

ST. GABRIEL'S SECONDARY SCHOOL
Lower Secondary Science
Chapter 7 Transfer of Thermal Energy

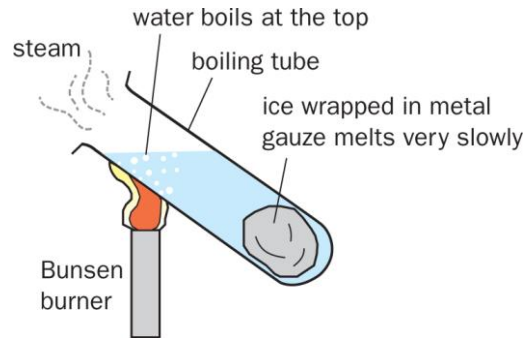
Worksheet 7.1

Name : Suggested Answers () Class : _____ Date : _____

Section A: Multiple Choice Questions

- 1 Two similarly-sized blocks, one made out of metal and the other, wood, are in contact with each other. The metal block is at a higher temperature than the wooden block. What is likely to happen to both blocks?
- A The metal block and the wooden block eventually reach thermal equilibrium with each other, and there will be no net thermal energy transfer between them.
 - B The metal block and the wooden block cannot reach thermal equilibrium even after a long time since they are made of different substances.
 - C The metal block gets hotter and the wooden block gets cooler due to net thermal energy transfer from the wooden block to the metal block.
 - D The metal block transfers some of its temperature to the wooden block, causing the wooden block to gain temperature.
- (A)
- 2 When the end of a rod is heated, how is the heat energy transferred across the rod?
- A By hot molecules moving along the rod.
 - B By hot molecules changing places with cool ones.
 - C By the air around the rod, which moves after being heated.
 - D By the transfer of energy from one molecule to the next.
- (D)
- 3 Ali touches a metal surface and the surface feels cool. Why is this so?
- A Metal is a good heat conductor and it conducts heat from Ali's hands to the surface.
 - B Metal is a good heat conductor and it conducts heat from the surface to Ali's hands.
 - C Metal is a good heat insulator and it does not conduct heat from Ali's hands to the surface easily.
 - D Metal is a good heat insulator and it does not conduct heat from the surface to Ali's hands easily.
- (A)

- 4 A metal gauze is wrapped around a piece of ice and dropped into a boiling tube containing water. The top of the boiling tube is then heated up by a Bunsen burner until the water near the surface begins to boil, as shown in the diagram below. During this time, the ice is observed to remain largely un-melted. What does this experiment show?



- A Ice is a poor conductor of heat.
- B Metal gauze is a good conductor of heat.
- C Water is a good conductor of heat.
- D Water is a poor conductor of heat.

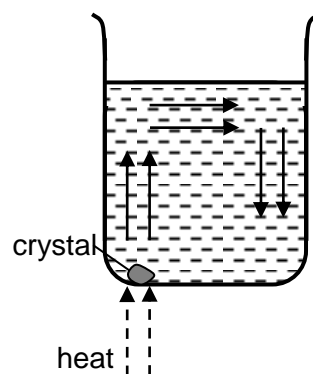
(D)

- 5 When is a convection current formed?

- A When the hotter fluid has a higher energy than the cooler fluid.
- B When the hotter fluid has a lower density than the cooler fluid.
- C When the hotter fluid has a lower mass than the cooler fluid.
- D When the hotter fluid has a lower volume than the cooler fluid.

(B)

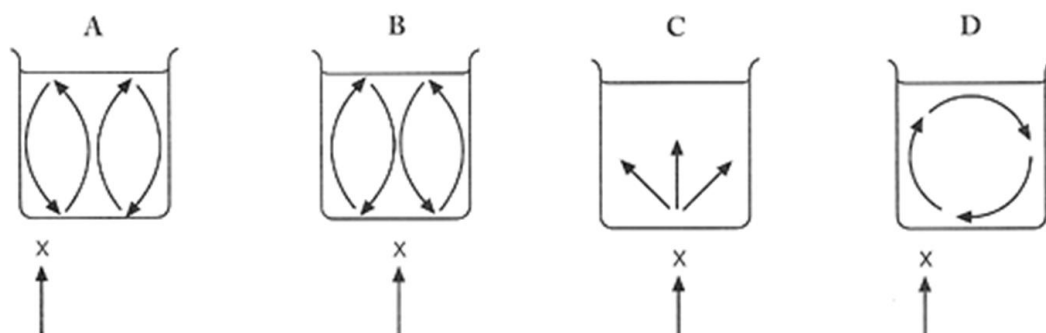
- 6 The diagram shows a crystal being heated in a beaker of water. The crystal releases a dye that shows how the water circulates around the beaker. What is happening to cause the water around the crystal to rise?



- A The water expands and its density decreases.
- B The water contracts and its density decreases.
- C The water expands and its density increases.
- D The water contracts and its density increases.

(A)

- 7 Water in a beaker is heated at **X** as shown. Which of the following diagrams best illustrates the convection current inside the container?



(**D**)

- 8 The tubes inside solar heating panels allow the radiation from the Sun to warm water. What is the reason that these tubes are painted black?

- A Dark surfaces absorb radiation well.
- B Dark surfaces conduct heat well.
- C Dark surfaces emit radiation well.
- D Dark surfaces reflect radiation well.

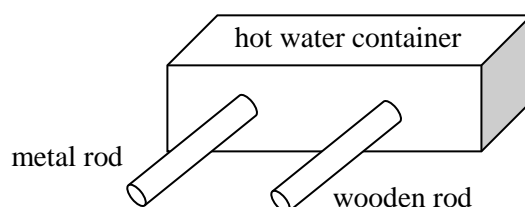
(**A**)

- 9 Two similar tin cans are placed under the hot Sun. One of the tin cans is painted over with black paint, and the other with white paint. A thermometer is placed inside each can to measure the temperature of its interior. Which thermometer will register a higher temperature after some time, and why?

- A The thermometer in the black can, because a black surface is a better absorber of heat.
- B The thermometer in the black can, because a black surface is a better emitter of heat.
- C The thermometer in the white can, because a white surface is a better absorber of heat.
- D The thermometer in the white can, because a white surface is a better emitter of heat.

(**A**)

- 10 Sharon inserts a wooden rod and a metal rod of equal length into a container, which is filled with very hot water, as shown in the diagram below. After a while, Sharon is still able to touch the wooden rod without burning herself, but the metal rod is too hot to be touched. What is the most appropriate explanation for this phenomenon?



- A Conduction takes place faster in metal than in wood.
- B The hot water transfers heat to the rods by convection.
- C The metal rod gains heat from the hot water, but the wooden rod does not.
- D The metal rod is shiny and reflective, so it is a better absorber of thermal radiation than wood.

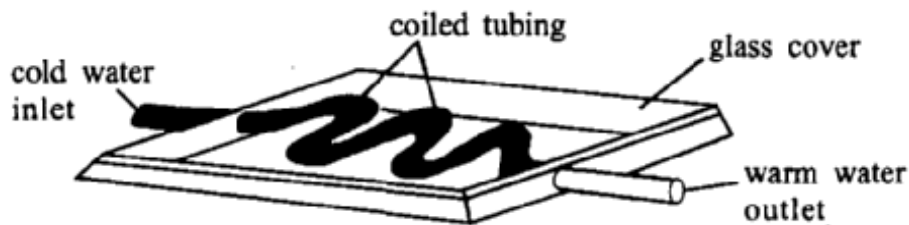
(**A**)

- 11 A match which is held 8 cm above a Bunsen flame will ignite. However, a similar match which is held 8 cm away to one side of the flame will not ignite. What can we conclude from the above observation?

A Air is a good conductor of thermal energy.
 B Most of the thermal energy is transferred by convection.
 C Most of the thermal energy is transferred by evaporation.
 D Most of the thermal energy is transferred by radiation.

(B)

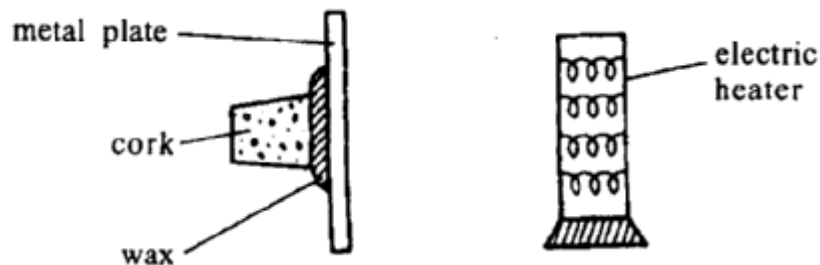
- 12 The diagram shows a simple form of solar water heater. Which coiled tubing would give the hottest water from the outlet?



A Copper, painted black
 B Plastic, painted black
 C Copper, painted silver
 D Plastic, painted white

(A)

- 13 A small cork is attached to a metal plate with wax. An electric heater is placed close to the plate. After some time, the wax melts and the cork drops off. How does heat reach the cork?



A By conduction only.
 B By conduction and convection.
 C By conduction and radiation.
 D By convection and radiation.

(C)

- 14 Certain physical characteristics of a polar bear help it to reduce heat loss in winter. Which of the following statements describe the characteristics and explain correctly how each characteristic reduces heat loss?

I Its white coat reduces heat loss by radiation.
 II A layer of fat under its skin reduces heat loss by conduction.
 III The thick fur reduces heat loss by conduction.

A I and II only B I and III only C II and III only D All of the above

(D)

- 15 A vacuum flask has a layer of vacuum with silvered glass walls surrounding the water compartment. Which statement correctly describes the transfer of heat minimized by each part of the flask?

	Glass Walls	Vacuum	Silvered Walls
A	Conduction	Conduction	Radiation
B	Conduction	Conduction and Convection	Radiation
C	Radiation	Conduction and Convection	Conduction
D	Radiation	Radiation	Conduction

(B)

Section B: Structured Questions

- 1 Describe the three processes of thermal energy transfer.

Conduction is the process of thermal energy transfer without any flow of the material medium;

conduction occurs via vibration and collision of particles.

Convection is the transfer of thermal energy by means of currents in a fluid; fluid movement is due to density changes.

Radiation is the transfer of thermal energy in the form of waves such as infrared radiation without the aid of a medium.

- 2 A saucepan with a thick copper base contains water and is placed on a flat electric hot plate.

(a) State the process by which energy is

- (i) transferred from the hot plate to the water;

Conduction

- (ii) spread through the water.

Convection

- (b) (i) An electric kettle is filled with water. The heating element is placed at the bottom. Explain why all of the water becomes heated when the kettle is switched on.

When the kettle is switched on, the water above the heating element becomes hot and less dense. The hotter water rises to the top and cooler water which is denser sinks to the bottom and the process repeats. This sets up a convection current which heats the whole water in the kettle.

- (ii) Explain why a shiny metal kettle loses energy more quickly when it becomes dirty.

When the shiny metal kettle becomes dirty, the surface becomes dull black. Dull black surfaces are better emitters of heat so thermal energy is lost quickly to the surroundings by radiation.

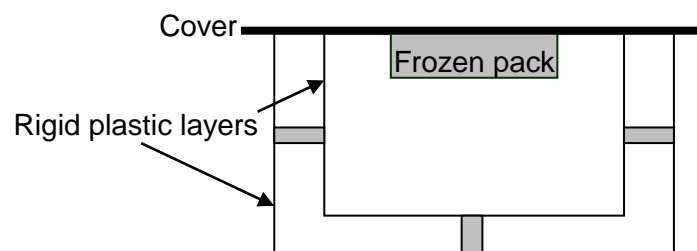
- 3 (a) Explain, in terms of movement of particles, how thermal energy is transferred from the heated end of a rod to the cooler end.

When one end of a rod is heated, the particles at this end of the rod gain energy and vibrate faster. These particles collide with the neighbouring particles, making them vibrate more and transferring energy to them. Hence, thermal energy is passed along the rod from the heated end to the cooler end by vibrating particles.

- (b) Should air-conditioners be placed high or low in a room? Explain.

Air-conditioners should be placed high because cold air sinks and hot air rises. This will set up a convection current which cools the room more efficiently.

- 4 A pack which contains frozen liquid is placed in a holder under the lid of a box as shown in the diagram below. The box is then used to keep the food cold.



- (a) Suggest one reason why the frozen pack is placed at the top of the box.

Cool air at the top is denser. Therefore, cool air sinks to keep the food cold.

- (b) Suggest one reason why the food could be kept cold for a longer period of time if the walls are made of two layers instead of one layer of plastic.

Air is trapped between the two layers of plastic. Air is a poor conductor of heat so food will be kept cold for a longer period of time.

- 5 In the event of a fire, we are advised to crawl close to the floor. The smoke particles produced in a fire create great discomfort by making breathing difficult and reducing our ability to find our way to safety.

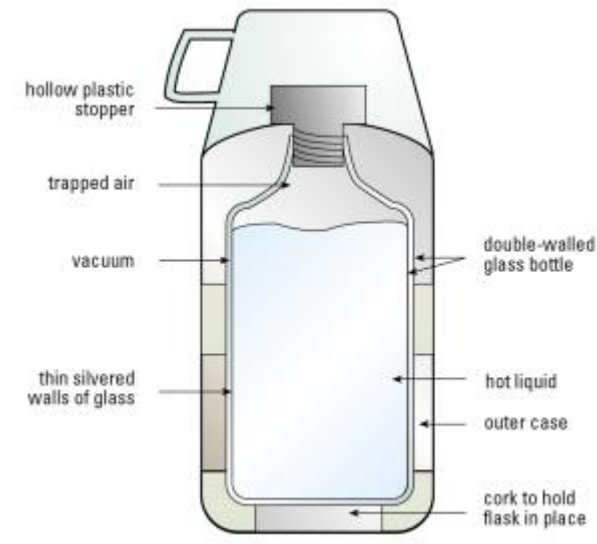
How does crawling close to the floor during a fire help to keep us safe?

A convection current is set up when air is heated. Smoke is carried upwards by hot air, and cool air sinks to the floor. Hence, the air nearer to the floor will allow us to breathe more easily. We are also less likely to lose consciousness because we breathe in less smoke.

- 6 A piece of ordinary kitchen aluminium foil is used to wrap around food to be cooked in a barbecue fire. The foil has a shiny side and a dull side. Which side should be on the outside, and why?

Dull side should be on the outside because dull absorbs radiation faster, thereby cooking the food in a shorter time.

- 7 Some cold liquid is placed in a vacuum flask. Describe how the following parts of the flask are able to keep the liquid inside it cold.



Double glass walls: Glass is an insulator, so it reduces heat gain from the surroundings by conduction.

Silver lining on double glass walls: Reflective surfaces reduce heat gain from the surroundings by radiation.

Vacuum between walls: The vacuum reduces heat gain by conduction through the walls. The vacuum also reduces heat gain by convection.

Plastic stopper: Insulators such as plastic reduce heat gain by conduction. The plastic stopper also reduces heat gain by convection and evaporation.