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Physics Topic P2
Energy transfer by heating

Section 1: Key terms

Thermal conductivity	A measure of how good something is at **conducting**.
(Thermal) Insulator	Thermal insulators **reduce energy transfers** (prevent heat loss to surroundings and hence have a **low thermal conductivity**)
Thermal Conductor	Good at **transferring heat** energy.
Specific heat capacity	The specific heat capacity of a substance is the **amount of energy** needed to change the **temperature of 1Kg** of the substance by **1°C**. Its units are J/Kg/°C
Joulemeter	Energy meter (measures energy supplied)

Section 2: Energy transfer by conduction

The higher the Thermal conductivity of a material the **higher the rate of energy transfer** by **conduction** across the material.

Metals	**Metals** are the **best conductors** of energy, Copper is a better conductor than steel.
Non-metals	**Non-metal** material (like wool and fibreglass) are the **best insulators**.

Factors affecting insulation

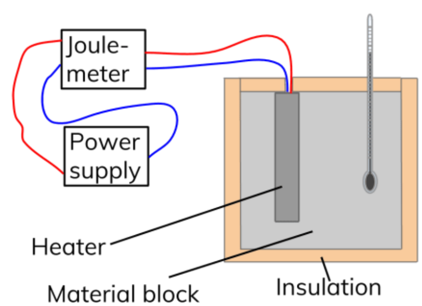
Thickness of material	The **thicker** the material the **better the insulation**.
Thermal conductivity	The **lower** the **thermal conductivity** the **better the insulator**.

Section 3: Specific heat capacity

Putting the same amount of heat into some materials gives a bigger temperature rise than in other materials. The specific heat capacity of a substance is the **energy needed** to **raise** the **temperature** of **1kg** of a material by **1°C**.
Investigations show that when a substance is heated, its temperature rise depends upon three factors:

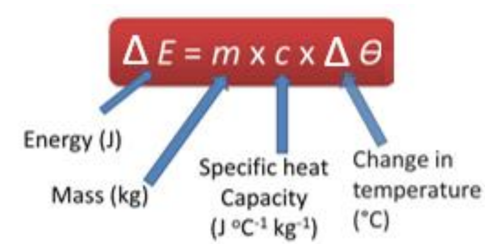
Amount of energy supplied to it	Specific heat capacity **increases** with **temperature**.
Mass of the substance	The **greater the mass** the more **slowly** its **temperature increases** when its **heated**.
What the substance is	**Metals** tend to have **lower specific heat capacities**. **Water** has a **high specific heat capacity**. Hence it takes less energy to raise the temperature of a block of aluminium metal by 1°C than it does to raise the same amount of water by 1°C.

Measuring specific heat capacity



A metal block of **known mass** is heated. A **joulemeter** is used to **measure the energy** supplied ΔE and a **thermometer** to **measure the temperature rise Δθ**.

The measurements are then inserted into the equation and used to calculate the specific heat capacity:



Storage Heaters

Storage heaters **use electricity at night** (off peak hours) to **heat special bricks** (which have a high specific heat capacity). The bricks **store** lots of **energy** and **take time** to heat up and cool down. Hence during the day (on peak) they **release heat slowly** when **the heater element is on** and cool down slowly when it is off.

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Section 4: Heating and insulating buildings

Homes are heated by electric or gas heaters, oil or gas central heating systems or solid fuels in stoves or fireplaces. A **poorly insulated house loses** more **energy** and so **costs more** to heat. It also means that **more pollution**, particularly carbon dioxide is released into the environment. The rate of energy transfer can be reduced by:

How to prevent heat loss from a house

Loft insulation	Contains **fibreglass** which **traps air, reducing convection** which is a good insulator.
Cavity wall insulation	**Traps air pockets** in gaps which is a good insulator
Double glazed windows	**Traps air** in **gaps between glass** which is a good insulator.
Aluminium foil behind radiators	**Reflects radiation.**
External walls with thicker bricks	**Thicker** bricks have a **lower thermal conductivity.**

Section 5: Infrared radiation Key terms (Triple only)

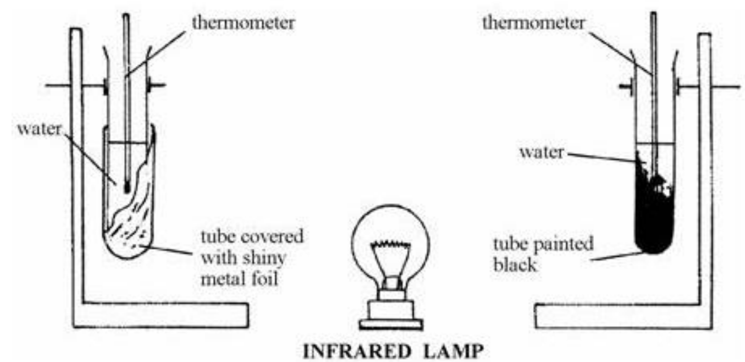
Electromagnetic radiation	**Transverse waves** that travel at **300,000,000 m/s.** Includes radio, microwave, infrared, visible, Ultraviolet, X-ray and gamma waves.
Infrared radiation	An **electromagnetic wave. Emitted** by **warm objects.** Also known as heat or thermal radiation.
Black body	A body that **absorbs all the radiation** that hits it.
Black body radiation	The **radiation emitted** by a **perfect black body**
Greenhouse gases	gases that contribute to the **greenhouse effect** by **absorbing infrared radiation**

Section 6: Infrared radiation (Triple only)

The Sun emits all types of electromagnetic radiation. Infrared radiation consists purely of electromagnetic waves of a certain range of frequencies. The **hotter** an object is, the **more infrared radiation** it **emits in a given time.**

What happens to infrared waves when they strike different surfaces.

Dark matt surfaces **absorb infrared radiation** much **better** than light glossy surfaces, **silvered surfaces reflect** nearly all heat radiation falling on them. **Dark matt surfaces** also **emit more infrared radiation.**



In the experiment above, the infrared lamp **radiates energy** to the test tubes. The **black painted tube absorbs** most of the energy (and **its temperature increases faster**) whereas the **shiny foil reflected** most of **the energy** that reached it.

Absorption and emission of infrared radiation

The **temperature** of an object **will increase** if it **absorbs more radiation than it emits.**

The **Earth's temperature depends** on a lot of factors like the **absorption of infrared radiation. Greenhouse gases** in the atmosphere (CO_2, CH_4 & H_2O) **absorb infrared radiation preventing it escaping** into space. This **process** is known as the **Greenhouse effect** and **makes the Earth warmer** than it would be if these gases were not present in the atmosphere.