

① Current

↳ Definition: Current is the **RATE of Flow of electric charge.**

SI unit: Ampere (A)

Symbol: I

Measuring Tool:

Ammeter



↑ placed in **SERIES**

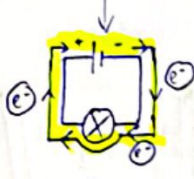
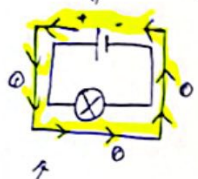
Conventional Current

vs Electron flow

← scientifically correct.
← real, actual flow of charge

Exam note!

★ Current = **Conventional Current** unless otherwise stated.

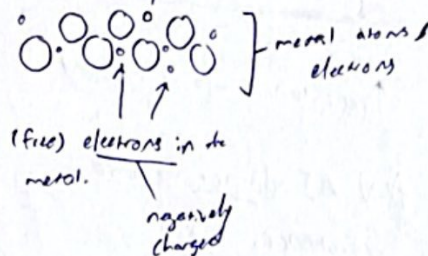


Engineers stick w/ it cuz it still works so why bother switching?

↑ electrons (negative) flow from **negative terminal** to **positive terminal**.

(no need to memorise but will help w/ understanding)

CHARGE
positive (protons)
negative (electrons)



★ The electrons flow through the circuit
↓
carry their charge with them
↓
rate of flow of charge.

Charge unit: Coulombs (C)

Symbol: Q

Effects of Electric Current

① Heating

↳ When current flows through a metal, the electrical energy gets converted to **heat**.

eg. toaster, iron

↑ current
↑ resistance → ↑ heat

② Magnetic

↳ When current flows, it naturally produces a magnetic field

eg. any wire carrying current, electromagnets

↑ current → ↑ magnetic field

③ Chemical

↳ Moving charges in liquids are moving ions → can react at electrodes

* called **electrolysis**

eg. getting H and O out of H₂O.

② Voltage

emf.
p.d.

① Electromotive force (e.m.f.)

↳ **Work done** by the source to drive 1C of charge around a complete circuit.

SI unit: Volts (V)

Symbol: V

→ Battery provides energy (J) for electrons to have net movement

→ A cell of 1V → 1J of E_p given to 1C of charge to go 1 whole round through the circuit.

emf.

2V each ⇒ 2(2) = 4V



★ voltmeter (parallel to component/source)

② Potential Difference (p.d.)

↳ **Work done** per unit charge driven across 2 points on the circuit.

SI Unit: Volts (V)

Symbol: V

1. Take the V bar points A & B
p.d. of bulb = **difference** between A & B.

③ Resistance

↳ Ratio of potential difference across a component to the current flowing through it.

SI Unit: Ohm (Ω)

Symbol: R

↑ resistance → ↓ current

★ V & I do not cause resistance.

★ Resistance only affects the rate of flow of charge.

→ If V is constant,

. When R ↑, I ↓

. When R ↓, I ↑

Factors Affecting Resistance (Controlled)

① Length ↑ = R ↑

② Thickness ↑ = R ↓

③ Material

(copper good, nichrome poor)

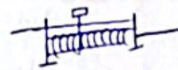
that's why most wires are made of copper.

Resistors

Fixed:



Variable:



eg. light dimmer switch

FYI

- Silver is the most electrically conductive element.

(but copper is cost-efficient)

Ohm's Law

The current flowing through a metallic conductor is directly proportional to the potential difference across the conductor, provided that all other physical conditions are constant.

FACTORS

temperature, CSA, material

↑

temp ↑, R ↑

↑ causes more vibration → more collision

$I \propto V$

has a constant ratio

$$R = \frac{V}{I}$$

Short Circuits

→ current will flow in the path of lower resistance

if there's a path with negligible resistance, current will only go through that path

$$I = \frac{V}{R}$$

Each Branch:

$$I_1 = \frac{V}{R_1}$$

→ $I_T = I_1 + I_2$

$$= \frac{V}{R_1} + \frac{V}{R_2}$$

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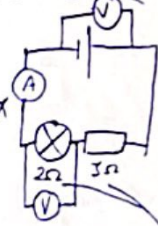
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④ Circuit types

(A) Series



emf = p.d. across bulb + p.d. across resistor

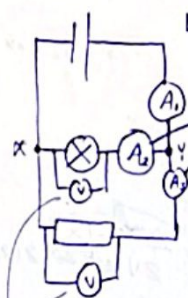
∴ Voltage: sum of p.d.s across all components.

Current is same throughout the circuit

Resistance

Total resistance = R of each component added tog.

(B) Parallel



Current → splits into 2 paths

$$A_1 = A_2 + A_3$$

$$(I_1 = I_2 + I_3)$$

∴ Sum of no. of electrons per path = total when the paths merge.

Voltage: Both branches are connected at points X & Y, and the p.d. between the 2 points for each branch is the same.

∴ emf = $V_1 = V_2$

Exam tip!!

if I → sum, the

V → same (vice versa)

I	$I_1 = I_2 = I_3$
V	$V_{\text{emf}} = V_1 + V_2$
R	$R_T = R_1 + R_2$

I	$I_T = I_1 + I_2$
V	$V_T = V_1 = V_2$
R	$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$

Practical electricity

13 Consumption of Electrical energy

② Heating

Electricity generated
converts to other
forms of energy
heat: kettles, iron

Power

$$P = VI$$

Energy: Joules

$$E = P \times T$$

energy (J)

Also in: kWh

time (s)

h

Power (Watts)

kW

household

Combo 1: $kWh = (kW)(h)$

2: $J = (W)(s)$

↑
engineering/working

③ Dangers

- Electrical insulation damage (wire rubbing breaks, causes live wire exposure)
- Overheating (caused by overload) (inappropriate wires)
- damp conditions
- accidentally making the metal casing of an appliance live.

human contact:

→ messes with nerve signals

→ heart attacks, muscle spasms
difficulty breathing.

too high resistance

fire

EXAM TIPS

FORMULAS

— memorize
— exam keyword

current
 $I = \frac{Q}{T}$
I in a Q/T

voltage work done (J)
 $V = \frac{W}{Q}$
Very weird Question
W/Q

resistance
 $R = \frac{V}{I}$
Really voltage individual

kilowatt-hour
 $P = \frac{E}{T}$
PET

power (FYI)
 $V = \frac{P}{I}$
very polite individual

$$I \propto V$$

Series vs Parallel

★ if I is same throughout, then V is sum.

	series	parallel
current	$I_1 = I_2 = I_3$	$I_T = I_1 + I_2$ → splits between the 2 parallel paths
voltage	emf = sum of p.d.s	Same in each parallel path
resistance	$R_T = R_1 + R_2$	$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$

Note: both sides have to be 1 fraction/term
if you're gonna cross-multiply