Chapters 48 & 49 – Heat

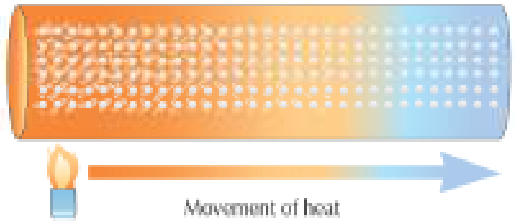
Heat is a form of energy; it is measured in units called Joules (J). We know heat is a form of energy because it can cause things to move, a hot air balloon will rise up and the liquid in a thermometer will too when heated.

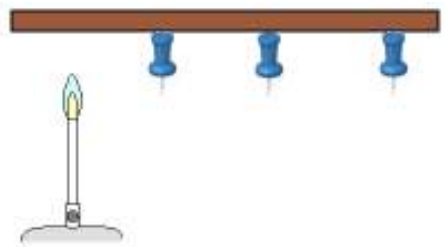
Transfer of Heat

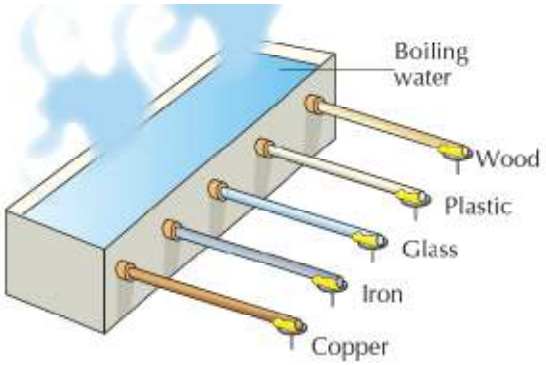
Heat can be transferred by conduction, convection and radiation.

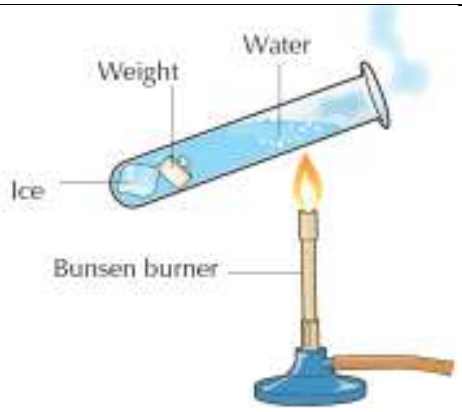
Conduction

Conduction is the transfer of heat in a substance (usually solid) without any movement of the substance.



To demonstrate conduction in solids	
Procedure: set up as shown in the diagram with three tacks held on by Vaseline. Heat one end of the bar for 5 minutes. **Result and Conclusion:** The heat travels along the metal bar melting the wax and allowing the tacks to fall off. The tack nearest the flame falls off first showing that heat is travelling along the bar.	

To compare the conductivity of different materials	
Procedure: Set up a water bath with rods of different materials as shown. Attach a tack to the end of each of the rods using Vaseline. Pour boiling water into the water bath and observe your results. **Result and Conclusion:** The heat travels along the rods at different rates and the tacks fall off at different times. The tack which falls off first is from the material which is the best conductor of heat. All the rods are the same length and diameter to ensure a fair comparison.	

To show that water is a poor conductor of heat. **Procedure:** Set up the apparatus as shown in the diagram, the ice can be held down with a couple of coins. Heat the water at the neck of the test tube using the Bunsen burner. **Result:** the water at the neck of the test tube boils however the ice does not melt. **Explanation:** this demonstrated that water is a poor conductor as the heat cannot pass down through the water and melt the ice.	

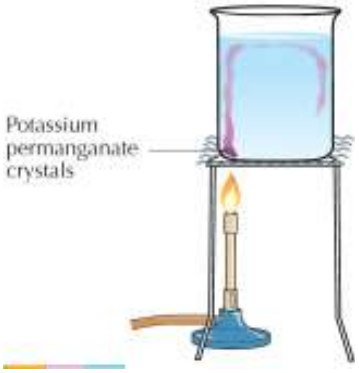
Insulators

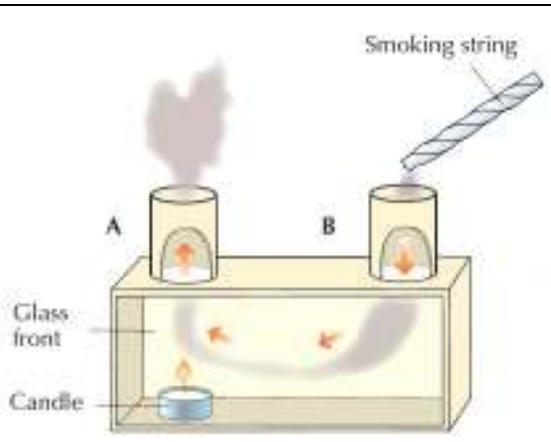
An insulator is a substance that does not allow heat to pass through it easily.

Examples include wool, fibreglass, wood and air.

Convection

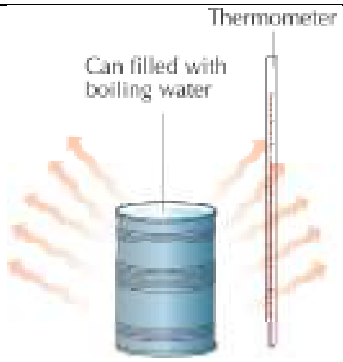
Convection is the transfer of heat in liquids or gasses where the hot molecules move around in convection currents carrying the heat.

To demonstrate convection in water **Procedure:** Fill a beaker of water and allow it to settle until there is no movement of the water. Place a crystal of dye (potassium permanganate) at the bottom of the beaker. Heat under the crystal of the dye. **Result:** A coloured trail of dye can be seen rising above the heat. **Explanation:** Hot water is less dense than cold water and so rises to the top. The dye is needed to show up the hot water rising in the form of a **convection current**.	

To demonstrate convection in air **Procedure:** Place a lighted candle inside a metal box containing two chimneys. The candle is placed under one chimney and a smouldering rope is placed near the other chimney. **Result:** The smoke can be seen coming in one chimney and out the other. **Explanation:** The candle heats the air making it less dense, therefore it rises through the chimney. The smoke shows up the moving air.	

Radiation

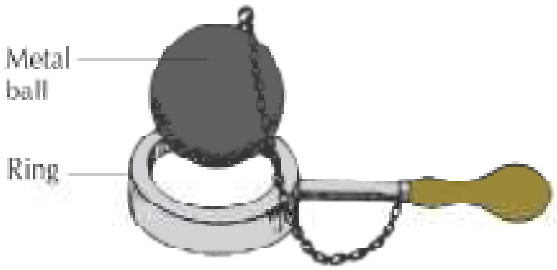
Radiation is the transfer of heat from a hot object without the need for a medium. A medium is a solid, liquid or gas which carries the heat.

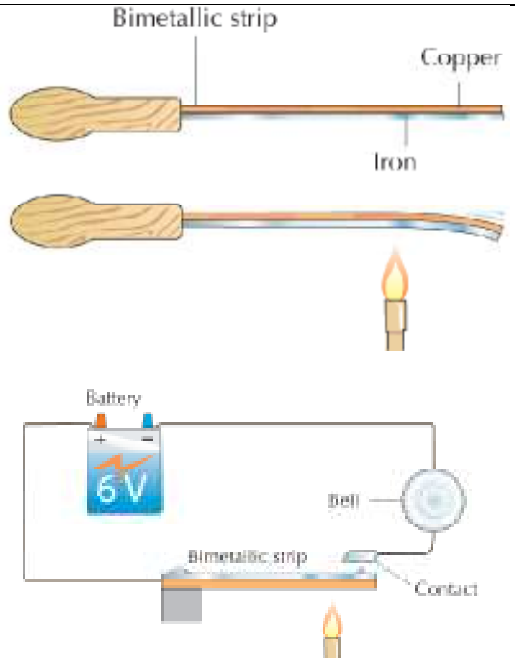
To demonstrate radiation	
Procedure: Fill a can with boiling water and place a thermometer beside it as shown. Leave it for three minutes. **Result:** The thermometer shows a temperature rise. **Explanation:** The heat travelled to the thermometer by radiation.	

Expansion and Contraction

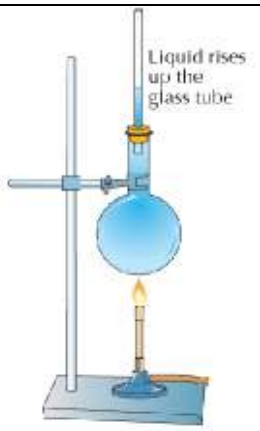
Solids, liquids and gasses all expand when heated and contract when cooled. When heated particles vibrate more quickly and therefore take up more space.

Expansion of solids

To demonstrate expansion of solids	
Procedure: Check that the ball will fit through the ring before you begin. Heat the ball using the Bunsen burner for three minutes. **Result:** The ball no longer fits through the ring; it has expanded due to the heat. Gaps are left between railway tracks and in concrete to allow for expansion in order to prevent buckling and cracking.	

To compare the rate of expansion of different materials using the bi-metallic strip	
A bi-metallic strip is made of two different types of metal riveted together, in this case iron and copper. **Procedure:** Heat the metals strongly over a Bunsen burner. **Result:** The metal strip bends. **Explanation:** Copper expands faster than iron, and because they are riveted together the pair of them bend toward the slower one. The diagram opposite shows a bi-metallic strip being used in a simple fire alarm.	

Expansion of Liquids

To demonstrate expansion of liquids **Procedure:** Fill a round bottomed flask with coloured water until it is nearly full. Place a narrow glass tube into the flask using a bung. Heat the flask gently. **Result:** When the water is heated it can be seen rising gently up the tube. **Explanation:** Water expands when it is heated and takes up more space which forces it up the tube. The narrow tube is used because it illustrated the expansion better.	

Expansion of gasses

To demonstrate expansion of gasses **Procedure:** Set up a round bottomed flask with a glass rod and rubber bung as shown. Heat the flask **very gently.** **Result:** When the flask is heated the air inside the flask expands and this can be seen by air bubbles in the water below. **Explanation:** the air expanded due to the heat and because it took up more space it was forced out of the flask. If the apparatus is allowed to cool, the water will be seen to rise up the glass tube; this is due to the suction caused by the contraction of the gas.