USING ELECTRICITY
Learning Outcomes

Section 1 - From the Wall Socket

Electricity is very important in the modern world. It is used in offices, factories, hospitals and for transport. In this section, you will be thinking about the safe use of electricity in the home.

At General level you should be able to:

- ❑ 1. Describe the mains supply or a battery as a supply of electrical energy.
- ❑ 2. Describe the main energy changes in some household appliances.
- ❑ 3. State approximate power ratings of different household appliances.
- ❑ 4. Choose the correct flex for an appliance if you are given its power rating.
- ❑ 5. State that the fuse in a plug is intended to protect the flex.
- ❑ 6. Choose the correct fuse for an appliance if you are given its power rating.
- ❑ 7. Give the correct colour of insulation for the *live*, *neutral* and *earth* wires.
- ❑ 8. State to which pin each wire must be connected in a plug, extension socket or lamp holder.
- ❑ 9. State that the human body is a conductor of electricity.
- ❑ 10. State what water does to this ability to conduct.
- ❑ 11. State that the earth wire is a safety device.
- ❑ 12. State that appliances do not require an earth wire if they have the double insulation symbol.
- ❑ 13. Draw the double insulation symbol.
- ❑ 14. Explain why situations involving electricity could result in accidents.

A*t Credit level you should also be able to:*

- ❍ 15. In addition to ***11*** above, explain how the earth wire acts as a safety device.
- ❍ 16. Explain why fuses and switches must be in the live lead.

Section 2 - Alternating and Direct Current

In this section you will find out about the differences between electricity from the mains and electricity from a battery.

At General level you should be able to:

- ❑ 1. State that the mains supply is *a.c.*
- ❑ 2. State that a battery supply is *d.c.*
- ❑ 3. Explain what *a.c.* and *d.c.* mean in terms of current.
- ❑ 4. State that the frequency of the mains supply is 50 Hz.
- ❑ 5. State that the mains voltage is 230 V.
- ❑ 6. Draw and identify the circuit symbol for the following components:
  cell; battery; fuse; lamp; switch; resistor; variable resistor; capacitor; diode.
- ❑ 7. State that electrons are free to move in a conductor.
- ❑ 8. Describe electric current in terms of moving charges.
- ❑ 9. State that the unit of current is the ampere (*A*) and that the unit of voltage is the Volt (*V*).

At Credit level you should also be able to:

- ❍ 10. State that the quoted value of an alternating voltage is less than its peak value.
- ❍ 11. Carry out calculations involving the relationship between charge (*Q*), current (*I*) and time (*t*).
- ❍ 12. State that the unit of charge is the Coulomb (*C*).
- ❍ 13. State that the voltage of a supply is a measure of the energy given to the charges in a circuit.

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Section 3 - Resistance

All electrical conductors have some 'resistance'. This means that some electrical energy is changed to heat as the current flows around the circuit. In this section you will use electrical meters to investigate how the resistance of a circuit affects the size of the current and the amount of energy used.

At General level you should be able to:

- ❑ 1. Draw and identify the circuit symbols for an ammeter and a voltmeter.
- ❑ 2. Draw circuit diagrams to show the correct positions of an ammeter and a voltmeter in a circuit.
- ❑ 3. State that in a circuit, an increase in resistance leads to a decrease in current.
- ❑ 4. Carry out calculations involving the relationship between resistance (R), current (I) and voltage (V).
- ❑ 5. State that the unit of resistance is the ohm (Ω).
- ❑ 6. Give two practical uses of variable resistors.
- ❑ 7. State that when there is an electric current in a wire, there is an energy transformation.
- ❑ 8. Give three examples of household circuits that use resistors to transform electrical energy to heat energy.
- ❑ 9. State that the electrical energy transformed each second = VI.
- ❑ 10. Carry out calculations involving the relationship between power (P), current (I) and voltage (V).
- ❑ 11. State the relationship between energy and power.
- ❑ 12. Use the terms *energy*, *power*, *joule* and *watt* correctly and in context.
- ❑ 13. State that electrical energy is transformed to heat and light in a lamp.
- ❑ 14. State that the energy transformation in an electric lamp takes place in:
  the *wire* for a filament lamp;
  the *gas* for a discharge tube.
- ❑ 15. State that a discharge tube is more efficient than a filament lamp.
- ❑ 16. State that the energy transformation in an electric heater takes place in the element.

At Credit level you should also be able to:

- ❍ 17. State that for a resistor, the ratio $^{V}/_{I}$ remains approximately constant for different currents.
- ❍ 18. Explain why power can be calculated using $P = I^2R$
- ❍ 19. Carry out calculations using this relationship between power (P), current (I) and resistance (R).

Section 4 - Useful Circuits

In this section you will find out about some rules which control the design of electric circuits and investigate some circuits used in cars and at home. You will also learn how to test for electrical faults.

At General level you should be able to:

- ❑ 1. State a practical example in the home that needs two (or more) switches used in series.
- ❑ 2. State that in a series circuit, the current is the same at all points.
- ❑ 3. State that in a parallel circuit, the sum of the currents in the parallel branches is equal to the current drawn from the supply.
- ❑ 4. State that in a series circuit, the sum of the voltages across the components is equal to the voltage of the supply.
- ❑ 5. State that in a parallel circuit, the voltage across each branch is the same.
- ❑ 6. Explain that connecting too many appliances to one socket can be dangerous because a large current may be drawn.
- ❑ 7. Describe how to make a simple continuity tester.
- ❑ 8. Describe how this continuity tester may be used for fault finding.

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At Credit level you should also be able to:

❍ 9. Draw circuit diagrams to show how various car lighting circuits work.

❍ 10. Carry out calculations involving resistances in series:

$$R_t = R_1 + R_2 + \ldots$$

❍ 11. Carry out calculations involving resistances in parallel:

$$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$$

Section 5 - Behind the Wall

In this section you will find out about the wiring in houses (but not enough for you to try anything dangerous at home!)

At General level you should be able to:

❑ 1. State that household wiring connects appliances in parallel.

❑ 2. State that the mains fuse protects the mains wiring.

❑ 3. State that a circuit breaker is an automatic switch that can be used in place of a fuse.

❑ 4. State that a kilowatt-hour (*kWh*) is a unit of energy.

At Credit level you should also be able to:

❍ 5. Describe a ring main circuit using a diagram.

❍ 6. State the advantages of the ring main over a simple parallel circuit.

❍ 7. Give two differences between the lighting circuit and the ring main circuit.

❍ 8. State a reason why a circuit breaker may be used instead of a fuse.

❍ 9. Explain the relationship between kilowatt-hours (*kWh*) and joules (*J*).

Section 6 - Movement from Electricity

Electric motors are used in the home in washing machines, tape recorders, toys, central heating pumps and many other devices. They are also used in industry and transport. In this section, you will find out about electric motors and other devices that use electricity to make movement.

At General level you should be able to:

❑ 1. On a diagram of a simple electric motor, identify the following parts:
rotating coil;
field coil;
brushes;
commutator.

❑ 2. State that a magnetic field exists around a current carrying wire.

❑ 3. Give two examples of applications that make use of this fact.

❑ 4. State that a current carrying wire experiences a force when it is in a magnetic field.

At Credit level you should also be able to:

❍ 5. In addition to ***4*** above, state that the direction of the force on a current carrying wire depends on two things:
the direction of the magnetic field;
the direction of the current.

❍ 6. Explain the operation of a simple *d.c.* electric motor in terms of forces acting on the coil.

❍ 7. Explain the purpose of the brushes and the commutator in a motor.

❍ 8. In commercial motors, explain why the following are used:
carbon brushes;
multi-section commutators;
field coils.