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Heat energy

This is a form of energy that flows from one point to another due to temperature differences.

Temperature a physical property of matter that quantitatively expresses the degree of hotness or coldness.

The difference between heat and temperature is that heat is a form of energy that increases the temperature of the body while the temperature is the degree of hotness or coldness of an object.

Source of heat include sun, burning firewood, electricity, microwaves etc.

Uses of heat

- (i) cooking food
- (ii) warming rooms in winter
- (iii) ironing
- (iv) drying clothes

Method of heat transfer

Heat is transferred from one point to another by conduction, convection and radiation.

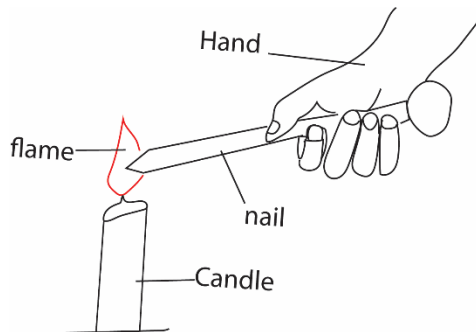
- (a) **Conduction** is the method of heat transfer in solids. Solids that conduct heat are called **good conductors** while those that do not conduct heat are called **bad conductors or insulators**.

Good conductors such as metals are used as electric cables, cooking utensils

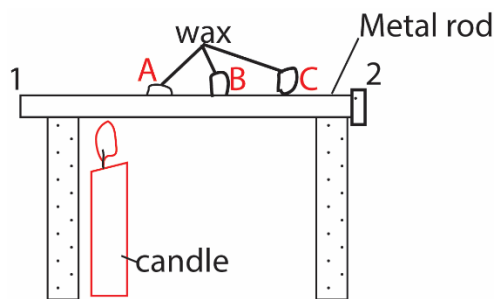
Insulators such as wood and plastics are used as handle for electric appliances such as electric iron and electric cooker. Feathers and clothes insulate bird's and human body respectively on cold days.

Experiments to demonstrate conduction of heat through solids

- (i) A nail heated on one end, and feeling heat on another end. Heat reaches the hand by conduction

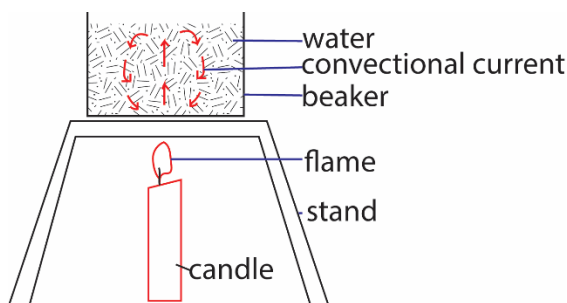


- (ii) Using metal wax on the a nail



Wax will melt in order A to B to C as heat travel from side 1 to side 2 of the rod

- (b) **Convection** is a method of heat transfer in gases and liquids. Here heat moves by means of convectional currents as shown in the diagram below



- (c) **Radiation** is heat transfer through the vacuum. A **vacuum** is an empty space without any medium. Heat travels from the sun to the earth by **radiation**
For instance heat energy from the sun to the earth is by radiation

Appliances that save heat energy/ fuel/cost of heating

(i) Using charcoal stove



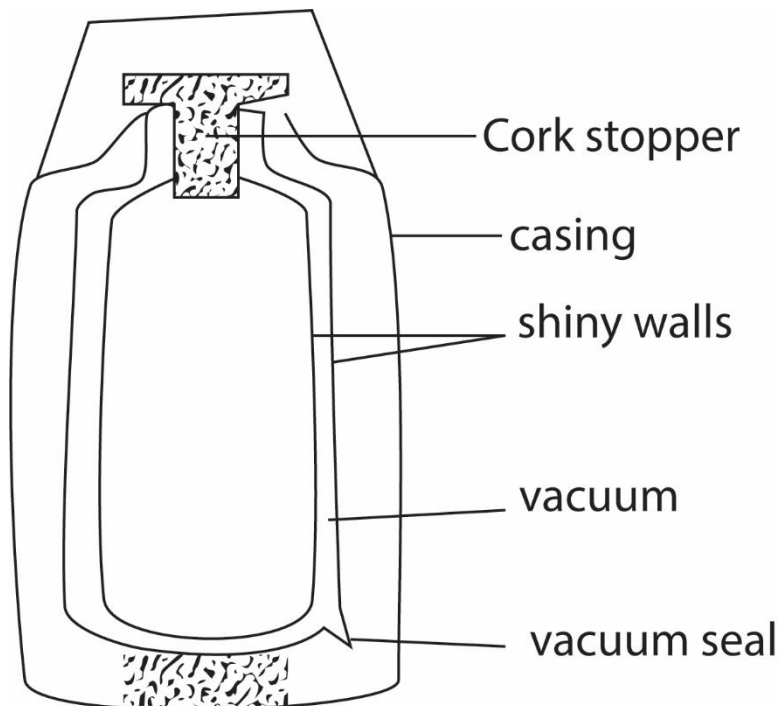
Metallic stove
does not save
heat/charcoal



Clay stove save
heat/charcoal

(ii) Pressure cooker

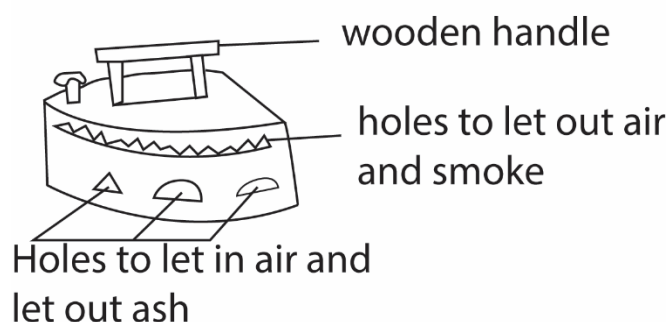
(iii) **Thermos flask** keep hot things hot and cold things cold



Functions of parts of vacuum flask

- (i) Cork stopper prevent s heat loss by conduction
- (ii) Vacuum reduce heat loss by conduction and convection
- (iii) Shiny material reduce heat loss by convection and radiation

A charcoal flat iron box



It is used for ironing clothes and heat transfer between the box and clothes is conduction.

Wooden handle is an insulator that prevents burning of hands

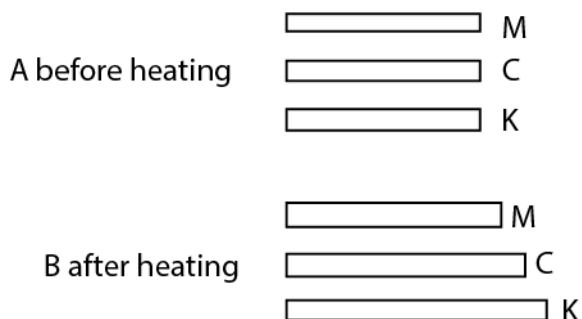
Effect of heat on substances

Heat causes

- Temperature increase
- Melting or change from solid form to liquid form
- Evaporation or change from liquid form to liquid form to vapor form
- Expansion or increase in length of size

The **linear expansivity** of a substance is the fractional change in length of a sample of the substance per degree C change in temperature. Units $^{\circ}\text{C}^{-1}$

Substances with a bigger linear expansivity lengthen more heating than one with low linear expansivity. For example, the diagram below shows three MCK with equal length before heating and different length after heating.



This shows linear expansivity of K is higher than that of metal C than that of metal M

Effect of cooling on substances

It causes

1. **Contraction** or reduction in size. Contraction may lead to breakage electric wires in winter if they were tightly fixed

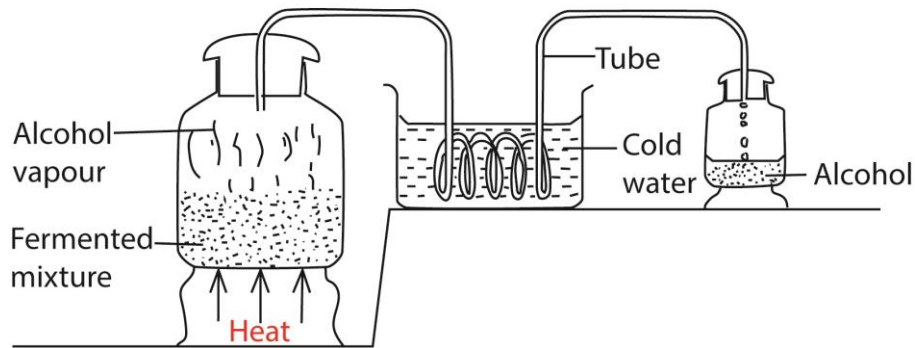
Loose electric wire prevents breakage due to contraction



2. **Solidification/freezing** or change from liquid to solid
3. **Sublimation** is change from solid directly to gas
4. **Condensation** or change from gases to liquid

Evaporation and condensation process may be used in purification of liquids such as alcohol. Here a fermented mixture is heated and alcohol turns into vapour which is cooled to form liquid alcohol. This process is called distillation.

Distillation of apparatus for alcohol



Thermometers



It is an instrument for measuring and indicating temperature.

It consists of a narrow, hermetically sealed glass tube marked with graduations and having at one end a bulb containing mercury or alcohol that expands and contracts in the tube with heating and cooling

Properties of liquids in the thermometer

- It should be visible.
- It should have uniform thermal expansion.
- It should have a low freezing point.
- It should have a high boiling point.
- It should not wet glass.
- It should be a good conductor of heat.
- It should have small specific heat capacity.

Advantages mercury in the thermometer

- It can measure high temperatures
- Mercury is visible without any dye
- Expansion of mercury is regular
- Mercury does not wet the capillary tube wall
- It gives precise results

Disadvantage of mercury thermometer

- It is expensive
- It is poisonous
- Responds slowly

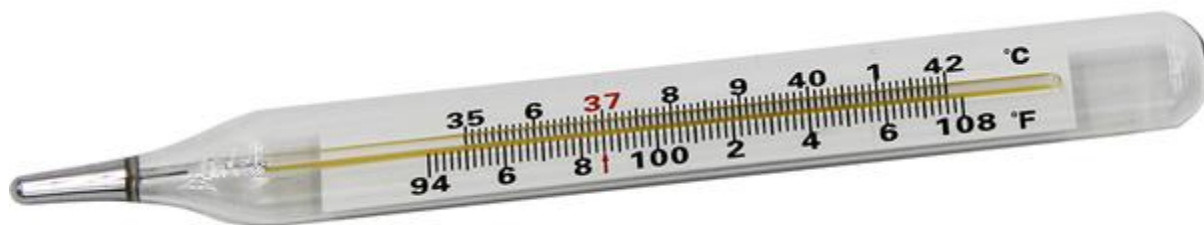
Advantages of alcohol in thermometer

It is nontoxic but has low boiling point

It is cheap

Can measure low temperature

Clinical thermometer



Clinical thermometer **one used to determine the temperature of the human body**

Before using mercury thermometer shake it **to get the mercury down to the bulb and then put it in the armpit or the anus. Normal body temperature is 36- 37.2°C**

However mercury thermometer have been replace by more accurate digital thermometer. Secondly mercury is very poisonous in case the thermometer breaks.

Scales of temperature

There are three temperature scales in use today, Fahrenheit, Celsius and Kelvin.

Celsius temperature scale also called centigrade temperature scale, is the scale based on 0°C for the freezing point of water and 100°C for the boiling point of water.

Fahrenheit temperature scale (F) is a scale based on 32°F for the freezing point of water and 212°F for the boiling point of water, the interval between the two being divided into 180 parts.

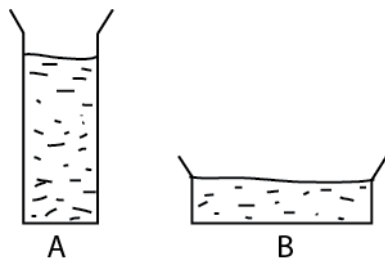
$$F = \frac{9}{5} C + 32 \text{ or } 0C = \frac{5}{9} (F - 32)$$

Kelvin temperature scale is the base unit of thermodynamic temperature measurement in the International System (SI) of measurement

Temperature in kelvin scale = 273 + temperature in Celsius temperature scale

Revision questions and answers

1. Equal volumes of hot water are poured into two glass container A and B as shown below.



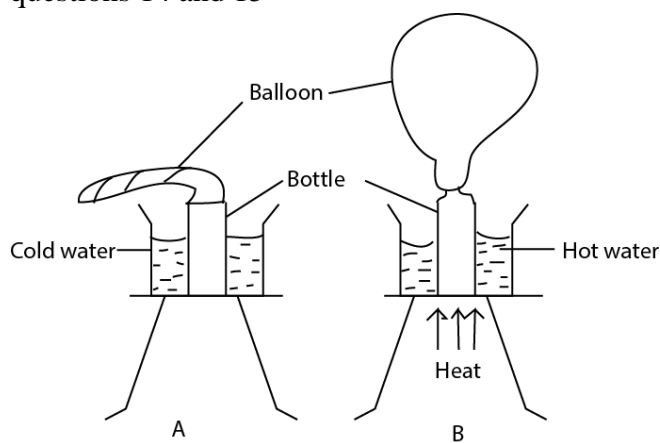
Why would the water in container B cool faster than in container A?

Has a larger surface area for evaporation than A; evaporation cools the liquid.

2. Jane put a bottle of soda in a bucket of ice. Two hours later, she found that the soda was frozen and the bottle broken. Why did the bottle break?

Due to expansion of soda in the bottle

3. The diagram below shows a setup of an experiment and its results. Use it to answer questions 14 and 15

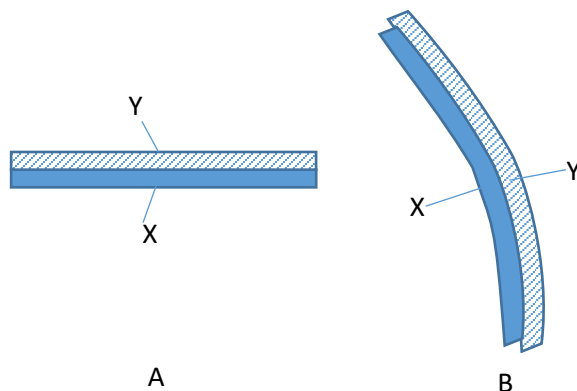


4. Why does a bulb swell out as shown in B?
5. Suggest what you think the experiment is intended to show?

Due to expansion of air that fills the bulb

To show that air expands when heated

The diagram below shows a metallic rod made of two different metal X and Y bound together as shown in A. when heated, the rod bends as shown in B. Use the diagram to answer questions 6 and 7.



6. Which of the metal expands faster, X or Y?

Y

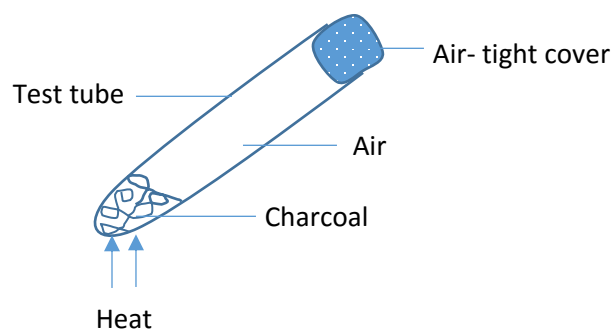
7. Give a reason for your answer in 6.

Y increases more in length than x that it bends outwards.

8. Why does a wet cloth spread on a line inside a house dry?

Due to evaporation and vapor blown away by wind

9. Some charcoal is burnt in a container as shown in the diagram below. The container and its contents were weighed before and after. There was no change in the weight. Why was there no change?

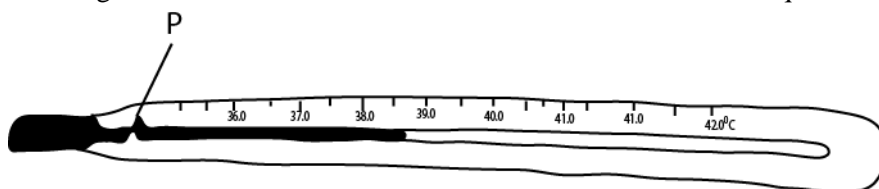


Matter is neither created or destroyed

10. What type of change takes place when a candle wax melts?

Physical change

The diagram below is of a clinical thermometer. Use it to answer questions 3 to 6.



11. What liquid is used in thermometer?

Mercury

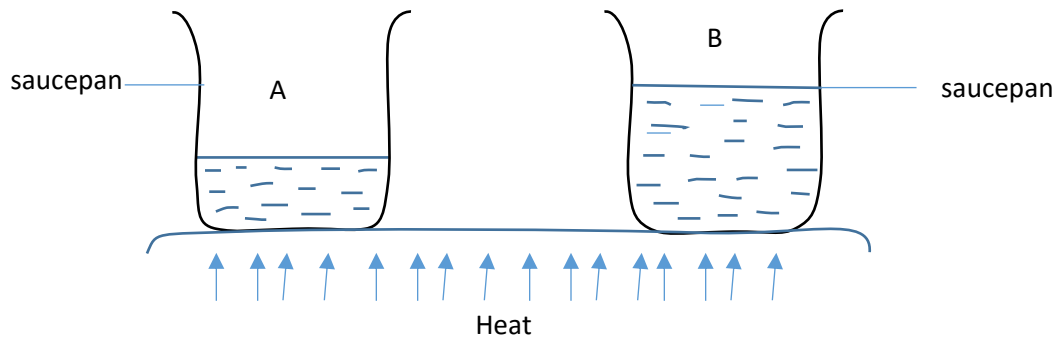
12. What is the main function of the part labelled P?

To prevent backflow of mercury

13. The temperature of a person was taken and the liquid rose to the level as shown in the diagram above. What was the person's temperature?

37°C

14. Two containers A and B containing some water as in the diagram below, were heated.



- (a) In which container did water boil first?

A

- (b) Explain your answer in (a) above.

Contains less water which require less heat to boil

15. (a) How does heat travel through:

- (i) Water?

By convection

- (ii) Vacuum?

By radiation

- (iii) Explain how the sun heats the air around us.

By radiation

16. Why is mercury used in a thermometer?

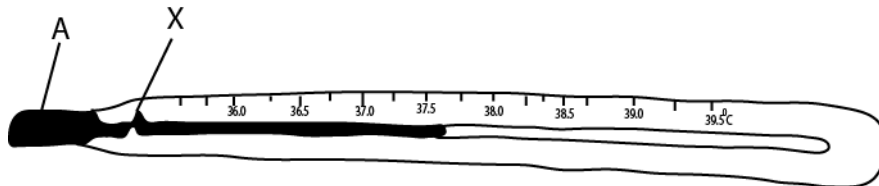
Mercury expands uniformly

Mercury does not wet glass

Mercury does not wet glass

It does not evaporate in glass

17. The diagram below shows a common instrument. Use it to answer the questions (a) to (d).



- (a) What is the use of the above instrument?

To measure body temperature

- (b) Name the liquid labelled A.

Mercury

- (c) Why is the liquid named in (b) used in the instrument?

It expands uniformly

Does not wet glass

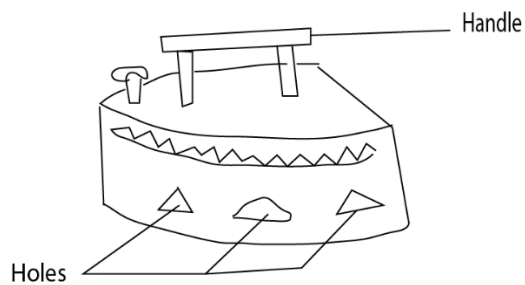
It can be seen easily

It does not evaporate inside the tube

- (d) What is the importance of part marked X?

To prevent backflow of mercury

18. The diagram below shows a charcoal flat iron box.



- (a) Why is the handle of the flat iron box made of wood?

Wood is a poor conductor of heat

- (b) State two uses of holes in that iron box.

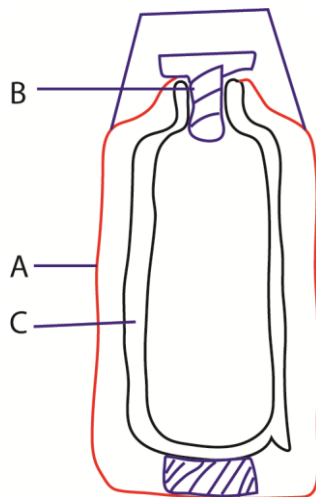
Allow in oxygen

For removing the ash

- (c) How does heat from the iron box reached the user's body?

Radiation

19. The diagram below is of domestic item. Study it and answer the question that follow.



(a) What is part marked A made of

Plastic

(b) What is the function of part marked C?

Prevents heat loss by convection and conduction

(c) Why part is marked B useful in this item?

Prevents heat loss

Toppers the flask

(d) Why is it that many homes do not use the item?

It is expensive

20. (a) If the temperature of tea which is 45°C reduces by 15°C . What will be the temperature of the tea?

$$45 - 15 = 30^{\circ}\text{C}$$

(b) Change your answer in (a) above to Fahrenheit Scale.

$$F = \left(^{\circ}\text{C} \times \frac{9}{5} \right) + 32$$

$$F = \left(30 \times \frac{9}{5} \right) + 32$$

$$= 86^{\circ}\text{F}$$

$$= 24\text{cm}^3$$

21. What should be done to a clinical thermometer before taking the temperature of a person?

Should shake to take mercury back to the bulb

22. 15. The diagram below are of three types of metals. Study them and answer the question that follows

A before heating

| | |
|----------------------|---|
| <input type="text"/> | M |
| <input type="text"/> | C |
| <input type="text"/> | K |

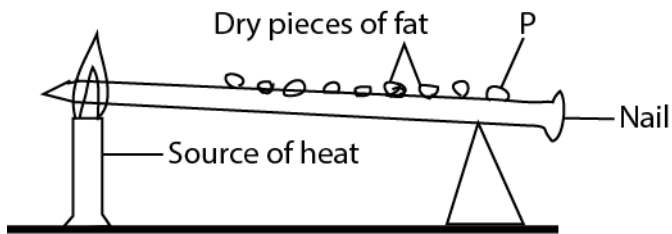
B after heating

| | |
|----------------------|---|
| <input type="text"/> | M |
| <input type="text"/> | C |
| <input type="text"/> | K |

Explain the cause of the difference in length after they have been heated.

K has a higher expansivity than C than metal M

23. The diagram below is of an experiment performed by a p& class. Study it and answer the question that follow.



- (a) What is the experiment about?
Heat transfer on metals or conduction of heat
- (b) What is the importance of fats pieces
To show that heat transfer through the metal
- (c) What will happen to piece P after sometimes?
It will melt after sometimes
- (d) Give a reason for your answer in (c).
Heat reaches P by conduction

24. (a) What is the use of a clinical thermometer?

To measure human body temperature

(b) Give any one reason why there is a bend in the tube of a clinical thermometers.

To prevent back flow of mercury

(c) Which liquid is mainly used in thermometers?

Mercury

(d) Why is the liquid you have named used instead of other liquids?

It expands uniformly

Does not wet glass

It is opaque

Does not evaporate

25. Give the difference between heat and temperature.

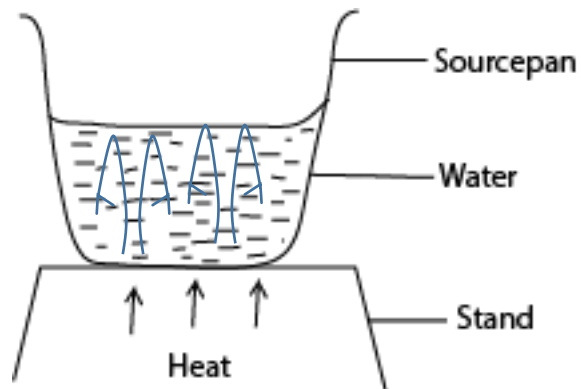
Heat is a form of energy that increases the temperature of the body; the temperature is the degree of hotness or coldness of an object.

26. Mention the instrument used to measure the temperature of a human body.

Clinical thermometer

27. The diagram below shows a saucepan with some water on fire.

Use it to answer the questions that follow.



(a) How will heat from the fire move to reach the water at the bottom of the saucepan?

Conduction through the saucepan

(b) Which method will enable that heat all the water in the saucepan?

Convection

(c) Use arrow to show the movement of water in the saucepan after it has been heated for some time.

(d) What will happen to the water in the saucepan to show that it is boiling?

Bumps up and down

28. What process makes dew to disappear during hot days?

Evaporation

29. Mention any one natural resource found under the ground and is used as fuel.

Petroleum

Coal

30. Name the kind of energy possessed by water at 100°C .

Heat and kinetic energy,

31. State one effects of heat on a metal

makes a metal to expand

makes a metal to melt

it increases the temperature of the metal

32. Why should a nurse shake the clinical thermometer before it is used on another patient?

To return mercury into the bulb

33. 25. Why does a clay-made charcoal stove use less charcoal than a metallic one?

Clay stove retain more heat than metallic ones

Clay stove conserve heat for a long time.

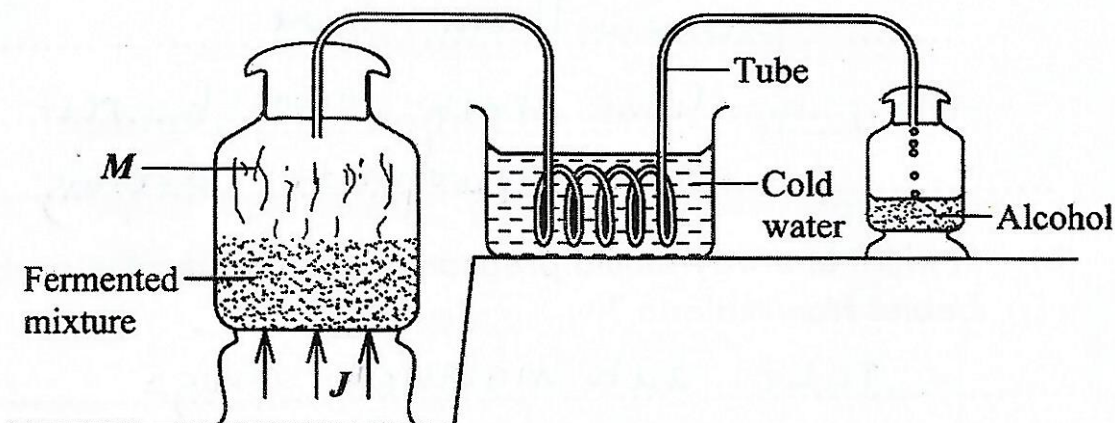


Metallic stove
does not save
heat/charcoal



Clay stove save
heat/charcoal

The diagram below shows one of the methods of preparing alcohol. Study and use it to answer questions 50.



34. (a) Name the methods used in the diagram

Distillation

(b) What do the arrows labeled **J** represent?

Heat

(c) Why is the tube passes through cold water?

To condense the alcohol vapour

(d) What process forms *M*?

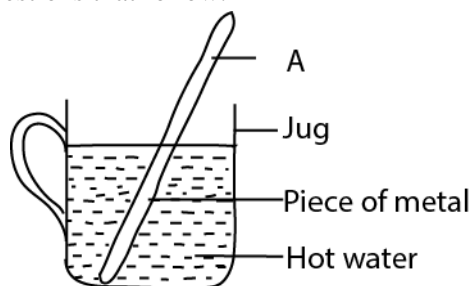
Evaporation

35. How do the silvery walls of a vacuum flask reduce heat loss?

Reduce heat loss by radiation

Reflect heat back to the food

36. The diagram below shows a piece of metal dipped in a jug containing hot water. Use it to answer the questions that follow.



How does part A become hot yet it is not in hot water?

By conduction

37. Mention any **one** factor that affects the rate of evaporation.

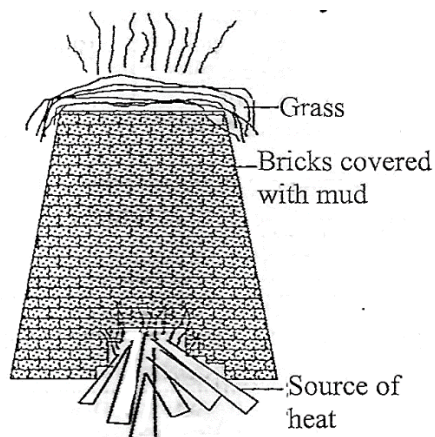
Humidity: the higher the humidity the lower the rate of evaporation because the air saturates faster.

Other factors include

- Surface area; the bigger the surface area, the higher the rate of evaporation due to increased exposure of liquid molecules
- Temperature: the higher the temperature, the higher that rate of evaporation because, it provides heat of vaporization.
- Wind increases the rate of evaporation by removing saturated air
- Pressure reduction in pressure increases the rate of evaporation

38. The diagram below shows firing bricks in a kiln

Study and use it to answer the questions that follows.



(a) Name the source of heat energy used in the firing the bricks.

Fire wood

(b) Give any one reason why the bricks are covered with mud before firing starts.

To prevent heat loss

(c) What is the importance of the grass put on top of the kiln during firing?

To show that all bricks are burnt.

(d) State any one disadvantage of using the above method of firing bricks to the environment.

Lead to deforestation and air pollution

39. Name any one scale in which temperature is measured

Celsius scale, Kelvin scale or Fahrenheit scale

40. (a) Name the change of state which takes place when

(i) Vapour changes to liquid

Condensation

(ii) A solid changes directly to a gas

Sublimation

(b) Apart from causing change of state, give two other effects of heat on matter.

(i) Increases its temperature

(ii) Expansion

(iii) Softens it

(iv) Turns it red hot

41. What type of electricity is lightning?

Static electricity

42. State any one physical change that takes place during the process of distillation of alcohol.

Evaporation

Condensations

43. (a) Apart from raising the temperature of a substance, give any two effects of heat on matter

(i) **Expansion**

(ii) **Melting**

(iii) **Evaporation**

(iv) **sublimation**

(b) State any two ways in which heat transfer by conduction is important to people

(i) **ironing clothes**

(ii) **sharing a bed and one warming another.**

(iii) **Melting suppositories in the anus**

44. Which method of heat transfer enables a person to iron clothes using a flat iron

Conduction

45. Use it to answer the question that follow



(a) State any one reason why the wires are loosely fixed.

To allow room for contraction and expansion of the wires

(b) What would happen to the wires if they were tightly fixed?

They would break when they are contracted on cold days.

(c) Give any one reason why wooden poles are usually used to carry electricity.

To protect people and animals from electroshock when they touch the poles.

(d) Why are the wires placed very high up?

To reduce theft of the wires

To prevent children reaching up the wire