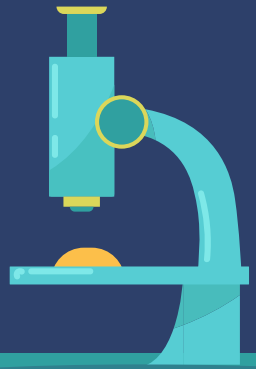
THERMAL PROPERTIES OF MATTER

By Aikya



LEARNING OBJECTIVE

01

THERMAL EXPANSION

of solids,liquids and gases

02

MOTION AND ARRANGEMENT OF PARTICLES

during thermal expansion

03

USES AND APPLICATIONS

of thermal expansion

04

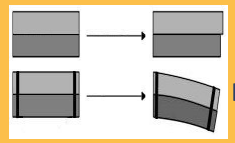
THERMOMETERS

using,working,design

THERMAL EXPANSION

Thermal expansion is the tendency of matter to change its shape, area, and volume i.e. expand or contract in response to a change in temperature.

THERMAL EXPANSION EXAMPLES



RIVETS

A red-hot rivet is passed through holes in two metal plates and then hammered until the ends are rounded. As the rivet cools, it contracts and pulls the two plates tightly together.

BIMETALLIC STRIPS

A strip made of two metals joined firmly together. On heating,,one metal expands faster than the other. causing the strip to bend. Ex-Cu & Al

METAL LID

A metal lid may stick on a glass jar and be hard to unscrew. On heating, it expands and loosens,and can be removed..

CONSEQUENCES OF EXPANSION

Railway lines

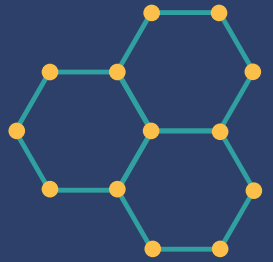
Railway lines expand on hot days,and there is a danger that they might buckle.To avoid this, they are made from a metal alloys that expand little and gaps can also be left.

Glass containers

Glass containers may crack when a hot liquidis place in them. This is because the inner surface of the glass expands rapidly, before the heat has conducted through the outer surface.

Pressure cookers

The pressure cooker works by expelling air from the vessel, and trapping the steam produced from the boiling liquid inside. This raises the internal pressures and permits high cooking temperatures. After cooking the steam is released so that the vessel can be opened safely.



EXPANSION IN

SOLIDS < LIQUIDS < GASES

TEMPERATURE

The measure of the average kinetic energy of the individual particles..

Units- Celsius , Kelvin, Fahrenheit

HEAT

Total amount of energy of all particles..

Units- Joules

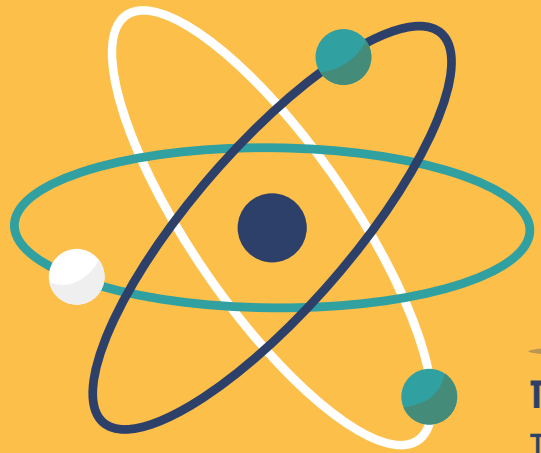
THERMAL EQUILIBRIUM

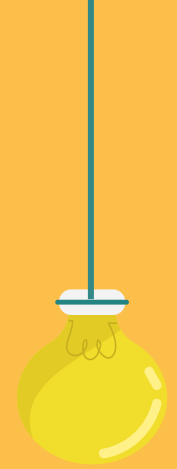
When the energy of the substance is equal to the energy in the thermometer bulb, we say they are in thermal equilibrium.

DESIGNING A THERMOMETER

THERMISTOR

A resistor that changes resistance over a narrow range of temperatures.





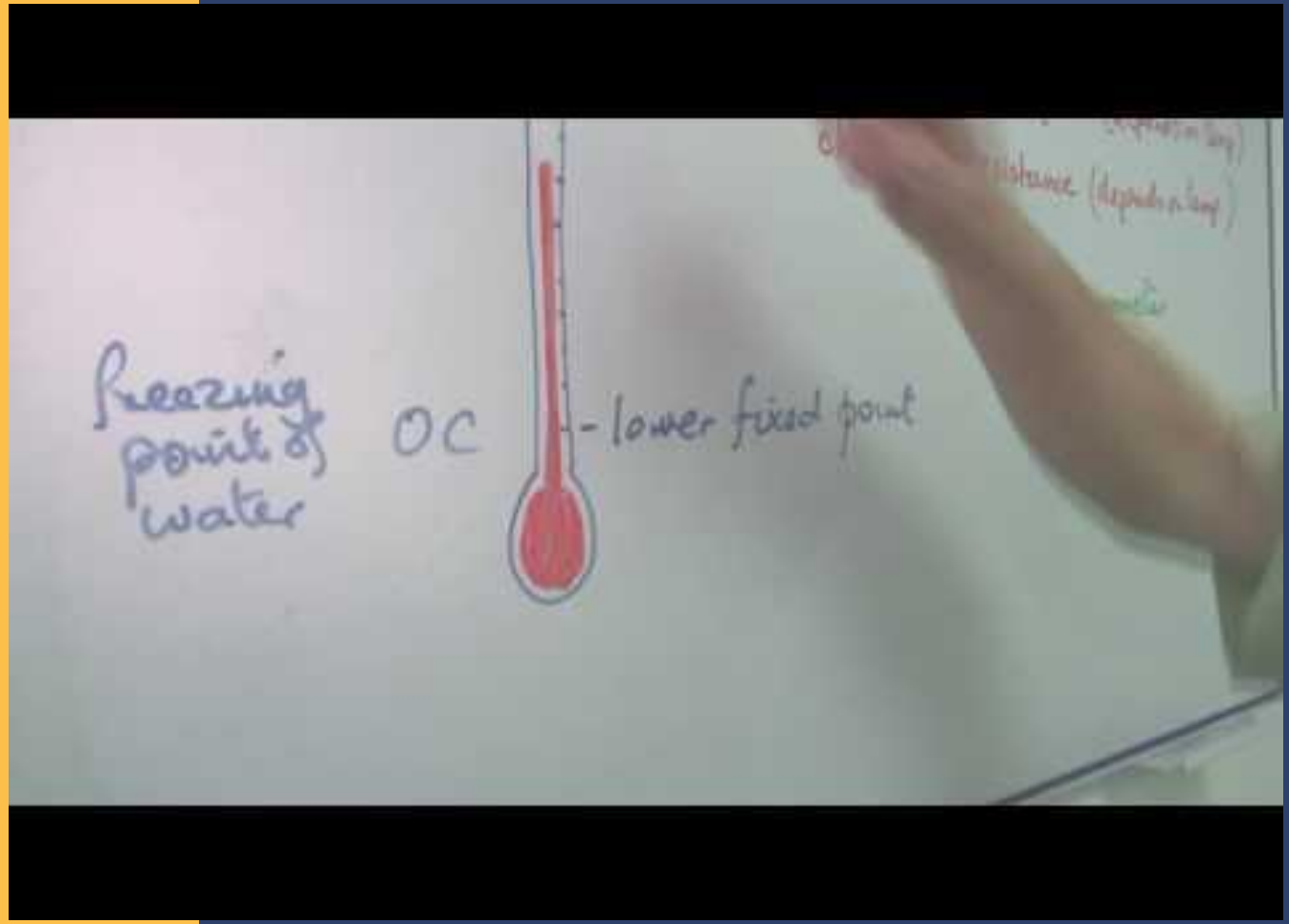
LIQUID-IN-GLASS THERMOMETER

- Mercury/ Alcohol
- Expands at a steady rate allows a wide range
- accurate results
- Narrow tube makes it sensitive

THERMOCOUPLE

Two metal wires made of different metals connected to a substance, a voltmeter and a beaker of melting ice cubes.

MERCURY-IN-GLASS THERMOMETER



CELSIUS SCALE

Galileo devised the first thermometer that used air which was unsatisfactory. It only showed the change in temperature.

1593

1742

Anders Celsius devised a more successful one that uses mercury in an enclosed and evacuated tube. He also calibrated it into 100 divisions starting with the melting point of water and ending with the boiling point.

TEMPERATURE SCALES

	CELCIUS	KELVIN	FAHRENHEIT
Melting point of water	0°C	273K	32°F
Boiling point of water	100°C	373K	212°F
Divisions	100	100	180

FORMULAE

$$V \propto \frac{1}{P}$$

$$C = K - 273$$

$$C = \frac{(F-32)5}{9}$$

$$\frac{^\circ C}{100} = \frac{(^\circ F - 32)}{180} = \frac{(K-273)}{100}$$

$$F = \frac{9}{5}C + 32$$

$$K = C + 273$$

$$Q = m \cdot c \cdot \Delta t$$

WHERE Q=HEAT ENERGY, M=MASS, C=SPECIFIC HEAT CAPACITY (THE ENERGY REQUIRED TO INCREASE THE TEMPERATURE OF ONE MOLE OF A SUBSTANCE BY ONE DEGREE) AND Δt= CHANGE IN TEMPERATURE

SOLVED EXAMPLES

A beaker contains 0.500 kg of water at a temperature of 3.0 °C. The beaker is heated, and the internal energy of the water increases by 21.0 kJ.

The specific heat capacity of water is 4200 J/(kg °C).

What is the temperature of the water after it has been heated?

A 5.5 °C B 10.0 °C C 13.0 °C D 31.5 °C

$$Q = m \cdot c \cdot \Delta t$$

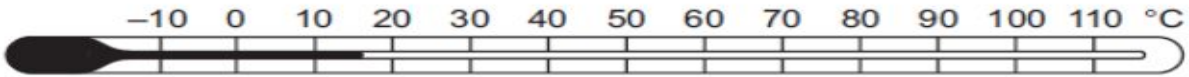
Q=21.0 kJ= 21000 J ---- 1 kJ= 1000 J
m = 0.5 kg
c(specific heat of water) = 4200 J/kg°C
final temperature = 3.0 + Δt
21000 J / 0.5 kg * 4200 J/kg°C= Δt = 21000 J/ 2100 J/°C = 10°C
final temperature = (3+10)°C= 13°C (option C)

1) Convert 315 K to Celsius scale and Fahrenheit scale.

ANS- C= K- 273 = 315- 273 = 42°C

F= 9C/5 + 32 = 9*42/5 + 32 = 107.6°F

A student wishes to check the upper and the lower fixed points on a Celsius scale thermometer.



She has four beakers P, Q, R and S.

Beaker P contains a mixture of ice and salt.

Beaker Q contains a mixture of ice and water.

Beaker R contains boiling salt solution.

Beaker S contains boiling water.

OPTION D (MELTING AND BOILING POINTS OF WATER)

Which two beakers should she use to check the fixed points?

A P and R B P and S C Q and R D Q and S

MINDMAP

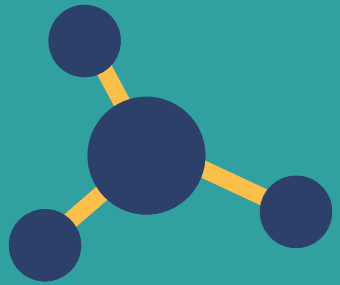
$Q = m*c*\Delta t$

THERMAL PROPERTIES OF MATTER

Liquid-in-glass thermometers

Temperature, heat and thermal equilibrium

Uses and applications



Conversions

Thermal expansion

Designing thermometers

Temperature scales

Expansion in solids<liquids<gases

$F= (9C/5)+ 32$

Kelvin

Celsius

Thermistors

Consequences

Thermocouple

$K= C + 273$

Fahrenheit

EXERCISE QUES

During one day, 250 kg of water is pumped through the solar panel. The temperature of this water rises from 16 °C to 38 °C.

The water absorbs 25 % of the energy incident on the solar panel. The specific heat capacity of water is 4200 J/(kg °C).

Calculate the energy incident on the solar panel during that day.

EXERCISE QUES

1) What type of thermometer is this?

2) What liquid does it use?

3) What the temperature scale of the thermometer?

4) Convert -10°C to Fahrenheit.

THANKS

Any questions?