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P11 Thermal(heat) energy transfers

P11.01 Conduction

Thermal energy: hotter place to colder place

3 ways to transfer: conduction, convection, radiation

Conduction



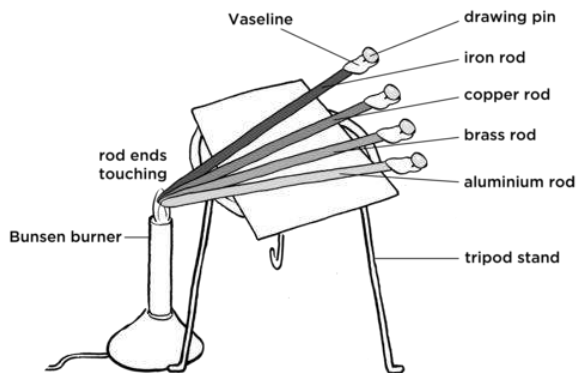
Finger to metal spoon

- Feels cold, because metal is a good **conductor**
- Heat escapes from finger and goes to metal
- Finger gets colder

Finger to plastic spoon

- Stays warm, because plastic is a good **insulator**
- Heat travels no further
- Finger doesn't lose much heat - stays warm

1. Demonstrating conduction

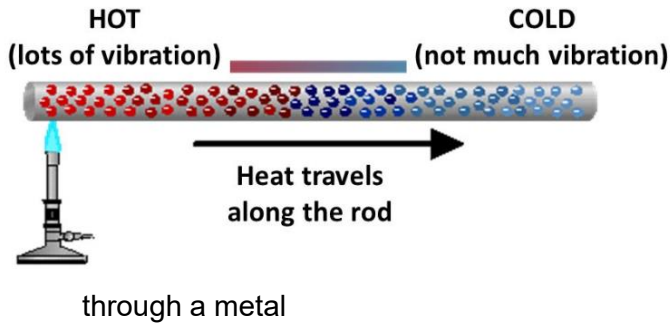


- Metals rods should be all same size
- Each has a wax at the end
- All heated equally
- Best conductor = whose wax melts at first

Best Conductor ↓ Worst conductor	Diamond	Worst Insulator ↑ Best insulator
	Silver, copper	
	Aluminium, steel	
	lead	
	Ice, marble, glass	
	Polythene, nylon	
	Rubber, wood	
	polystyrene	
	Glass wool	

2. Explaining conduction in metals and non-metals

The way how poor conductors and diamond conduct heat



- At the hot end, atoms are vibrating a lot
- At the cold end, atoms are not vibrating
- By vibration, each atom shares its energy with neighboring atoms
- Atoms from lot energy to less energy - transfer
- Metals - have **electrons** which move freely
- They can carry energy, when heat is transferred

P11.02 Convection

1. Demonstrating convection

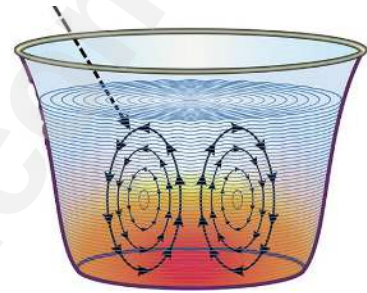
Process

- Water gets heat and expands above the flame
- Density is less, so it floats upwards
- Colder water at surface is more dense - replaced

Convection current: movement of a fluid that carries energy from a warmer place to a cooler one

Difference between conduction

- Convection, energy is transferred by the **movement of the material itself**
- Conduction, energy is transferred **without the material itself moving**



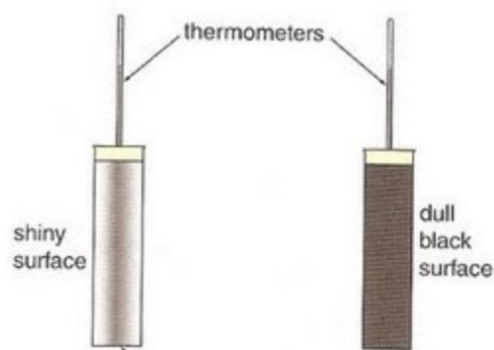
P11.03 Radiation

- We get **electromagnetic radiation** from sun
 - Includes infrared and ultraviolet
- The hotter an object, the more **infrared radiation** given out
 - Produced by warm or hot objects
 - Form of electromagnetic radiation
 - Travels through empty space in the form of waves
 - Travels in straight lines
 - Warms the object that absorbs it
 - Invisible to the naked eye
 - Can be detected by nerve cells

1. Good absorbers, good emitters

Surface determines whether object absorbs or reflects infrared radiation

	MATT BLACK	WHITE	SILVER
EMITTER	Best	Worst	Worst
REFLECTOR	Worst	Best	Best
ABSORBER	Best	Worst	Worst



- Both are filled with hot water
- Cool by radiation
- black cools more rapidly

P11.04 Some consequences of thermal energy transfer

- Hot energy have a lot of internal energy
- Thermal energy travels from hotter place to a colder place
 - Temperature difference makes it flow
 - Solid itself can't move
- Conduction is the only way that energy can pass through a solid
- Convection is how energy is transferred in a fluid
 - Warm fluid carries energy itself
- Radiation is the only way that thermal energy can travel through empty space