GRAYS TUITION CENTRE – Online Tutoring

WEEK: 3

Week Beginning: (04/01/2021)

Subject: SCIENCE

Year: 9

Lesson Objective:

- Recap Specific Heat Capacity
- Questions on Energy stores and work done
- The measure of work done

Keywords/ Concepts

- Work, dissipate, energy
- Specific Heat Capacity

Class Worksheets

- Questions below

Homework

- Notes on Conduction and Convection

Additional Notes

- Attach all the classroom worksheets and homework worksheets to this lesson plan and email together.
- Assume the students don't have revision guides and workbooks. Attach all the pages you want them to have.

Classwork

1 A motor lifts a load of mass 20 kg.
The load gains 137.2 J of energy in its gravitational potential energy store.

1.1 State the equation that links gravitational potential energy, mass, gravitational field strength and height.
Use this equation to calculate the height through which the motor lifts the load.
Assume the gravitational field strength = 9.8 N/kg

[4 marks]

1.2 The motor releases the load and the load falls.
Ignoring air resistance, describe the changes in the way energy is stored that take place as the load falls.

[2 marks]

1.3 Describe how your answer to **1.2** would differ if air resistance was not ignored.

[1 mark]

2 36 000 J of energy is transferred to heat a 0.5 kg concrete block from 20 °C to 100 °C.

2.1 Calculate the specific heat capacity of the concrete block.
Use the correct equation from the Physics Equation Sheet on the inside back cover.

[4 marks]

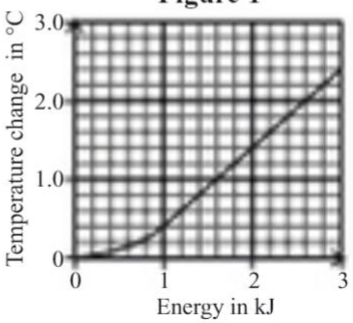
2.2 Energy is transferred to the thermal energy store of an electric storage heater at night, and then transferred away to the thermal energy stores of the surroundings during the day.
Lead has a specific heat capacity of 126 J/kg°C.
Using your answer to **2.1**, explain why concrete blocks are used in storage heaters rather than lead blocks.

[2 marks]

PRACTICAL

3 A student transfers energy steadily to a 1.0 kg aluminium block.
They produce a graph of the energy supplied against the increase in temperature of the block, shown in **Figure 1**.

Figure 1



3.1 Use **Figure 1** to find a value for the specific heat capacity of aluminium in J/kg°C. Use the correct equation from the Physics Equation Sheet on the inside back cover.

[4 marks]

3.2 Would you expect the true value for the specific heat capacity of aluminium to be higher or lower than the value found in this experiment? Explain your answer.

[3 marks]

Conduction

You're probably familiar with the idea that metals are good thermal conductors but wood isn't, and so on. This page is about how conduction actually happens and about the energy transfers that take place.

Conduction Occurs Mainly in Solids

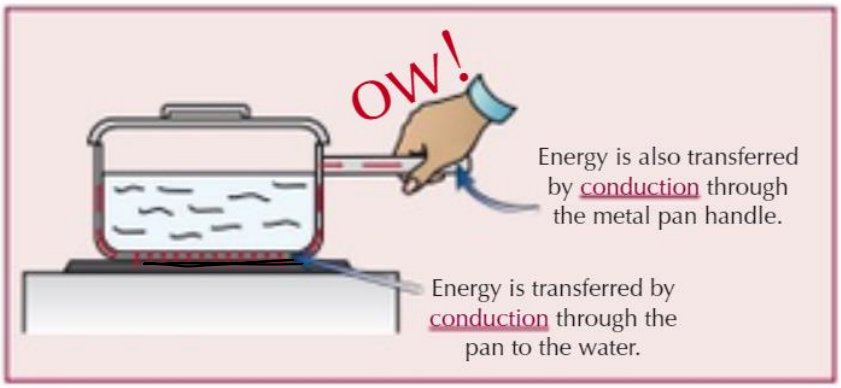
Conduction is the process where vibrating particles transfer energy to neighbouring particles.

1) Energy transferred to an object by heating is transferred to the thermal store of the object. This energy is shared across the kinetic energy stores of the particles in the object.

2) The particles in the part of the object being heated vibrate more and collide with each other. These collisions cause energy to be transferred between particles' kinetic energy stores. This is conduction.

3) This process continues throughout the object until the energy is transferred to the other side of the object. It's then usually transferred to the thermal energy store of the surroundings (or anything else touching the object).

Particles in liquids and gases are much more free to move around, which is why they usually transfer energy by convection (see the next page) instead of conduction.



4) Thermal conductivity is a measure of how quickly energy is transferred through a material in this way. Materials with a high thermal conductivity transfer energy between their particles quickly.

Some substances are better thermal conductors than others...

Denser materials (see page 64) are usually better conductors than less dense materials. It's easy to see why — particles that are right next to each other will pass energy between their kinetic energy stores far more effectively than particles that are far apart. For example, water is a much better thermal conductor than air.

Convection

You'll have heard it said that hot air rises. Well, it does (assuming the air above it is cooler).

Convection Occurs Only in Liquids and Gases

Convection is where energetic particles move away from hotter to cooler regions.

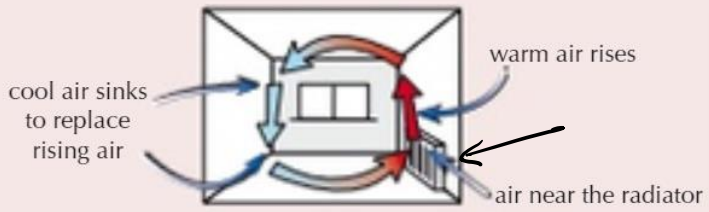
1) Convection can happen in gases and liquids. Energy is transferred by heating to the thermal store of the liquid or gas. As with conduction, this energy is shared across the kinetic energy stores of the gas or liquid's particles.

2) Unlike in solids, the particles in liquids and gases are able to move. When you heat a region of a gas or liquid, the particles move faster and the space between individual particles increases. This causes the density (p.64) of the region being heated to decrease.

3) Because liquids and gases can flow, the warmer and less dense region will rise above denser, cooler regions. If there is a constant heat source, a convection current can be created.

Radiators Create Convection Currents

1) Heating a room with a radiator relies on creating convection currents in the air of the room.
2) Energy is transferred from the radiator to the nearby air particles by conduction (the air particles collide with the radiator surface).
3) The air by the radiator becomes warmer and less dense (as the particles move quicker).
4) This warm air rises and is replaced by cooler air. The cooler air is then heated by the radiator.
5) At the same time, the previously heated air transfers energy to the surroundings (e.g. the walls and contents of the room). It cools, becomes denser and sinks.
6) This cycle repeats, causing a flow of air to circulate around the room — this is a convection current.



In convection, particles move from hotter regions to cooler regions...

So in convection, the particles move taking their energy with them. Don't get this confused with conduction though. Conduction is the process where vibrating particles transfer energy to neighbouring particles. Have a flick back to the last page if you need to remind yourself about this.