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INTERACTIONS: Heat

CHAPTER ANALYSIS



6 KEY CONCEPTS

- Infer that generally solids, liquids, and gases expand when heat is absorbed and contract when heat is given out
- Infer that thermal expansion results in a change in volume and density of a substance
- Describe some effects and applications of expansion and contraction in everyday life
- State the SI unit of temperature
- Explain what is meant by conduction, convection, and radiation
- Show an understanding that the rate of heat loss or gain by a body through radiation is affected by the (i) nature of its surface and (ii) temperature difference between the body and its surroundings



2 ADVANCED CONCEPTS

- Identify and explain applications of heat conduction, heat convection and heat radiation
- Infer from experiments that different materials have different rates of heat flow

KEY CONCEPT

HEAT





EFFECTS OF HEAT

HEAT

Expansion: the increase in size of objects when heated

Contraction: the decrease in size of objects when cooled

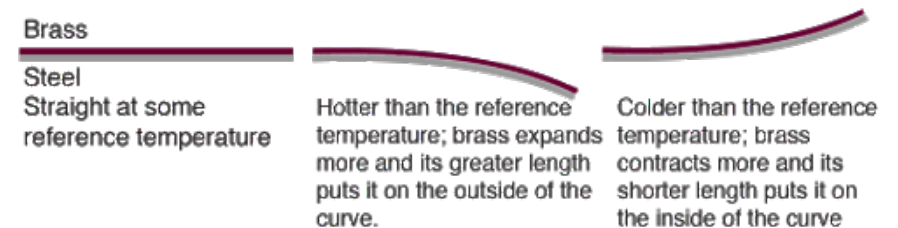
Measurement of temperature

Instrument: thermometer

SI unit: kelvin (K)

Bimetallic strips

- Made up of 2 different metal strips (eg. Brass and steel)
- When heated or cooled, the flat strip bends because one metal expands or contracts more than the other
- Used in bimetallic thermometers and thermostats



Expansion & Contraction in daily life

- Steel MRT tracks have small gaps to allow for expansion during hot weather
- Bridges have expansion gaps or rollers to allow for movement

KEY CONCEPT

CONDUCTION, CONVECTION, & RADIATION





CONDUCTION

CONDUCTION

Definition: Conduction is the transfer of heat through a material without the obvious movement of the medium itself

Good conductors	Poor conductors
Metals (eg. Aluminium, steel, iron)	Liquids, gases, some solids (wood, plastic, glass)

Uses

- The bottom of an iron is made of steel (good conductor) to conduct heat to clothes
- Oven gloves contain trapped air (poor conductor) so that heat cannot conduct easily through to reach our hands

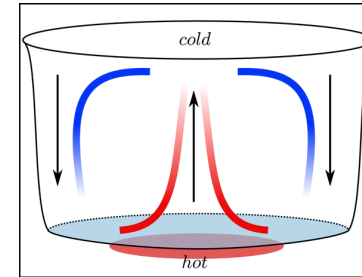
CONVECTION

CONVECTION

Definition: Convection is the transfer of heat from one place to another by the movement of the medium itself

Heat is transferred through liquids and gases (poor conductors of heat) mainly through convection.

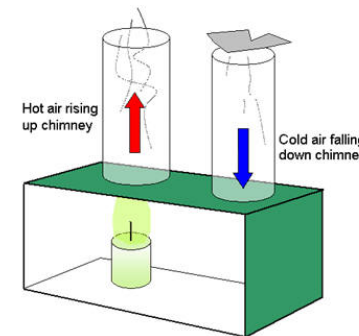
Liquids



- When water is heated, the water molecules move faster and spread further apart. The volume of water increases, causing its density to decrease
- The hot, less dense water rises while the cooler, denser water sinks

The moving water forms a current called a *convection current* which transfers heat around the beaker.

Gases



- Air above the candle flame gets hot, becomes less dense and rises
- Cooler air sinks into the box through the other chimney to replace the escaping hot air

Convection in daily life

- Electric kettles
- Air conditioners



RADIATION

RADIATION

Definition: Radiation is the transfer of heat without the need for a medium (ie. A solid, liquid, or gas)

Objects warmer than their surroundings (like the sun, fires, gas flames) give out heat as radiation.

Features	Good absorbers	Poor absorbers	Good radiators	Poor radiators
Appearance of surface	Black, dull	White, shiny	Black, dull	White, shiny
Type of surface	Rough	Smooth	Rough	Smooth

Factors for rate of heat gain/loss

- Nature of the surface
 - The darker or rougher the surface, the more heat gained or lost per second
- Surface area
 - The greater the surface area of a body, the more heat gained or lost per second
- Temperature of the body
 - The greater the temperature difference between the body and its surroundings, the more heat gained or lost per second

Applications

- White clothes absorb less radiation from the sun and keep us cool
- The shiny surface of an electric kettle is a poor radiator of heat – water inside the kettle stays hot for a longer time

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