



Electricity-Part 3

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RESISTANCE

R



Ω

Resistance

- ❑ Resistance is a measure of the opposition to current flow in an electrical circuit.
- ❑ Resistance is measured in ohm, symbolized by the Greek letter omega (Ω).
- ❑ The unit is named after Georg Simon Ohm (1784-1854), a German physicist who studied the relationship between voltage, current and resistance.

❑ Resistance = $\frac{\text{Voltage}}{\text{Current}}$

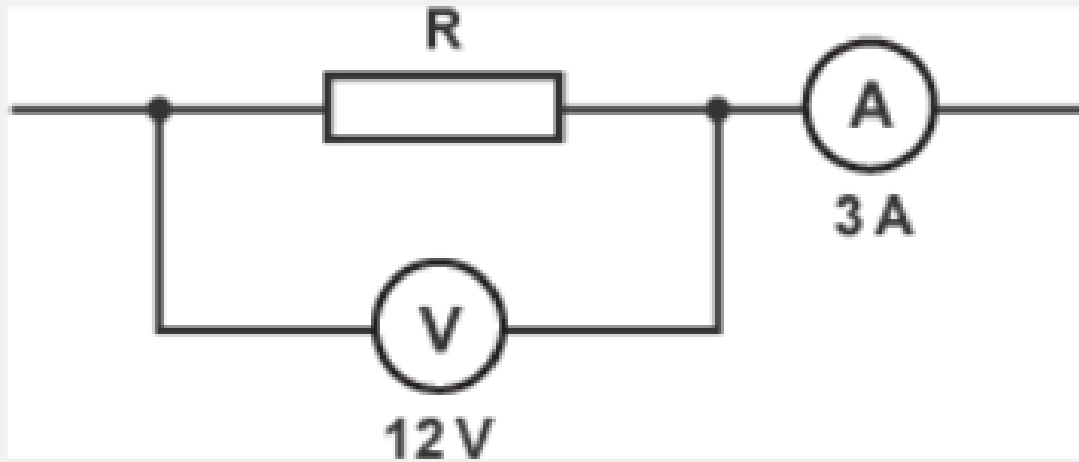
$$R = \frac{V}{I}$$

$$V = I \times R$$

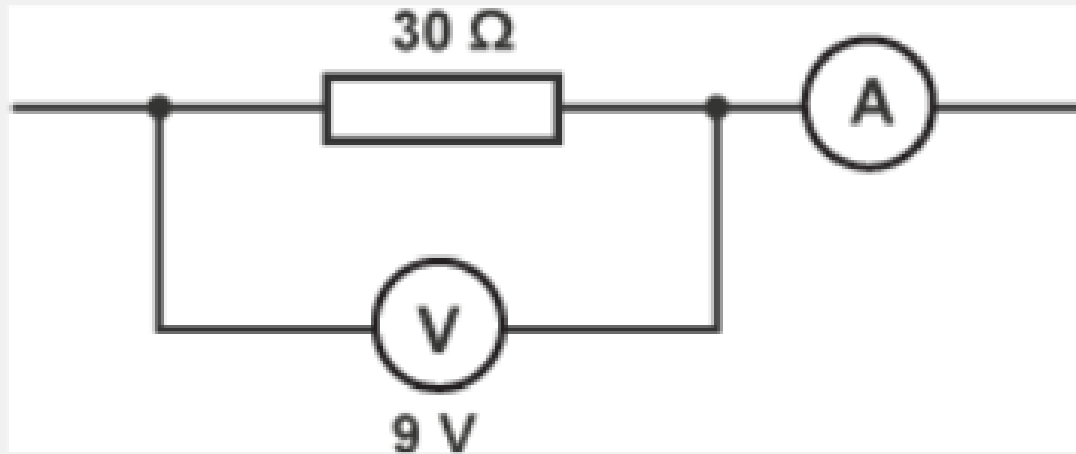
← Ohm's law

Concept learning questions.

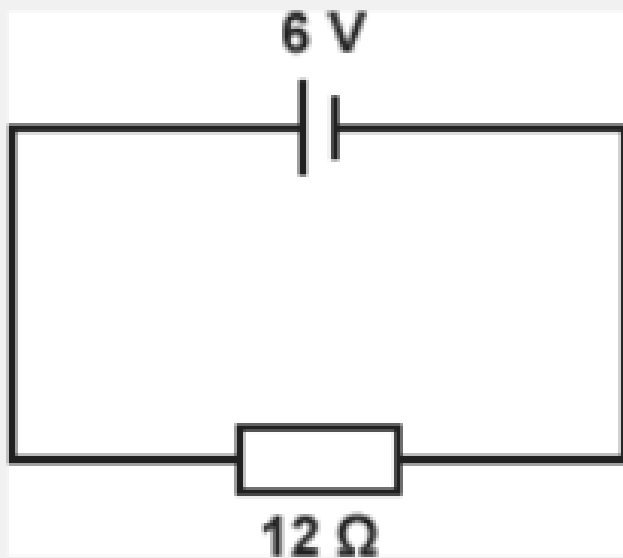
The diagram shows part of a circuit. What is the resistance of the resistor shown?



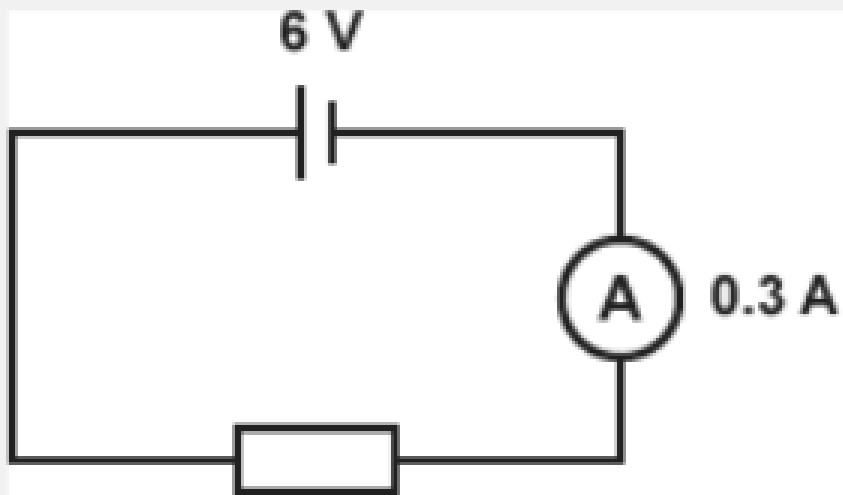
The diagram shows part of a circuit. What is the reading shown on the ammeter?



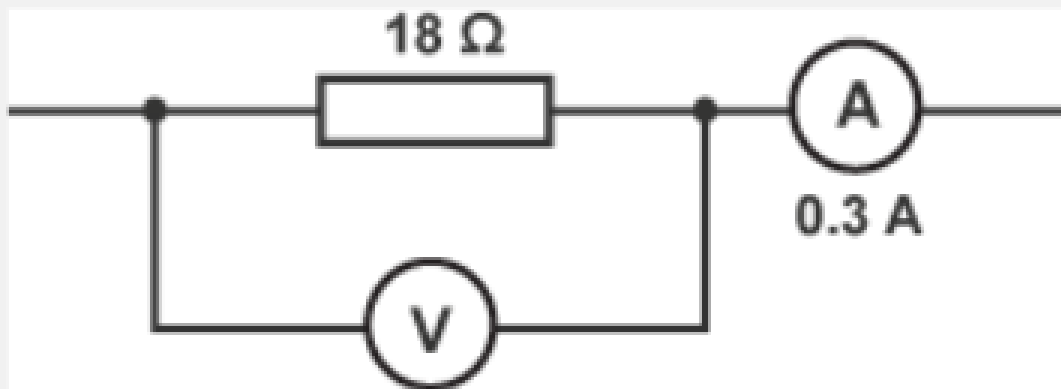
What is the current in this circuit?



What is the resistance of the resistor in this circuit?



The diagram shows part of a circuit. What is the reading displayed on the voltmeter?



Ohm's law

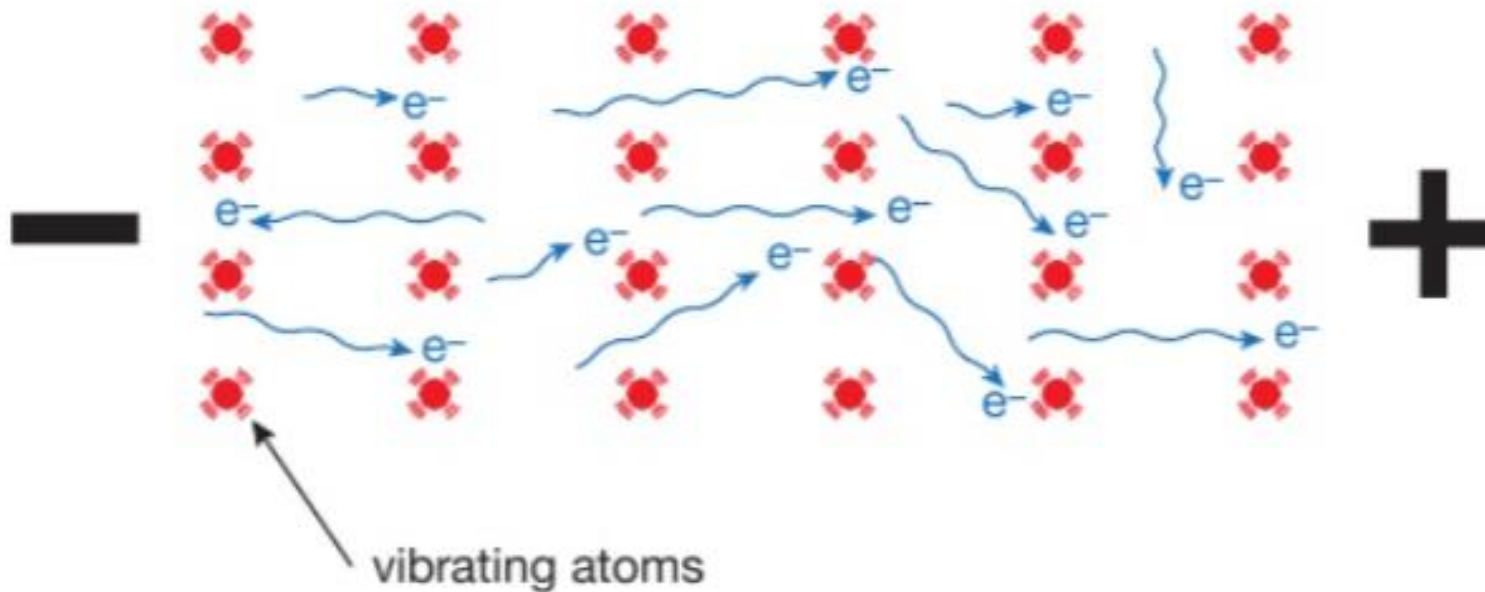
The relationship between the voltage across a component and its current is described by Ohm's law, which states:

The current in a conductor is directly proportional to the potential difference across its ends, provided its temperature remains constant.

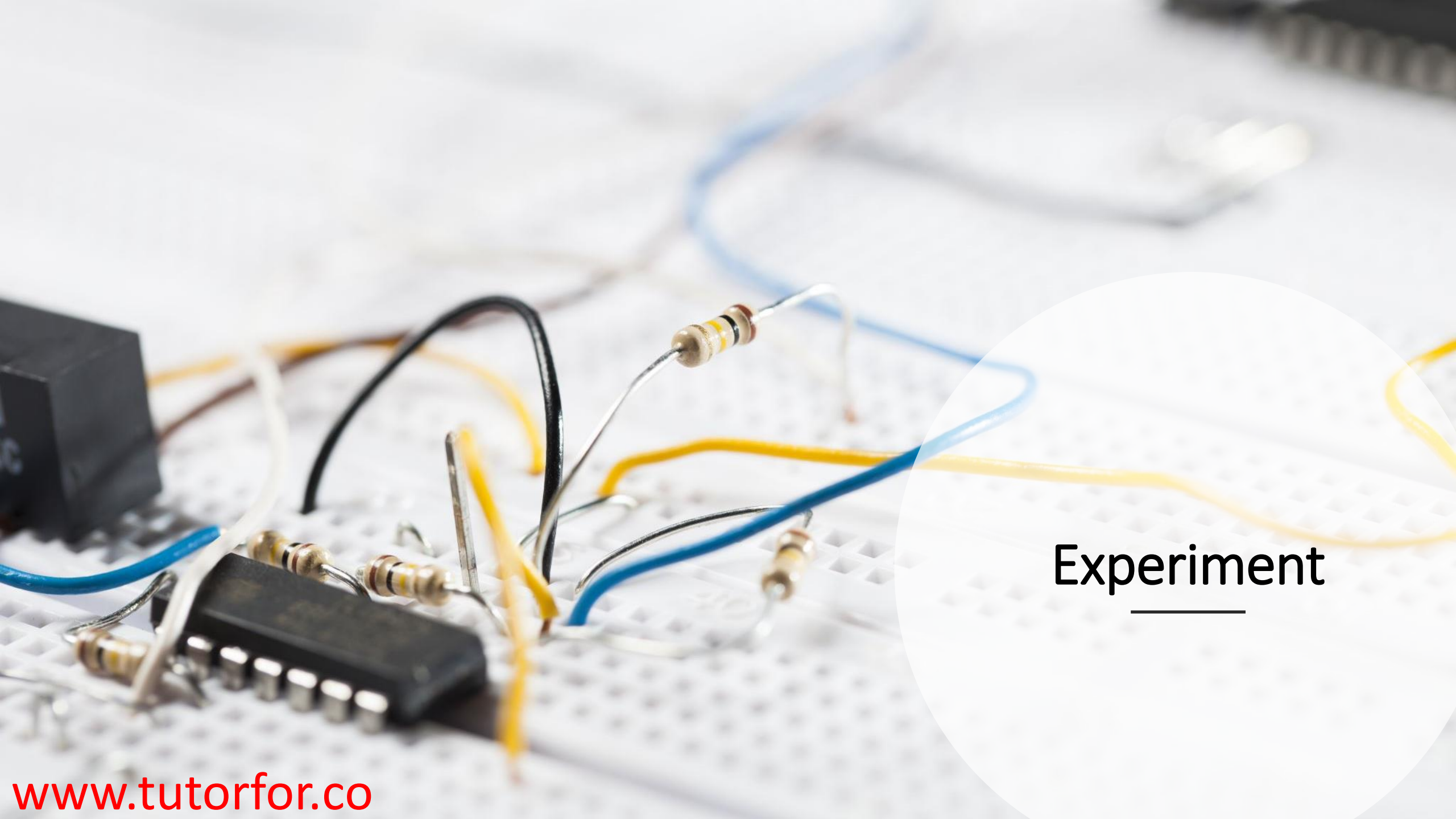
$$I \propto V$$

$$V = IR$$

When temperature of a metal increases, atoms vibrate more vigorously and disturb the flow of electrons.



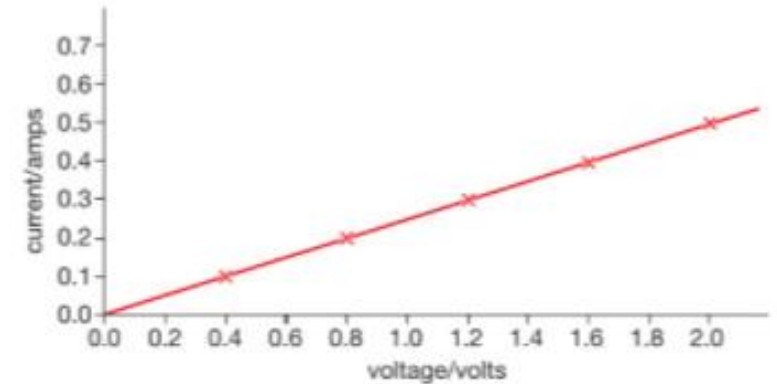
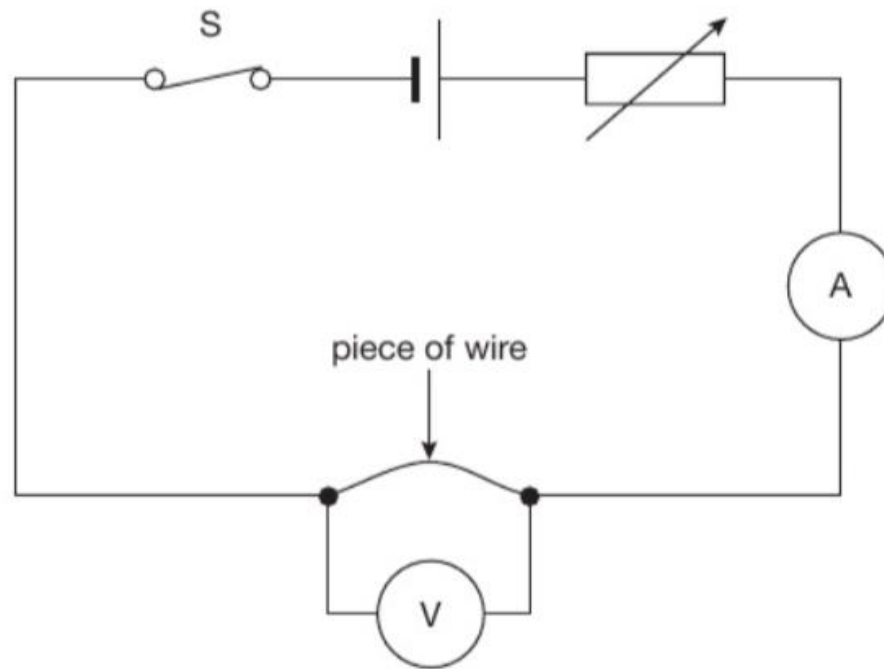
- The resistance of a metal is higher at high temperatures.
- The resistance of a metal is very low at low temperatures →
Superconductivity



Experiment

Lab Practical: Investigate how current varies with voltage for different components.

Voltage	Current



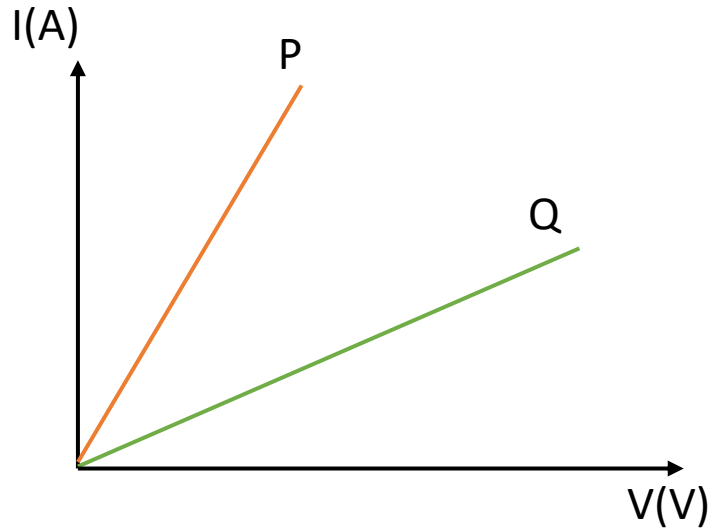
$$I = \frac{1}{R} V \rightarrow y = mx$$

$$\text{Gradient}(m) = \frac{1}{R}$$

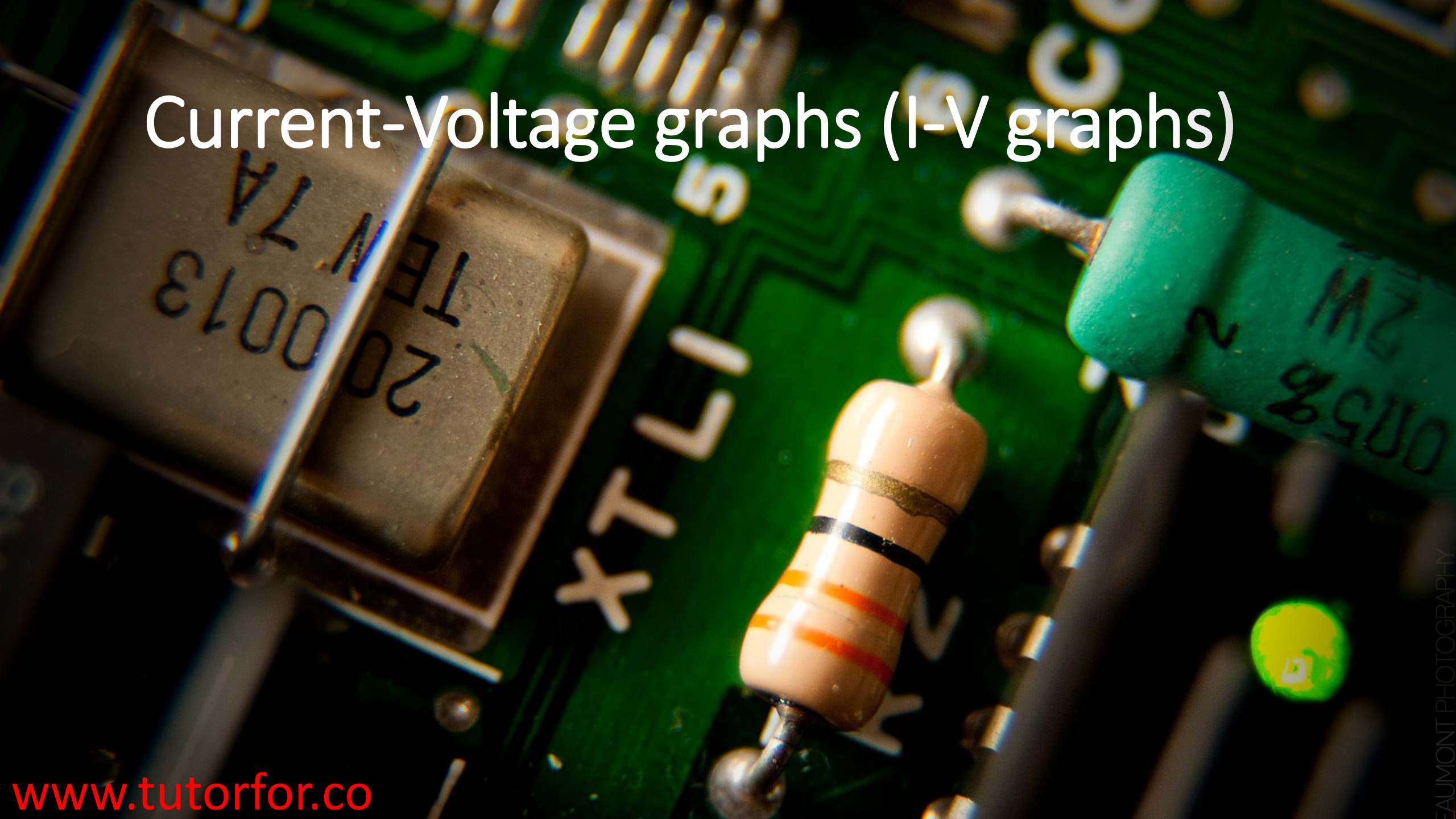
The steeper the slope the smaller the resistance

Concept learning question:

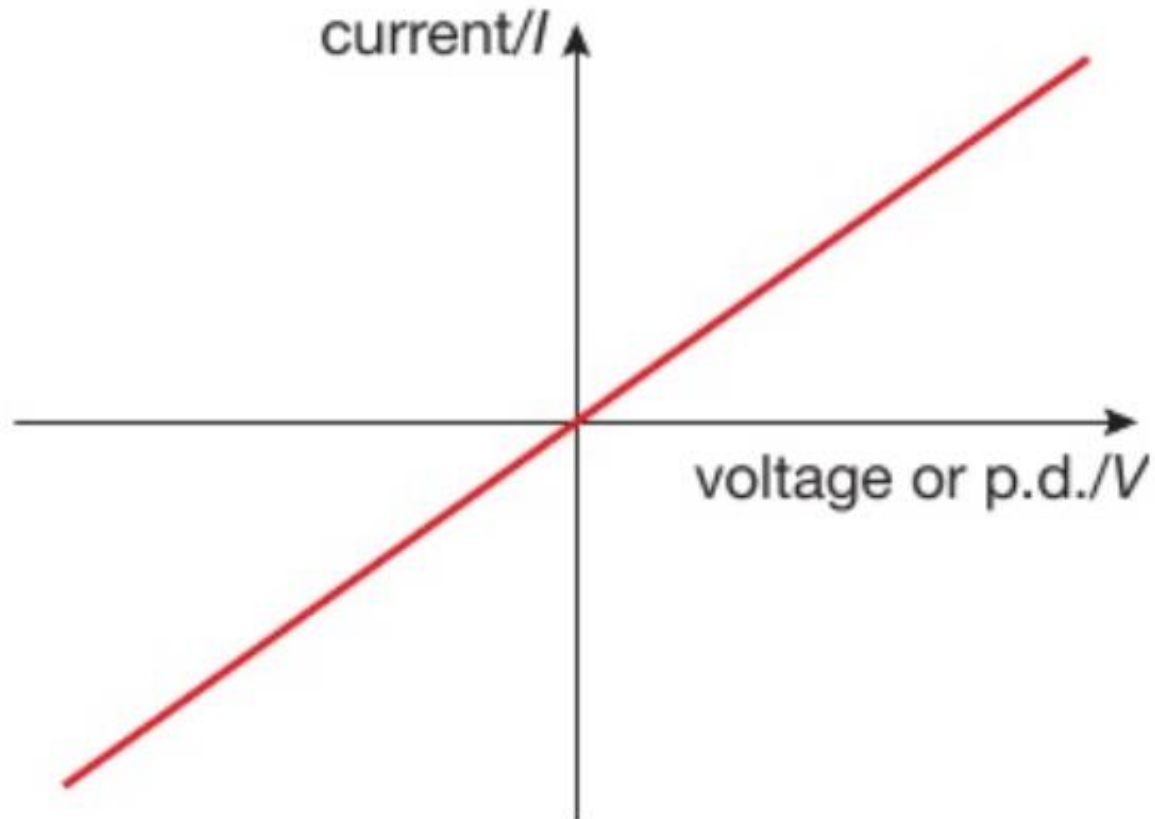
The following diagram shows I-V graph of two metal wires P and Q. Which metal has a higher resistance? Explain your answer.



Current-Voltage graphs (I-V graphs)



I-V graphs

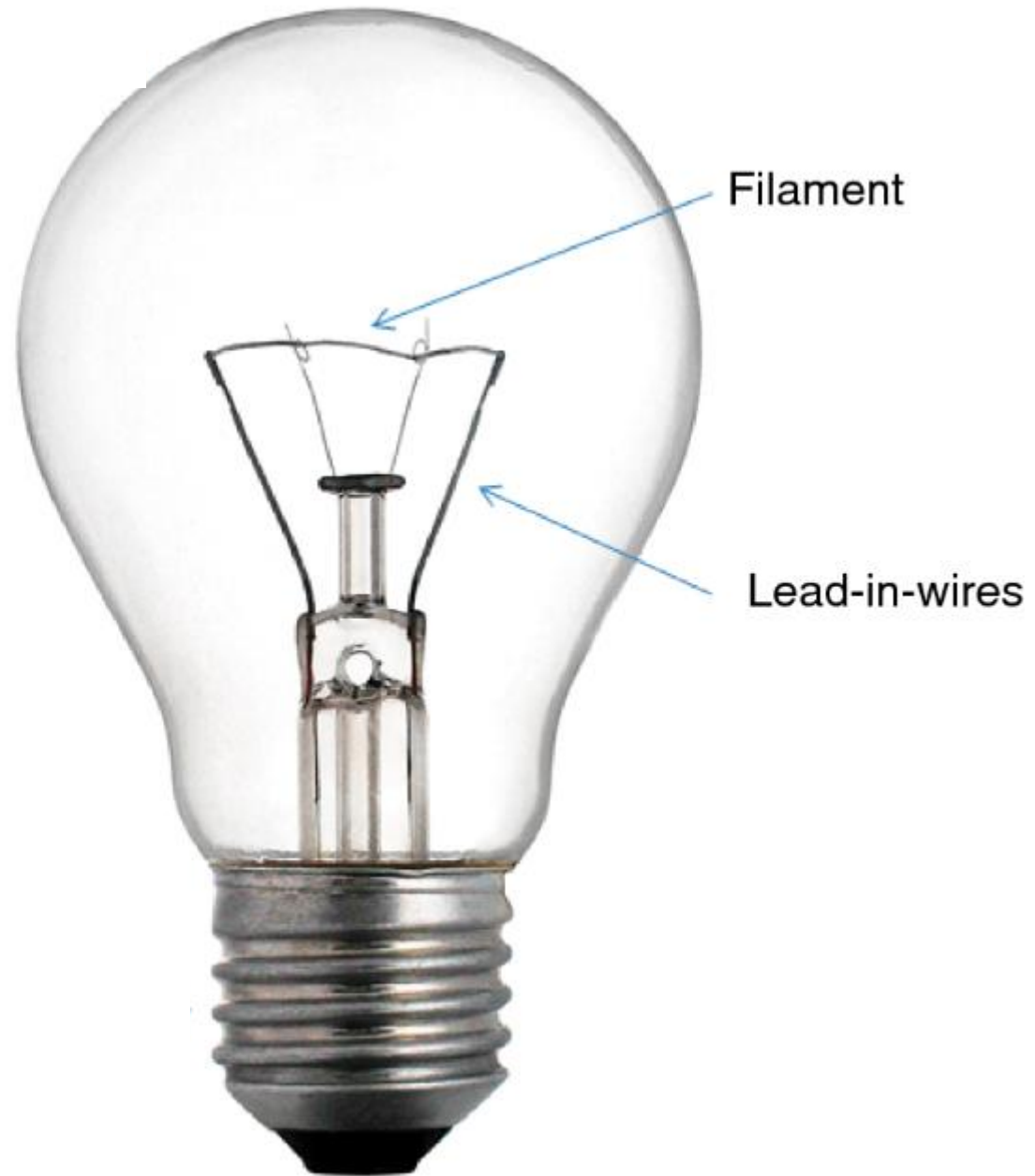


**A straight line through the origin.
Constant gradient → Constant resistance**

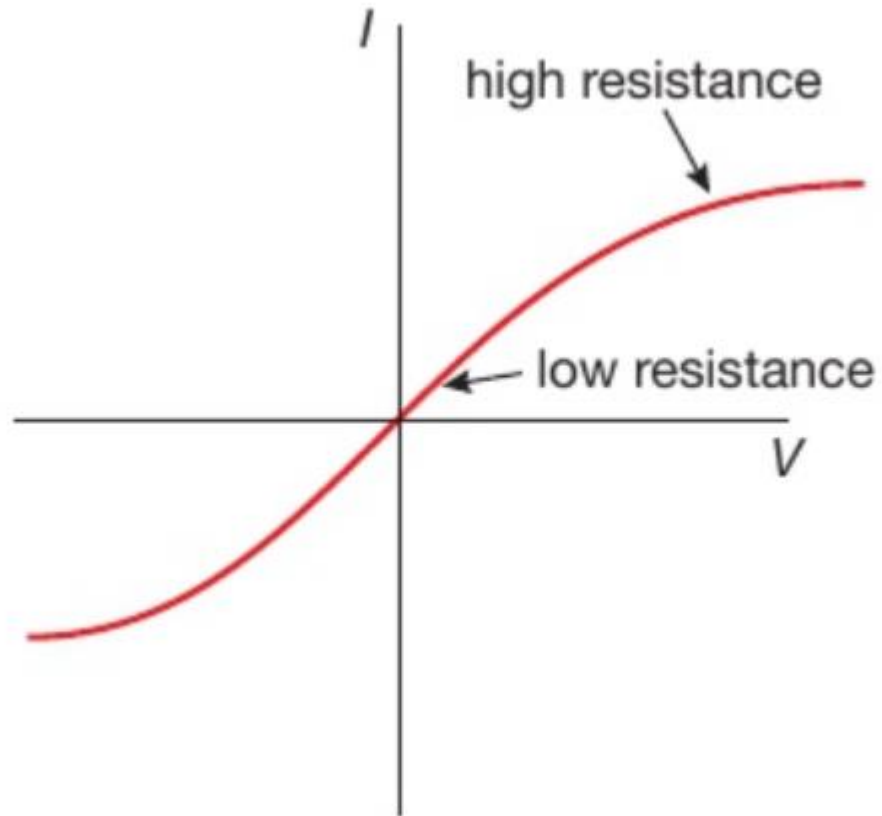
- Metal wires**
- Fixed resistors**
- Variable resistors**

They follow the Ohm's law ($V=IR$).

Filament lamp

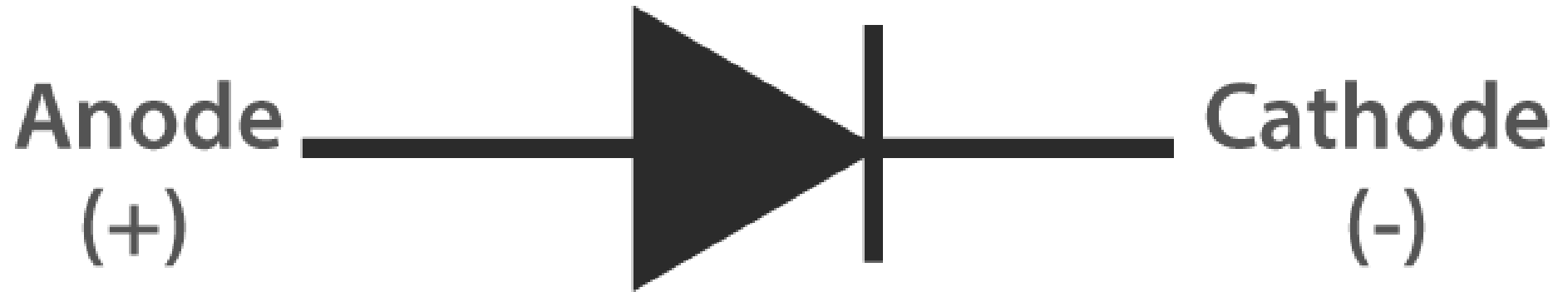


I-V graph of a filament lamp

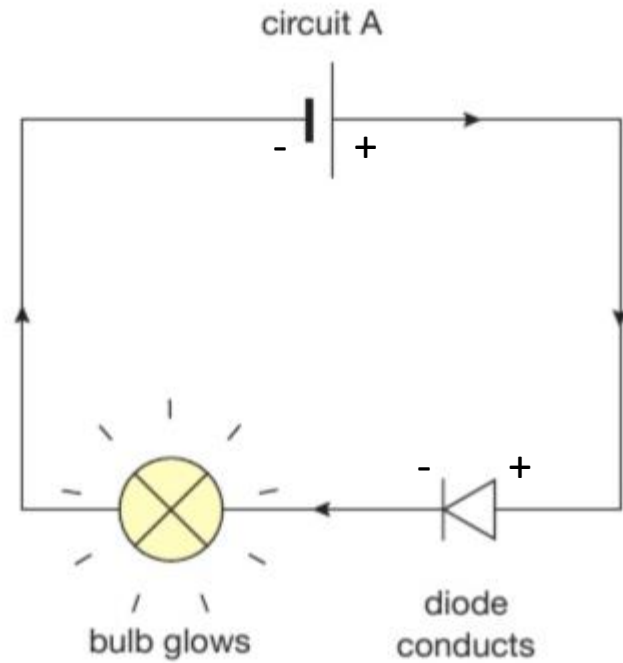


- The gradient is changing with the voltage.
- Gradient decreasing \rightarrow Resistance increasing
- When voltage increases, resistance of the filament increases.

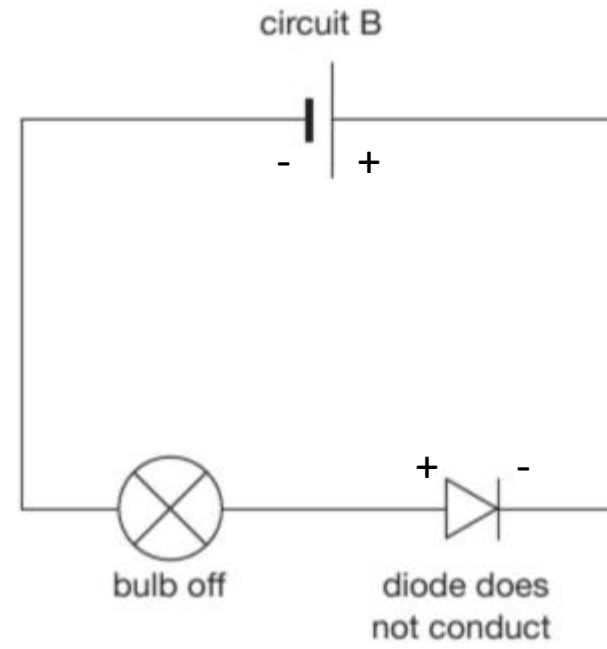
Diode



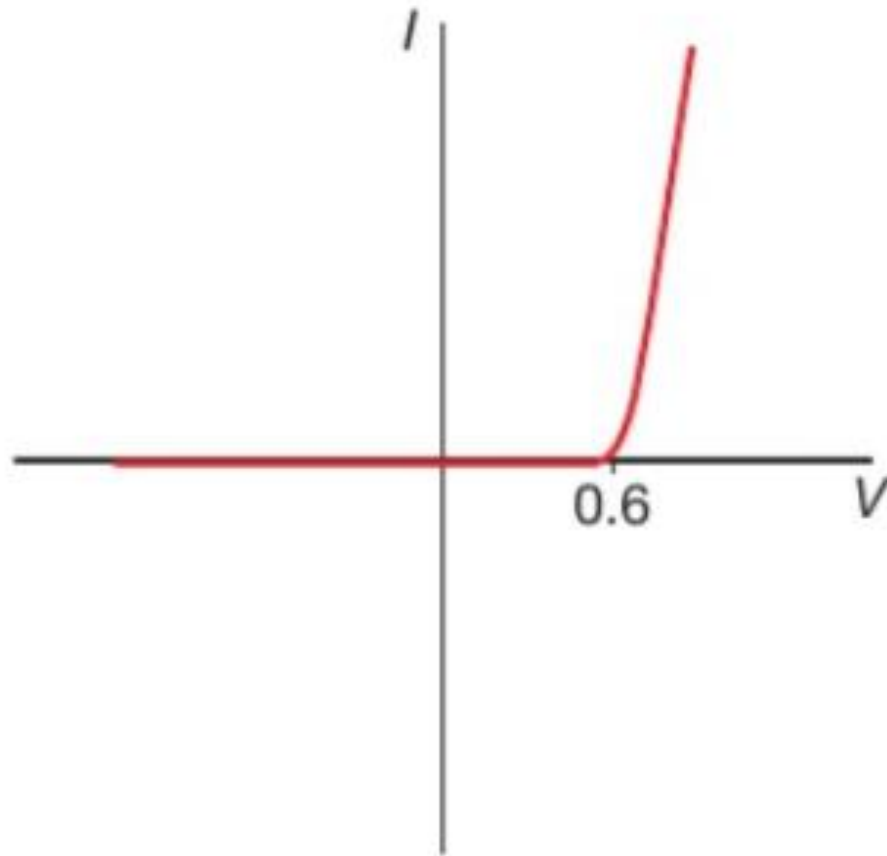
**Positive voltages
greater than +0.6 V**



**Negative voltages
across the diode**



I-V graph of a diode.



After +0.6 V :

**Higher gradient → Lower resistance
Current is higher.**

Negative voltages:

**Flat line on the x-axis
Zero gradient → Very high resistance
Current is zero**

Past exam questions

2020-May-Paper-1

- 5 A student does an investigation to determine the current-voltage graph for an unknown component, X.

The student uses this equipment

- component X
- cell
- variable resistor
- ammeter
- voltmeter
- connecting wires

- (a) Complete the circuit diagram to show how the student should set up this equipment for her investigation.

(4)

component X



2019-June

6 (a) (i) A student investigates how current varies with voltage for a metal filament lamp.

Draw a diagram of the circuit that a student could use for this investigation.

(4)

(ii) Describe a method the student could use for their investigation.

(4)

(b) The student extends the investigation by recording additional data for the lamp.

This is her method.

For each voltage

- switch the current on for 45 seconds
- record the current and colour of the lamp
- calculate the power and the energy transferred by the lamp

The table shows the student's results.

Voltage in V	Current	Power in W	Energy in J	Colour of lamp
0.0	0.00	0.0	0.0	off
2.0	0.40	0.8	36	red
4.0	0.90	3.6		orange
6.0	1.60	9.6	430	yellow
8.0	2.80	22.4	1000	white

(i) State the unit for current.

(1)

(ii) Calculate the missing value of energy for the voltage of 4.0 V.

Give your answer to 2 significant figures.

(2)

energy = J

(iii) The colour of a star is related to its surface temperature.

The Sun is yellow.

Use the student's results to identify a colour for a star that is cooler than the Sun.

(1)