred through the air from the fire to the fire fighter?

....

(1)

(ii) Why is the outside layer of the clothing shiny?

....

....**(1)**

Q2. The diagram shows a simple type of portable shower. The water container is a strong plastic bag that is black on one side and white on the other. To warm the water, the bag is placed on the ground in direct sunlight, with the black side facing the Sun.
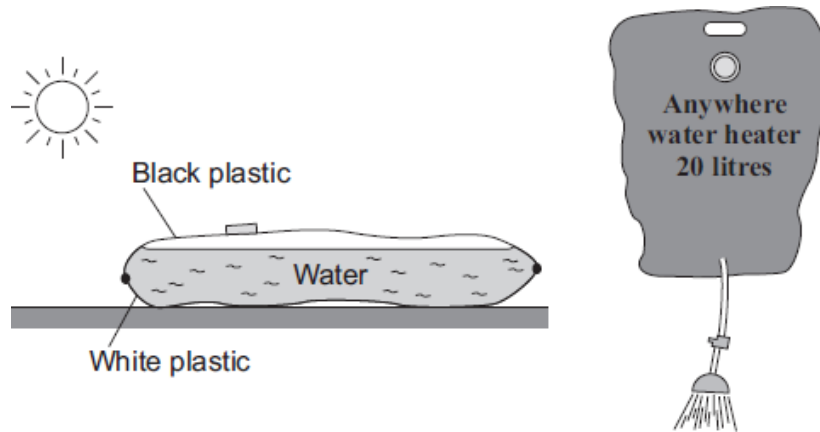
(a) (i) Name the process by which heat is transferred from the Sun to the outside of the bag.

....(1)

(ii) Explain why the black side of the bag and not the white side should face the Sun.

....

....

....

....(2)

**Q3.** The drawing shows someone ironing a shirt. The top of the ironing board is covered in a shiny silver-coloured material.
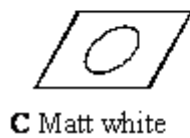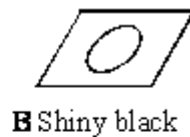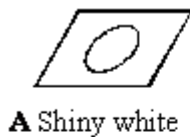
Explain why the shiny silver-coloured material helps to make ironing easier.

....

....

....

....

(Total 2 marks)

Q4. The diagram shows four identical pieces of aluminium. Each had been painted with a different type of paint. A drop of water was placed on each and they were then heated by a radiant heater held about one metre above them.

A Shiny white

B Shiny black

C Matt white

D Matt black
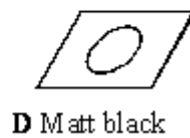
(i) Suggest in which order the pieces of aluminium would become dry.

first .... last

(1)

(ii) Explain why you chose your order.

....

....

....

....

(2)
(Total 3 marks)

M1. (a) (i) convection

1

(ii) conduction

1

(b) (i) 2

1

black is the best <u>absorber</u> (of thermal energy / heat)
accept black is the best emitter (of thermal energy / heat)
note that a comparative is needed (eg better or best)

1

(ii) the colour of the metal plates

1

(iii) any **one** from:

• more precise / accurate / reliable
*do **not** accept better reading*
*do **not** accept thermometer is unreliable*

• can measure continuously

• take many readings in a small time

• removes (human) reading error
accept easier to read

• can compare / draw graphs automatically

• records data automatically

1

(c) (i) radiation
accept radiates
accept infra red (IR) waves
*do **not** accept heat waves*

1

(ii) to reflect (heat away from the fire fighter)
accept it reflects
accept it is a poor absorber (of thermal radiation / heat)
*do **not** accept deflect / bounce for reflect*

1

(d) **N**
*the mark is for the reason which does not score if **M** is chosen*

transfers / absorbs less heat
or
gives smallest increase in temperature

        accept will keep fire fighters cooler

        *accept **N** is cooler (after 15 minutes)*

        *an answer **N** goes up to 52°C and **M** goes up to 100°C is insufficient*

                                                  1

                                                                     [9]

M2. (a) (i) radiation

        ignore thermal / infrared

                                                1

(ii) black is a better / good absorber (of heat / radiation)

        ignore reference to black being a good emitter

        black absorbs heat is insufficient

        *do **not** accept black attracts / absorbs the Sun*

        *do **not** accept black attracts heat*

                                                  1

    (so) temperature rises faster

        must be an indication of heating up quicker
or
white is a worse / poor absorber (of heat / radiation) (1)

        accept white is a better / good reflector (of heat / radiation)

    (so if white faces) temperature would rise slower (1)

        ignore any reference to light

                                                  1

(b) (i) 1.2 (hours) **or** 1 hour 12 minutes

        no tolerance

                                                  1

(ii) increases (rapidly at first then increases at a slower rate)

        *do **not** accept increases at a steady rate*

                                                  1

(c) (i) any **two** from:

    • (fill with) same mass / volume / amount of water

    • same level of (sun)light / sunshine

        accept same heat / light source

        accept same place

          • outside for the same (length of) time

          • outside at same time (of day / year)

          • initial water temperature

          • the side of the bag facing the Sun

               *do **not** accept any factors to do with the construction of plastic bags eg thickness*

2

     (ii) curved line drawn above given line

               both lines must start from the same point

               ignore if continues beyond one hour or levels off after 1 hour

               *do **not** accept a straight line*

1

[8]

M3. silver is a (good) reflector of <u>heat</u>
(radiation) **or**
silver reflects the heat (radiation)

               fact

               heat = infra red

               ignore references to light

               accept shiny for silver

               good radiator negates the mark

               ignore references to good conductor

               *do **not** accept bounce back*

1

less heat is lost through the board **or** more heat is retained by the shirt

               explanation

               accept both sides of shirt heated

               *reflects heat back up gets **1** mark only*

               ignore mention of friction

1

[2]

M4. (i) D, C **or** B, in either order, then A

               tick or cross on the A

1

(ii) matt absorbs energy (better than shiny)

the converse arguments are acceptable

1

black absorbs energy (better than white)

1

[3]