

## Chapter 11

# Heat



Let's compare this image taken by 'thermography camera' with the picture on the right.

Red coloured areas show the areas of higher temperature and blue coloured area shows the areas of lower temperature.



Picture taken by a normal camera



# 11.1

## Properties of Heat

### Lesson 1 What is Heat?

When we are outside, cold wind makes our body cold. Then we might make a fire so that the fire will make our body warm.



**What makes objects hot or cold?**



**Activity : Making something hot or cold**

#### What We Need:

➔ cup of warm water, ice cubes

#### What to Do:

1. Draw a table like the one shown below.

	How do you feel?	Does your palm become warm or cold?
Place an ice cube on your palm		
Hold a cup of warm water		

- Place an ice cube on your palm. Record in the table how your palm feels and whether your palm becomes hot or cold.
- Hold the cup of warm water in both palms. Record in the table how you feel and whether your palms become hot or cold.
- Share your findings with your classmates.



**Do not use hot water.**

Why does your palm feel cold when you hold an ice cube?



## Result



Your palm becomes cold when you place an ice cube on it.



Your palms become warm when you hold a cup of warm water.

## Summary

**Heat** is a form of energy. We feel heat energy as heat. Heat always moves from warmer objects to cooler objects. For example, we feel warm when we are close to a fire because heat comes from the fire to us.

Why does our palm become cold when we hold an ice cube? This is because heat moves from our palm to the ice cube. In other words, your palm loses heat, while the ice cube gains the heat.

On the other hand, our palm becomes warm when we hold a cup of hot water. This is because heat moves from the cup of hot water to our palms.

Why doesn't your palms become warm when you hold an ice cube?



## Lesson 2 Sources of Heat

Burning wood gives off heat that makes our body warm.



**What are the sources that produce heat?**



**Activity : Find sources and the ways they produce heat**

### What to Do:

1. Draw a table like the one shown below.

Sources that produce heat	The ways that produce heat
wood	burning the wood

2. Write the names of things that produce heat and how they produce heat.

3. Share your ideas with your classmates. Discuss the sources of heat and the ways they produce heat.



Do you remember how you made fire by using the magnifying lens?



You eat food every day to get energy and keep your body warm. How does your body use food?

# Summary

There are many kinds of sources of heat such as; the Sun, electrical appliance and fire wood. These heat sources basically change energy such as electrical energy and chemical energy into heat energy. The following are some examples of sources of heat.

## The Sun

We feel warm or hot when we stand in a sunny place. This is because the Sun gives off heat energy.



## Electrical Appliance

When we cook food we might use an electrical cooker. It can produce heat by changing electrical energy into heat energy.



## Rubbing Your Hands Together

When we rub our hands together they get warm. This is because friction between the two hands produce heat energy.



## Burning Wood

When wood is burnt, the chemical energy stored in the wood changes to heat energy.



## Eating Food

Our body temperature is normally kept between 36 °C to 37°C. It means our body is also producing heat. How can our body produce heat? Our body changes food we eat into heat energy.





## Lesson 3 Uses of Heat

We use heat in many ways. How do we use heat in our daily lives?



What is heat used for?



**Activity : What can heat do?**

### What to Do:

1. Draw a table like the one shown below in your exercise book.

What is heat used for in your daily life?	What is heat used for in factory and thermal power plant?

2. List what heat can do in our daily lives.
3. Refer to the pictures below and list how heat is used in factories and plants to make our daily lives convenient.
4. Share your ideas with your classmates.

Let's guess what heat can do in factories and plants.



# Summary

We use heat for many purposes in daily lives.

## Making things warm

Heat is used to warm your body on a cold morning. Heat can make things warm.

## Causing a change in matter

Heat is used to cook food such as boiling water and frying eggs. When a lot of heat is added, even metal will melt. In a car factory, heat is used to melt metal so that it can be shaped to build cars.

## Generating electricity

At a thermal power plant, heat is used to generate electricity which is used in our daily lives.

Heat used for making things warm



Heat is used for cooking



Heat is used for boiling water



Heat used for generating electricity



Heat is used for melting steel



Try it!

**How does a refrigerator work to keep food cold?**



Does 'coldness' move to food?

We studied that 'heat' can move from a warm place to a cold place.



Refrigerator can take heat away from food. The food inside the refrigerator loses its heat so that it can keep cold. Where does the heat go? The heat goes away from the refrigerator into the air.

# Lesson 4 Temperature

We shiver when it is cold and sweat when it is hot. What is the temperature outside? How can we measure the temperature?



## What is temperature?



### Activity : Measuring temperature

#### What We Need:

- ➔ thermometer, warm water, cold water



Do you remember how to use a thermometer?



#### What to Do:

1. Draw a table like the one shown below.

	Your prediction (°C)	Temperature (°C)
Warm water		
Cold water		
Mixture of cold and warm water		

2. Predict the temperatures of warm water, cold water and record your predictions in the table.
3. Place the thermometer in warm water. Observe how the liquid in the thermometer changes and measure the temperature.
4. Repeat Step 3 using cold water.
5. Mix warm and cold water. Predict the temperature of the mixture and repeat Step 3.
6. Based on your results, think about the following questions:
  - (1) How does the liquid in the thermometer change?
  - (2) What is the relationship between hotness, coldness and temperature?
7. Share your ideas with your classmates.





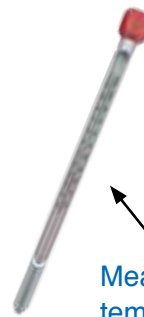
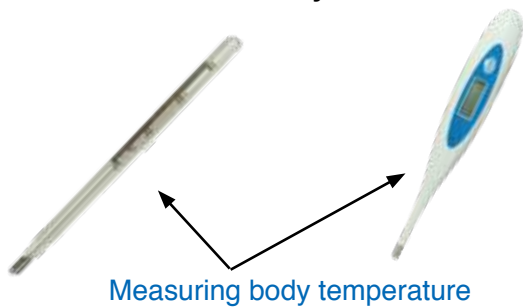
# Summary

Temperature and heat are related to each other but they are different. Heat is the form of energy that is transferred from hot area to cold area.

**Temperature** is a measure of how hot or cold matter is. In other words, it is a measure of heat.

Temperature can be measured using a **thermometer**. A thermometer consists of a glass tube filled with a liquid, usually alcohol or mercury. The hotter the temperature, the higher the liquid rises in the tube. When it is cold, it moves down. There are several kinds of thermometers. Some thermometers measure the temperature of air and some measure the temperature of our body.

Do you have any ideas on what temperature is measured using thermometer?



Measuring air temperature



Different types of thermometer

Temperature is measured in units called degree.

A thermometer shows **degrees Celsius ( $^{\circ}\text{C}$ )**.

Celsius is the most common temperature scale in the world. The scale sets the freezing point of water at  $0^{\circ}\text{C}$  and the boiling point of water at  $100^{\circ}\text{C}$ .

degrees Celsius

Eye level



A glass tube filled with a liquid, alcohol



- Position your eyes at the level with the top of the liquid.
- Read the scale line that is closest to the surface of the liquid.
- For example, the temperature on the thermometer is  $20^{\circ}\text{C}$ .

## Properties of Heat

- ☒ Heat energy moves from warmer places to cooler places.
- ☒ Heat energy never travels from cool objects to warm objects.



Heat moves from the cup to the palms

## Source of Heat

- ☒ Examples of sources of heat energy are the Sun, electrical appliances, burning wood, eating food and friction.
- ☒ Some forms of energy can be changed to produce heat energy.

Example:

1. Sunlight is changed to heat energy.
2. Electricity is changed to heat energy.
3. Chemicals in food and wood are changed to heat.
4. Rubbing of two objects cause friction to produce heat energy.



Sun is a source of heat

## Use of Heat

- ☒ Heat is used to make things warm, to boil water and fry eggs and to melt metal to build cars.
- ☒ Heat is used to generate electricity at a thermal power plant for our daily lives.



Heat used to melt steel

## Temperature

- ☒ Temperature is the measure of how hot or cold matter is.
- ☒ Temperature is measured in units called degrees Celsius ( $^{\circ}\text{C}$ ).
- ☒ Thermometer is the instrument used to measure temperature.
- ☒ Thermometer consists of a glass tube filled with a liquid alcohol or mercury.

Q1. Complete each sentence with the correct word.

- (1) A form of energy that moves from warm to cool places is \_\_\_\_\_.
- (2) A measure of how hot or cold something is called \_\_\_\_\_.
- (3) The boiling point of water is \_\_\_\_\_ degrees Celsius.

Q2. Choose the letter with the correct answer.

- (1) Which sentence is not true about heat energy?
  - A. Heat can only move from warm to cool place.
  - B. Heat energy can be felt as warmth.
  - C. Heat moves from cool to warm place.
  - D. Heat can change states of matter.
- (2) What does a thermal power plant provide for our daily use? It provides
  - A. light energy.
  - B. sound energy.
  - C. heat energy.
  - D. electricity.

Q3. Answer the following questions.

- (1) What is the instrument used to measure how hot or cold an object is?
- (2) How is fire used in daily life? Give two examples of how fire is used as heat energy.
- (3) Give two sources of heat energy.

Q4. Our hands become cold when we hold a cold drink, ice block or an ice cube. Why do our hands become cold when we hold cold things for sometime?



# 11.2

## Heat Transfer

### Lesson 1

### Heat Transfer 1: Conduction

Heat moves from warmer to cooler places. When you cook food using a frying pan with the burner, the food gets hot. How does the heat from the burner transfer to the food on the frying pan?



**How does heat transfer?**



#### Activity : Melting margarine on a spoon

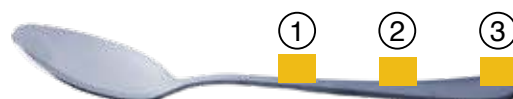
##### What We Need:

- ➔ a metal spoon, margarine, a cup of hot water ( $\sim 60^{\circ}\text{C}$ )



##### What to Do:

1. Place three small pats of margarine on the spoon handle at equal distances.
2. Predict what will happen to three pats of margarine at these three spots. Record your predictions in your exercise book.
3. Place the metal spoon into hot water and observe the three pats of margarine.
4. Record your observations in your exercise book.
5. Share your results with your classmates.



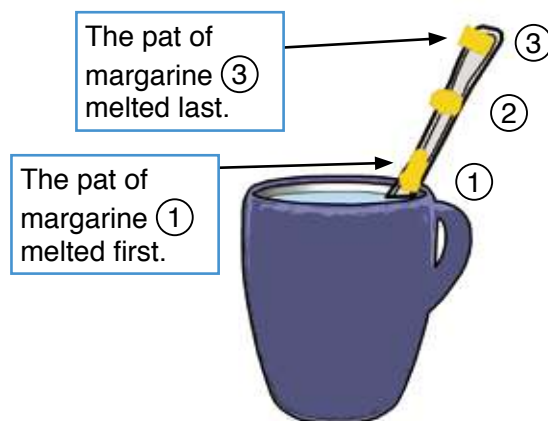
How is the heat from hot water transferred?



**Be careful when you touch the spoon in the cup of hot water because it will be hot.**

## Result

We found out that the pats of margarine on a spoon handle melted in the order of ①, ② and ③.



## Discussion

Think about the following questions based on your results.

1. What is the source of heat in this activity?
2. Which pat of margarine is closest to or furthest from the source of heat?
3. Why did the pats of margarine on the spoon handle melted in the order of ①, ② and ③?

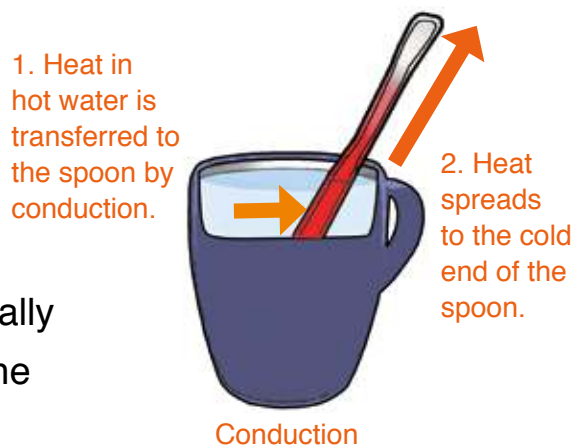
## Summary

How did heat move through the spoon?



The transfer of heat from one place to another through matter is called **conduction**. Conduction occurs mainly in solids. Heat is transferred from warmer places to colder places through conduction until they are both at the same temperature.

For example, in the activity, heat from the hot water is transferred to one end of the spoon by conduction and the heat is gradually transferred to the cold end of the spoon. The spoon in a cup of hot water becomes warmer. When we cook food, heat from the burner is transferred to the bottom of the pan through conduction. The heat is transferred throughout the pan and into the food. So, the pan and the food become warmer and hotter.



Cooking is an example of conduction.

## Lesson 2

# Heat Transfer 2: Convection

Conduction occurs mainly in solids. How about liquids and gases? What type of heat transfer would occur in liquids and gasses?



**How does heat transfer in liquids and gases?**



### Activity : Observing how warmed water moves

#### What We Need:

- transparent plastic cup, water, dye, candle, dropper or straw



#### What to Do:

1. Predict how heat is transferred in water and record your predictions in your exercise book.
2. Put some drops of dye at the bottom of water in a plastic cup using a dropper or a straw as shown in the picture on the right.
3. Bring the cup close to a flame and heat the cup of water at the spot where you put some drops of dye. Keep it more than 3 cm away from the top of the flame.
4. Observe and sketch how the dye moves inside the cup.
5. Share your results with your classmates. Discuss how heat is transferred in water.



**Hold the plastic cup as shown in the picture when heating the cup to avoid getting burnt.**

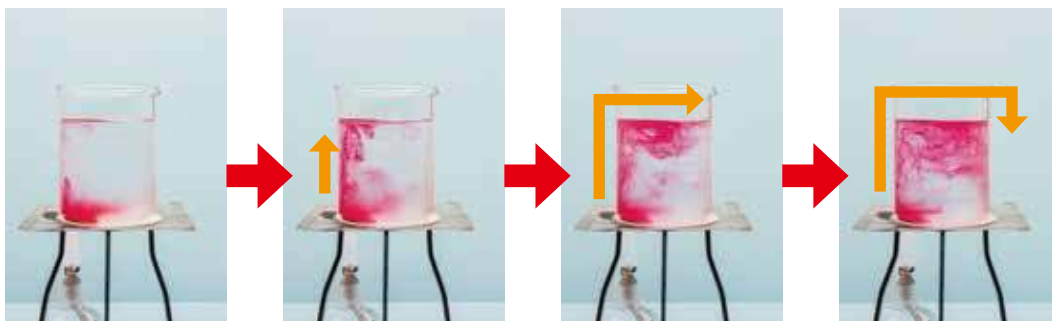


A dye makes it easier to observe the movement of heat in the water.





## Result



How is the transfer of heat in liquid different from conduction?



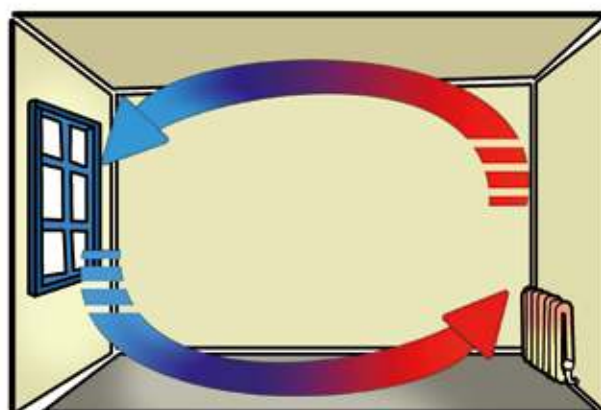
We found out that when we heated water, the warmed part of water rises upward. Water near the surface of water went down. This process continues until all the water in the cup was heated.

## Summary

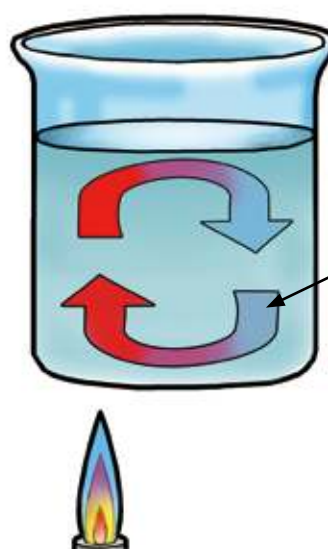
The transfer of heat through liquids and gases such as water and air is called **convection**. Convection occurs when heat is transferred by the movement of liquids or gases.

For example, the picture on the right shows the convection of air. Air is warmed by the stove and the warm air rises. As the air cools, it goes down. The cool air is warmed by the stove again and rises. This process continues until all the air in the room has been heated.

The movement of water or air created by the process of convection is called **convection current**.



Convection of air



Convection Current

Heat is transferred in liquids through convection.

## Lesson 3

# Heat Transfer 3: Radiation

When we stand in the sunlight, we feel the warmth of the Sun. Why are we warmed by the Sun even though it is millions of kilometres away in space?



**What is another way of heat transfer?**



### Activity : Inferring how heat transfers

#### What to Do:

1. Draw the table below:

Situation	Is heat transferred?	Why did you choose the option?
(1) Heat from a fire to people		
(2) Heat from the Sun to the Earth		

2. Study the pictures below in situations (1) and (2).
3. Think about how heat is transferred from a heat source and choose the best choice from the options: a) conduction, b) convection and c) other ways.
4. Write down your choice in the table with your reasons.
5. Share your ideas with your classmates. Discuss how heat is transferred in each situation.

Do you remember how heat is transferred by conduction and convection?



(1) Heat from a fire to the people.



(2) Heat from the Sun to the Earth.

# Summary

The transfer of heat in the form of waves through air or empty space is called **radiation**.

When we are near a fire, we receive and absorb radiation from the fire. Then we feel the warmth.



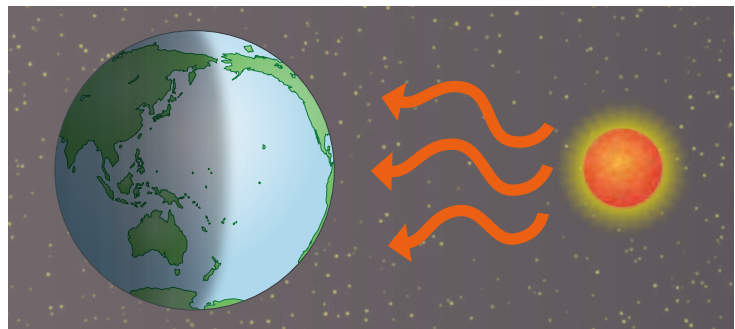
Radiation from the fire.

Both conduction and convection need matter such as solids, liquids and gases to transfer energy but radiation does not require matter.

There is no air in the space.

The Space is an empty space.

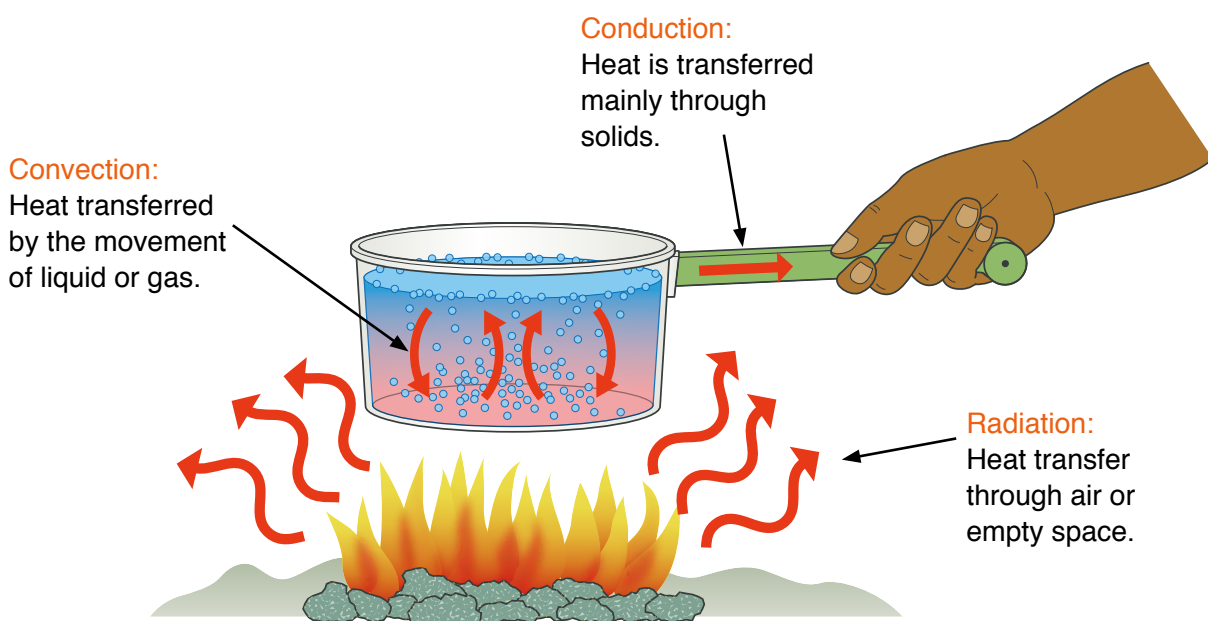
The Sun give off heat. The heat is transferred through space to the Earth by radiation.



The heat is transferred through empty space.

Heat can be transferred in

three ways: conduction, convection and radiation. The following diagram shows an example of the three ways in which heat is transferred.



Three ways of heat transfer.



## Heat Transfer

- ☒ Three ways of heat transfer to receive or give off heat are; conduction, convection and radiation.

### (1) Conduction

- ☒ Conduction is the transfer of heat from one place to another through matter.
- ☒ Heat is transferred from warmer places to colder places through conduction until they are both at the same temperature.

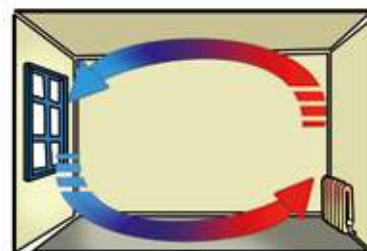
Example: Heat from the burner is transferred to the pan. The heat is transferred throughout the pan and into the food.



### (2) Convection

- ☒ Convection is transfer of heat through liquids and gases such as water and air.
- ☒ Convection occurs when heat is transferred by the movement of liquids or gas

Example: Air is warmed by the stove and the warm air rises and as the air cools it moves down. The cool air is warmed again by the stove and rises. This process continues until all the air in the room has been heated.



### (3) Radiation

- ☒ Radiation is the transfer of heat in the form of waves through air or empty space.

Example: We receive and absorb radiation when we are near the fire. This makes us feel warm.



Q1. Complete each sentence with the correct word.

- (1) The transfer of heat through liquids and gases is called \_\_\_\_\_.
- (2) Heat from the Sun travels through space and reaches the Earth by \_\_\_\_\_.
- (3) The transfer of heat from one place to another through matter is called \_\_\_\_\_.

Q2. Choose the letter with the correct answer.

- (1) When you put a metal spoon into the hot water, the spoon gradually becomes warm. Which type of heat transfer is occurring?
  - A. Conduction
  - B. Absorption
  - C. Radiation
  - D. Convection

Q3. Answer the following.

- (1) When you sit near a fire you can feel the heat. What type of heat transfer is this?
- (2) Study the picture on the right. Water in the pot is heated by the fire. Draw an arrow on the picture to show how the heated water moves by convection.



- Q4. Study the picture of the frying pan on the right. Infer the reason why the pan has a handle, using the word 'conduction'.



## How is heat produced? Can heat be absorbed?

What do you notice when lighting a candle? The beginning energy causes oxygen and wax to react which produces carbon dioxide, water and heat. When you put a laundry detergent powder in your hand and add water you can feel the heat. This type of change gives off heat.

There are changes that give off heat while other changes take in or absorb heat. Changes that release energy into the environment in the form of heat cause the reaction products and its surroundings to become hotter. It feels warm or hot or may even explode. Some examples of heat been given off are; lighting a match and burning wood.

Heat can also be taken in or absorbed. It is a change in which heat energy is absorbed from its environment. The absorbed energy provides the beginning energy for the change to occur. An example of heat taken in includes dissolving salt. When salt is dissolving into water, the temperature of the water decreases. Other examples include melting ice cubes and evaporating liquid water.

An example of change in which heat is given off.



A burning candle

Examples of change in which heat is taken in.



Dissolving salt



Melting ice cube



# 11. Heat

**Q1**

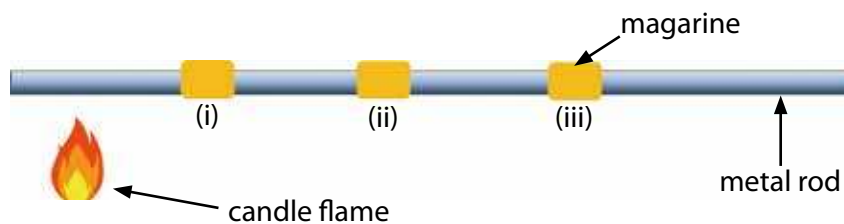
Complete each sentence with the correct word.

- (1) We feel warm when we are near a fire because \_\_\_\_\_ energy from the fire is transferred to us.
- (2) The transfer of heat mostly in liquids and gases is called \_\_\_\_\_.
- (3) The transfer of heat by \_\_\_\_\_ occurs mainly in solids.
- (4) The measure of how cold or hot an object is called \_\_\_\_\_.

**Q2**

Choose the letter with the correct answer.

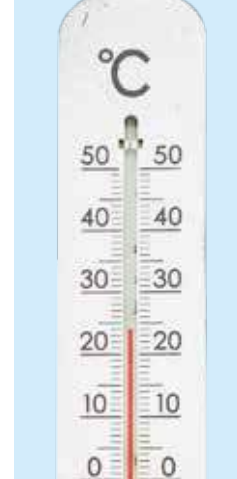
- (1) Which is not a source of heat energy?
  - A. A lit kerosene lamp
  - B. Cooling a metal with water
  - C. Burning a wood
  - D. Burning newspapers
- (2) What is radiation? It is the transfer of heat
  - A. in a form of waves through air or an empty space.
  - B. by movement of liquid and gases.
  - C. through one solid to another that are touching.
  - D. that occurs in solid only.
- (3) Placed at different parts of the metal rod were pats of margarine at (i), (ii) and (iii). What is the correct order of the pats of margarine that would melt when heated as shown below?



- A. (i) → (ii) → (iii)
- B. (ii) → (iii) → (i)
- C. (iii) → (i) → (ii)
- D. All places at the same time

**Q3**

- (1) Study the diagram on the right.
- (i) What is this instrument? \_\_\_\_\_
- (ii) What is the unit used in this instrument?  
\_\_\_\_\_
- (iii) What is the reading shown on the instrument?  
\_\_\_\_\_



- (2) Study the diagram below. The hot cup of tea is held by hand and cold metal spoon dipped in the tea.
- (i) Identify the object losing heat and gaining heat in the picture.

Example	Object that is losing heat	Object that is gaining heat

- (ii) How does the heat move from one part of the object to another in the picture?

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**Q4**

Moses says that ice cube cools a drink because the cold from the ice gets into the drink. Evaluate his statement and explain your idea.

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