AQA Physics 1a - Energy and Electricity

13.1 How is heat (thermal energy) transferred and what factors affect the rate at which heat is transferred?

Sometimes we want to transfer heat effectively from one place to another. At other times we want to reduce the rate of heat loss as much as we can. To be able to do either of these things we need to know how heat is transferred and which methods of heat transfer are most important in particular cases.

You should be able to:
evaluate ways in which heat is transferred in and out of bodies and ways in which the rates of these transfers can be reduced.

Know that:

- Thermal (infra red) radiation is the transfer of energy by electromagnetic waves.
- All bodies emit and absorb thermal radiation.
- The hotter a body is the more energy it radiates.
- Dark, matt surfaces are good absorbers and good emitters of radiation.
- Light, shiny surfaces are poor absorbers and poor emitters of radiation.
- The transfer of energy by conduction and convection involves particles and how this ransfer takes place.
- Under similar conditions different materials transfer heat at different rates.
- The shape and dimensions of a body affect the rate at which it transfers heat.
- The bigger the temperature difference between a body and its surroundings, the faster the rate at which heat is transferred.

13.2 What is meant by the efficient use of energy?

Many devices take in input energy in one form and transform (change) it to output energy in another form. They never transform all of the input energy to the output form we want or transfer (move) it all to the place we want. We need to know how efficient devices are so that we can choose between them and try to improve them.

You should be able to:

- describe the intended energy transfers/transformations and the main energy wastages that occur with a range of devices
- calculate the efficiency of a device
- devaluate the effectiveness and cost effectiveness of methods used to reduce energy consumption.

Know that:

- Energy cannot be created or destroyed. It can only be transformed from one form to another form.
- When energy is transferred and/or transformed only part of it may be usefully transferred/transformed.
- Energy which is not transferred/transformed in a useful way is ‘wasted.’
- Both wasted energy and the energy which is usefully transferred/transformed are eventually transferred to their surroundings which become warmer.

- Energy becomes increasingly spread out and becomes increasingly more difficult to use for further energy transformations.
- The greater the percentage of the energy that is usefully transformed in a device, the more efficient the device is.

13.3 Why are electrical devices so useful?

- We often use electrical devices because they transform electrical energy to whatever form of energy we need at the flick of a switch.

You should be able to:

- compare and contrast the particular advantages and disadvantages of using different electrical devices for a particular application
- calculate the amount of energy transferred from the mains using: energy transferred = power = time
- (kilowatt-hour, kWh) (kilowatt, kW) (hour, h)
- calculate the cost of energy transferred from the mains using: total cost = number of kilowatt-hours k cost per kilowatt-hour

Know that:

- Examples of energy transformations that everyday electrical devices are designed to bring about.
- Examples of everyday electrical devices designed to bring about particular energy transformations.
- The amount of electrical energy a device transforms depends on how long the appliance is switched on and the rate at which the device transforms energy.
- The power of an appliance is measured in watts (W) or kilowatts (kW).
- Energy is normally measured in joules (J).
- Electricity is transferred from power station to consumers along the National Grid.
- The uses of step-up and step-down transformers in the National Grid.
- Increasing voltage (potential difference) reduces current, and hence reduces energy losses in the cables.

13.4 How should we generate the electricity we need?

Various energy sources can be used to generate the electricity we need. We must carefully consider the advantages and disadvantages of using each energy source before deciding which energy source(s) it would be best to use in any particular situation.

You should be able to:
compare and contrast the particular advantages and disadvantages of using different energy sources to generate electricity.

Know that:

- In most power stations an energy source is used to heat water. The steam produced drives a turbine which is coupled to an electrical generator.
- Common energy sources include coal, oil and gas, which are burned to produce heat and Uranium/plutonium, in which nuclear fission produces heat.
- Energy from renewable energy sources can be used to drive turbines directly.

- Renewable energy sources used in this way include wind, the rise and fall of water due to waves and tides, and the falling of water in hydroelectric schemes.
- Electricity can be produced directly from the Sun's radiation using solar cells.
- In some volcanic areas hot water and steam rise to the surface. The steam can be tapped and used to drive turbines. This is known as geothermal energy.
- Using different energy resources has different effects on the environment. These effects include the release of substances into the atmosphere, noise and visual pollution, and the destruction of wildlife habitats.
- The advantages and disadvantages of using fossil fuels, nuclear fuels and renewable energy sources to generate electricity. These include the cost of building power stations, the start-up time of power stations, the reliability of the energy source, the relative cost of energy generated and the location in which the energy is needed.