AQA A-Level Physics

5.1 Current Electricity

Flashcards

What is electric current? State its units.

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The rate of flow of charge. It is measured in amperes (amps).

What is potential difference?

What is potential difference?

The work done moving a unit charge between 2 points in a circuit

$$V = W / Q$$

What is resistance?

What is resistance?

How difficult it is for current to flow through an appliance.

A component has a resistance of 1Ω if 1A flows through it when a p.d of 1V is applied across it.

$$R = V / I$$

What is meant by an ohmic conductor?

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A conductor that obeys Ohm's law, meaning that current is directly proportional to potential difference providing physical conditions (such as temperature) remain constant.

How can you measure the current in a circuit?

How can you measure the current in a circuit?

You can measure the current in a circuit with an ammeter connected in series with the component.

How do you measure potential difference across a component?

How do you measure potential difference across a component?

Using a voltmeter, connected in parallel across the component being measured.

What does the gradient of a current-potential difference graph represent?

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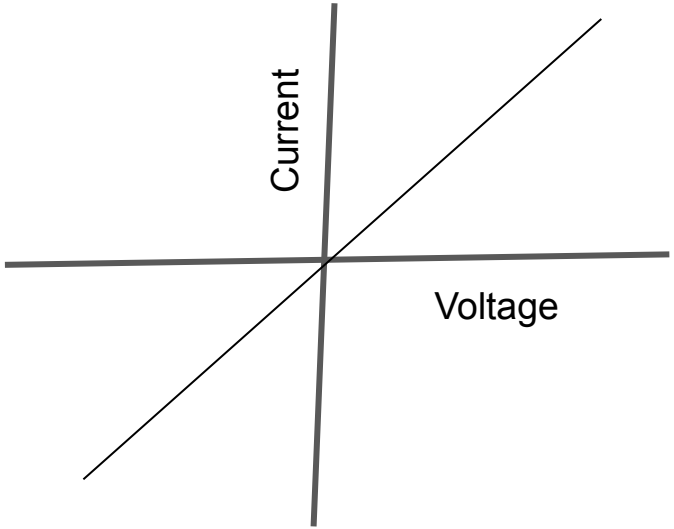
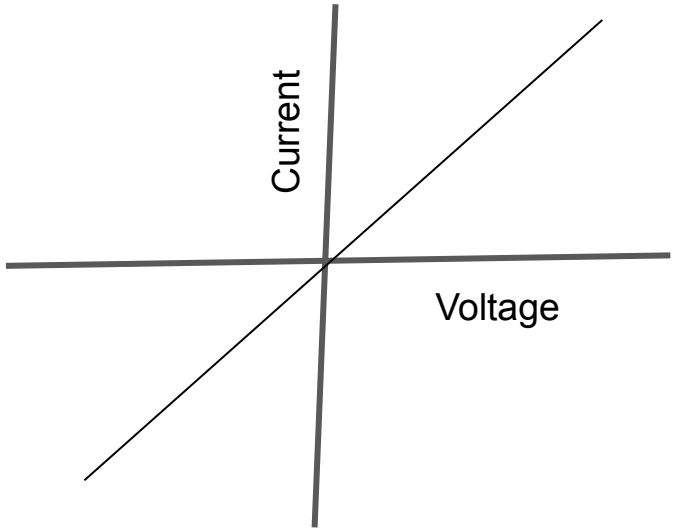
Rate of change of current with respect to voltage.

This is not the same as 1/R

Does this graph represent an ohmic conductor?



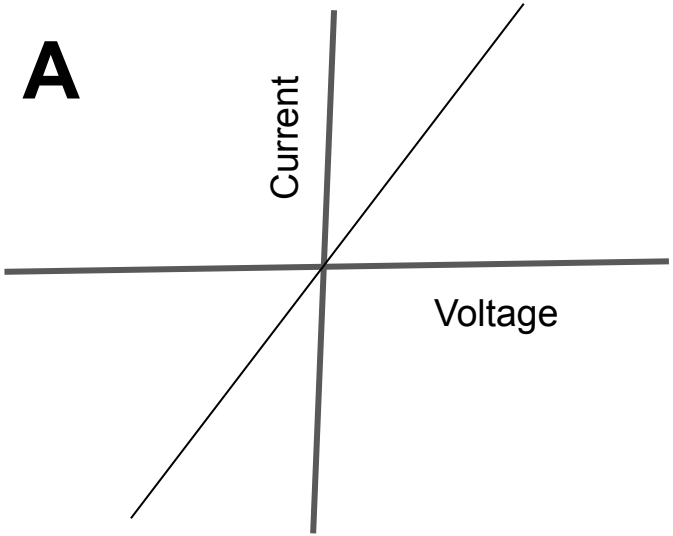
Does this graph represent an ohmic conductor?



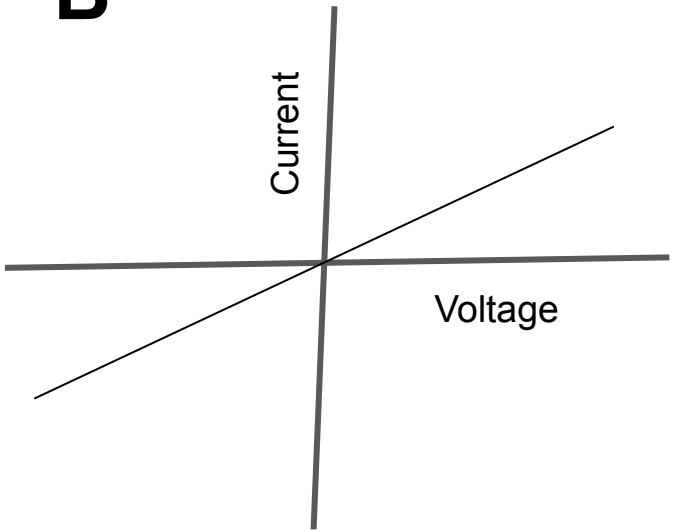
Yes, as the line has a constant gradient and passes through the origin. This shows that voltage is directly proportional to current.

Which graph represents an appliance with higher resistance?

A

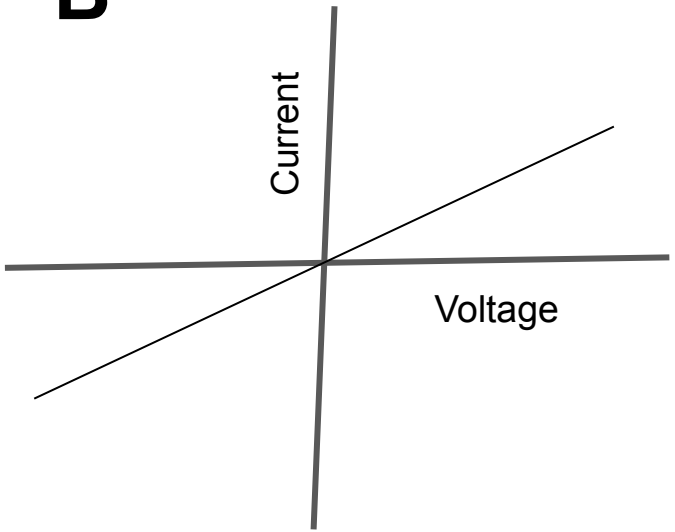


B



Which graph represents an appliance with a higher resistance?

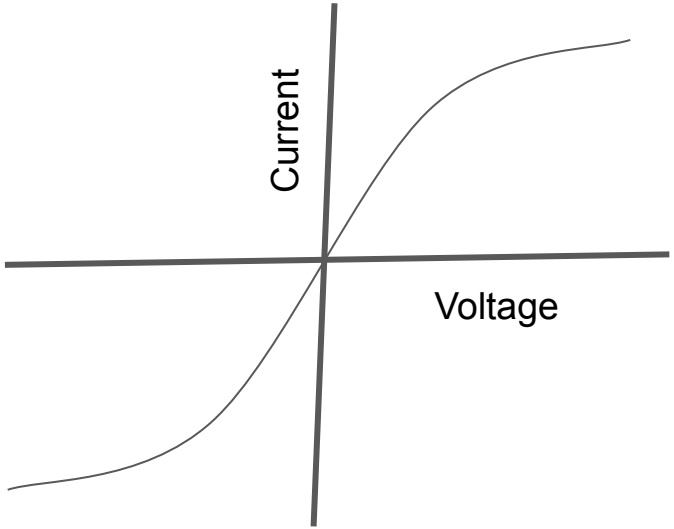
B



B

A higher voltage is required in B for the same change in current in comparison to A.

What common appliance could this curve represent?



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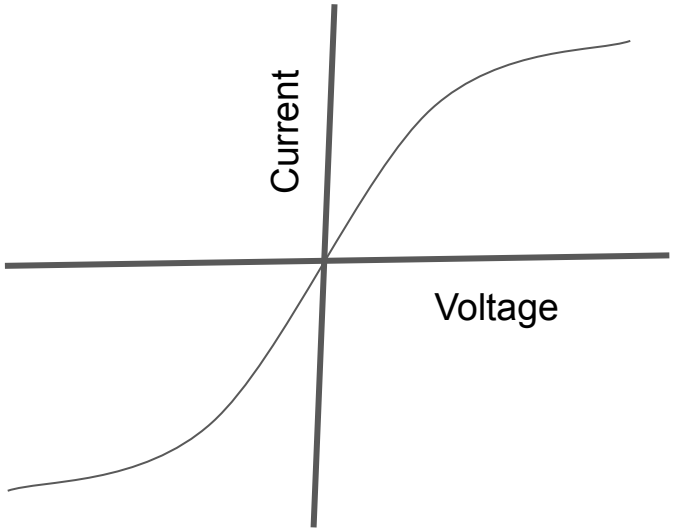


A filament lamp. As the current increases the the resistance also increases. A big increase in the voltage produces only a small increase in current

Why does the current increasing on a filament lamp cause an increase in the resistance?

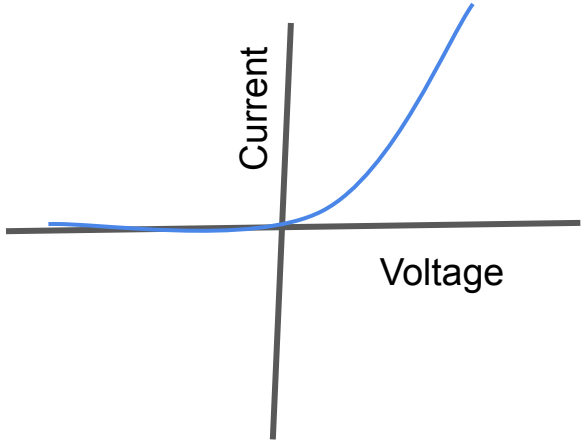
Why does the current increasing on a filament lamp cause an increase in the resistance?

As current flows through the lamp, electrical energy is converted to heat energy so the metal ions vibrate with increased amplitude. This impedes the movement of electrons through the lamp as they collide with the ions (resistance has increased).

What is a diode?

What is a diode?

A diode is a appliance that only allows current to flow in one direction.



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You should assume they have infinite resistance. Current takes the path of least resistance so, if the voltmeter has infinite resistance, when applied in parallel to the appliance, no current will flow through it and all the current will flow through the appliance.

Why should you assume that an ammeter has zero resistance unless stated otherwise?

Why should you assume that an ammeter has zero resistance unless stated otherwise?

This assumption means that there would be 0 potential difference across the ammeter and no energy is lost across it; it does not affect the circuit.

What is an Light Dependent Resistor (LDR)?

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A semiconductor that is sensitive to light.

As the light intensity increases, its resistance decreases.

How does a thermistor work?

How does a thermistor work?

Similar to an LDR but, as the temperature increases, the resistance decreases (This means thermistors have a negative temperature coefficient).

What is resistivity?

What is resistivity?

The resistance of a 1m cylinder with a cross sectional area of $1m^2$. Resistivity is an inherent property of a material.

$$\rho = RA/L$$

ρ = resistivity (Ωm) R = resistance (Ω)

A = cross-sectional area (m^2) L = length (m)

Describe an experiment to determine the resistivity of a metal.

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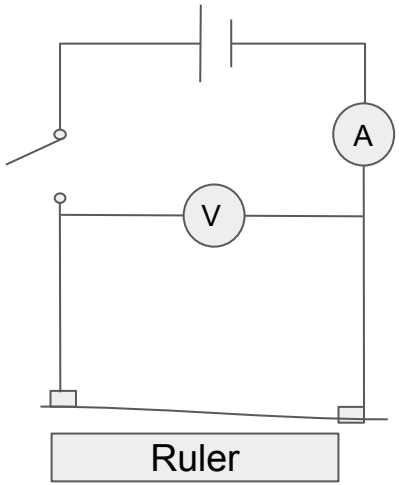

1. Measure the diameter of the wire with a micrometer. Then calculate the cross-sectional area = $\pi(d/2)^2$.
2. Set up the circuit as shown.
3. Vary the wire length and record the voltage and current for each length.
4. Use R=V/I to work out the resistance.
5. Plot a graph of resistance against wire length.
6. The gradient = resistivity ÷ cross-sectional area
7. So resistivity = gradient x cross-sectional area

What is a superconductor?

What is a superconductor?

A material that has a resistivity of zero at or below a critical temperature. The critical temperature is an inherent property of the material.

How do you find the total resistance in a series circuit?

How do you find the total resistance in a series circuit?

$$R_{Total} = R_1 + R_2 + R_3 + \ldots$$

Add the individual resistances of each component

If 6 cells, each of voltage 5V, are arranged in parallel what is the voltage in the circuit?

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5V.

If 6 cells, each of voltage 5V, are arranged in series what voltage is provided to the circuit?

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30V

(5V x 6)

How does the current vary between each component of a series circuit?

How does the current vary between each component of a series circuit?

The current through all of the components is the same so the current does not vary.

Is the current in parallel components the same?

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No, each branch of a parallel circuit can have different currents through them according to Kirchhoff's first law.

What is Kirchhoff's first law?

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All of the current going into a junction is equal to the current leaving the junction.

What is Kirchhoff's second law?

What is Kirchhoff's second law?

For any path (loop) of a circuit, the sum of all of the potential differences must equal to total emf of the circuit.

In a series circuit, if two cells are connected negative to negative, would their emf add up or cancel out?

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They will cancel out. The total emf would be equal to:

$$\varepsilon_{total} = \varepsilon_1 - \varepsilon_2.$$

What is power?

What is power?

The rate of energy transfer.

Give an equation for power in terms of current and voltage.

Give an equation for power in terms of current and voltage.

$$Power = Current \times Voltage$$

$$P = IV$$

What is the purpose of a potential divider?

What is the purpose of a potential divider?

- To provide variable potential difference, or
- To provide a constant specific potential difference

A circuit is set up with a cell providing a voltage of 12V to 2 resistors of 6Ω and 7Ω respectively, in series. What is the voltage across the 7Ω resistor?

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Total resistance = 6 + 7 = 13Ω

(7/13) x 12 = 6.5V

What is emf?

What is emf?

Electromotive force: the electrical energy transferred by a power supply per unit charge.

Rearrange the equation $\mathcal{E} = I(R + r)$ into the form $y = mx + c$

Rearrange the equation $\varepsilon = I(R + r)$ into the form $y = mx + c$

$\varepsilon = IR + Ir$

$\varepsilon = V + Ir$

So for a graph of V against I

$V = -rI + \varepsilon$

Gradient = -r and y-intercept = ε

What are two applications of superconductors?

What are two applications of superconductors?

- Power cables, which would reduce energy loss through heating to zero during transmission.
- Strong magnetic fields, which would not require a constant power source. These could be used in maglev trains, where there would be no friction between the train and rail, and in certain medical applications.

What is the total resistance of a parallel arrangement of 3Ω, 7Ω and 9Ω resistors?

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$1 / R_T = ⅓ + 1/7 + 1/9$

$1 / R_T = 37 / 63$

$R_T = 63 / 37 = 1.7Ω$