

O Level Combined Physics Structured

Thermal Transfer Test 1.0

Q1

- (a) Fig. 11.1 shows a frozen pack placed in a box. The box is then used to keep frozen food cold.

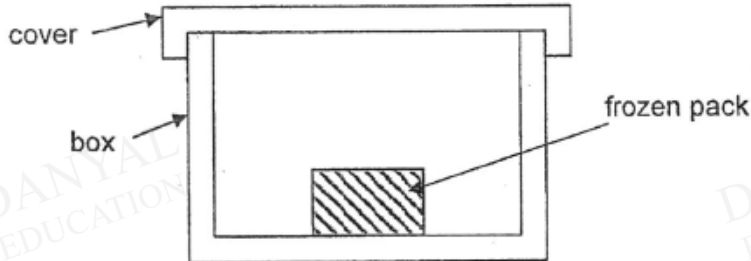


Fig. 11.1

- (i) It is discovered that some of the food that is placed near the cover is **not** kept cold. Explain why it is ineffective to place the frozen pack at the bottom.

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..... [3]

- (ii) The frozen pack, which is sticky on the outer surface, can be placed at any position in the box.

Suggest a better position to place the frozen pack in order to keep the food cold.

..... [1]

- (iii) Would you use plastic or metal as the walls of the box? Explain your answer.
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- [3]

Q2

Fig 10.1 shows a solar oven that is used to heat a pot of water .

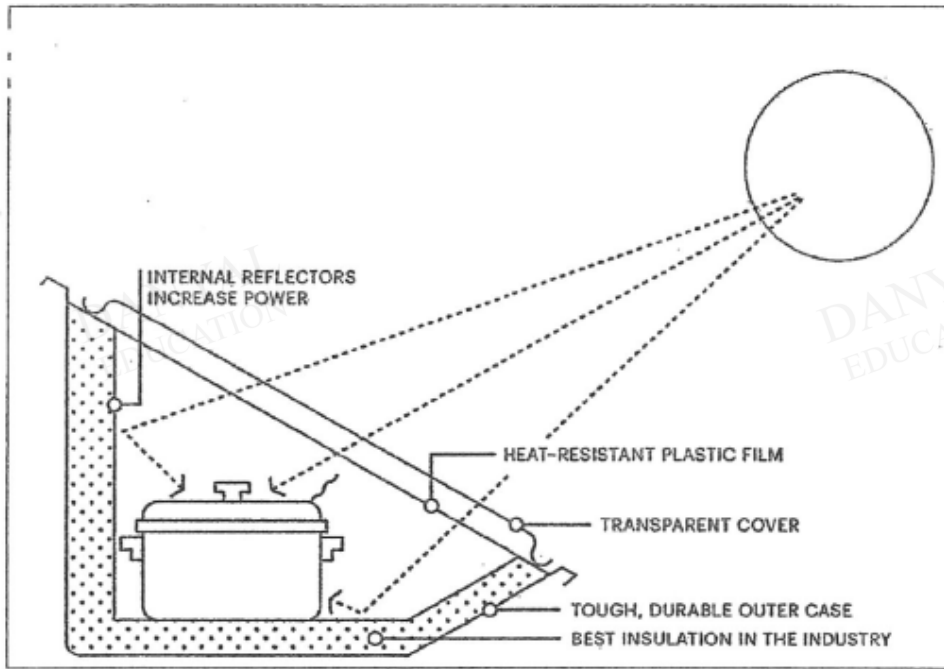


Fig 10.1

- (a) Describe and explain how the design of the oven allows the water to be heated up quickly.

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..... [3]

Q3

A heat pipe is a device that transmits thermal energy along its length. Fig. 12.1 shows a heat pipe attached to black metal fins. The fins absorb energy from the Sun. The sealed pipe transmits this energy along its length into a tank of cold water.

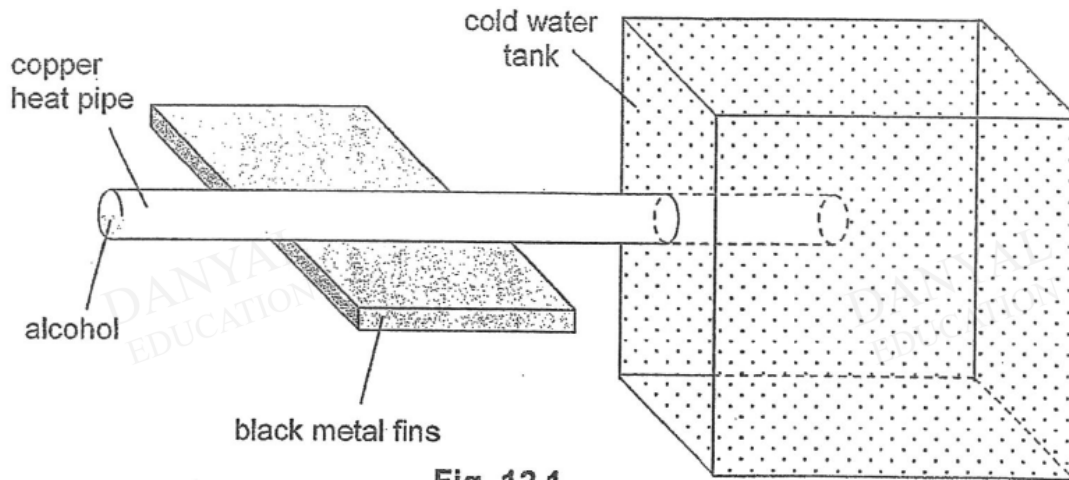


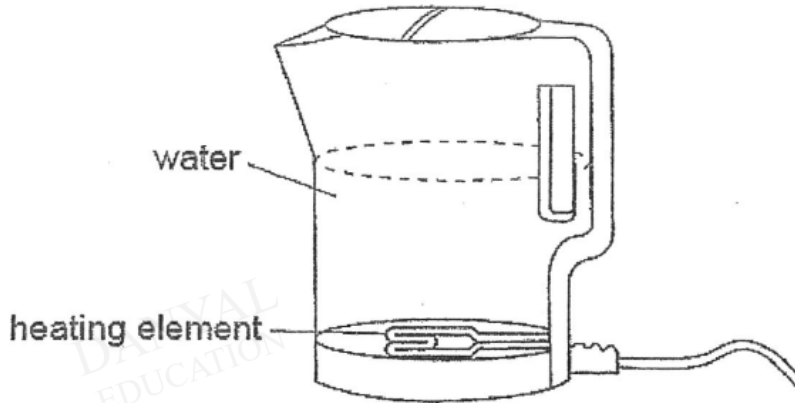
Fig. 12.1

Thermal energy from the fins is conducted through the walls of the copper pipe and causes the alcohol to boil. At the end of the copper pipe which is in contact with cold water, the alcohol condenses. The liquid alcohol runs along the pipe to be boiled again. There is little change in the temperature of the alcohol.

- a) Describe how molecules in the copper conduct energy to the alcohol. [1]
- b) Explain how boiling and condensation within the heat pipe cause the transfer of energy. [2]
- c) Another company has the metal fins painted in silver. Suggest why it is a disadvantage to the device. [1]
- d)
 - i) Describe how the water in the tank above the heat pipe is heated. [3]
 - ii) The temperature of the water in the tank above the heat pipe was measured to be higher than that below the heat pipe. Explain why there is a difference in the temperature. [2]
 - iii) State one change that could be made so that the water in the tank could be heated up more efficiently. [1]

Q4

The figure below shows an electric kettle connected to the mains supply.



(a) Explain, using the concept of density changes, how the water in the kettle is heated by convection.

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..... [3]

(b) Suggest a reason why the body of the kettle is made of plastic instead of metal.

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..... [1]

(c) Should the body of the kettle be painted black or white? Give reason for your answer.

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..... [2]

Q5

Fig. 5.1 shows the main parts of an electric grill. An electric current in the heating element causes it to become red hot and emit visible light and infrared radiation. The infrared radiation is used to cook the food placed under it.

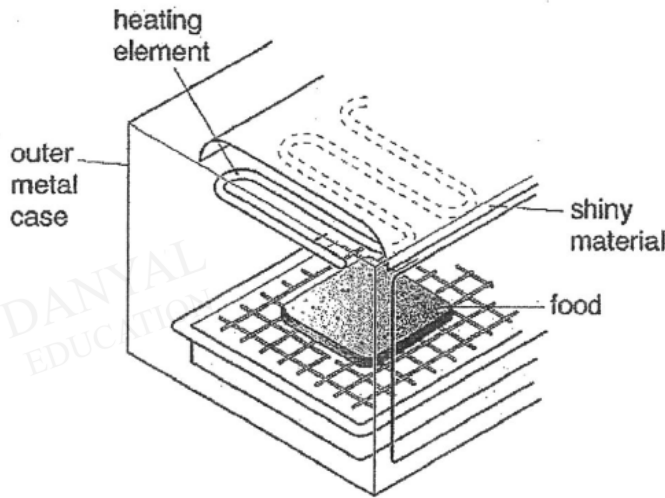


Fig. 5.1

(a) Explain why heat cannot be transferred by conduction from the heating element to the food.

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..... [2]

(b) Explain why heat cannot be transferred by convection from the heating element to the food.

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..... [2]

(c) There is a layer of shiny material between the heating element and the outer case on top of the grill. Explain the function of this layer of shiny material.

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..... [2]

Answers

Thermal Transfer Test 1.0

Q1

- (a)(i) As cold air around the frozen pack is denser and sinks, B½
the surrounding hot air is less dense and rise. B½
No convection current is set up in the box to cool the food that is placed near the cover
of the box. B1
And air is a poor heat conductor. B1
- (ii) Any one of the following answers: B1
- Place the frozen pack under the cover of the box.
 - Place the frozen pack at side of the box but high up
- (iii) I would use plastic as the walls. B1
Plastic are poorer heat conductors than metals, B1
therefore they conduct heat from the surrounding into the box slowly. B1

Q2

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|-----|---|---|
|)a) | 1. Transparent cover allows thermal radiation to enter the pot. | 1 |
| | 2. Reflectors increase the rate of thermal radiation absorption by pot. | 1 |
| | 3. Insulation at the base/plastic film reduces rate of heat loss by conduction from the pot | 1 |

Q3

- a) The molecules in the copper vibrate about its fixed position [1] and transfer the thermal energy absorb from the metal fins to alcohol as copper is a good conductor of heat.
- b) During boiling and condensation, the thermal energy needs to be absorbed or released is used to overcome or form intermolecular [1] bonds which will result in changing of state. These processes will cause transfer of energy to and from the heat pipe.[1]
- c) Silver is a poorer radiator or emitter of radiation which will result in slower transfer of heat to the surrounding air.
- d) i) Heat pipe will conduct heat to the surrounding water in the tank. Since hot water being less dense will rise [1] and cold water, being denser will sink to take its place around the heat pipe. [1] This set up a convection current which will heat up the water above the tank.[1]
- ii) Heat pipe will heat up the water above the pipe through convection and conduction [1]. Heat pipe however can only transfer heat to the bottom through conduction. [1]
The water above the heat pipe will reach a higher temperature faster than the water below the tank.
- iii) put heat pipe at the bottom of tank [1]

Q4

(a)	When the water near the heating element gets heated, it becomes less dense and rises to the top. The cooler water near the top, being denser, will sink and in turns gets heated and rises. This process continues and a convection current is set up, causing all the water to be heated.	[1] [1] [1]
(b)	Plastic is a poor conductor of heat. It will reduce heat loss by conduction.	[1]
(c)	It should be painted white to reduce heat loss by radiation as a white surface is a poor emitter of heat radiation.	[1] [1]

Q5

(a) Air particles are very far apart. Energy cannot be transferred from particle to particle.	1 1
(b) When the air around the heating element is heated, it becomes less dense. It rises and does not sink to the food.	1 1
(c) The shiny material is a poor absorber of infrared radiation. So, less heat is lost.	1 1