4.2 Energy transfers by particles

Name: _____ Class: _____ Date: _____ **Total: 21 marks**

Objective

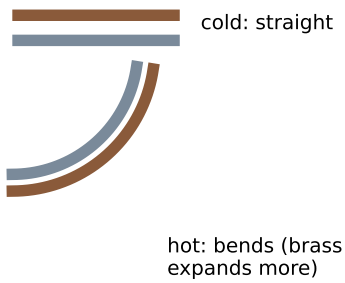
Cover energy transfers and particle motion (3.4.2): conduction with free electrons, convection by density change, evaporation and condensation, rate-of-transfer design (fins, ear size), temperature difference, and expansion with the bimetallic strip. Original OxfordAQA practice.

1 Key knowledge and worked examples

Transfers by particles

faster evaporation with:

- higher temperature
- larger surface area
- air movement (draught)
- lower humidity



Conduction: vibration + free electrons (metals). Convection: warmed fluid expands, is less dense, rises. Evaporation cools: the fastest molecules leave.

Design and expansion

Bigger temperature difference → faster transfer; big surface area → faster transfer (cooling fins; desert rabbits' large ears). Expansion: hazard (bridges need gaps), use (bimetallic thermostat).

2 Practice

2.1 Name the two particle carriers of conduction in a metal. [2]

2.2 Explain why a convection current forms in warming water. [3]

2.3 Explain why evaporation cools a liquid. [2]

2.4 State three factors that speed up evaporation. [3]

2.5 State one hazard and one use of thermal expansion. [2]

3 Exam-style questions

3.1 Explain how a metal spoon heats up in soup, naming the energy transfer. [3]

3.2 A sea breeze blows from sea to land on a hot day. Explain, using convection. [3]

3.3 Explain how a bimetallic strip can switch off a heater, naming the mechanism. [3]

Solutions

2.1 Vibrating particles (ions/lattice) and free electrons.

2.2 Heated water expands – particles move apart – becoming less dense; the less dense warm water rises; cooler, denser water sinks to replace it, forming the circulating current.

2.3 Only the fastest molecules have enough energy to escape the surface; the molecules left behind have lower average kinetic energy, so the liquid's temperature falls.

2.4 Higher temperature, larger surface area, air movement (draught) over the surface; also lower humidity (any three).

2.5 Hazard – bridges/rocks cracking as they expand (gaps needed); use – the bending bimetallic strip in a thermostat.

3.1 The soup's fast-moving particles collide with the spoon's particles at the interface and transfer kinetic energy to them; the lattice vibrations and free electrons pass the energy along the spoon to the far end; this is conduction.

3.2 The land warms faster than the sea, heating the air above it; the warm air expands, becomes less dense and rises; cooler air from over the sea flows in to replace it – a convection current felt as the sea breeze.

3.3 The strip is two metals bonded together; on heating one expands more, bending the strip; the bend breaks (or makes) an electrical contact, switching the heater off – a thermostat.