ENERGY MATTERS
Learning Outcomes

Section 1 - Supply and Demand

Energy is vitally important to our survival. In the world today, we consume huge quantities of energy in heating, manufacturing and transport. All of this energy must come from somewhere. At the moment, most of our energy still comes from fossil fuels.

Fossil fuels are running out, though, and alternative supplies of energy must be found. These should be safe, plentiful, and environmentally friendly. At the same time, we have to look at ways of conserving our supplies of fossil fuels.

At General level you should be able to:

- ❑ 1. State that fossil fuels are our main source of energy at the moment.
- ❑ 2. State that reserves of fossil fuels are *finite* - *i.e.* they will run out one day.
- ❑ 3. State and explain one method of conserving energy in:
  a) *Industry*;
  b) *The home*;
  c) *In transport*.
- ❑ 4. Carry out calculations relating to energy supply and demand involving the units *gigawatts* and *gigajoules*.
- ❑ 5. Classify sources of energy as renewable or non-renewable.

At Credit level you should also be able to:

- ❍ 6. Explain the advantages and disadvantages of at least *three* renewable energy sources.

Section 2 - Generation of Electricity

The main type of energy used in our homes and industry is electricity. It is chosen because of its convenience and cleanliness. It is produced in a variety of power stations: coal, oil or gas burning; nuclear, and hydro, for example. Each of these has its particular advantages and disadvantages, but the disadvantages of nuclear power stations, whilst major, are probably the most publicised yet least understood.

In each energy conversion, some energy is "lost". Energy cannot be destroyed, however, and this energy is really wasted as low temperature heat energy. This cannot be used, and is scattered into the atmosphere. Because of this, the efficiency of any power station is much less than 100%.

At General level you should be able to:

- ❑ 1. Identify, **from a diagram**, the energy transformation at each stage of:
  a) a thermal power station (coal, oil or gas fired);
  b) a hydroelectric power station;
  c) a nuclear power station.
- ❑ 2. State that nuclear reactors produce radioactive waste.
- ❑ 3. Carry out calculations on energy transformations using the principle of *conservation of energy*.
- ❑ 4. Describe the principle of a pumped hydroelectric scheme.
- ❑ 5. Give the advantages of a pumped hydroelectric scheme.

At Credit level you should also be able to:

- ❍ 6. Compare energy output from equal masses of coal and nuclear fuel.
- ❍ 7. Carry out calculations involving efficiency of energy transformations.
- ❍ 8. State that in every energy transformation, some energy is wasted as heat and/or sound.
- ❍ 9. Explain in simple terms a nuclear chain reaction.

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Section 3 - Source to Consumer

Reliable and efficient electric generators are the basis of the electricity production industry. The alternating voltage they produce can be stepped up or down to different values as required by transformers. This allows very high voltages to be used for energy transmission over long distances in the National Grid and Super Grid systems, so reducing the power loss in cables. At the place of use, the voltage is transformed down to a safer and usable value.

At General level you should be able to:

- ❑ 1. Identify the circumstances in which a voltage will be induced in a conductor.
- ❑ 2. Identify, **on a diagram**, the main parts of an *a.c.* generator.
- ❑ 3. State that transformers are used to change the size of an *a.c*. voltage.
- ❑ 4. Describe the physical structure of a transformer.
- ❑ 5. Carry out calculations involving primary voltage (V_p), secondary voltage (V_s), number of turns in the primary coil (N_p), and in the secondary coil (N_s).
- ❑ 6. State why high voltages are used in electricity transmission.
- ❑ 7. Describe the stages in the transmission of electrical energy by the National Grid system.

At Credit level you should also be able to:

- ❍ 8. In addition to ***2*** above, explain how an *a.c*. generator works.
- ❍ 9. State the main differences between an *a.c*. generator, a car's alternator and a simple dynamo.
- ❍ 10. State the three factors that affect the size of the induced voltage and explain the effect of each.
- ❍ 11. Explain why a transformer is not 100% efficient.
- ❍ 12. In addition to ***5*** above, carry out calculations involving primary and secondary voltages (V_p & V_s), turns ratio (N_p & N_s), primary and secondary currents (I_p & I_s), power (P) and efficiency.
- ❍ 13. Carry out calculations involving power loss in transmission lines.

Section 4 - Heat in the Home

A large proportion of the electricity used in our homes is used to produce heat: for space heating; for cooking; etc. Because of the high cost of electricity, it is important to keep the loss of this heat to a minimum. This can be done by various methods of insulation - plastic foam in cavity walls, double glazing, draught proofing, etc.

It is common knowledge that the water in a kettle, once boiling, does not get any hotter. The heat energy coming from the element is used to change the water from its liquid state to its gaseous state and is called latent heat. Latent heat is useful in some applications such as cooling ice cream by solid carbon dioxide, refrigeration and picnic box coolant keeping the food cold.

At General level you should be able to:

- ❑ 1. Use the following terms correctly: *temperature*, *heat* and *Celsius*.
- ❑ 2. Describe methods for reducing heat loss due to conduction, convection and radiation.
- ❑ 3. State that heat loss depends on temperature *difference* between the inside and the outside of a house.
- ❑ 4. Carry out calculations involving heat energy (E_h), mass (m), specific heat capacity (c) and temperature change (ΔT).
- ❑ 5. Give examples of applications which involve a change of state (*e.g.* a refrigerator or picnic box).
- ❑ 6. Use these terms correctly: *specific heat capacity*, *change of state*, *latent heat of fusion*, *latent heat of vaporisation*.
- ❑ 7. State that a change of state does not involve a change in temperature.
- ❑ 8. State that energy is absorbed or given out by a substance as it changes state.

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At Credit level you should also be able to:

- ❍ 9. Use the principle of *conservation of energy* to carry out calculations on energy transformations which also involve temperature changes; *i.e.* $E_e = ItV = E_h = cm\Delta T$.
- ❍ 10. Carry out calculations involving specific latent heat (L), heat energy (E_h) and mass (m).