WJEC A-Level Physics

2.2 Resistance

Flashcards

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?

A measure of 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.

$R=V/I$ measured in ohms = VA^{-1}

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 the temperature remains constant.

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

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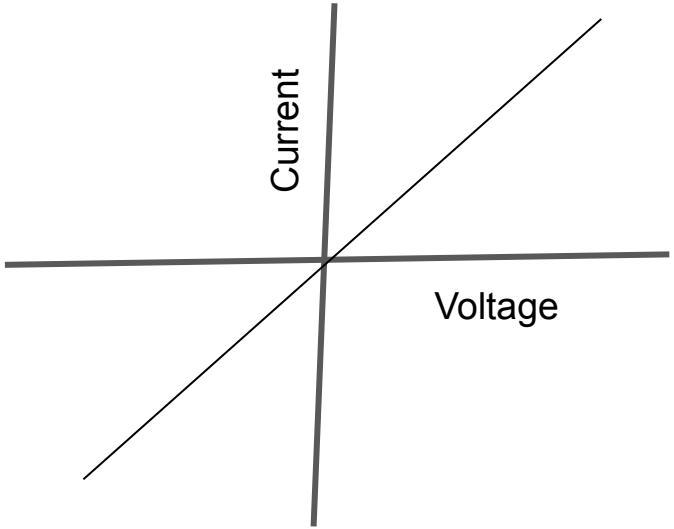
1/R.

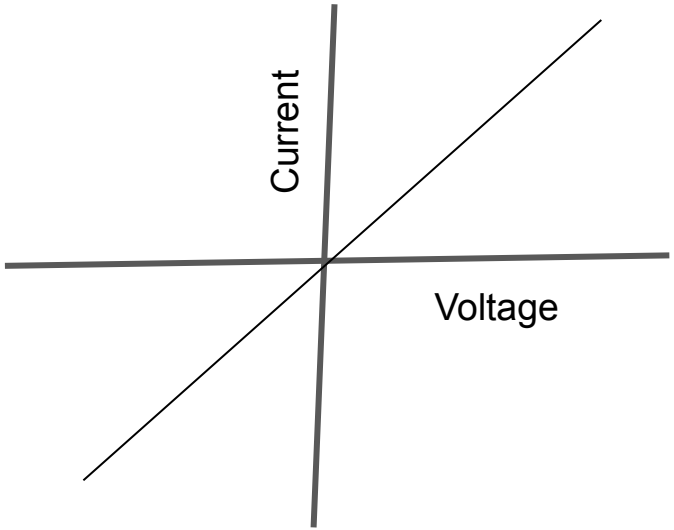
Because the gradient = rise in current/change in potential difference i.e. gradient = I/V.

As resistance= V/I, the gradient = 1/R

Does this graph represent an ohmic conductor?



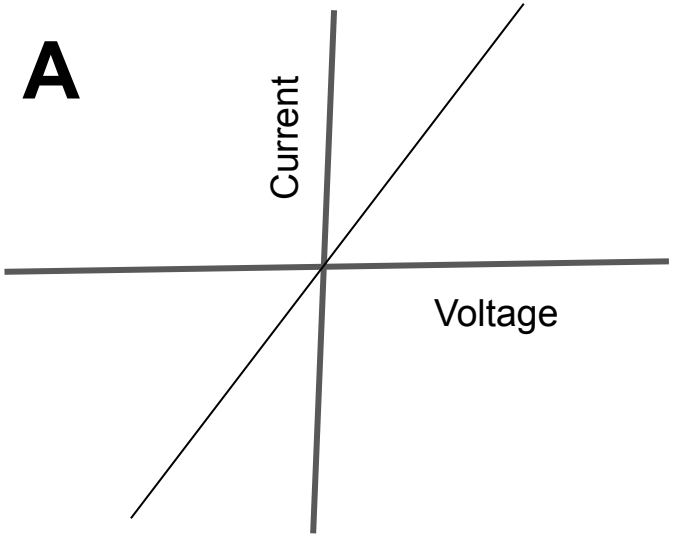
Does this graph represent an ohmic conductor?



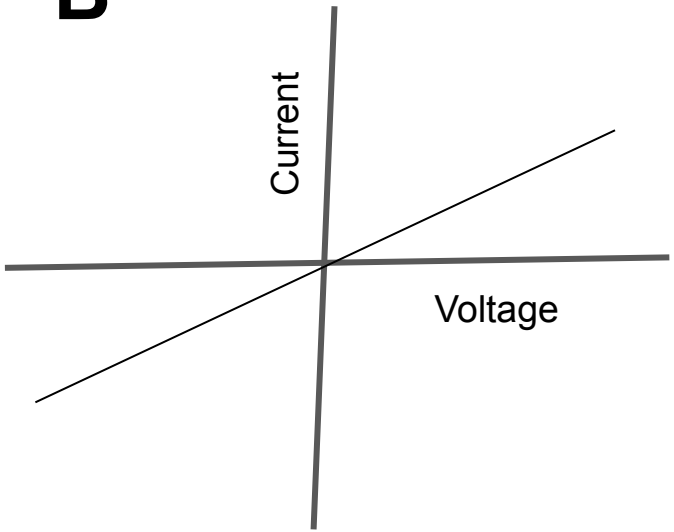
Yes, as the line has a constant gradient and passes through the origin. This shows that voltage is directly proportional to current.

Which graph represents a appliance with higher resistance?

A

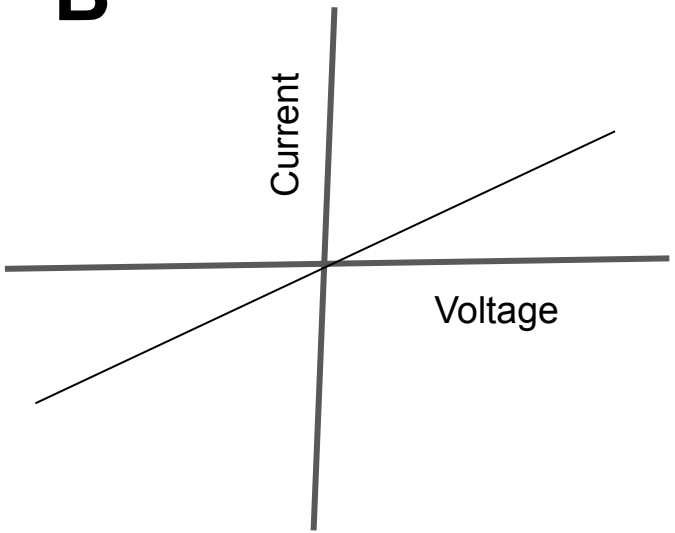


B



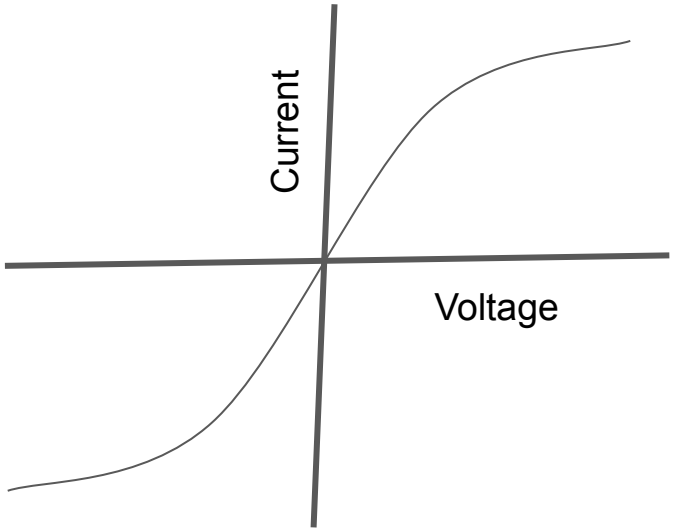
Which graph represents an appliance with a higher resistance?

B



B has a shallower gradient. Since the gradient =1/R, a smaller value for the gradient means a higher value for the resistance.
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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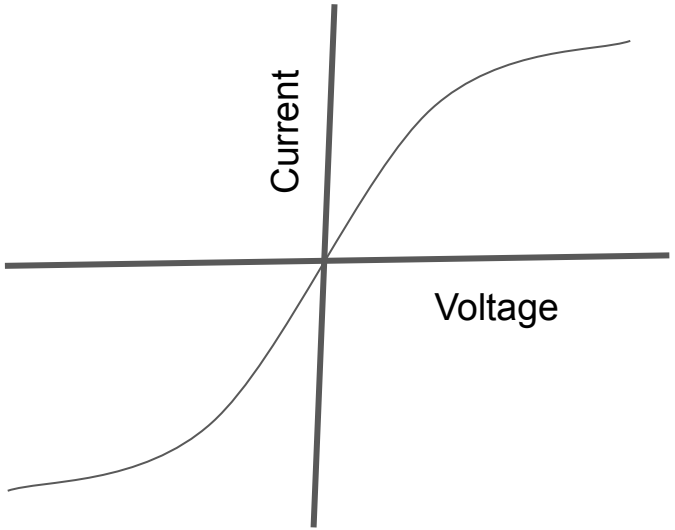

A filament lamp. As the current increases the resistance also increases. This means the gradient will decrease as current increases.

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 impeding the movement of electrons through the lamp as they collide with the ions (resistance has increased).

What is resistivity?

What is resistivity?

The resistance of a 1m cylinder with a cross sectional area of $1m^2$

$$p = RA/L$$

p = 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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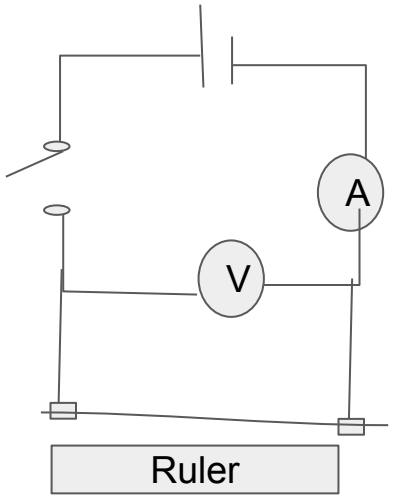

1. Measure the diameter of the wire with a micrometer. Then calculate the cross sectional area = $\pi(d/2)^2$.
2. Set up circuit as shown.
3. Vary the wire length and record the voltage and current for each length.
4. Use R = V/I to work out the resistance.
5. Plot a graph of resistance against the length.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

What is power?

What is power?

The rate of energy transfer.

What is a superconductor?

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A material that, when cooled below its critical temperature, has a resistivity of zero.

State 2 applications of superconductors.

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1. **Power cables**, which would reduce energy loss through heating to zero during transmission.
2. **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. They could also be used in certain medical applications.

What is resistivity?

What is resistivity?

The resistivity is a property of a metal which shows how easy or difficult it is for current to flow in the material (at a specific temperature).

$$\rho = RA/L$$

Where ρ = resistivity, R = resistance, A = cross-sectional area, and L = length.

Describe an experiment to determine the resistivity of a metal.

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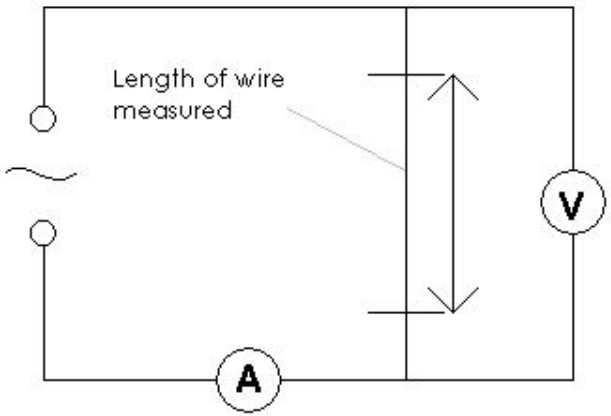

1. Measure the diameter of your wire using a micrometer.
2. Use this to calculate the area.
3. Set up circuit as shown.
4. Vary the length and record the voltage and current for each length.
5. Use R=V/I to work out the resistance.
6. Plot a graph of resistance against the length.
7. The gradient = resistivity / area.
8. Rearrange to work out resistivity.

True or false? The resistivity of both metals and semiconductors increases with temperature.

True or false? The resistivity of both metals and semiconductors increases with temperature.

False.

The resistivity of a metal increases with temperature because as the metal ions heat up they vibrate more and the electrons bang into them and slow down.

Some semiconductors get less resistive as temperature increases, because supplying energy actually causes more charge carriers to be released, so current can flow more easily.

What is superconductivity?

What is superconductivity?

Superconductivity is when a material conducts with zero resistance. A material will begin to do this when it is cooled to below a certain temperature. Not all materials can do this however.

What is the transition temperature?

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The temperature below which a superconductor must be cooled in order to have zero resistance is called the transition temperature.

When do metals show superconductivity?

When do metals show superconductivity?

Most metals do show superconductivity and will have transition temperatures a few degrees higher than absolute zero.

Initially, it was thought that superconductivity was not possible above 30K. In 1987, a Nobel prize was given out for the discovery of superconductivity of a material at a transition temperature of 35K. Higher transition temperatures were later found to exist. Some materials are described as high temperature superconductors which have transition temperatures above 77K.

Describe some uses of superconductivity.

Describe some uses of superconductivity.

- Superconductors can be used as magnets to make vehicles (such as trains) float.
- MRI scanners use superconducting magnets to expose the human body to a strong magnetic field.
- Superconducting magnets are often used in particle accelerators to alter the paths of subatomic particles.