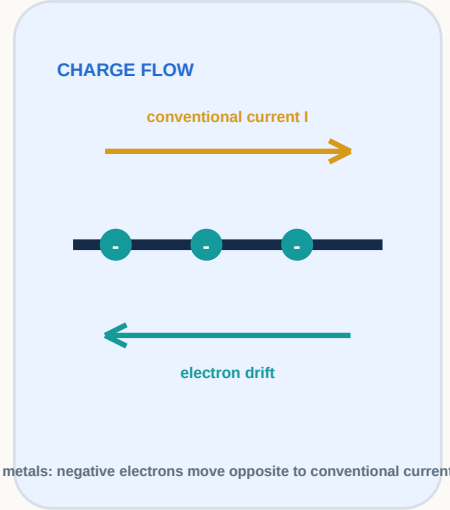
PEARSON EDEXCEL IAL PHYSICS | UNIT 2

LESSON 2.2.1

Current, Charge,

Potential Difference and Resistance

Circuits transfer energy because charge moves through potential differences. Current describes how quickly that charge flows.



metals: negative electrons move opposite to conventional current

THE FOUR CORE QUANTITIES

Q — CHARGE

Amount of electric charge carried or transferred; measured in coulombs.

I — CURRENT

Rate of flow of charge through a point; measured in amperes.

V — POTENTIAL DIFFERENCE

Energy transferred per unit charge between two points; measured in volts.

R — RESISTANCE

Potential difference per unit current for a component; measured in ohms.

RELATIONSHIPS TO LEARN

CURRENT

$$I = \Delta Q/\Delta t$$

1 ampere = 1 coulomb per second

POTENTIAL DIFFERENCE

$$V = W/Q$$

1 volt = 1 joule per coulomb

RESISTANCE

$$R = V/I$$

1 ohm = 1 volt per ampere

Current is not used up: charge is conserved as it moves around a complete circuit.

1 A linked circuit calculation

A 12 V lamp draws a current of 0.75 A for 8.0 minutes. Find the transferred charge, number of electrons, resistance and energy.

START BY CONVERTING TIME

$\Delta t = 8.0 \text{ min} \times 60 = 480 \text{ s}$

CHARGE AND NUMBER OF ELECTRONS

1 CHARGE

$Q = I\Delta t$

$Q = 0.75 \times 480 = 360 \text{ C}$

2 ELECTRONS

$N = Q/e$

$N = 360/(1.60 \times 10^{-19})$

$N = 2.25 \times 10^{21}$

RESISTANCE AND ENERGY

3 RESISTANCE

$R = V/I$

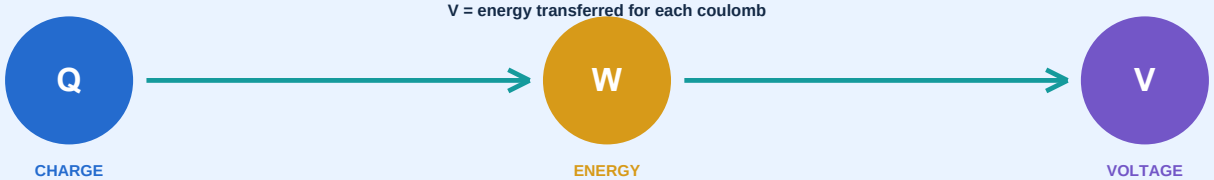
$R = 12/0.75 = 16\ \Omega$

4 ENERGY

$W = VQ$

$W = 12 \times 360 = 4320 \text{ J}$

WHAT POTENTIAL DIFFERENCE MEANS



SENSE CHECK

A current of 0.75 A transfers 0.75 C each second. Over 480 s, 360 C is reasonable.

2 Measuring current, voltage and resistance

An ammeter measures charge flow through a component. A voltmeter compares energy per charge between two points.

CONNECT THE METERS CORRECTLY



WHAT EACH METER DOES

A SERIES

Measures the current through the component.

Ideal ammeter: negligible resistance.

V PARALLEL

Measures potential difference across the component.

Ideal voltmeter: very large resistance.

DETERMINE RESISTANCE

measure V and I → calculate R = V/I

Resistance describes how much potential difference is needed to produce each ampere of current under those conditions.

COMMON CIRCUIT MISCONCEPTIONS

CURRENT

Charge flows; current is its rate of flow.

VOLTAGE

A potential difference exists between two points.

RESISTANCE

It is not a force; it is the ratio V/I.

Never place an ammeter directly across a supply: its low resistance can cause a large current.