Edexcel IAL Physics A-Level

Topic 2.2 - Electric Circuits

Flashcards

Define current/potential difference/resistance and state the equation connecting the three.

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Current: rate of flow of charge ($I = Q / t$)

Potential difference: work done per unit charge ($V = W / Q$)

Resistance: measure of how difficult it is to get a current to flow through ($R = V / I$)

State Ohm's Law.

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In an ohmic conductor, current is directly proportional to voltage, provided physical conditions remain constant (e.g. temperature).

State how current is distributed in series and parallel circuits.

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In series, current is constant throughout as the charge carriers aren't split up. In parallel, the current is distributed (as in Kirchhoff's 1st Law).

State Kirchhoff's Laws.

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1st Law: the current flowing into a junction is the same as the current flowing out it. (Charge is conserved).

2nd Law: the total emf around a loop = the sum of the potential differences across each component.

State the power equation and two other derivations of the formula.

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$$P = IV$$

$$P = I^2R$$

$$P = V^2 / R$$

Sketch the I-V graphs for an ohmic conductor, filament lamp, thermistor and a diode.

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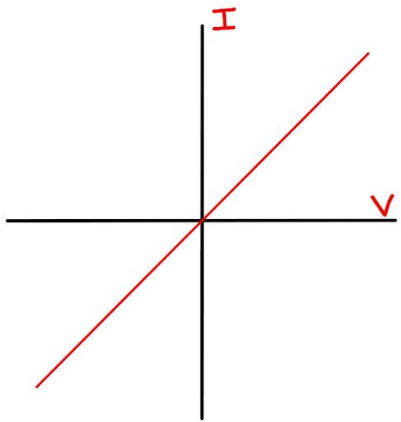
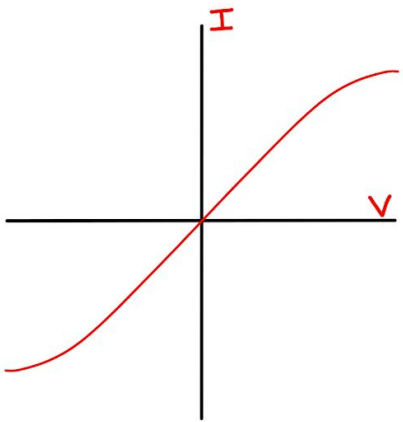
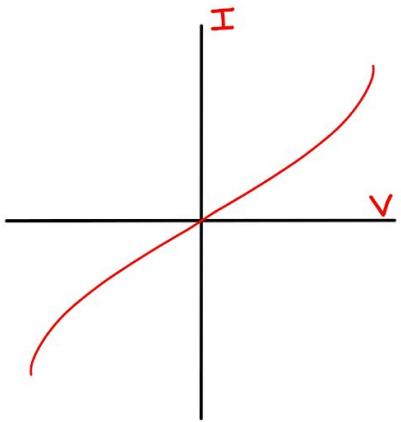


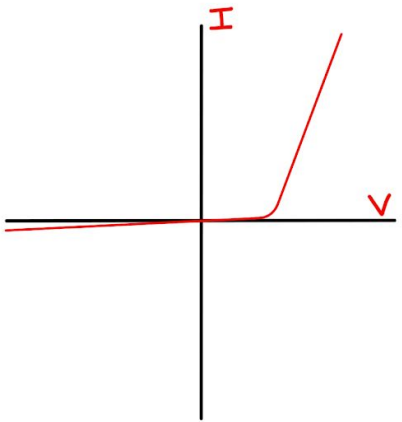
Ohmic Conductor



Filament Lamp



Thermistor



Diode

Define resistivity.

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The resistance of a 1m length of a material with a 1m² cross sectional area. Resistivity is characteristic of the material.

$$\rho = RA/L$$

State the terms and definitions from the following equation:

$$I = nAvq$$

State the terms and definitions from the following equation: I = nAvq

I = current; rate of flow of charge

n = number of charge carriers

A = cross sectional area

v = mean drift velocity

q = charge of charge carriers

How can you increase the resistance of a wire?

How can you increase the resistance of a wire?

- Use a material with a higher resistivity.
- Use a wire which is longer.
- Use a wire with a smaller cross sectional area.

How do you calculate the voltage output in a potential divider circuit?

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$$V_{out} = (V_{in} \times R_1) / (R_1 + R_2)$$

Explain how a circuit is used for regulating central heating (thermostat).

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- A parallel circuit is used with a thermistor, with the central heating attached to the other ‘branch’ of the circuit.
- As the area heats up, the resistance in the thermistor decreases, meaning more current will flow through the thermistor branch.
- This means the central heating won’t have much current flowing through it and won’t turn on.

Define electromotive force, internal resistance and lost volts.

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EMF: The energy provided by a cell or battery per coulomb of charge passing through it.

IR: The resistance inside a cell which prevents the total amount of volts going round in a circuit. (represented by lowercase r).

LV: potential difference that is lost due to resistance within the cell/battery. (lost volts = I x r).

Define terminal PD.

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The potential difference across the terminals of the cell/battery. This is the potential difference supplied to the circuit.

Terminal PD = EMF of power supply - lost volts

List two equations linking terminal PD, internal resistance & current.

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$$\varepsilon = IR + Ir$$

$$\varepsilon = V + v$$

ε = cell/battery EMF, V = terminal PD, v = lost volts, I = current, R = circuit resistance, r = internal resistance

How does temperature affect vibrations, resistance and current?

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As the temperature increases, the kinetic energy of the lattice cations in the wire increases, causing more collisions between the ions and electrons so more energy is dissipated and electrons slow down. This resistance in the wire has increased and the current decreased as the collisions slow down the rate of flow of charge.

If an LDR has more light shining on it, what happens to the charge carriers, and why?

Use these ideas to explain what happens to the current if the same voltage continues to be applied.

If an LDR has more light shining on it, what happens to the charge carriers, and why? Use these ideas to explain what happens to the current if the same voltage continues to be applied.

- If light intensity increases, the number of charge carriers increases as there is more energy (due to light) in the semiconductor so more charge carriers are released
- This means the electrons have more energy
- More charge carriers means the charge carrier density (n) increases also
- This results in increases current (I) as I = nAvq (cross sectional area (A), drift velocity (v) and charge on each charge carrier (q) all remain constant.)
- The increased current (I) results in a decreased Resistance (R) as R=V/I