

Investigation of the methods of heat transfer

Introduction

Heat can be transferred through materials (and indeed empty space) in different ways. This series of experiments explores the methods of heat transfer and aims to develop your understanding of the differences between conduction, convection and radiation.

Apparatus

Convection:

2 × 250cm³ beaker
 1 crystal of potassium manganate(VII)
 10cm³ glass tube
 tripod and gauze
 heat proof mat
 Bunsen burner
 forceps

Radiation:

filament lamp
 2 × thermometers
 1 small piece of black paper
 1 small piece of silver foil
 Sellotape
 stopwatch
 2 × clamp stand, clamp and boss

Conduction:

EITHER

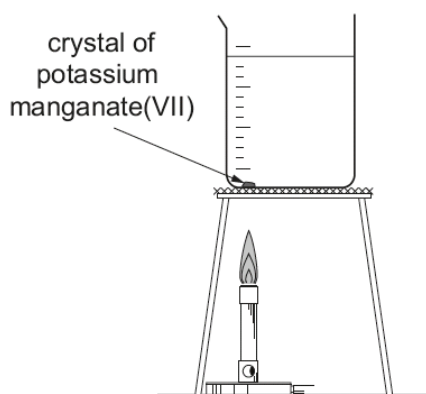
4 × metal rods
 (aluminium, brass, copper and iron)
 4 × drawing pins
 Vaseline
 tripod
 Bunsen burner
 heat proof mat
 stopwatch

OR

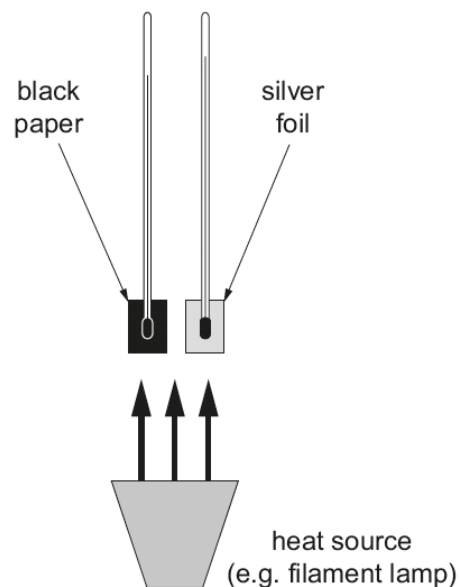
conductive ring
 (aluminium, brass, copper and steel)
 4 × wooden matches
 Vaseline
 clamp stand, clamp and boss
 Bunsen burner
 heat proof mat
 stopwatch

Diagram of Apparatus

Convection Experiment

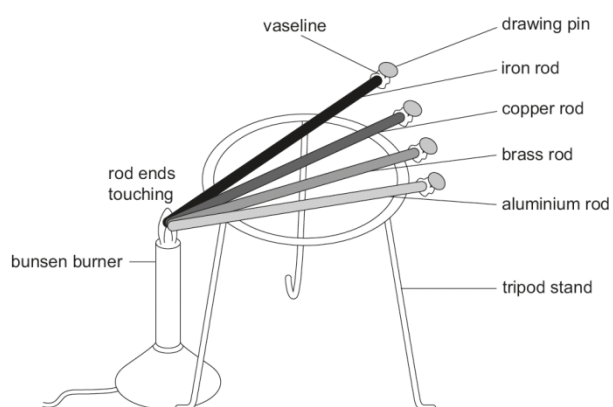


Radiation Experiment

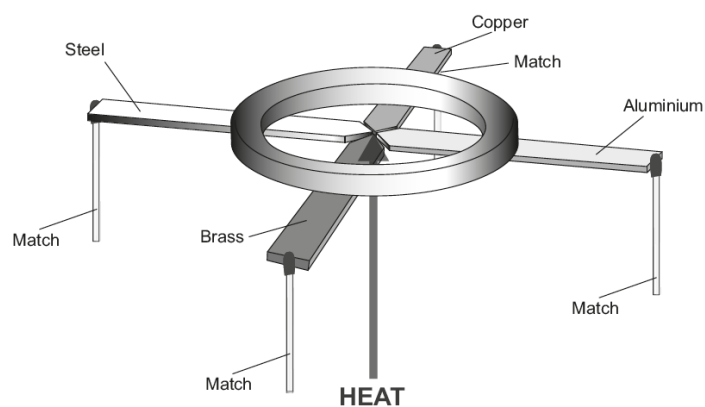


Conduction Experiment

EITHER Metal Rods Experiment



OR Conductive Ring Experiment



Method

Convection Experiment

1. Fill the beaker to $\frac{3}{4}$ full of water.
2. Use forceps to pick up a single crystal of potassium manganate(VII) and drop it carefully through the glass tube to one side of the bottom of the beaker.
3. Place your finger on the top of the tube and remove carefully.
4. Light the Bunsen burner well away from the apparatus. Use the gas tap to get the smallest blue flame that you can.
5. Put the small Bunsen flame directly underneath the crystal and record your observations.

Method

Radiation Experiment

1. Use Sellotape to attach a 2cm strip of black paper to the bulb of one thermometer.
2. In the same way attach a 2cm strip of silver foil to the bulb of another thermometer.
3. Clamp the 2 thermometers **the same distance away** (about 10cm) from a filament lamp.
4. Record the temperatures shown by the two thermometers.
5. Switch on the lamp and record the temperatures again after 10 minutes.

Analysis

1. Determine which colour is the best absorber of heat.

Method

Conduction Experiment

Metal Rods Experiment

1. Set up the apparatus as shown in the diagram above.
2. Attach a drawing pin to the end of each rod with a small blob of Vaseline.
3. The ends of the rods (without the drawing pins) should be brought together so that they can be heated equally (see diagram).
4. Heat the ends of the rods equally with a blue Bunsen flame.
5. Record the time taken for each rod to lose its drawing pin.

Conductive Ring Experiment

1. Clamp the conductive ring taking care to keep the clamp away from the mid-point of the ring.
2. Attach a wooden match to the outer end of each metal using a small blob of Vaseline.
3. Heat the centre point of the ring with a blue Bunsen flame.
4. Record how long it takes for each metal to lose its wooden match.

Analysis

1. Determine the order of conductivity of the metals.