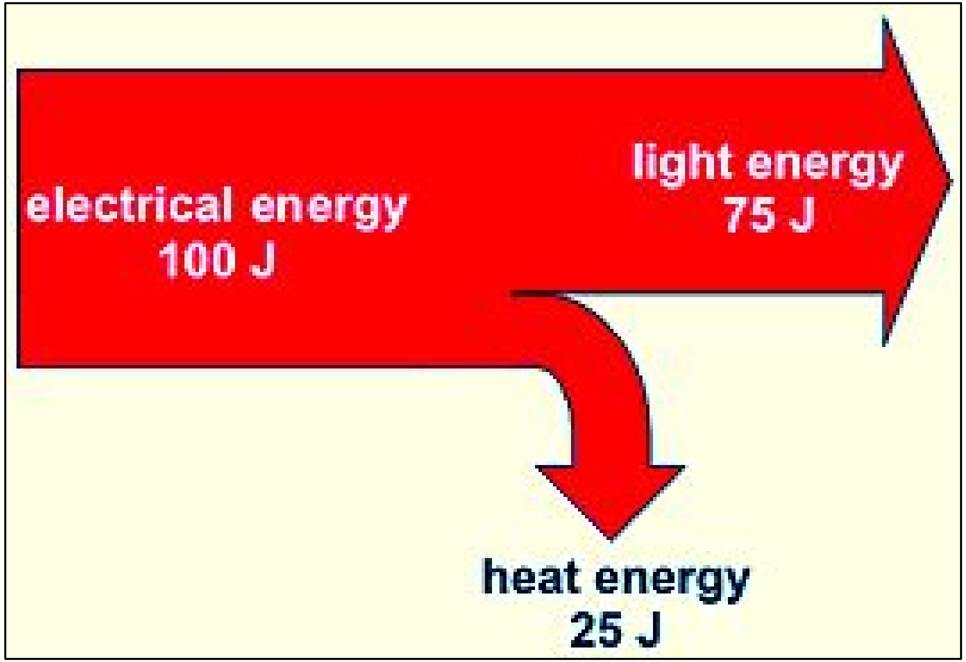
Energy Transfer Workshop

In this workshop we will be covering the following:

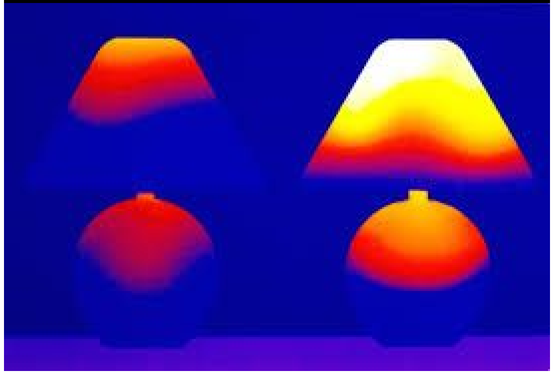
a. Energy Transfer Diagrams
b. Conduction, Convection and Radiation
c. Use of natural gas in the home
d. Use of electricity in the home
e. Energy in food (kJ)
f. Power and its Units



Energy Transfer Diagrams

When drawing an energy transfer diagram you must do the following:

1. Work out what the input energy comes from. Where does the energy come from? ***E.g a light bulb starts with Electrical energy!***
2. Work out what the (useful) output energy is. What is the device/machine/object for? ***E.g a light bulbs useful output is Light energy!***
3. What is wasted? A perfect energy transfer is impossible! Some energy must be wasted. What happens to it?
   Eg. A light bulb wastes a lot of energy as heat and a little as sound!!



Energy Transfer Diagrams

Next we need to start layout out our diagram...

Input Energy:

Electrical Energy

(Useful) Output Energy:

Light Energy

Waste Energy:

Heat Energy

Waste Energy:

Sound Energy

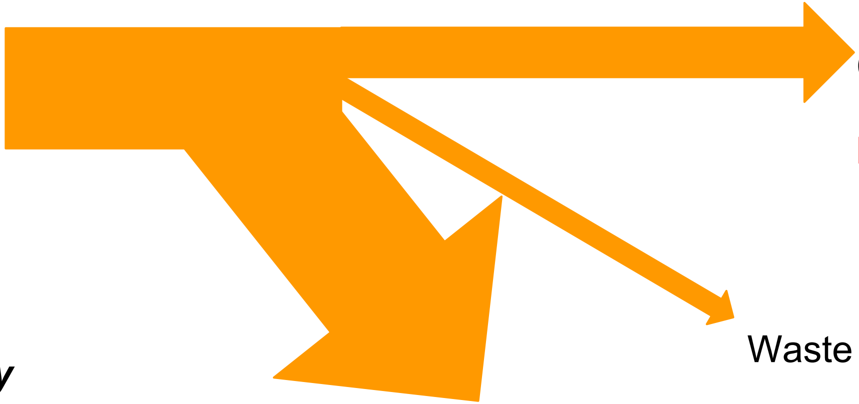
Although this is sufficient for your assessment questions you should know that energy transfer diagrams can be way more powerful……

Advanced Energy Transfer Diagrams

For more advanced Energy Transfer Diagrams we need to show the amount of energy that is transferred into each type. This is done using the size of the arrows.The example for the light bulb should really look like this!

Input Energy:

Electrical Energy



(Useful) Output Energy:

Light Energy

Waste Energy:

Sound Energy

Waste Energy:

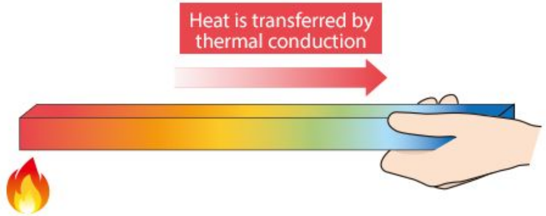
Heat Energy

Notice that we can see that most energy in a light bulb is in fact wasted as heat!!

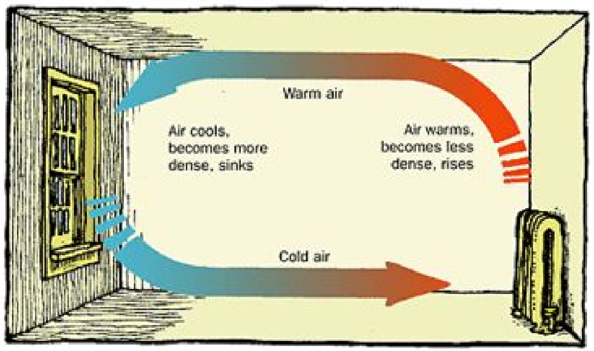
Heat Transfer - Methods

Heat can be transferred in the following ways:

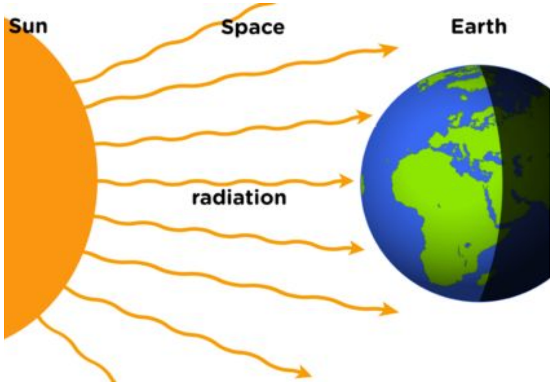
Conduction



Convection



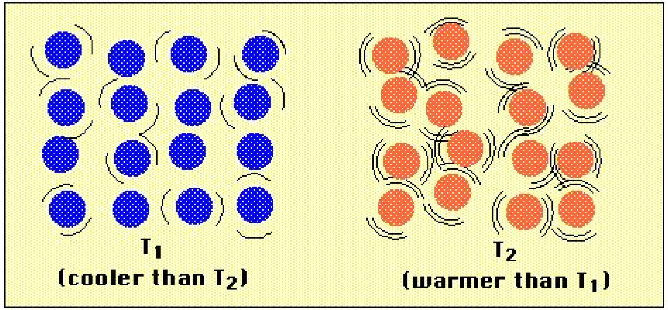
Radiation

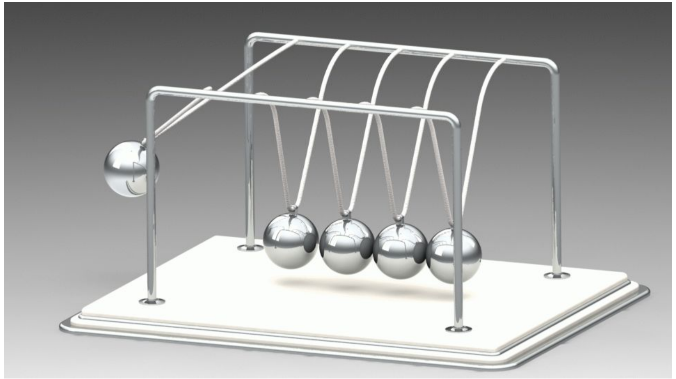


Conduction

Ever burned your mouth eating a hot chip?!? This is due to conduction. Heat is basically the movement of atoms. The hotter an object is the more the atoms in it are vibrating (moving). When two objects touch the atoms from one bang into the atoms in the other object. This in turn makes these atoms vibrate - the heat has been "conducted"!!

Remember Conduction requires objects to touch each other!!!



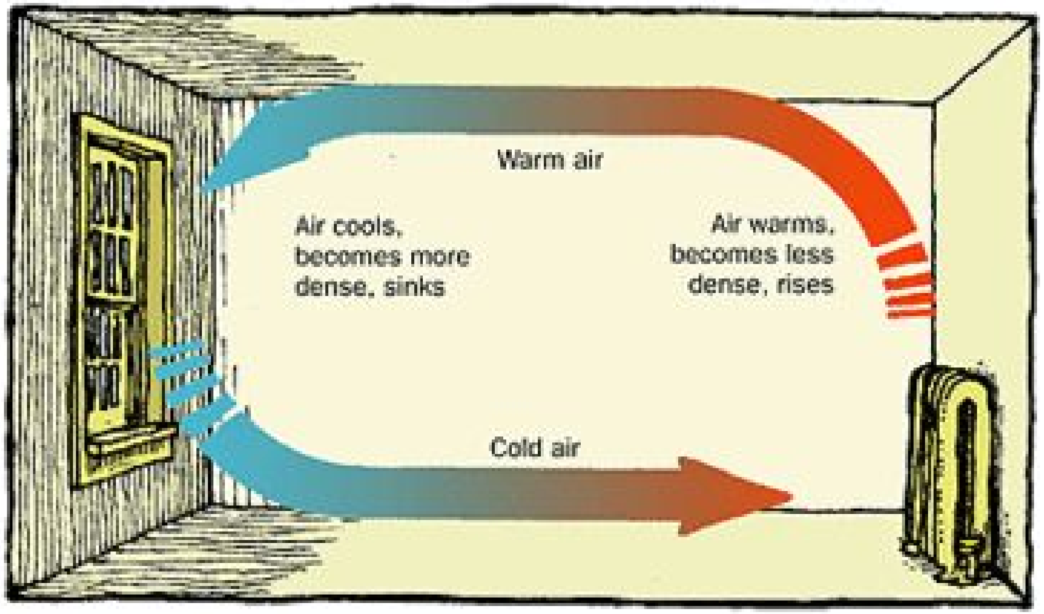


Convection

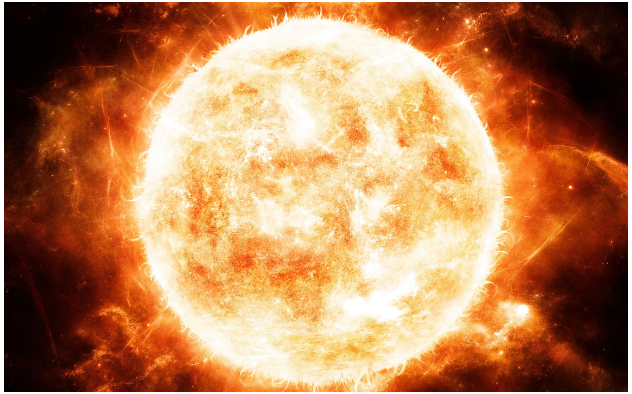
Ever felt a cold draft from a window or door? You are not touching the window or door so we know conduction is not responsible!

We have Convection to blame!

Convection relies on the principle that heat rises. It only occurs in liquids and gases in which the particles can flow.



Radiation



Ever enjoyed the feel of the sun on your back? That heat comes from the sun 150 million kilometers away!

How does the heat get here from the sun?

We are not touching the sun (thankfully!) so it cannot be conduction!

Space is a vacuum (there are no particles in space, no liquids or gases to convect the heat via convection) so we know it isn't convection.

Instead the heat gets here via **radiation** in the form of Infrared light.

All hot things radiate infrared (thermal) energy in the form of infrared light. All types of light can travel through a vacuum!

Energy in the home!

How do we heat and light our homes? How to we provide the huge number of devices we now have in houses with energy?

The answer is natural gas and electricity!

You need to be able to give examples of how these energy forms are used in the home.

Energy in the home!

How is Gas used in our homes?

Gas is used to do the following:

- Heating - most central heating boilers burn gas to heat water which is then pumped to taps and radiators to provide hot water and heating.
- Cooking - Some kitchens have gas ovens and hobs. These devices burn gas either to heat the oven or to heat the saucepans and frying pans to cook our food!
- In very old houses they used to use gas for lighting - literally burning gas to produce a flame that lights the room. There are of course many health and safety issues with this so it is not done anymore!

How is Electricity used in our homes?

Electricity is used to do the following:

- Heating - some people use electric radiators, these are effectively large toasters and use electricity to heat “elements”
- Lighting - Light bulbs convert electrical energy to light (and heat!)
- Electrical device (TVs, Computers, Laptops and Mobile phones all require electricity to work!
- Cooking - Toasters, Microwaves and Kettles all use electricity to heat food and drinks!

Energy in food

We eat food to extract the energy in it which we use to power our body and its daily activities.

On average a human body uses a respectable 12000 kJ (approx 2500 kCal) of energy in a day. Most of this energy is used to keep our poorly insulated bodies warm!!

Energy in food has two units that are often used kiloJoules (kJ) and kiloCalories (kCal) - remember that kilo means 1000!

1 kCal = 4.184 kJ

As anyone who has done a diet will know some foods contain more energy than others!

Energy in food

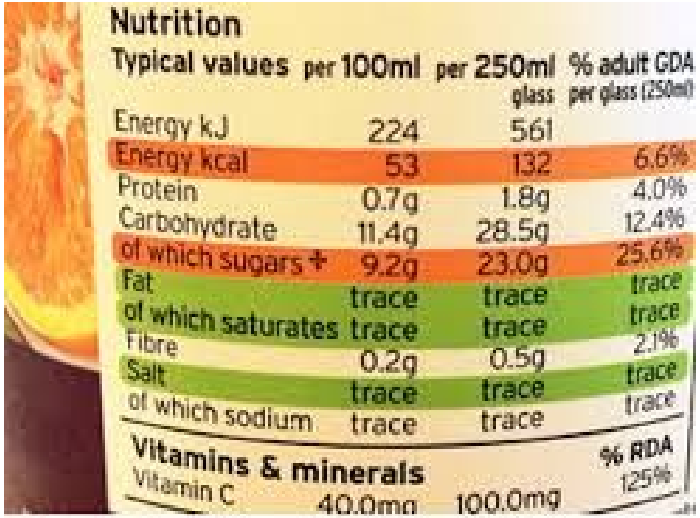
How do we know how much energy is in foods?

The answer is FOOD LABELS!

Food labels give a lot of information on what is in the food.

They key information in regards to Energy is the top two lines. These tell you in both kCals and kJs how much energy is in the food.

To compare foods we usually use the first column (per 100ml or per 100 g) to compare the amount of energy in them.



Example of Nutritional Information on a bottle of fruit juice.
See the energy values listed in both kJ and kcal.

Power!

In everyday life “Power” has a wide range of meanings. In physics however, it has a very specific meaning. It is a measure of the rate at which energy is transferred.

Power is measured in Watts (W), **one Watt is equal to 1 joule of energy transferred per second.**

1 W = 1 Joule per second **Therefore 250W = 250 Joules per second!**

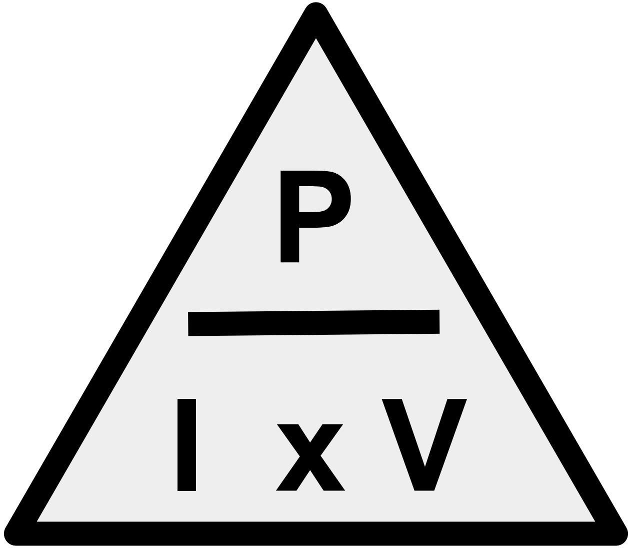
You will often be asked to calculate the power of an electrical device such as a TV or Lightbulb. For this you will need the to know the following:

- The voltage of the appliance
- The current of the the appliance

Electrical Power!

Once you know your voltage and current values you need to plug them into the following equation

$$P = I \times V$$



P is Power measured in Watts,

I is Current measured in Amps

V is Voltage measured in Volts!

Eg. A heater that uses 240v and draws 10 amps would have a power rating of 240v x 10 amps = 2400W