ST. LAWRENCE HIGH SCHOOL

A JESUIT CHRISTIAN MINORITY INSTITUTION

Sub: Physical Science **Class: 8** **Date: 05.05.20**

STUDY MATERIAL: CHAPTER 6 HEAT (PHYSICS)

Concepts

Q1. What are the effects of heat that are observed in a body?

Ans: The different effects of heat are:

a. Change in temperature
b. Change of state
c. Change of size

Q2. Differentiate between boiling and evaporation.

Ans. Liquid state is changed to the vapour state by the process of evaporation and boiling.

Properties	**Boiling**	**Evaporation**
Nature	Bulk phenomenon	Surface phenomenon
Temperature	Takes place at boiling point	Takes place at all temperature of the liquid
Average Kinetic Energy of molecules	Remains constant	Increases
Average potential energy of molecules	Increases	Remains constant
Energy source	External source needed	From surrounding
Cooling	No cooling caused	Cooling caused as molecules escape from the surface with kinetic energy thus decreasing temperature of liquid and surrounding.
Cavitation (Bubbling)	Observed	Absent
Acoustic effect (sound)	Observed	Silent
Rate	Fast	Slow
Stages	Occurs in three stages: nucleate, transition and film	No stages observed

Q3. What are the factors that affect the rate of evaporation of a liquid?

Ans. The rate of evaporation depends on :

(a) The temperature of the liquid
(b) The surface area of the liquid
(c) Wind velocity over the surface of the liquid
(d) Nature of the liquid

Q4. Why does evaporation cause cooling?

Ans. Evaporation takes place as molecules with high kinetic energy leave the surface of the liquid. As a result the average kinetic energy of the liquid is decreased. Since temperature is directly proportional to kinetic energy, cooling is caused due to evaporation.

Q5. What is latent heat? Which form of vaporisation utilizes latent heat?

Ans. The heat absorbed or released by a body during change of state is called latent heat. Latent heat does not affect the Kinetic energy of the molecules but alters the potential energy.

Boiling involves a latent heat of vaporization.

Q6. What do you mean by thermal expansion?

Ans. Thermal expansion is the tendency of matter to change in shape, area, and volume in response to a change in temperature.

Q7. What are the types of thermal expansion observed in a solid?

Ans. There are three types of thermal expansion observed in solids:

(a) Linear expansion
(b) Superficial expansion
(c) Cubical expansion

Q8. Define the coefficient of linear expansion, coefficient of superficial expansion and coefficient of cubical expansion. State their units. How are they related?

Ans. Different materials expand by different amounts. Just how much a particular material expands depends on the forces of cohesion between neighbouring atoms or molecules. If these forces are strong, the material can only expand slightly for a given rise in temperature. A metal such as lead which has a low melting point and is relatively easily compressed expands a great deal for a given rise in temperature.

The coefficient of linear expansion is the change in length of a specimen one unit long when its **temperature** is changed by one degree.

The **coefficient of superficial expansion** is defined as the ratio of increase in area to its original area for every degree increase in temperature.

Coefficient of cubical expansion is the fraction of volume increased when a body is heated. Its the property of the material and Aluminium has the highest **coefficient** of **expansion** among the metals. Coefficients of thermal expansion are usually given in "per °C".

Often the equation for linear expansion is given as: $L_t = L_o(1 + \alpha t)$

where L_t is the new length after expansion, α the coefficient of linear expansion, and t the rise of temperature.

A similar equation for calculating the increase in *area* (superficial expansion) is $A_t = A_o(1 + \beta t)$, where A_t is the new area after expansion, A_o the original area, and β the coefficient of superficial expansion. β is equal to twice the coefficient of linear expansion, i.e., $\beta = 2\alpha$.

The equation for calculating the increase in *volume* (cubical expansion) is $V_t = V_o(1 + \gamma t)$, where V_t is the new volume after expansion, V_o the original volume, and γ the coefficient of cubical expansion. γ is equal to three times the coefficient of linear expansion, i.e., $\gamma = 3\alpha$.

Thus $\alpha: \beta: \gamma = 1:2:3$

Q9. Define the coefficient of real expansion and apparent expansion of a liquid. How are they related?

Ans: **Coefficient of real expansion** of the **liquid** is defined as the ratio of **real** change in the volume to its original volume per 1°C rise in temperature. **Coefficient** of apparent **expansion of liquid** is defined as the ratio of apparent change in volume of the **liquid** to its original volume per 1°C rise in temperature.

The relation between the coefficient of real expansion (γr) **and coefficient of apparent expansion** (γ_a) **of a liquid and the coefficient of linear expansion** (α_g) **of the material of the container is :**

$\gamma_r = 3\alpha_g + \gamma_a$

Q10. Does the coefficient of apparent expansion depend solely on the nature of the liquid? Explain.

Ans. The coefficient of apparent expansion depends on the thermal expansion of both the liquid and the container.

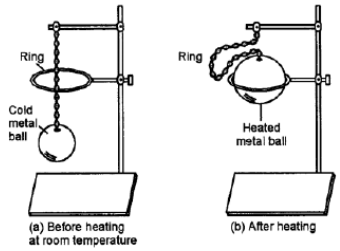
Q11. Describe an experiment to show

a. Linear expansion
b. Superficial expansion
c. Cubical expansion
d. Different rate of expansion of liquids
e. Expansion in gases

Ans. A. A metal rod with one end fixed is kept on two wooden stands. The other end is connected to a pointer needle free to move along a circular scale. As the rod is heated the pointer notes a change in the scale denoting a change in length.

b. A metal sheet is taken with a hole drilled inside such that a nail cannot pass through it. This sheet is heated. After some time it is seen that the nail can pass through. This is because of a change in area of the hole in the sheet.

c. [Gravesand's ball and ring experiment] A metallic ball and ring are taken so that ball can pass through ring easily. Now the ball is heated. We see that heated ball cannot pass through the same ring. This is because on heating the ball increases in size. Now on cooling the ball again it can pass through the ring. This experiment shows that solids expand on heating and contract on cooling.



d. To demonstrate that equal volumes of different liquids expand by different amounts for the same rise in temperature :
1. Take 3 large test tubes and fill it with water, paraffin oil and benzene.
2. Mark the starting height of each liquid in the test tubes.
3. Tie test tubes together with the rubber band so the liquids are at the same level in the glass tubing.
4. Pour the hot water into the beaker around the test tubes. Watch the height of the liquids closely as the liquids warm.
5. After sometime, it is found that the level of liquid is different in different tubes. Water rises the least and benzene rises the most. Thus, water expands the least and benzene expands the most.

e. Take an empty test tube and close its mouth with a single-holed rubber stopper.
Take a capillary tube in which a small amount of coloured water is trapped.
Insert it into the test tube through the single-holed rubber stopper.
Hold the test tube with a test tube holder, and heat it over a burner.
Observe the level of coloured water in the capillary tube.
On heating the test tube, the air in the test tube expands and pushes the coloured water up.
Stop heating the test tube and cool it.
If the test tube is cooled, the air contracts and the level of the coloured water comes down to its original level.

Short Notes

1. Write short notes on:

a. Linear expansion
b. Superficial expansion
c. Cubical expansion
d. Real expansion
e. Apparent expansion
f. Anomalous expansion of water
g. Riveting
h. Bimetallic strip

Ans: (a) Linear expansion is the phenomenon by which when heat is applied on a body, its length expands proportional to the original length or the change in temperature in the body. The factors on which the linear thermal expansion depends are:

i. Original length
ii. Nature or material of the solid
iii. Change in temperature

(b) Superficial expansion is the phenomenon by which when heat is applied on a body, its area expands proportional to the original area or the change in temperature in the body. The factors on which the superficial thermal expansion depends are:

i. Original area
ii. Nature or material of the solid
iii. Change in temperature

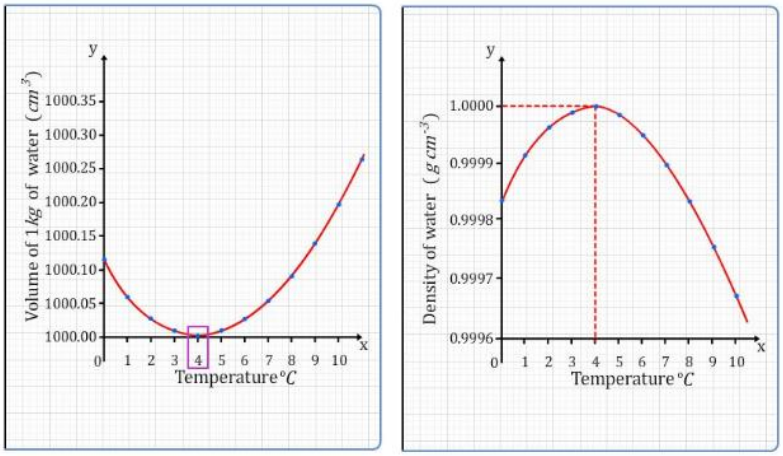
(c) Cubical expansion is the phenomenon by which When heat is applied on a body, its volume expands proportional to the original volume or the change in temperature in the body. The factors on which the cubical thermal expansion depends are:

i. Original volume
ii. Nature or material of the solid
iii. Change in temperature

(d) The change in the volume of a liquid when heated, irrespective of the container in which it is kept, is called the real expansion of the liquid. Real expansion can be measured by adding the expansion of the container to the apparent expansion observed through the rise in liquid level.

(e) A liquid is heated in a container. Heat flows through the container to the liquid. This means that the container expands first, due to which the level of the liquid falls. When the liquid gets heated, it expands more and beyond its original level. We cannot observe the intermediate state. We can only observe the initial and the final levels. This observed expansion of the liquid is known as the apparent expansion of the liquid and is less than its actual expansion.

(f) The anomalous expansion of water is an abnormal property of water whereby it expands instead of contracting when the temperature goes from 4*o C* to 0*o C*, and it becomes less dense. The density is maximum at 4 degree centigrade and decreases below that temperature as shown in graph. The density becomes less and less as it freezes because molecules of water normally form open crystal structures when in solid form.



(g) A rivet is a mechanical joint which is cylindrical in shape and having a head. The process by which two plates are joints together by use of rivet is called riveting.

Rivets are used to hold steel plates together very tightly. In this operation two holes are created in both plates and the rivet is inserted between these holes. A very hot rivet is pushed through the two plates and its end is hammered over. When the rivets cools down it pulls the two plates together very tightly.

(h) A bimetallic strip is a temperature-sensitive electrical contact used in some thermostats, consisting of two bands of different metals joined lengthwise. When heated, the metals expand at different rates, causing the strip to bend.

Examples of bimetallic strip include:

i. Copper and iron
ii. Brass and iron
iii. Brass and invar

Explanation

1. Give reason for the following:

a. Earthen pots are used for heating water in summer.
b. Hot tea is poured on a saucer to cool
c. Perspiration regulates body temperature
d. Cold compress is applied during high fever to bring down temperature.
e. Riveting fastens too plates more tightly than a screw
f. A glass tumbler breaks when hot water is poured in it
g. A small gap is left between rails
h. Steel girders of bridges have only one end fixed
i. Bimetallic strips are used in fire alarms
j. Electric wires are left sagging when laid in summer
k. Pyrex glass is preferably used in kitchen
l. Considerable space is left in medicine bottles when sent from cold to warm areas
m. Automobile tyres are filled with less air in summer

Ans. A. There are some pores in an **earthen pot** through which the liquid inside the **pot** evaporates. This evaporation makes the **water** inside the **pot** cool. In this way, **water** kept in an **earthen pot** becomes cool during **summers**. It keeps **water** cool.

b. The rate of evaporation depends upon the surface area. So, by putting the **tea** in the **saucer**, **we** are increasing the area and thereby increasing the evaporation. This makes the **tea** a little cold and **we** are able to drink it. In the cup, evaporation **will** take place but at a slower pace as the surface area **is** comparatively less.

c. Your **sweat** glands release **sweat**, which cools your skin as it evaporates. This helps lower your internal **temperature as evaporation causes cooling**.

d. If you have **a** raging **fever**, an **ice pack** will **help** to **reduce** your **temperature**. Contact with something **cold** creates **a** heat exchange between your body and the outside world.

e. Rivets are used to hold steel plates together very tightly. In this operation two holes are created in both plates and the rivet is inserted between these holes. A very hot rivet is pushed through the two plates and its end is hammered over. When the rivets cools down it pulls the two plates together very tightly.

f. Glass falls under the insulator class of material which means it is a poor conductor of heat. When you pour a very hot liquid into a thick tumbler what happens is, the surface of glass that comes in contact with the hot liquid heats up and expands as per its coefficient of thermal expansion, while the outer layer still remain cold and does not expands (because glass is a poor conductor and does not carry heat quickly). This leads to development of thermal stresses which eventually causes cracking.

g. In traditional railway tracks gaps were left between two rails so that there was enough margin for the tracks to expand and contract due to the temperature changes. If that gap was not left then the tracks might have enormous stress in them while expanding due to heat, which could damage them.

h. Roller supports are commonly located at one end of long bridges. This allows the bridge structure to expand and contract with temperature changes. The expansion forces could fracture the supports at the banks if the bridge structure was "locked" in place.

i. When the bimetallic strip is heated by fire, the high-expansion side bends the strip toward an electrical contact. When the strip touches that contact, it completes a circuit that triggers the alarm to sound. The width of the gap between the contacts determines the temperature that will set off the alarm.

j. Telephone and electric wires stretch (expand) when the weather is hotter. Conversely, in the winter they shrink. Without some slack, they could become too tight and break, or pull loose from their anchors.

k. **Pyrex glass** in commonly used in **kitchenware** because **pyrex glass** has a very low coefficient of expansion. There it does not crack on heating.

l. Sometimes as temperature increases the solubility of gases decreases. It require some **space**. If the **bottles** are fully filled then it may blast due to excessive pressure formed by increased kinetic movement or temperature. Also the spaces allow for thermal expansion to take place in the liquid.

m. According to Gay Lussacs law, at constant volume, pressure of a fixed amount of a gas varies directly with the temperature. In **summer**, due to the high temperature , the pressure inside the **tyre** also increases. And thus to prevent the bursting of the **tyre**, it is inflated to a slightly lesser pressure in **summer**

Solution of Previous Years' Question Papers

2019

1st Term

4. What do you mean by evaporation? How is it different from boiling?

Ans: Evaporation is the slow and gradual conversion of liquid to its gaseous state at any temperature.

Boiling	Evaporation
Bulk phenomenon	Surface Phenomenon
Takes place at fixed temperature	Takes place at all temperatures
Fast process	Slow process

3rd Term

2. Name the following:

2.3 Glass that expands very little on heating-Pyrex glass

State reason for the following-

(i) Why is water sprinkled outside houses and shops during summer?

During summer water is sprinkled outside shops and houses so that as the molecules evaporate they carry off the kinetic energy of the area, thereby causing cooling.