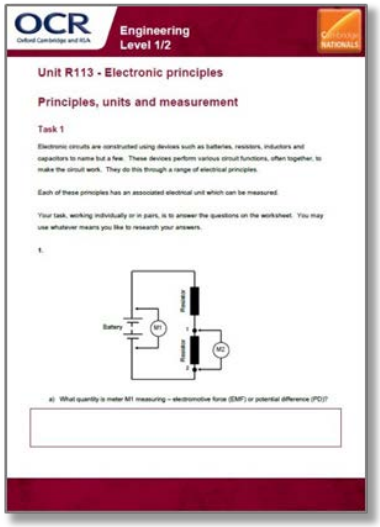
Unit R113 – Engineering principles

Principles, units and measurement

Instructions and answers for teachers

*These instructions should accompany the OCR resource **'Principles, units and measurements'** activity which supports OCR Cambridge Nationals in Engineering.*



The Activity:

This resource comprises of 1 task.

This activity offers an opportunity for maths skills development.

Associated materials:

'Principles, units and measurement' activity sheet

Suggested timings:

Task 1: 2 hours

Task 1

Learners will probably need an introduction to, and some background information on electrical principles before they can attempt the activity.

Internet resources might be used to explain some or all of the following electrical principles. The teacher might only cover some of these, leaving learners to explore the others as part of the activity. Some possible internet sources include www.schoolscience.co.uk and some useful demonstration and tutorial videos are also available through YouTube.

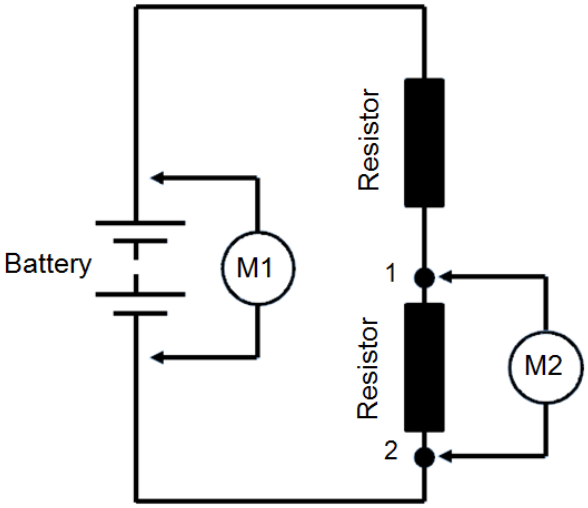
Principle	Possible reference source
Electromotive Force (EMF)	http://www.youtube.com/watch?v=tC6E9J925pY http://www.youtube.com/watch?v=J4Vq-xHqUo8
Potential Difference (PD)	http://www.youtube.com/watch?v=-2epDX0mF4I
Resistance	http://www.youtube.com/watch?v=J4Vq-xHqUo8
Capacitance	http://www.youtube.com/watch?v=_S-kbHdduB4
Current	http://www.youtube.com/watch?v=J4Vq-xHqUo8
Induction (including back-EMF)	http://resources.schoolscience.co.uk/CDA/16plus/copelech4pg2.html http://www.youtube.com/watch?v=tC6E9J925pY
Frequency	http://www.youtube.com/watch?v=vGFgDSkdZjM
Power and Energy	http://www.youtube.com/watch?v=Y8CevHPpCg4

The teacher should ensure, through questioning during the activity, that learners can relate the electrical principle to unit of measurement. Getting learners to understand the connection between principles, physical components that exhibit these and units might also be useful to secure understanding (ie resistance > ohms > resistor; capacitance > farad > capacitor, EMF > volts > battery or generator).

Alternative or complementary approach:

An alternative or complementary approach for teaching electrical principles, units and measurement might be to develop practical activities and experiments using simple components. In this way, learners can discover these in a practical setting using real devices before relating back to theory. For example, EMF and PD might be demonstrated with measuring voltages; current, resistance and power with a simple circuit etc.

1.



a) What quantity is meter M1 measuring – electromotive force (EMF) or potential difference (PD)?

Meter M1 – EMF of battery

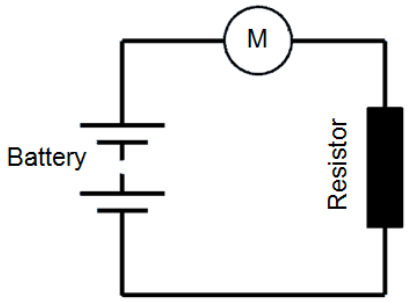
b) What quantity is meter M2 measuring - electromotive force (EMF) or potential difference (PD)?

Meter M2 – PD between points 1 and 2

c) What is the unit of measurement for both meter M1 and M2?

Volts

2.



a) What is meter M measuring in the circuit?

Current

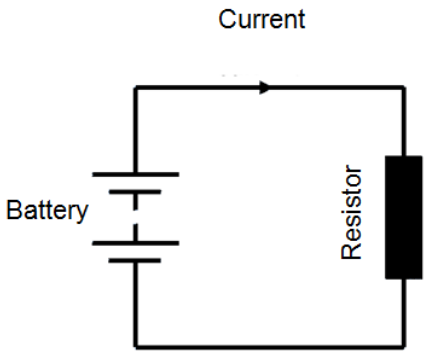
b) What are the units of measurement?

amps (ampere)

3. Match (by drawing a line as shown) the principle/quantity to their unit of measurement:

Principle/Quantity	**Units of Measurement**
EMF	volts
current	amps
resistance	ohms
power	watts
inductance	henry
capacitance	farads
frequency	hertz

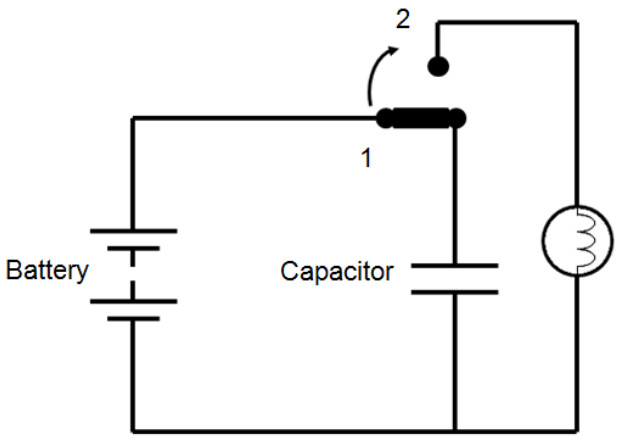
4. Will the current flowing in the circuit **increase** or **decrease** if the value of the resistance (resistor) is increased?



If resistance increases then current flow will **decrease** (more resistance to current flowing).

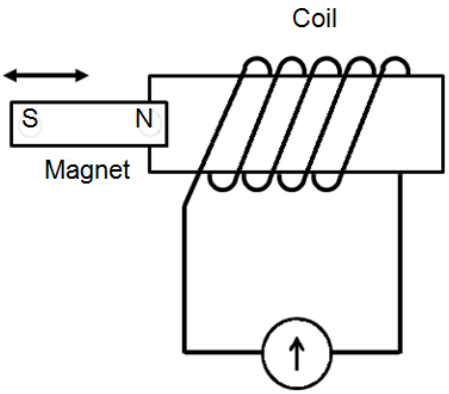
5. The capacitor in the circuit is connected to the battery with the switch at position 1.

What will be shown by the lamp when the switch is moved from position 1 to position 2?



The lamp will glow for a time, and then dim till it goes out due to voltage (charge) in capacitor discharging.

6.



a) What will happen to the pointer on the meter when the magnet is moved in and out of the coil of wire?

Meter will deflect one way as magnet enters coil, and opposite way as magnet is taken out.

b) What principle is being shown?

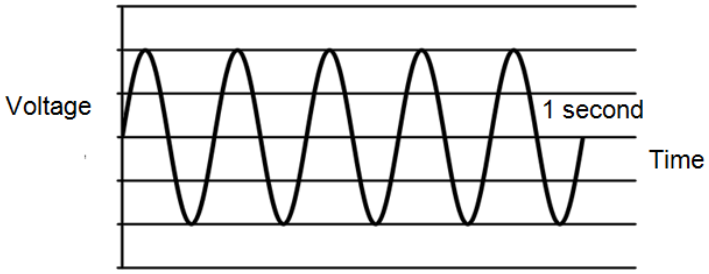
Induction

7. When an inductor is disconnected from a supply a back-EMF is generated.

Explain what back-EMF is and how this happens?

Back-EMF is current generated in a coil (inductor, relay) when the magnetic field in the coil collapses once the supply is removed. This generates an EMF across the inductor.

8.



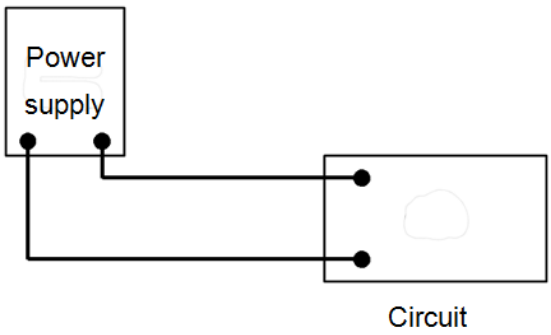
a) What is the frequency of the a.c. voltage supply shown?

5 Hz (5 cycles in 1 second)

b) What is the frequency of the mains a.c. supply?

50 Hz

9. Power is transferred from the power supply to the circuit.



If the power supply voltage is fixed, what affects how much power the circuit draws?

The current taken by the circuit affects how much power the circuit takes from the supply. Power is given by V x I, and so if I increases then power increases. Learners might also explain that I is affected by circuit resistance: Lower resistance (more current) = more power taken.

10. The picture shows a domestic electric meter.

What does the meter read and what are the units?

The meter reads energy supplied to the house – unit: kWh

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