Learning Outcomes

Topic	You should be able to	R	A	G	Comments
4.2.2 Electric current					
1	Define electric current as the charge passing a point per unit time; recall and use the equation electric current = $\frac{\text{charge}}{\text{time}}$ $I = \frac{Q}{t}$	☐	☐	☐	
2	Describe electrical conduction in metals in terms of the movement of free electrons	☐	☐	☐	
3	Know that current is measured in amps (amperes) and that the amp is given by C / s	☐	☐	☐	
4	Know the difference between direct current (d.c.) and alternating current (a.c.)	☐	☐	☐	
5	State that conventional current is from positive to negative and that the flow of free electrons is from negative to positive	☐	☐	☐	
6	Describe the use of ammeters (analogue and digital) with different ranges	☐	☐	☐	
4.2.3 Electromotive force and potential difference					
1	Define e.m.f. (electromotive force) as the electrical work done by a source in moving a unit charge around a complete circuit; recall and use the equation e.m.f. = $\frac{\text{work done (by a source)}}{\text{charge}}$ $E = \frac{W}{Q}$	☐	☐	☐	
2	Define p.d. as the work done by a unit charge passing through a component; recall and use the equation p.d. = $\frac{\text{work done (by a component)}}{\text{charge}}$ $V = \frac{W}{Q}$	☐	☐	☐	
3	Know that e.m.f. and p.d. are measured in volts and that the volt is a joule per coulomb (V = J / C)	☐	☐	☐	
4	Describe the use of voltmeters (analogue and digital) with different ranges	☐	☐	☐	

Topic	You should be able to	R	A	G	Comments
5	Calculate the total e.m.f. where several sources are arranged in series	☐	☐	☐	
6	State that the e.m.f of identical sources connected in parallel is equal to the e.m.f. of one of the sources	☐	☐	☐	
4.2.4 Electric circuits					
1	Recall and use the equation resistance = $\frac{\text{p.d.}}{\text{current}}$ $R = \frac{W}{I}$	☐	☐	☐	
2	Describe an experiment to determine resistance using a voltmeter and an ammeter and do the appropriate calculations	☐	☐	☐	
3	Recall and use, quantitatively, for a wire, the direct proportionality between resistance and length, and the inverse proportionality between resistance and cross-sectional area	☐	☐	☐	
4	State Ohm's Law, including reference to constant temperature	☐	☐	☐	
5	Sketch and explain the current–voltage graphs of a resistor of constant resistance, a filament lamp	☐	☐	☐	
6	Describe the effect of temperature increase on the resistance of a resistor, such as the filament in a filament lamp	☐	☐	☐	

Electrical Quantities (Electric Current, Voltage & Resistance)

Electric Charges
- SI unit: Coulomb.
- Symbol 'Q'
- positive charge (proton)
- negative charge (electron)

Def: **Electric Current**: It is the rate of flow of electric charge

Formula: Electric Current = $\frac{\text{Electric Charge}}{\text{time}}$

Formula in symbols: $I = \frac{Q}{t}$

SI unit: Amperes

Apparatus: Ammeter (A)

Reference!

- Speed = $\frac{\text{distance}}{\text{time}}$
- Speed is the rate of change of distance
- $s = \frac{d}{t}$

charge time

A lightning flash carries 40 C of charge and lasts for 5.0 ms.

0.005

What is the average current in the flash?

A 0.20 A **B** 8.0 A **C** 200 A **D** 8000 A

$$I = \frac{Q}{t} =$$

$$= \frac{40}{0.005}$$

$$I = 8000\,A$$

The flash on a camera operates when a capacitor discharges through a flash-tube. In 3.2 ms, a charge of 6.0 C passes through the flash-tube.

What is the average current in the flash-tube?

A 0.019 A

B 1.9 A

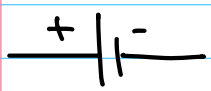
C 19 A

D 1900 A

$$I = \frac{Q}{t} = \frac{6}{0.0032} = 1875\,A$$

1900A

Circuit Components



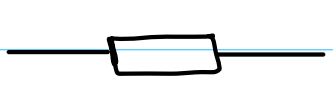
Fill the blanks — cell

" " — battery

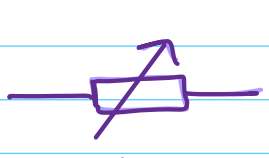
Ammeter

Voltmeter

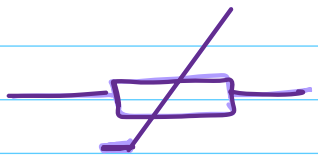
Bulb



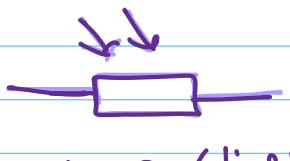
resistor



variable resistor

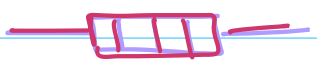


Thermistor



LDR (light dependent resistor)

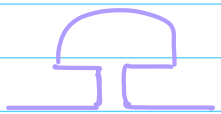
fuse



heater

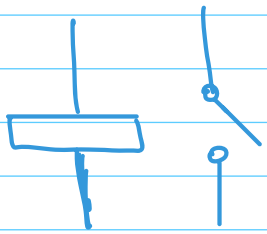
switch (open)

Switch (closed)



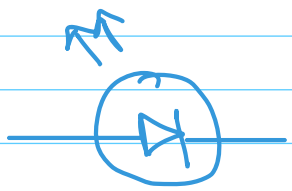
Buzzer

Connecting wire



relay

diode



LED (light emitting diode)

Potential difference is just the scientific name for Voltage

Voltage (Potential Difference)

Def: It is the workdone (energy converted from electrical to other forms) by the electric charge while passing through a component.

Formula: $\text{Voltage} = \frac{\text{Workdone}}{\text{Electric Charge}}$

Formula in symbols: $V = \frac{W.d}{Q}$

$5V = \frac{5J}{C}$

SI unit: Volt (V)

$1V = \frac{1J}{C}$

$10V = \frac{10J}{C}$

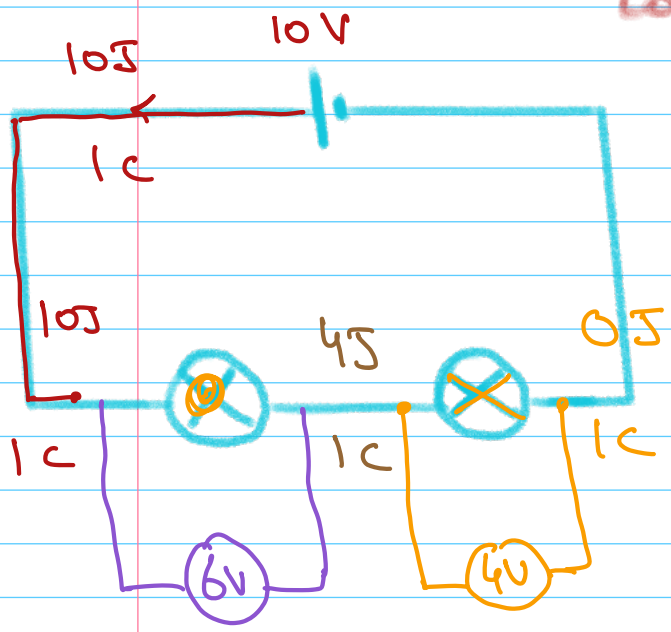
You Should Know!

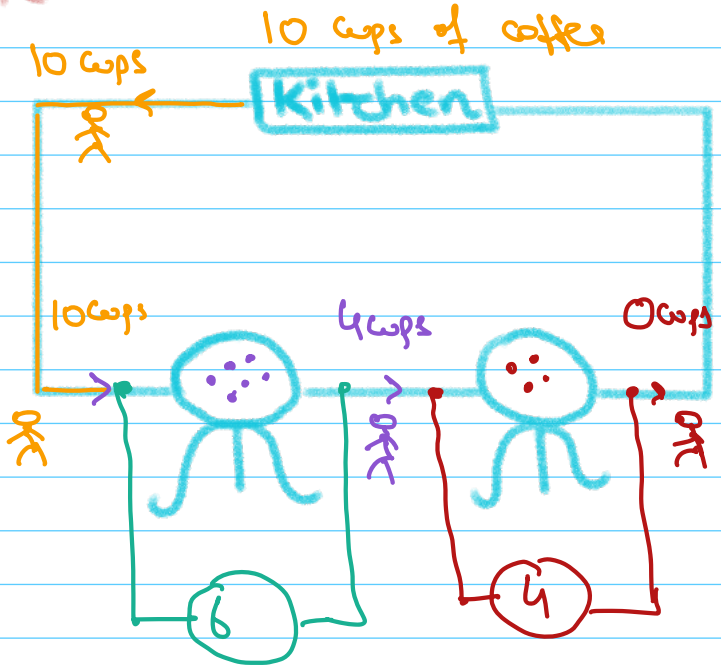
Work done = Energy transfer

SI unit: Joules

Apparatus:  Voltmeter (always connected across the component).

Circuit → Let's compare ← Cafe





Def **Resistance** It is the measure of opposition to the flow of current in a circuit.

SI unit ohms Ω

circuit symbol 

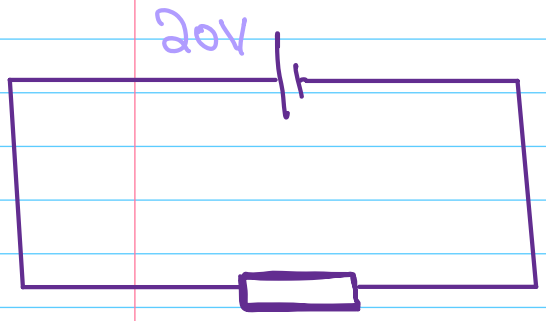
→ **Formula relating Current, Voltage & Resistance.**

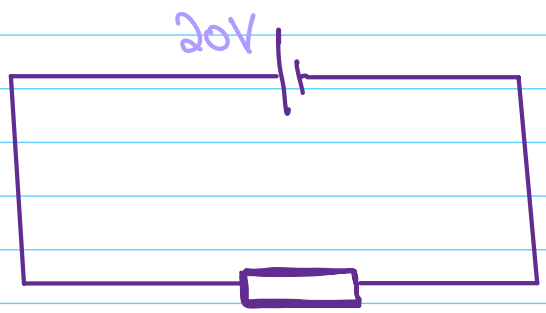
$V = I \times R$

$I = V/R$

$R = V/I$

Note For the same amount of voltage different currents may pass depending on the resistance of the circuit.

i) 

ii) 

Calculate Current (I)?

$I = \frac{V}{R} = \frac{20}{10} = 2A$

$I = \frac{V}{R} = \frac{20}{5} = 4A$

voltage current

A digital watch is powered by a 1.3V cell. The cell supplies a current of 4.1×10^{-5} A (0.000041 A) for 1.6×10^{7} s.

time

Calculate

(a) the charge that passes through the cell in this time,

$I = \frac{Q}{t}$ $Q = I t$

$= 4.1 \times 10^{-5} \times 1.6 \times 10^{7}$

$= 656\ C$

charge = 660 C [2]

(b) the resistance of the electrical circuit in the watch,

$V = IR$

$R = \frac{V}{I} = \frac{1.3}{4.1 \times 10^{-5}}$

$= 31,707.3\ \Omega$

resistance = 32000 Ω [2]