Transfer of Heat

Name	Description
Heat (Thermal Energy)	Measured in Joules (J), thermal energy
Temperature (symbol T)	Measured in Kelvin (K), determined by the average kinetic energy of particles
Transfer of heat	Occurs when there is a difference in temperaturerom a region of higher temperature to a region of lower temperature
Temperature gradient	Affects the rate of heat transfer
Thermal Equilibrium	Reached when no net heat flow occurs (same temperature)
Thermal Conductivity	How well a substance transfers heat. In increasing order of thermal conductivity: gas, liquid, solid

Expansion and Contraction

Phenomenon	Definition
Expansion	As an object gains heat, it expands
Contraction	As an object loses heat, it contracts
What do they cause?	Results in a change of volume, While mass remains the same → density changes

Methods of Heat Transfer

Method	Definition
Conduction	Transfer of thermal energy from one place to another without any flow of the material medium, occurs in all states of matter
Convection	Transfer of thermal energy by means of convection currents in a fluid (gas, liquid), due to differences in density, only occurs in fluids as particles are able to move freely
Radiation	Transfer of heat in the form of electromagnetic waves, does not require any medium for heat transfer. Good radiators are also good absorbers of radiation.

Applications of Conduction

Examples of Good Conductors	Cooking utensils, Electric irons, kettles
Examples of Poor Conductors	Handles of cooking utensils, thermal underclothes, polystyrene cups
Describe how the design of a vacuum flask keeps the liquid inside hot/cold.	• Vacuum flask keeps hot liquids hot and cold liquids cold • No heat can enter or leave the flask by conduction or convection across the vacuum • Inner silvered surface reflects radiation from hot fluids back into the flask • Outer silvered surface reflects external radiation away from the flask • Plastic cap (and foam support) minimise heat transfer by conduction • Plastic cap stops convection and evaporation
Why does a stone floor feel cold to bare feet?	• Feet has higher temperature than stone floor • Stone floor will conduct heat away from feet
Why does the cloth with the coin inside not burn when exposed to fire?	• The coin is made of metal and has delocalised electrons • Thus the coin conducts heat better • The coin conducts heat energy from the coin • Prevents the cloth from burning

Applications of Convection

Examples of Convection	Hot water system, Cooling system in car radiator, Refrigerators and air conditioners
Why does placing a lid over a pot of hot soup keep the soup warm longer?	• Lid does not allow hot air to rise and escape • Lid prevents convection current from existing

Factors influencing radiation

Factor	Description
Temperature of surface	The higher the surface temperature, the higher the rate of heat transfer by radiation
Colour of surface	Black, dull surfaces absorb and radiate heat much faster compared to bright, shiny surfaces; Shiny surfaces are better reflectors of radiation
Surface area	The larger the surface area, the higher the rate of heat transfer by radiation

Emitters of Radiation

Good Emitter	Poor Emitter
Black colour fins of refrigerators to cool the coolant in the condenser coil	Shiny teapot to keep tea hot

Absorbers of Radiation

Good Absorber	Poor Absorber
Solar panels are painted dull black to absorb maximum radiation from the sun	Houses are painted white to keep them cool
	Roofs are coated with aluminum paint to reduce heat absorption during the day and minimize emission of heat at night

Absorbers of Radiation

Good Absorber	Poor Absorber
Solar panels are painted dull black to absorb maximum radiation from the sun	Houses are painted white to keep them cool
	Roofs are coated with aluminum paint to reduce heat absorption during the day and minimize emission of heat at night

Applications of Radiation

I am at home and need a warm drink quickly. There is a cup of cold black coffee and a cup of cold milk. Which drink should I take to warm up and get my drink?	Black coffee (that is black) is a better absorber of heat radiation than milk which is white, hence it will gain heat faster

Applications of Radiation

I am at home and need a warm drink quickly. There is a cup of cold black coffee and a cup of cold milk. Which drink should I take to warm up and get my drink?	Black coffee (that is black) is a better absorber of heat radiation than milk which is white, hence it will gain heat faster