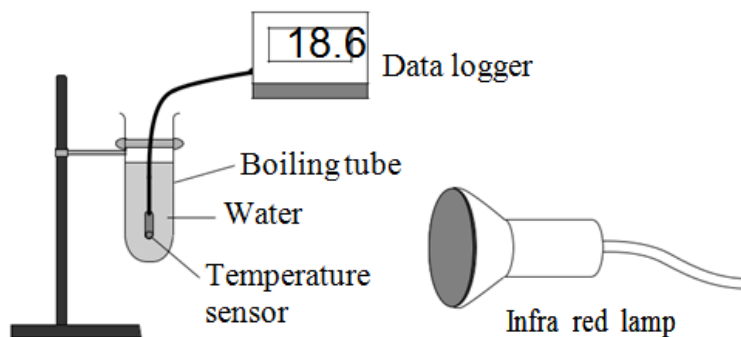


Conduction and Convection 1

Q:1 A student had read about a glacier that had been covered in insulating material. The idea was to slow down the rate at which the glacier melts in the summer.

She investigated this idea using the apparatus shown in the diagram.



- (a)** These are the steps taken by the student.
- z Measure 30 cm³ of cold water into a boiling tube.
 - z Place the boiling tube 25 cm from an infra red lamp.
 - z Record the temperature of the water.
 - z Switch on the infra red lamp.
 - z Record the temperature of the water every minute for 5 minutes.
 - z Repeat with boiling tubes covered in different insulating materials.

(i) Why did she use an infra red lamp?

(1 mark)

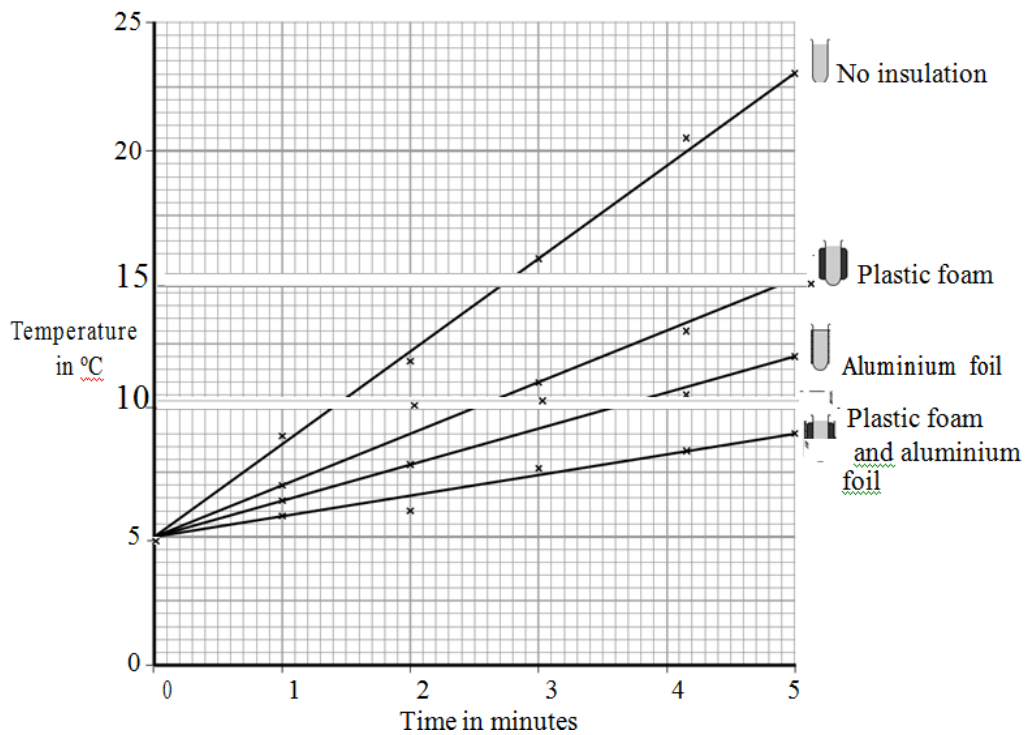
(ii) Name one control variable in this investigation.

(1 mark)

(iii) Give one advantage of using a temperature sensor and data logger instead of a glass thermometer to measure temperature.

(1 mark)

(b) The results of the investigation are shown in the graph.



(i) Why did the student use a boiling tube with no insulation?

(1 mark)

(ii) From her results, what should she recommend is used to insulate the glacier?

(1 mark)

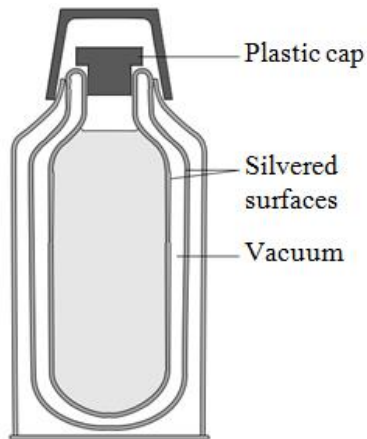
(iii) Explain why the insulation recommended by the student will reduce the heat transfer from the Sun to the glacier.

(2 marks)

(c) Explain, in terms of particles, how heat is transferred through the glass wall of a boiling tube.

(2 marks)

Q:2 A vacuum flask is designed to reduce the rate of heat transfer.



(a) (i) Complete the table to show which methods of heat transfer are reduced by each of the features labelled in the diagram. The first row has been done for you.

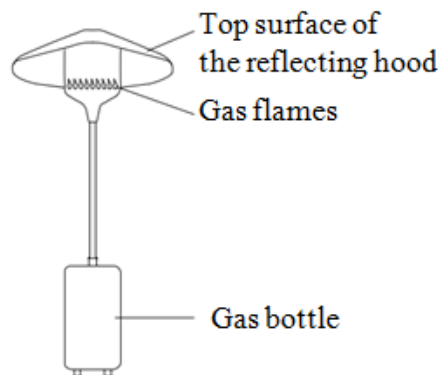
Feature	Conduction	Convection	Radiation
vacuum	✓	✓	
silvered surfaces			
plastic cap			

(2 marks)

(a) (ii) Explain why the vacuum between the glass walls of the flask reduces heat transfer by conduction and convection.

(2 marks)

(b) The diagram shows a gas flame patio heater.



(b)(i) Explain why the top surface of the reflecting hood should be a light, shiny surface rather than a dark, matt surface.

(2 marks)

(b)(ii) Most of the chemical energy in the gas is transformed into heat. A small amount of chemical energy is transformed into light.

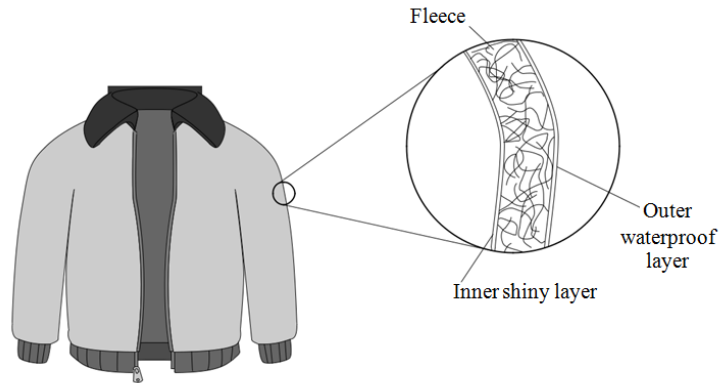
Draw and label a Sankey diagram for the patio heater.

(2 marks)

(b) (iii) State why the total energy supplied to the patio heater must always equal the total energy transferred by the patio heater.

(1 marks)

Q:3(a) The diagram shows a ski jacket that has been designed to keep a skier warm. The jacket is made from layers of different materials.



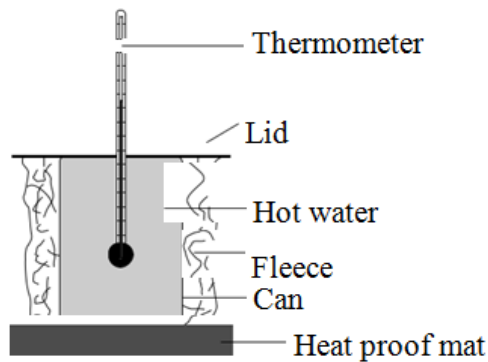
(a)(i) The inner layer is shiny to reduce heat transfer. Which process of heat transfer will it reduce?

(1 mark)

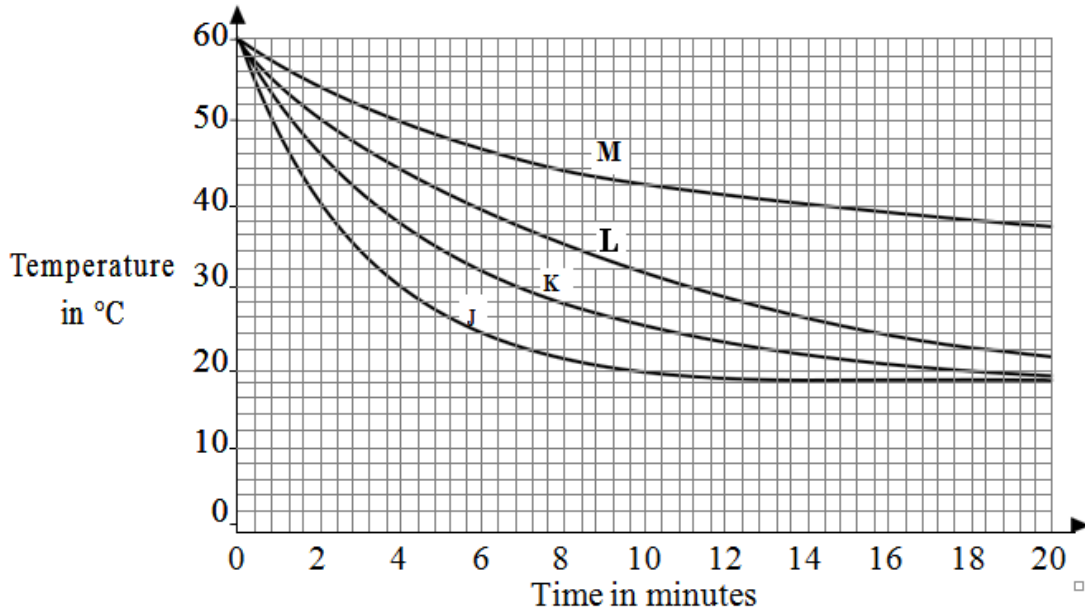
(a) (ii) Why is the layer of fleece good at reducing the transfer of heat from a skier's body?

(1 mark)

(b) A student tested four different types of fleece, J, K, L and M, to find which would make the warmest jacket. Each type of fleece was wrapped around a can which was then filled with hot water. The temperature of the water was taken every two minutes for 20 minutes.



The graph shows the student's results.



(b) (i) In each test, the water cooled faster during the first five minutes than during the last five minutes. Why?

(1 mark)

(b)(ii) To be able to compare the results, it was important to use the same volume of water in each test.

Give one other quantity that was the same in each test.

(1 mark)

(b)(iii) Look at the graph line for fleece K. Estimate what the temperature of the water in the can wrapped in fleece K would be after 40 minutes.

(1 mark)

(b)(iv) Which type of fleece, J, K, L or M, should the student recommend to be used in the ski jacket?

Give a reason for your answer.

(2 marks)

Q:4 (a) Use the words from the box to complete the following sentences.

conduction	convection	radiation
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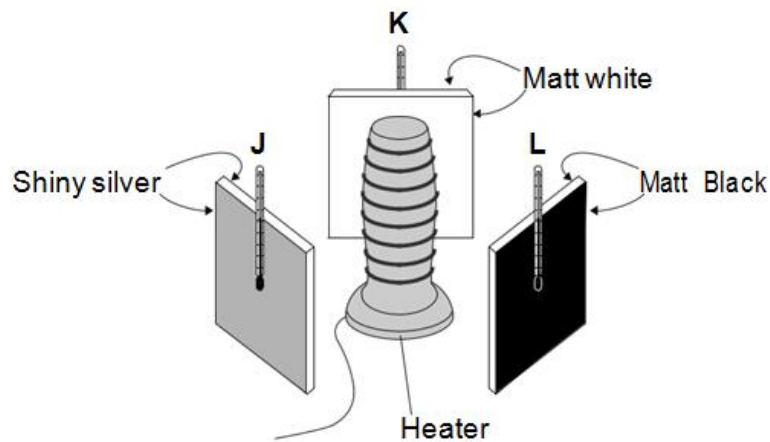
(a) (i) The transfer of thermal energy (heat) by the movement of hot liquid is called

(1 mark)

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

(1 mark)

(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

(b) (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 marks)

(b) (ii) Which one of the following was not a control variable in this experiment? Put a tick (☑) in the box next to your answer.

the distance between the heater and the metal plates

the power of the heater

the temperature before the heater was switched on

the colour of the metal plates

(1 mark)

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

(1 mark)

(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.



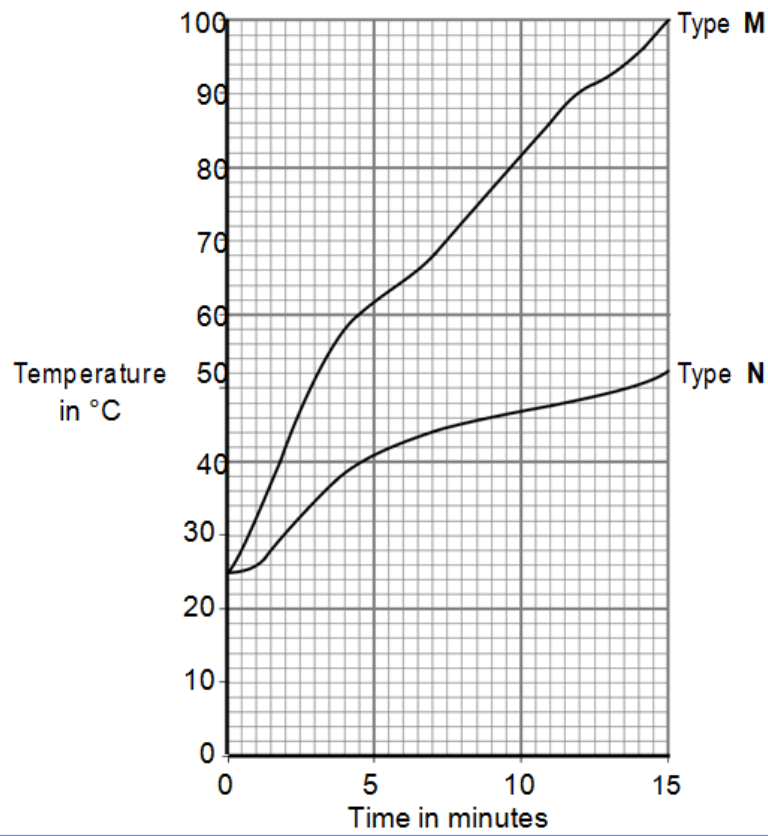
(c) (i) What is the main way that heat is transferred through the air from the fire to the fire fighter?

(1 mark)

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

(1 mark)

(d) The graph shows the result of a laboratory test on two types of thermal padding. Each type of padding was put onto a very hot metal surface and the temperature inside the padding was taken every minute.

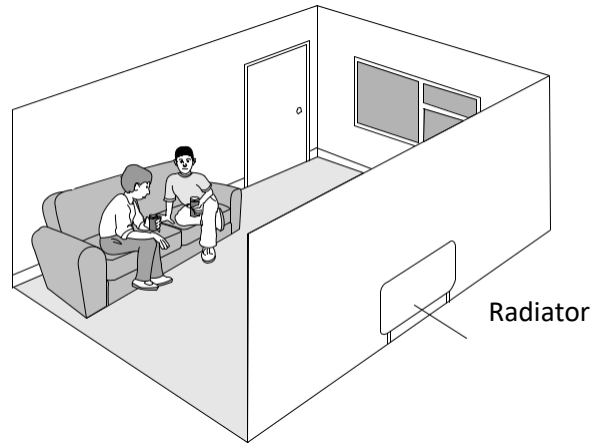


Which type of padding, M or N, would it be best to use inside the fire fighter's clothing?

Give a reason for your answer.

(1 mark)

Q:5 The diagram shows the position of a radiator inside a room. The radiator is made from metal and is painted white.



(a) (i) Heat is transferred from the hot water inside the metal radiator to the air touching the outside surface of the radiator. What name is given to this method of heat transfer?

(1 mark)

(a) (ii) Explain, in terms of the particles in the metal, how heat is transferred through the radiator.

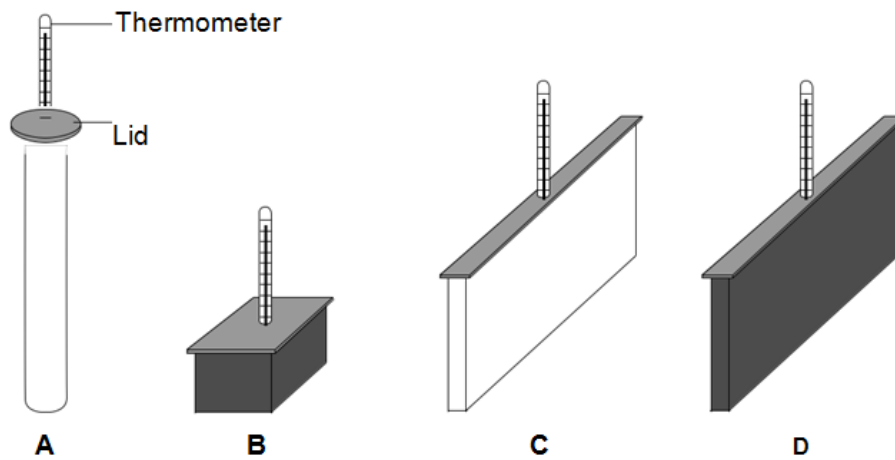
(2 marks)

(a) (iii) What name is given to the main method by which heat is transferred from the radiator to the people on the other side of the room?

(1 mark)

(b) A student investigated the effect of shape and colour on heat transfer.

The student used metal containers with the same volume but with different shapes and outside colour. The containers were each filled with water at 100 °C. After 20 minutes the temperature of the water inside each container was measured.



The results from the investigation are given in the table.

Container	Colour	Temperature after 20 minutes in °C	Temperature fall in °C
A	White	86	14
B	Black	86	14
C	White	73	27
D	Black	60	40

(b) (i) The student uses the results in the table to see if shape has affected heat transfer.

Which containers should the student compare to do this?

Give a reason for your answer.

(1 mark)

(b) (ii) Explain why the temperature of the water in both containers A and B fell by the same amount.

(2 marks)

(b) (iii) A central heating system has several radiators joined together. The hot water goes from the boiler, through each radiator in turn and then back to the boiler for reheating.

Give one reason, other than appearance, why it might not be a good idea to paint radiators black.

(1 mark)

TOTAL MARKS=44