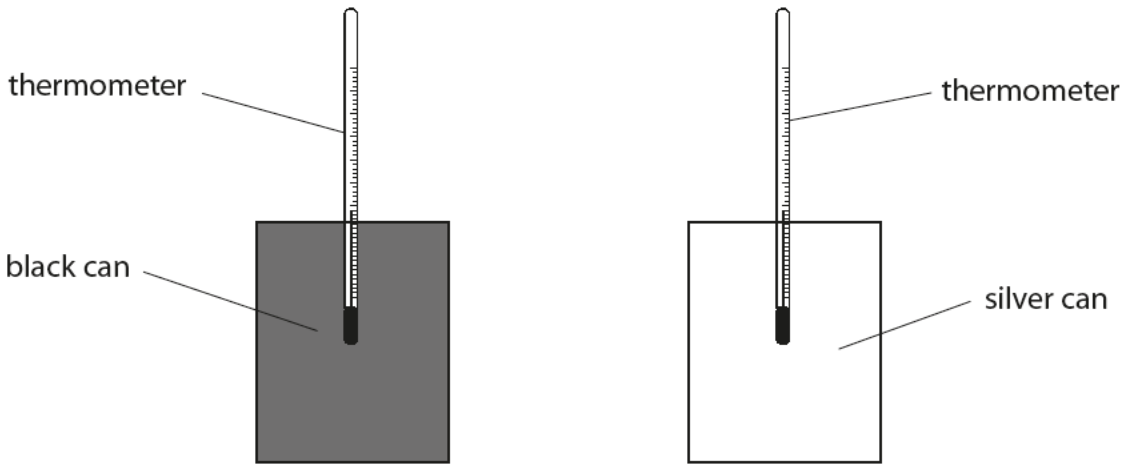
Thermal radiation

1 Some students investigate the cooling of different coloured cans.

They use two cans each fitted with a thermometer.



Hot water is poured into the cans and the temperature of the water in each can is measured every two minutes.

(a) The students want to find out if a black can cools quicker than a silver can.

Which row of the table shows the conditions they should use?

Put a cross (☒) in the box next to your answer.

(1)

	the volume of water in each can should be	the size of cans should be
☐ **A**	the same	the same
☐ **B**	the same	different
☐ **C**	different	the same
☐ **D**	different	different

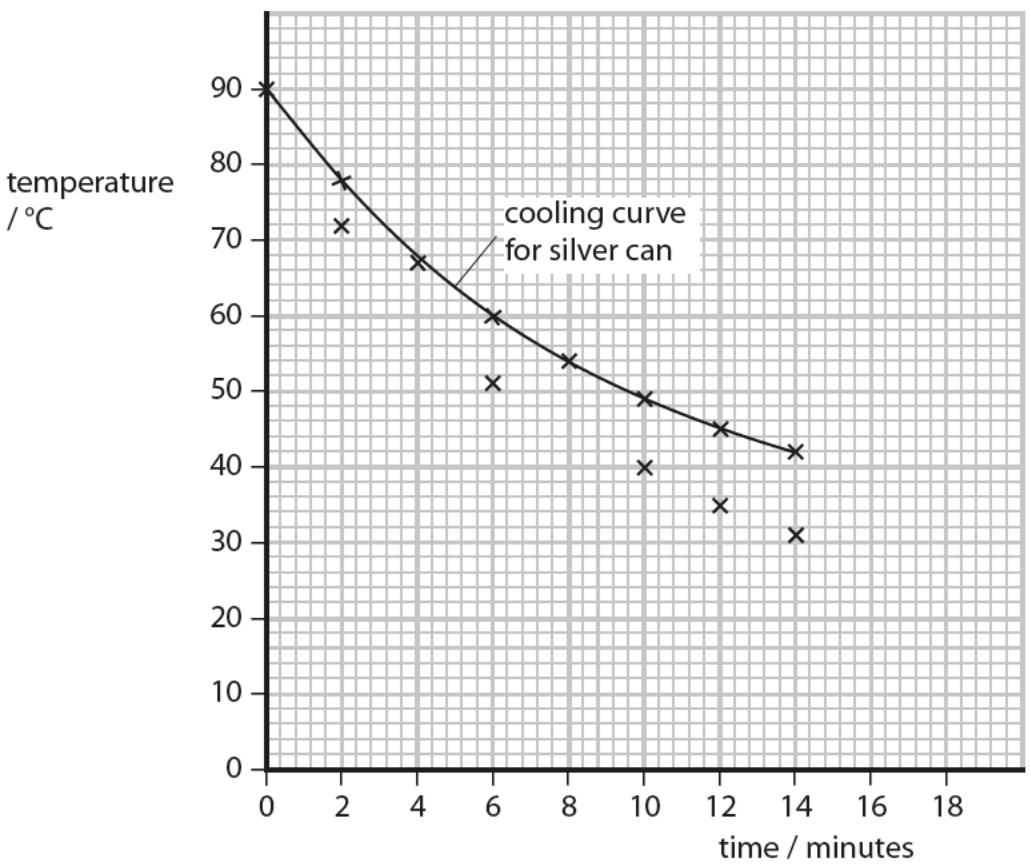
(b) The table shows the students results.

time / minutes	temperature / °C	
	black can	silver can
0	90	90
2	72	78
4	60	67
6	51	60
8	45	54
10	40	49
12	35	45
14	31	42

(i) The graph for the silver can has been plotted on the axes.
Six points for the black can have been plotted.

Plot the points for 4 minutes and 8 minutes for the black can.

(1)



(ii) The line of best fit has been drawn for the silver can.
Draw the line of best fit for the black can.

(1)

(iii) Estimate the temperature of the silver can when the time is 18 minutes.

(1)

temperature = ... °C

(iv) The room temperature is kept at a temperature of 21 °C.
Suggest what the temperature of the cans will be after two hours.

(1)

temperature = ... °C

(c) The photograph shows a solar water heater.

(i) State why the pipes in the solar water heater are painted black.

(1)

.....

.....

(ii) The heater supplies 9000 J of thermal energy in 20 seconds.

Calculate the power output of the heater.

(2)

power output = ... W

(iii) To produce the 9000 J of thermal energy, the heater needs 18 000 J of energy from the Sun.

Calculate the efficiency of the solar water heater.

(2)

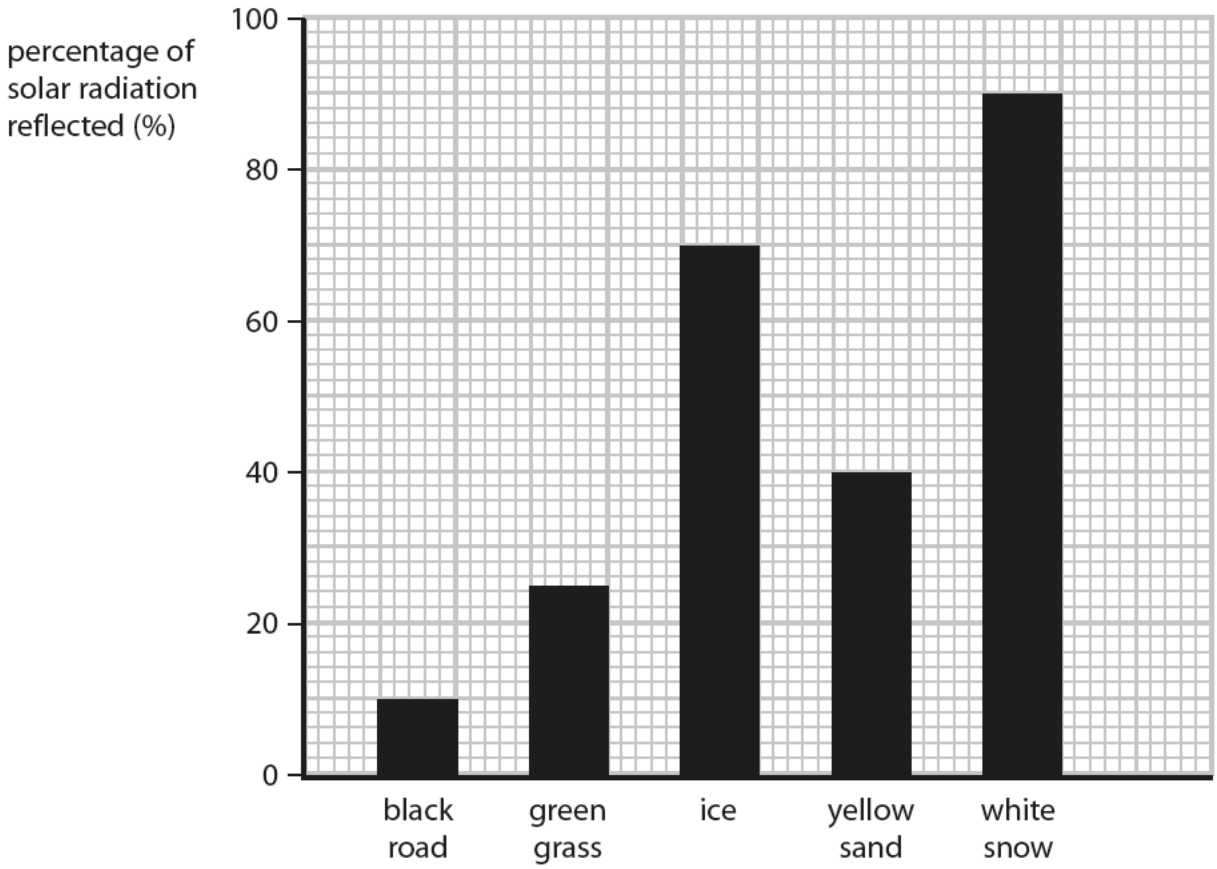
efficiency = ...

(Total for Question 3 = 10 marks)

Solar radiation

2 Most of the energy we receive on Earth comes from the Sun.

The bar chart shows the percentages of solar radiation reflected by some materials.



(a) Complete the sentence by putting a cross (☒) in the box next to your answer.

A student used the bar chart to estimate the percentage of solar radiation **reflected** by a rough piece of coal.

The percentage is most likely to be about

(1)

☒ **A** 10%

☒ **B** 40%

☒ **C** 60%

☒ **D** 80%

(b) Radiation from the Sun which is not absorbed is reflected.
For water, the amount of solar radiation absorbed (taken in) is 94%.

(i) Calculate the percentage of solar radiation reflected by water.

(1)

.....

percentage of solar radiation reflected by water .....

(ii) Use the graph to show how this information supports the idea that solid surfaces reflect better than liquid surfaces.

(1)

.....

.....

(c) As Antarctic ice melts, its surface area decreases.
At the same time, the area of water surface increases.

(i) Explain what happens to the amount of radiation absorbed.

(2)

.....

.....

.....

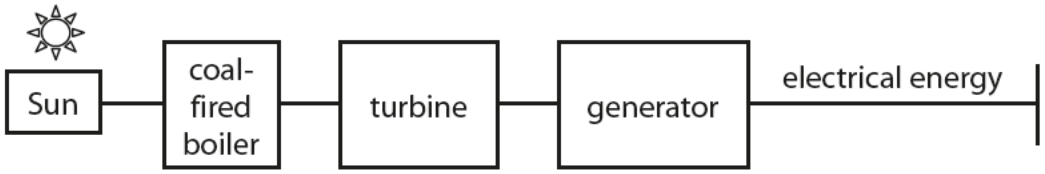
.....

(ii) State the effect that this change in the amount of radiation absorbed will have on the water.

(1)

.....

*(d) The diagram shows how some of the energy released by the Sun is converted into electrical energy.



A student boils some water using energy which came from the Sun.

Using the information in the diagram, describe the energy transfers involved in producing the electrical energy he used.

(6)

(Total for Question 6 = 12 marks)