CAIE Physics A-level

9 - Electricity

Flashcards

What is electric current? State its units.

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The rate of flow of charge. It is measured in Amps.

Give the symbol equation relating charge, current and time (include units).

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$$I = \frac{\Delta Q}{\Delta t}$$

Q = charge (Coulombs)

I = current (Amps)

t = time (seconds)

In electricity what does ‘e’ represent?
What are the units of ‘e’?

In electricity what does ‘e’ represent? What are the units of ‘e’?

e is the elementary charge. A proton has charge +e, an electron has charge -e

Charge is conventionally measured in Coulombs.

Why is charge described as being quantised?

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This is because the precise value of charge carried by a material object, must be a multiple of the elementary charge.

Give two examples of possible charge carriers.

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1. Electrons - in metals.
2. Ions - in electrolytes (aqueous solutions).

True or false? Current flows from negative to positive.

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False.

Conventional current is the ‘flow of positive charge’ - it is in the opposite direction to the movement of the electrons in the circuit.

How can you measure the current in a circuit?

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You can measure the current in a circuit using an ammeter, connected in series.

What is meant by an ohmic conductor?

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A conductor that obeys Ohm's law.

What does Ohm's law say? (In words)

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The current through an ohmic conductor is directly proportional to the potential difference across it (ie. resistance doesn't vary with voltage or current).

(This is only true if the temperature is constant.)

Give an equation that outlines Ohm's law.

Give an equation that outlines Ohm's law.

$$V = IR$$

What is resistance?

What is resistance?

A measure of how difficult it is for current to flow through a material object.

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 i.e. if the temperature remains constant, the current of the conductor will be directly proportional to the potential difference.

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

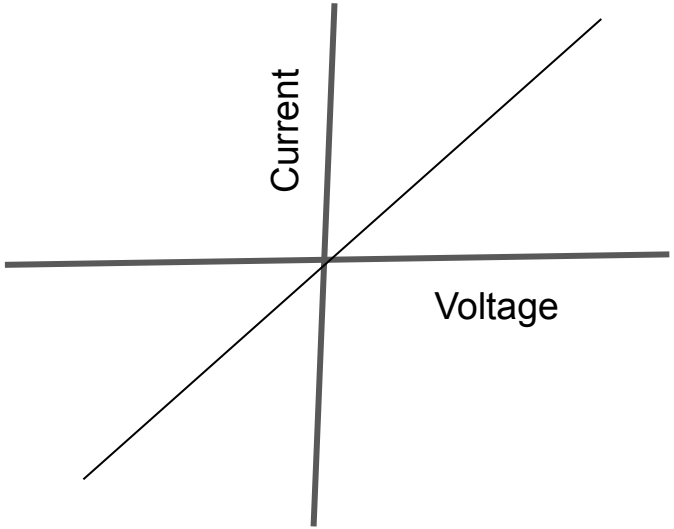
What does the gradient of a current-potential difference graph represent?

1/R.

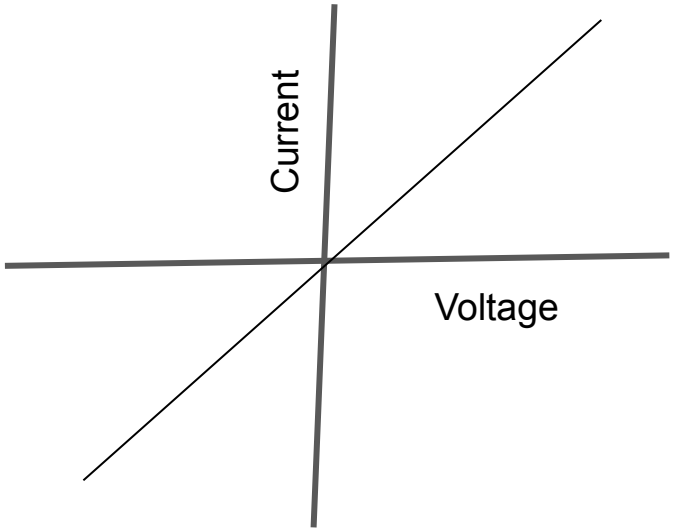
Because the gradient = rise in current/change in potential difference i.e. gradient = I/V.

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

Does this graph represent an ohmic conductor?



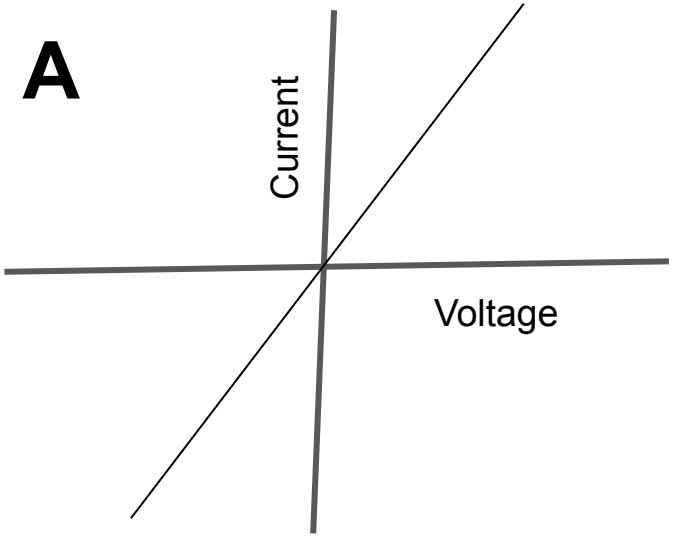
Does this graph represent an ohmic conductor?



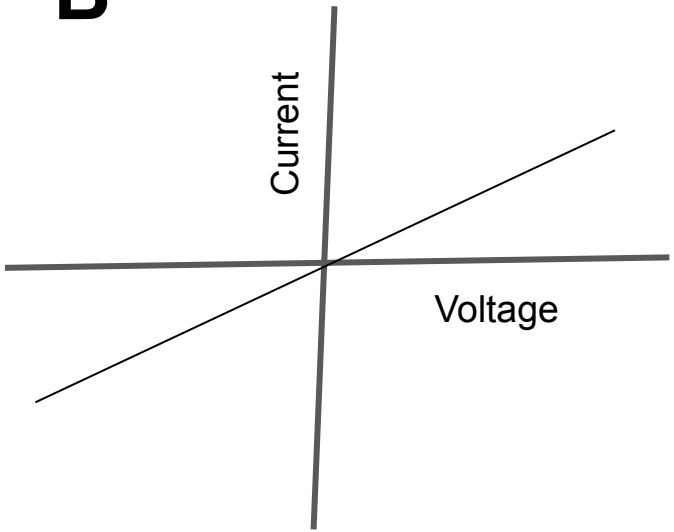
Yes, as the line has a constant gradient and passes through the origin. This shows that voltage is directly proportional to current.

Which graph represents a appliance with higher resistance?

A

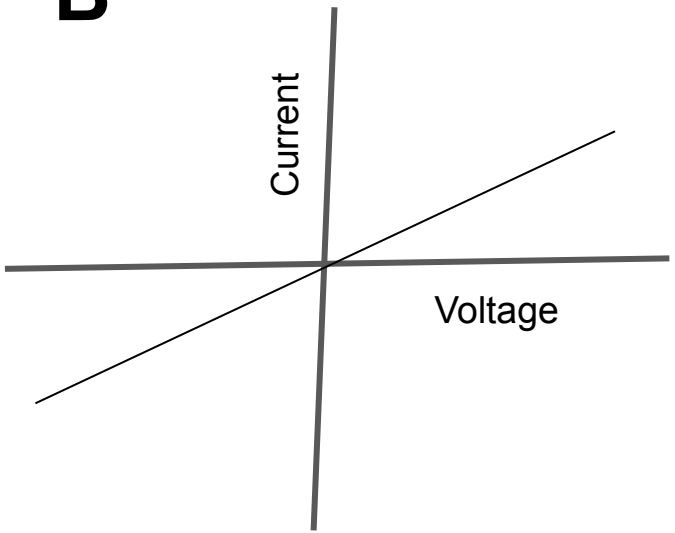


B



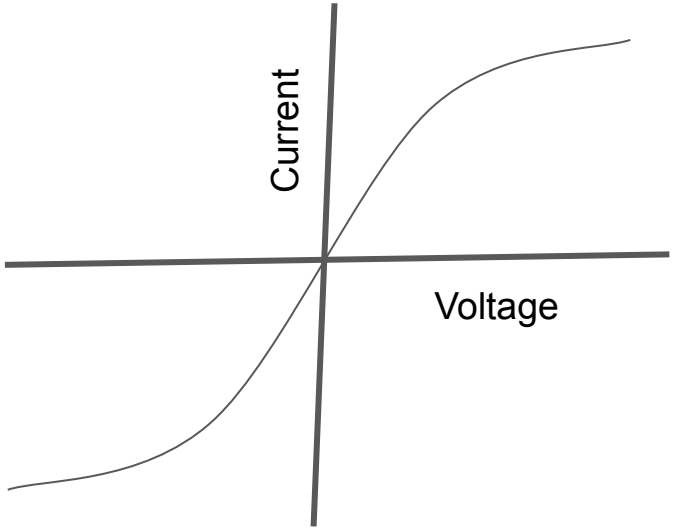
Which graph represents an appliance with a higher resistance?

B

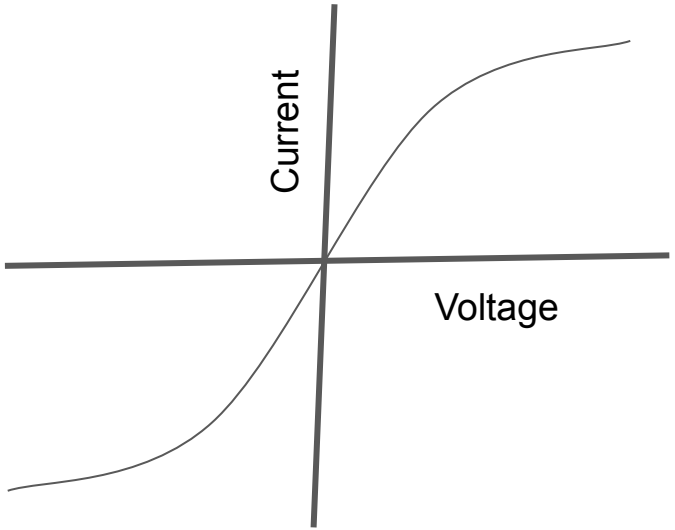


B has a shallower gradient, and as the gradient=1/R, a smaller value for the gradient = a higher value for the resistance. A higher voltage is required in B for the same change in current in comparison to A.

What common appliance could this curve represent?



What common appliance could this curve represent?



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

What is power? State the unit.

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The rate of energy transfer.

Measured in J/s or Watts (W).

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

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$$P = VI = I^2R = V^2/R$$

Is a kilowatt-hour (kWh) a unit of power, potential difference or energy?

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Energy because it's a unit of power multiplied by time.

What is meant by ‘mean drift velocity’?

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The average velocity of the charge carriers due to the applied electric field.

It has to be an average because they’re often moving randomly in all directions.

What equation uses the drift velocity to calculate current?

What equation uses the drift velocity to calculate current?

$$I = Anev$$

Where I = current, A = cross-sectional area of conductor, n = number density of charge carriers, e = the elementary charge, v = mean drift velocity

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 into heat energy.
- This causes the metal ions to vibrate with an increased amplitude.
- The electrons collide more frequently with these metal ions, resulting in an increase in resistance.

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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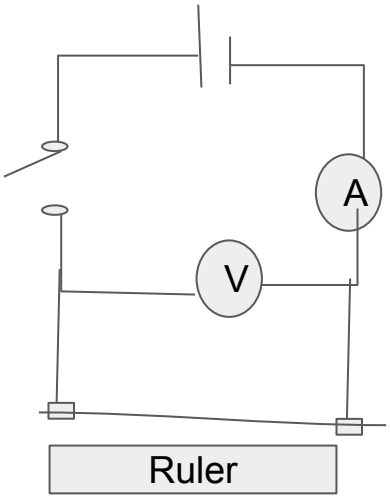


- Measure the diameter of the wire with a micrometer and calculate the cross sectional area= $\pi(d/2)^2$
- Set up circuit as shown.
- Vary the wire length and record the voltage and current for each length.
- Use R=V/I to work out the resistance.
- Plot a graph of resistance against the length.
- The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

Give the equation relating energy transferred to voltage.

Give the equation relating energy transferred to voltage.

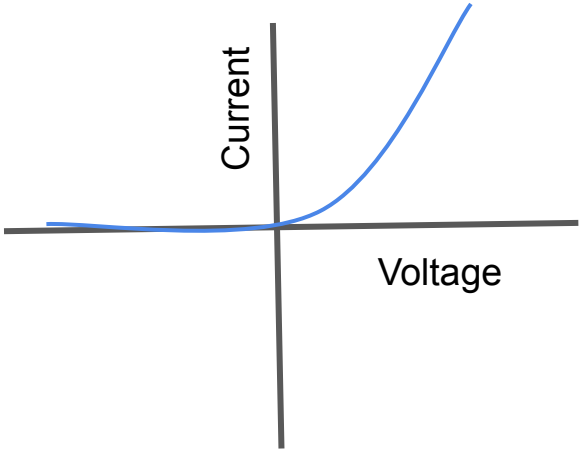
$$W = VQ$$

Where W = work done (energy transferred), V = potential difference, Q = charge.

What is a diode?

What is a diode?

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



What is a Light Dependent Resistor (LDR)?

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A semiconductor that is sensitive to light.

As the light intensity increases, the resistance decreases.

How does an NTC thermistor work?

How does an NTC thermistor work?

Similar to a LDR, but as the temperature increases, the resistance decreases.

(Note - the ‘NTC’ in NTC thermistors stands for negative temperature coefficient, explaining describing their unusual behaviour)