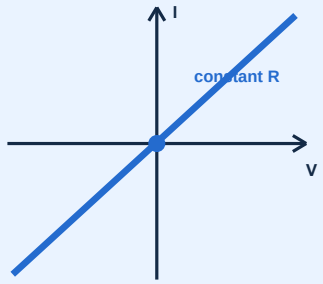
LESSON 2.2.2

I-V Characteristics

and Electrical Power

A component's current-potential difference graph reveals whether its resistance stays constant and how it transfers energy.

CURRENT-P.D. GRAPH



straight through origin

HOW TO READ AN I-V GRAPH

1 CHECK THE AXES

Current I is vertical; potential difference V is horizontal.

2 CHECK THE ORIGIN

No applied p.d. normally means no current through a passive component.

3 CHECK THE SHAPE

A changing slope signals changing resistance.

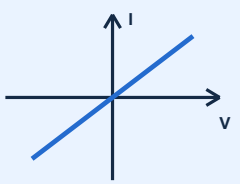
RESISTANCE FROM THE GRAPH

$$R = V/I$$

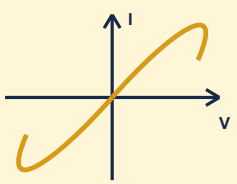
Use the coordinate values V and I at the operating point.

THE FOUR SIGNATURE SHAPES

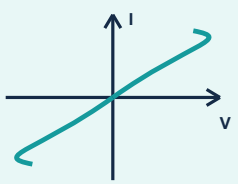
OHMIC



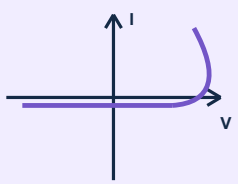
FILAMENT



THERMISTOR



DIODE



Do not use the tangent gradient as resistance: at a point, resistance is V/I.

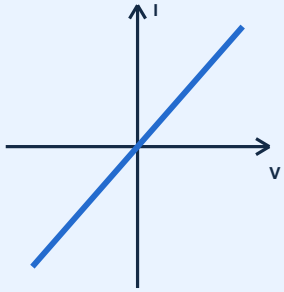
1 Recognise each I-V characteristic

The graph shape links the current response to the component's resistance and temperature.

FOUR COMPONENT PATTERNS

OHMIC CONDUCTOR

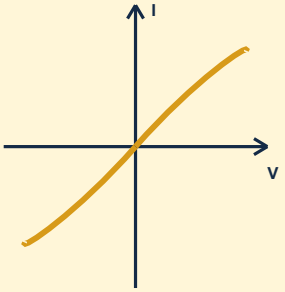
constant temperature



- Straight line through the origin.
- I is proportional to V.
- Resistance is constant.

FILAMENT BULB

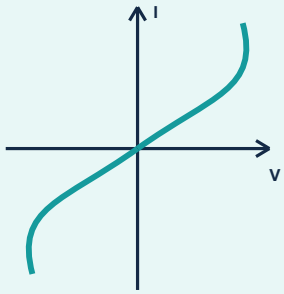
temperature rises



- Curve becomes less steep.
- Hotter lattice vibrates more.
- Resistance increases.

NTC THERMISTOR

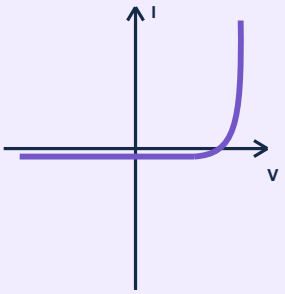
self-heating lowers R



- Curve becomes steeper.
- More charge carriers are available.
- Resistance decreases as T rises.

DIODE

one-way component



- Tiny current in reverse bias.
- Forward current rises rapidly after turn-on.
- Characteristic is not symmetric.

A steeper I-V line means more current for each volt: greater conductance and lower resistance.

2 Electrical power and energy

Power is the rate of energy transfer. Choose the equation that matches the quantities you know.

POWER EQUATIONS

CORE

$$P = VI$$

use voltage and current

SUBSTITUTE V = IR

$$P = I^2R$$

use current and resistance

SUBSTITUTE I = V/R

$$P = V^2/R$$

use voltage and resistance

ENERGY TRANSFER

$$W = Pt = VIt$$

1 watt = 1 joule per second; use time in seconds.

WORKED EXAMPLE

A 24 V heater draws 3.0 A for 15 minutes. Find its power, resistance and transferred energy.

1 CONVERT TIME

t = 15 × 60 = 900 s

2 POWER

P = VI = 24 × 3.0 = 72 W

3 RESISTANCE

R = V/I = 24/3.0 = 8.0 Ω

4 ENERGY

W = Pt = 72 × 900 = 64 800 J = 64.8 kJ

Power is measured in watts; energy is measured in joules. Do not interchange the units.