

1 The water in a copper hot-water tank is heated during the night. During the day, the water cools as thermal energy (heat) passes from the water to the air surrounding the tank.

(a) (i) Describe the process by which the thermal energy is transferred from the hot water to the air.

.....  
.....  
.....  
.....  
..... [3]

(ii) State why the rate at which thermal energy passes into the air decreases as the water temperature falls.

.....  
..... [1]

- (b) The manufacturer of the hot-water tank says that when the outside surface is polished regularly and kept bright and shiny, the hot water will cool more slowly.

Describe, with the aid of a diagram, an experiment that shows whether a container with a bright and shiny surface is better at keeping its contents warm than one with a dull and dark surface.

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.....

.....

..... [4]

[Total: 8]

- 2 (a) Four identical metal plates, at the same temperature, are laid side by side on the ground. The rays from the Sun fall on the plates.

One plate has a matt black surface.

One plate has a shiny black surface.

One plate has a matt silver surface.

One plate has a shiny silver surface.

State which plate has the fastest-rising temperature when the sunlight first falls on the plates.

..... [1]

- (b) The apparatus shown in Fig. 4.1 is known as Leslie's Differential Air Thermometer.

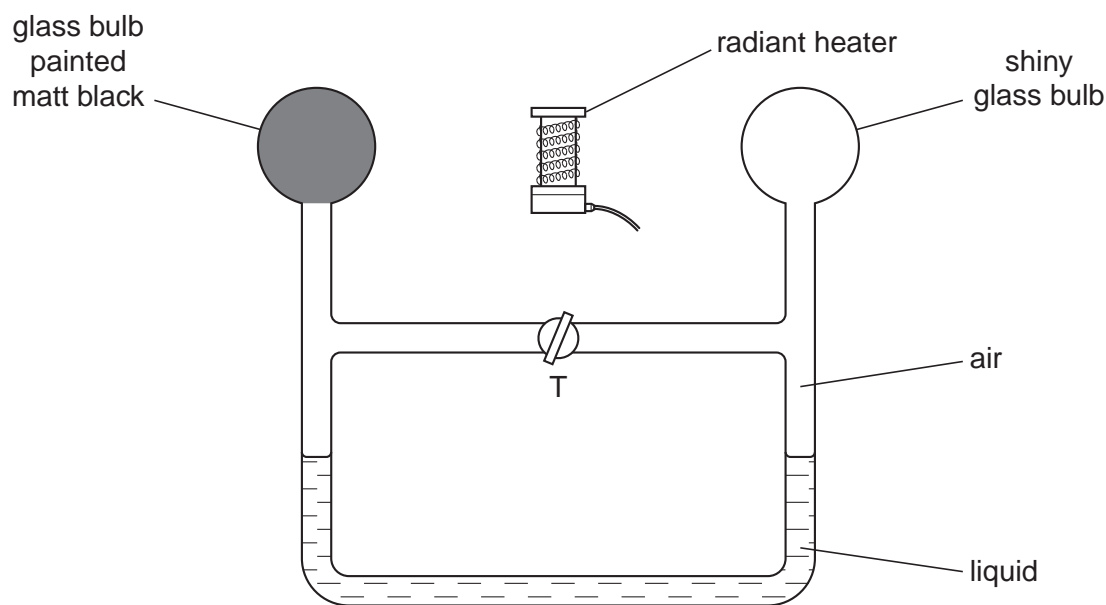


Fig. 4.1

The heater is switched off. Tap T is opened so that the air on the two sides of T has the same pressure. Tap T is then closed.

(i) The heater is switched on. On Fig. 4.1, mark clearly where the two liquid levels might be a short time later. [1]

(ii) Explain your answer to (b)(i).

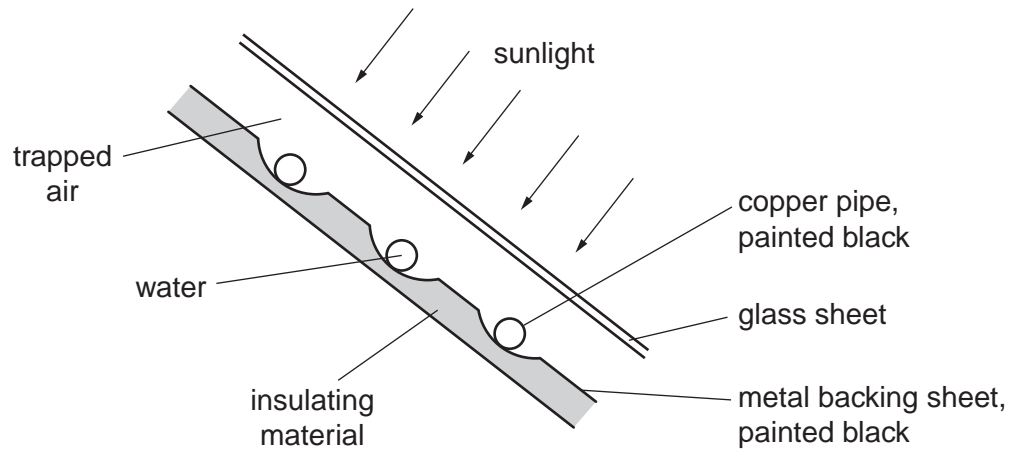
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..... [2]

[Total: 4]

- 3 A solar panel is mounted on the roof of a house. Fig. 4.1 shows a section through part of the solar panel.



**Fig. 4.1**

A pump makes water circulate through the copper pipes. The water is heated by passing through the solar panel.

**(a)** Suggest why

- (i)** the pipes are made of copper,

.....  
 ..... [1]

- (ii)** the pipes and the metal backing sheet are painted black,

.....  
 ..... [1]

- (iii)** an insulating material is attached to the metal backing sheet,

.....  
 ..... [1]

- (iv)** the presence of the glass sheet increases the energy collected by the water.

.....  
 ..... [1]

- (b) During one day, 250 kg of water is pumped through the solar panel. The temperature of this water rises from 16 °C to 38 °C.

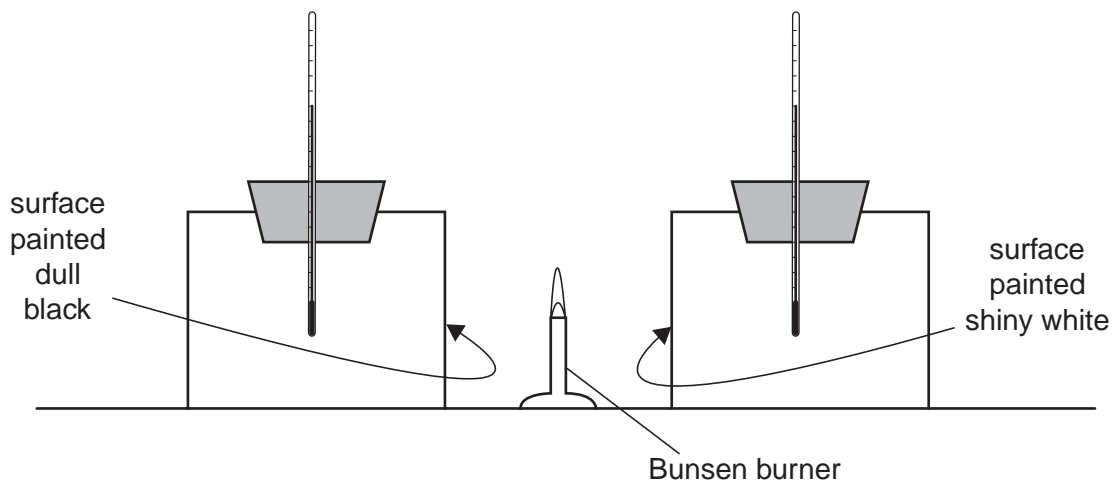
The water absorbs 25% of the energy falling on the solar panel, and the specific heat capacity of water is 4200 J/(kg °C).

Calculate the energy falling on the solar panel during that day.

energy = ..... [4]

[Total: 8]

- 4 Fig. 5.1 shows some apparatus designed to compare the ability of two surfaces to absorb infra-red radiation.



**Fig. 5.1**

The containers, which are identical, are painted on the outside. One is dull black, the other is shiny white. Both are filled with water, initially at the same temperature.

- (a) (i) Describe how you would use the apparatus to compare the abilities of the two surfaces to absorb infra-red radiation.

.....  
.....  
.....  
..... [2]

- (ii) State the result that you would expect.

..... [1]

**(b)** The thermometers used have high sensitivity and linear scales.

**(i)** State what is meant by *high sensitivity*.

.....  
..... [1]

**(ii)** Explain why a high sensitivity is important for this experiment.

.....  
..... [1]

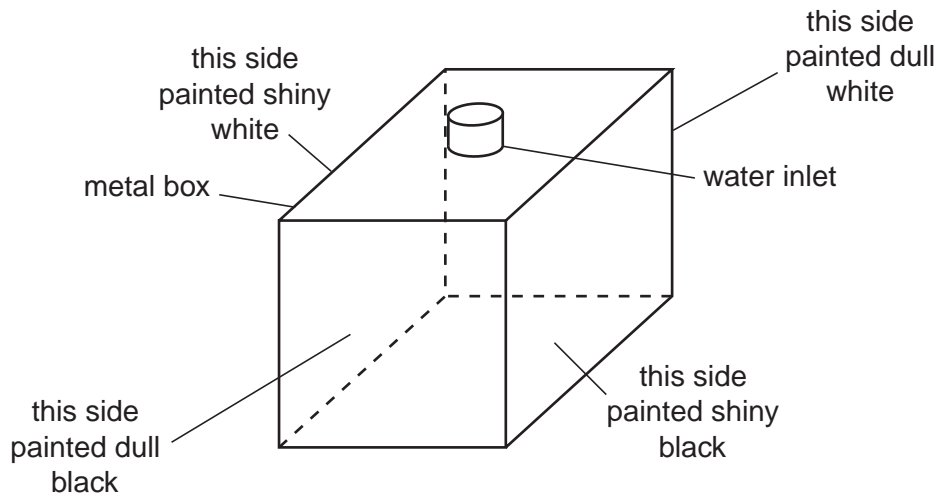
**(iii)** State what is meant by a *linear scale*.

.....  
..... [1]

[Total: 6]



- 5 Fig. 5.1 shows some apparatus which is to be used to compare the emission of infra-red radiation from four differently painted surfaces.



**Fig. 5.1**

Near the centre of each side is an infra-red detector. The four detectors are identical.

A supply of very hot water is available.

- (a) Describe how you would use this apparatus to compare the infra-red radiation from the four surfaces.

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 .....  
 ..... [3]

- (b) Suggest which surface will be the best emitter and which will be the worst emitter.

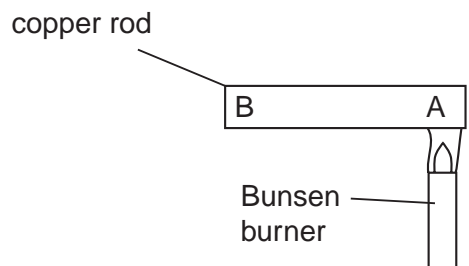
best emitter .....  
 worst emitter ..... [1]

- (c) The infra-red detectors are made from thermocouples soldered to blackened metal plates. These are connected to galvanometers.

In the space below, draw a labelled diagram of a thermocouple. [2]

[Total: 6]

6 (a) Fig. 5.1 shows a copper rod AB being heated at one end.



**Fig. 5.1**

(i) Name the process by which heat moves from A to B.

.....

(ii) By reference to the behaviour of the particles of copper along AB, state how this process happens.

.....

.....

[3]

- (b)** Give an account of an experiment that is designed to show which of four surfaces will absorb most heat radiation.  
The four surfaces are all the same metal, but one is a polished black surface, one is a polished silver surface, one is a dull black surface and the fourth one is painted white.  
Give your answer under the headings below.

labelled diagram of the apparatus

readings to be taken

one precaution to try to achieve a fair comparison between the various surfaces

.....  
.....[3]

[ Total : 6]

- 7 (a) Fig. 5.1 shows two identical metal plates. The front surface of one is dull black and the front surface of the other is shiny silver. The plates are fitted with heaters that keep the surfaces of the plates at the same temperature.



Fig. 5.1

- (i) State the additional apparatus needed to test which surface is the best emitter of heat radiation.

.....

- (ii) State one precaution that is needed to ensure a fair comparison.

.....

.....

- (iii) State the result that you expect.

.....

- (iv) Write down another name for heat radiation.

.....

[4]

- (b) In the space below, draw a labelled diagram of an everyday situation in which a convection current occurs.

Mark the path of the current with a line and show its direction with arrows.

[3]

[ Total : 7 ]