Voltage, current, resistance and meters

LEARNING INTENTION

We are learning what voltage, current and resistance are, their units and prefixes, and how to measure them.

SUCCESS CRITERIA – I CAN

- ☐ state the symbol and unit for V, I and R
- ☐ convert between prefixes (k, M, m, μ)
- ☐ choose and connect the right meter
- ☐ give answers with a unit that suits the value

Three quantities

Quantity	Symbol	Unit	What it means
Voltage (potential difference)	V	volt (V)	The 'push' that drives current round a circuit. Measured across a component.
Current	I	ampere, amp (A)	The flow of charge round the circuit. Measured through a component.
Resistance	R	ohm (Ω)	How much a component opposes the current.

A bigger voltage pushes more current. A bigger resistance lets less current through. Ohm's law links them (E2.2).

Prefixes

Prefix	Symbol	Multiply by	Example
mega	M	1 000 000 (10^6)	2.2 MΩ = 2 200 000 Ω
kilo	k	1000 (10^3)	4.7 kΩ = 4700 Ω
milli	m	0.001 (10^{-3})	25 mA = 0.025 A
micro	μ	0.000 001 (10^{-6})	50 μA = 0.000 05 A

DATA BOOKLET pages 3–4

V (volt, V)
voltage, potential difference

I (ampere, A)
current

R (ohm, Ω)
resistance

k = 10^3, M = 10^6
kilo, mega

m = 10^{-3}, μ = 10^{-6}
milli, micro

Voltage, current, resistance and meters

WORKED EXAMPLE **Converting prefixes**

1 GIVEN	2 FIND	3 FORMULA	4 SUBSTITUTE	5 ANSWER + UNIT
R = 4.7 kΩ I = 25 mA R = 2.2 MΩ	values in base units	k = × 10^{3} m = × 10^{-3} M = × 10^{6}	4.7 × 1000 = 4700 25 ÷ 1000 = 0.025 2.2 × 1 000 000	**4700 Ω,** **0.025 A** 2 200 000 Ω

Multiply for k and M. Divide for m and µ.

SHORT CIRCUIT

× WHAT EXAMINERS SAW

Answers such as “I = 0.005” with no unit, or “5 A” when the working was in kΩ and the answer was really 5 mA.

V THE FIX

Every answer needs a unit that suits the values you used: V ÷ kΩ gives mA; V ÷ Ω gives A.

Course reports 2025–26: the final unit must suit the values used.

Measuring

DATASHEET · METERS

01 Ammeter: current, in series, low resistance.

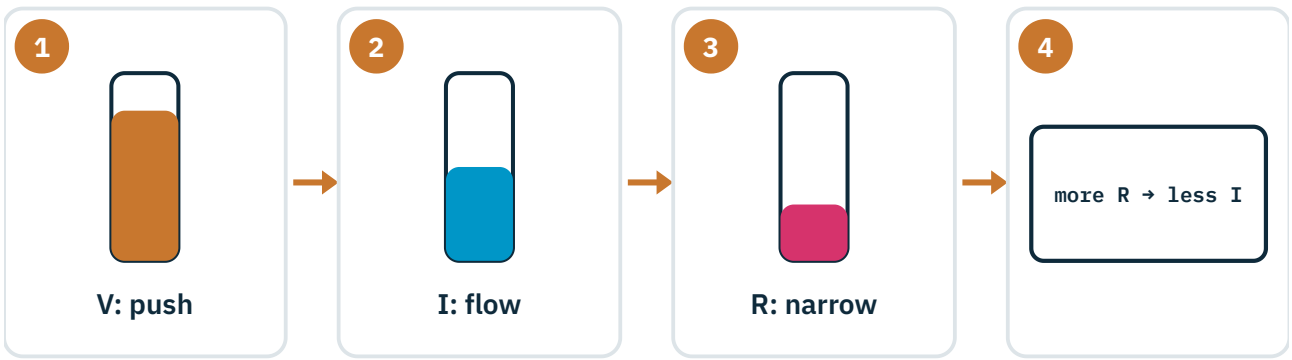
02 Voltmeter: voltage, in parallel (across), high resistance.

03 Multimeter: one meter, choose A, V or Ω.

04 Measure resistance with the component out of the circuit.

Voltage, current and resistance as a water model

A PICTURE OF V, I AND R



Voltage is the push from the battery

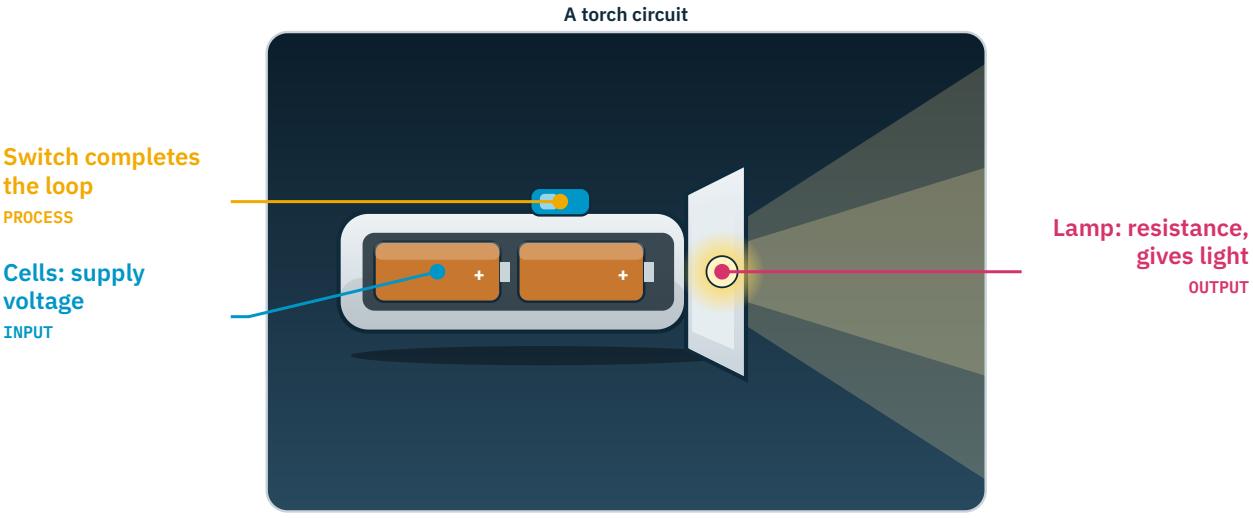
Current is the flow of charge round the loop

Resistance opposes the flow

Bigger resistance means smaller current

Voltage, current, resistance and meters

A torch circuit



WORKED EXAMPLE Choosing the multimeter range

1 GIVEN	2 FIND	3 FORMULA	4 SUBSTITUTE	5 ANSWER + UNIT
expected voltage about 4.5 V ranges: 200 mV, 2 V, 20 V, 200 V	best range	smallest range ABOVE the value	200 mV and 2 V are too small 20 V is the next above 4.5 V	**20 V range**

A reading of 'OL' (overload) means the range is too small.

WORKED EXAMPLE Prefixes in a calculation

1 GIVEN	2 FIND	3 FORMULA	4 SUBSTITUTE	5 ANSWER + UNIT
V = 9 V R = 4.5 kΩ	I in mA	I = V/R k = ×1000	I = 9 / 4500 = 0.002 A	**2 mA**

Convert to base units first, then back to a prefix.

Voltage, current, resistance and meters

WRONG

$I = 9 / 4.5 = 2\ A$

kΩ left as 4.5: answer is 1000 times too big.

RIGHT

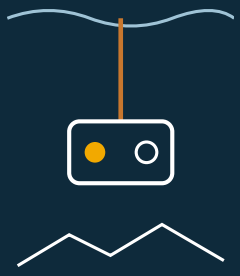
$I = 9 / 4500 = 0.002\ A = 2\ mA$

Convert kΩ to Ω first.

REAL ENGINEERING · SUBSEA CABLE CHECKS

Engineers at Deepline Subsea (fictional) test power cables for offshore wind farms. A healthy cable insulation reads several MΩ.

A low reading in kΩ warns of seawater getting in. Reading the prefix correctly is the difference between 'safe' and 'faulty'.



PROBE · QUICK CHECKS

1. Unit of resistance? _____
2. 25 mA in amps? _____
3. How is a voltmeter connected? _____

EXAM READY · 5 MARKS

1 **State** the unit of current. **[1]**

2 **State** 3.3 kΩ in ohms. **[1]**

3 **State** 150 mA in amps. **[1]**

4 **Describe** how an ammeter must be connected, and **explain** why. [2]