

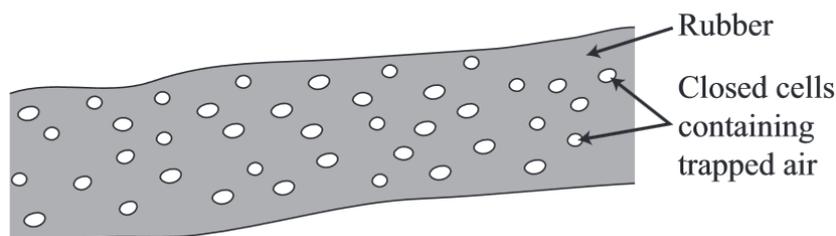
**ASPECTS OF HEAT QUESTIONS – AS 90939 (2011 – 2013)**

<http://www.nzqa.govt.nz/ncea/assessment/search.do?query=Physics&view=exams&level=01>

<http://www.nzqa.govt.nz/ncea/assessment/search.do?query=Physics&view=reports&level=01>

**HEAT TRANSFER QUESTIONS – FROM SCIENCE 90191 (EXPIRED)****WETSUITS (2010:1)**

Wetsuits are used by people to keep themselves warm in the water. A wetsuit is made from a type of rubber that contains small bubbles of trapped air, as shown in the diagram, to insulate the person from the cold water outside the suit.

**Cross-section of wetsuit material**

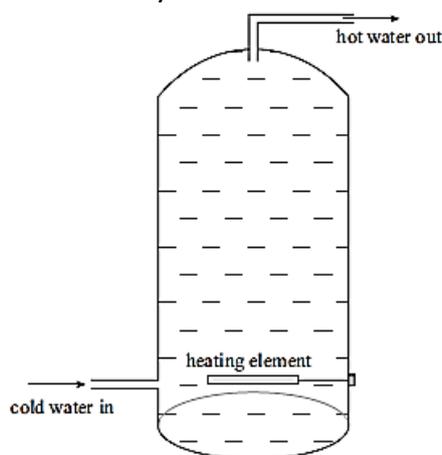
Discuss how the wetsuit reduces heat loss from the body in cold water

In your answer you should:

- Explain how heat is transferred by conduction
- Explain how the wetsuit material affects the heat transfer process of conduction.
- Explain why having trapped air in the rubber makes it a better insulator than just rubber.

**THE HOT-WATER CYLINDER (2009:4)**

Water can be heated by a hot-water cylinder. The water in the cylinder is heated by an electric element made from metal, placed near the base of the cylinder as shown in the diagram.



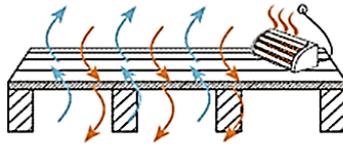
Discuss how the water heats in the water cylinder and why it is important to take the hot water out from the top of the cylinder rather than the bottom.

In your answer you should include:

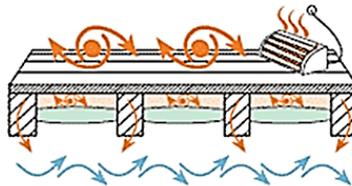
- A description of any heat transfer process(es) involved in terms of particles
- Named arrow(s) on the diagram above to show any heat transfer
- An explanation of why metal is used for the heating element
- An explanation of why the hot-water exit is placed at the top.

### WARMER, DRYER HOMES (2008:3)

Older homes with wooden floors can lose a large amount of heat through the floor.



Underfloor insulation helps to reduce heat loss by conduction. One way of achieving this is to put insulation across the bottom of the floor joists, or in between them, as shown in the diagrams below.



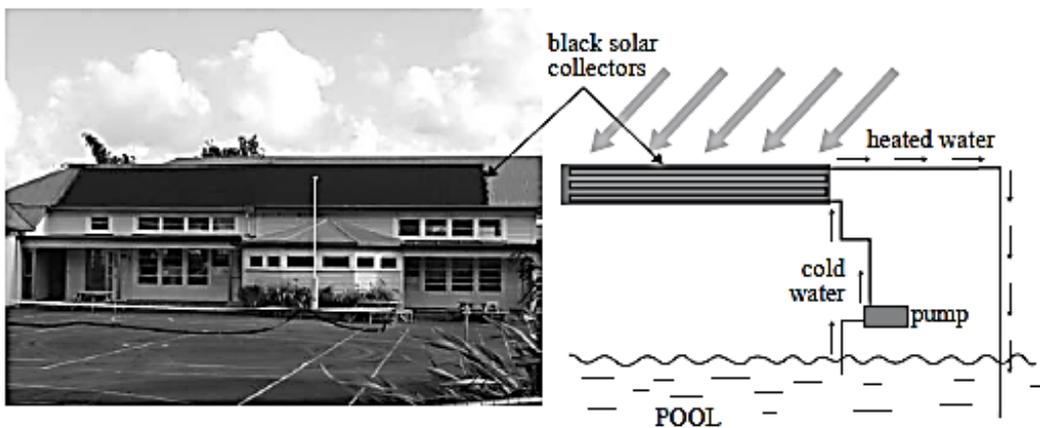
Discuss why placing insulation below the joists is more efficient at insulating the floor than placing it between the joists.

In your discussion you should:

- describe the process of conduction
- describe what insulation is
- explain why an air gap is needed.

### SOLAR POOL HEATING (2007:3)

The photo and diagram below show a Solar Pool Heating System



The solar collectors on the Solar Pool Heating System are made from black plastic (polypropylene).

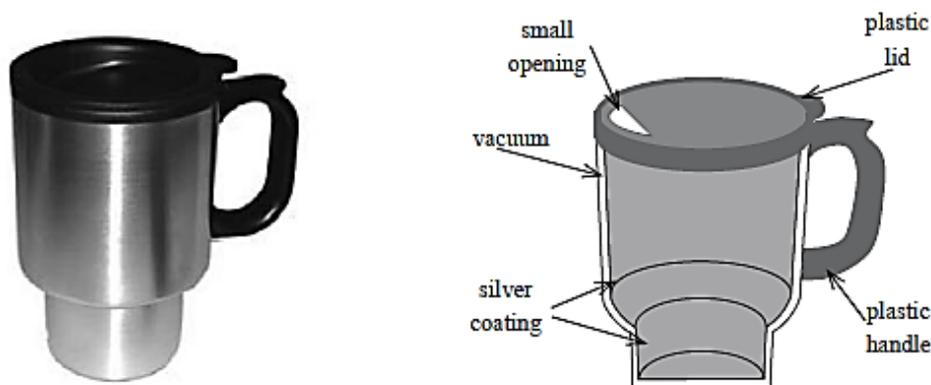
- (a) Name the heat transfer process that transfers the Sun's solar energy into the solar collectors.
- (b) Explain why the solar collectors are black.

The heated water is pumped back into the bottom of the pool. After 'some time' the heated water spreads through the whole pool.

- (c) Name the heat transfer process that causes the heated water to spread through the whole pool.
- (d) Discuss why it is important that the heated water enter at the bottom rather than the top of the pool.

**COFFEE TO GO! (2006:3)**

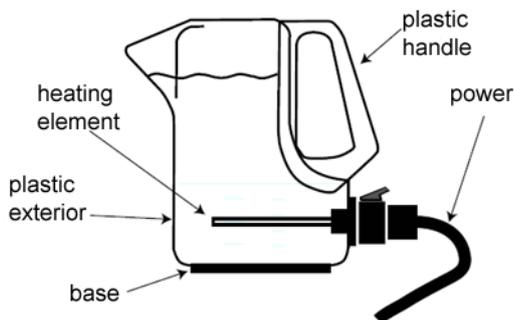
The photo and diagram below show a travel mug used to keep coffee warm for up to an hour.



- (a) A vacuum exists between the outer layers. Describe the term vacuum.
- (b) Discuss, in terms of heat transfer, TWO features of the travel mug that would help to keep the coffee warm.

**AN ELECTRIC JUG (2005:2)**

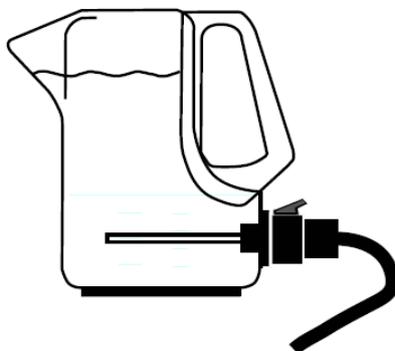
The diagram below shows the parts of an electric jug.



- (a) Name the process by which heat energy is transferred from the heating element to the water.

Heat energy is then spread through the rest of the water by the process of convection.

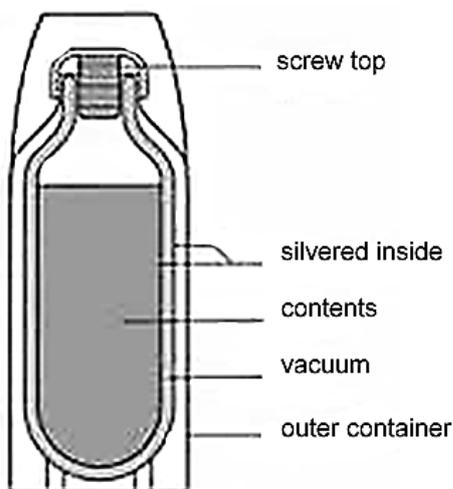
- (b) Draw in arrows on the diagram below to show the convection currents occurring.



- (c) Discuss, in terms of water particles, how the process of convection heats the water in the electric jug.
- (d) Explain, in terms of heat transfer, why the outside of the jug is made from plastic.

**REFRESHMENTS (2004:4)**

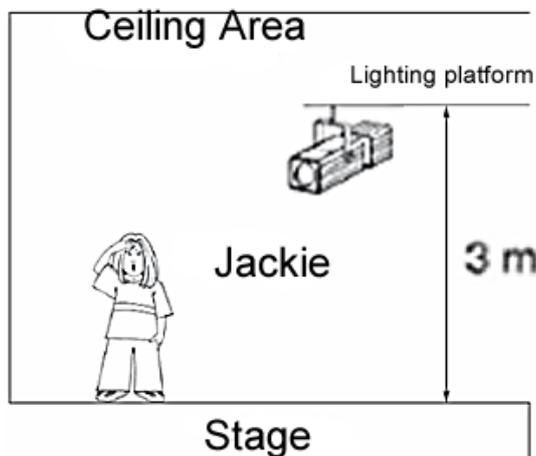
Marty brings a vacuum flask of hot coffee with him to the game. A simplified diagram of a vacuum (or thermos) flask is shown.



- (a) Name the process by which heat travels through a metal.
- (b) Name the process by which heat travels through a vacuum.
- (c) Explain how a plastic stopper in the top of the flask stops heat transfer better than a metal stopper.
- (d) A vacuum flask is made to keep drinks hot. Discuss how the flask shown above is able to keep the drink hot.

**QUESTION ONE (2003:1)**

A group of friends have decided to help in the school stage production.



Jackie notices that it gets very hot on the stage soon after the lights are switched on.

- (a) What type of heat transfer is heating the stage area?
- (b) Explain why the air is hotter in the ceiling area above the lights than on the stage.
- (c) Sometimes the lights need to be moved. Explain why the handles of the lights are made of plastic.
- (d) The director and an actor were standing on the stage under the lights. The actor was dressed in black and felt hot. The director was dressed in white and felt cool. Discuss how the colour of their clothing made the temperature appear different to each of them.

**ANSWERS (AS 90191)****WETSUITS (2010:1)**

Conduction is the process whereby heat is transferred by the vibration of particles.

Air is an insulator preventing the transfer of heat by conduction as it is a gas / particles are far apart.

Rubber is also a poor conductor / good insulator as its particles are further apart than metals, but closer together than air.

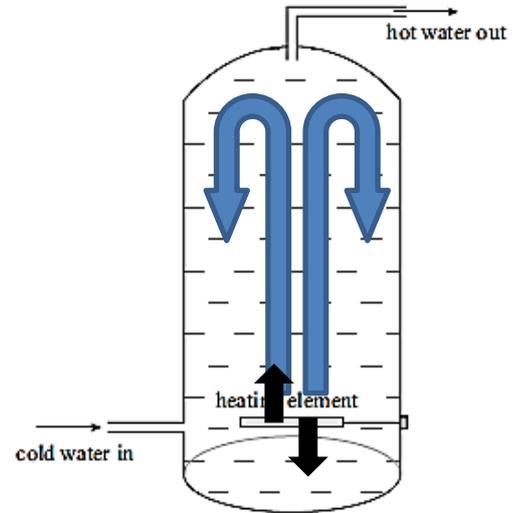
The cells of trapped air make the wetsuit material a better insulator than rubber alone because air particles are far apart.

**THE HOT-WATER CYLINDER (2009:4)**

The element is made of metal which is a good conductor of heat because its particles are closely packed it has a high electrical resistance. This allows heat to be transferred to the water in direct contact by vibration.

This heated water is less dense than the cold water as its particles are further apart, causing the hot water to rise and the cold water to sink and fill its place, creating convection currents. As the hot water has risen it is important to draw off the water from the top of the cylinder.

PLUS Fully labelled arrows on diagram for BOTH conduction AND convection.

**WARMER, DRYER HOMES (2008:3)**

Conduction is the process whereby heat is transferred by the vibration of particles. Air is an insulator as (the particles are far apart) therefore the air gap prevents conduction.

In the joists, heat can be conducted through (as they are made of a solid with particles close together). By placing the blanket at the base of the joists in diagram one, heat loss is reduced out of the end of the joists. However, in diagram two the ends are exposed allowing heat to be lost through them

**SOLAR POOL HEATING (2007:3)**

Hot water is less dense than cold water so it will rise causing the cold water to sink and fill its place, creating convection currents. If the hot water entered at the top it would stay there (and there would be no convection currents occurring) and therefore the water would not heat up.

**COFFEE TO GO! (2006:3)**

Conduction/convection will not occur as they need particles / medium to transfer heat.

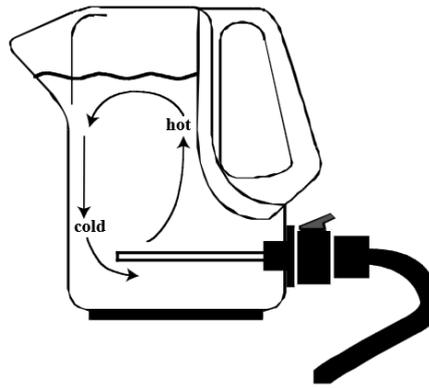
The silvered internal surface reflects radiated heat back into the mug, reducing heat loss by radiation.

The plastic top is a poor conductor / good insulator of heat, thereby reducing the loss of heat through the lid. The small opening / lid reduces the amount of heat lost through convection as less hot air particles can escape.

**AN ELECTRIC JUG (2005:2)**

(a) Conduction

(b) Correctly drawn convection currents



- (c) *Warm water particles (which have gained heat energy from the element) move apart and the water becomes less dense and rises. Cold water particles are more dense and therefore sink.*
- (d) *Plastic is a good insulator / bad conductor of heat. This means that the heat (energy) from the water inside the jug will not pass through (that is heat transfer to the outside is being prevented).*

**REFRESHMENTS (2004:4)**

- (a) *Conduction*
- (b) *Radiation*
- (c) *Plastic is a heat insulator and lessens / stops heat loss through the top. Metals are good conductors and would allow more heat loss through the top.*
- (d) *There are no particles (air) / medium in a vacuum so although radiation can travel through it conduction and/or convection will not occur. Shiny surfaces are better reflectors of radiated heat and so reflect the heat back into the liquid. The shiny surfaces are poor radiators of heat so heat is not lost to the surroundings. The plastic stopper prevents the loss of heated air through convection.*

**QUESTION ONE (2003:1)**

- (a) *Radiation*
- (b) *Heated/hot air rises / Convection / Heat source near the top. Heated air is less dense so it rises (above cooler air & collects in ceiling space). Cool air is more dense so it drops (below the warmer air & collects at the floor)*
- (c) *Plastic is a poor heat conductor/insulator. Heat from lamp is not conducted into the handle.*
- (d) *Black absorbs radiation(heat) better. Light colours reflect radiation (heat) better. So black clothes make the body hotter.*