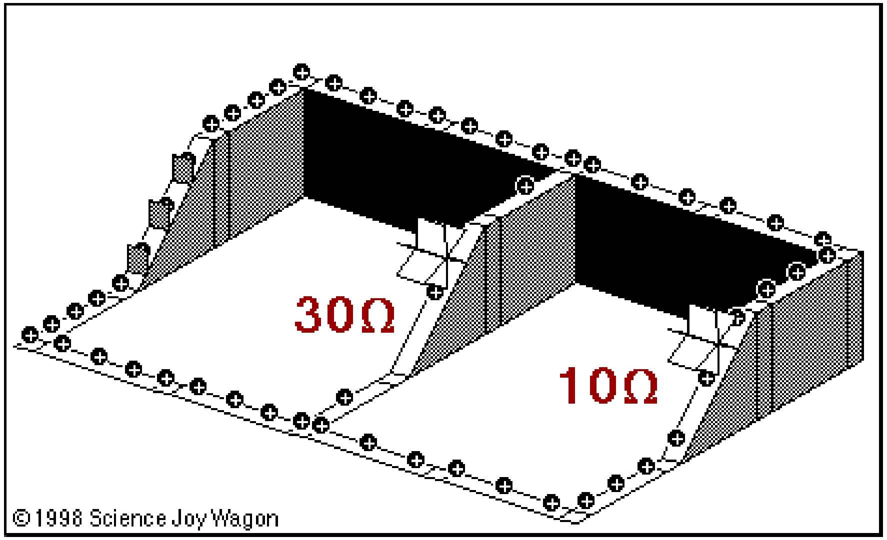
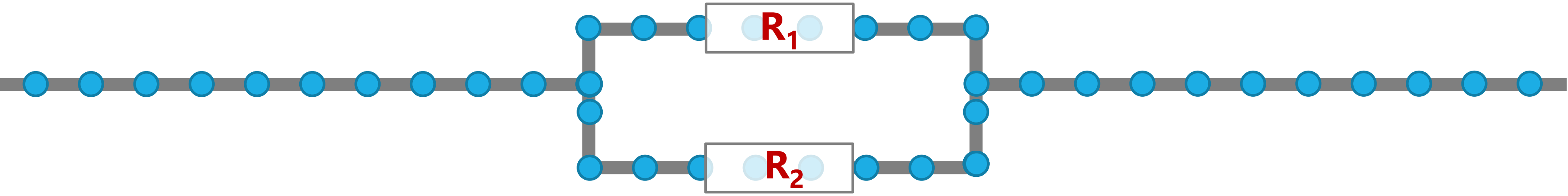
Circuit Analysis

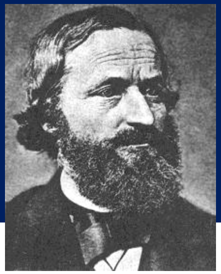
IB PHYSICS | ELECTRICITY

Review of Parallel Circuits

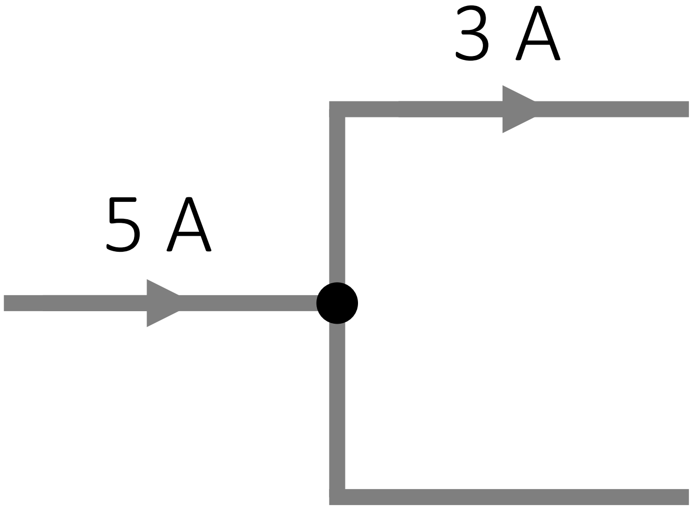


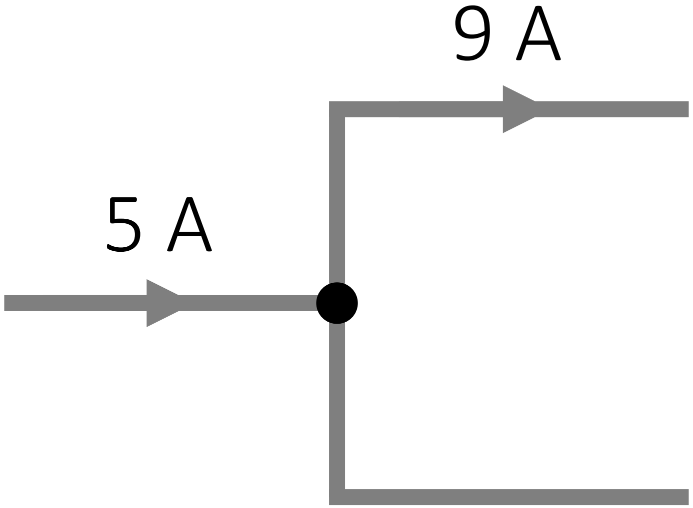


Kirchhoff's First Law

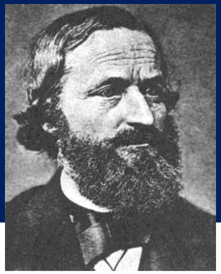


The total current coming into a junction must equal the total current leaving the same junction





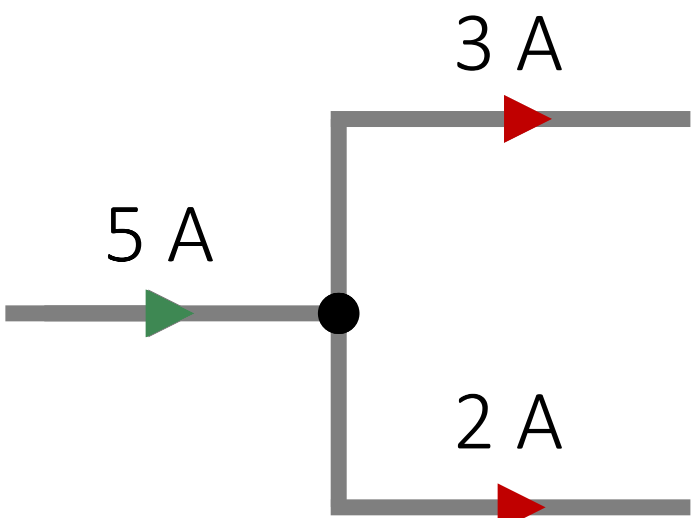
Kirchhoff's First Law



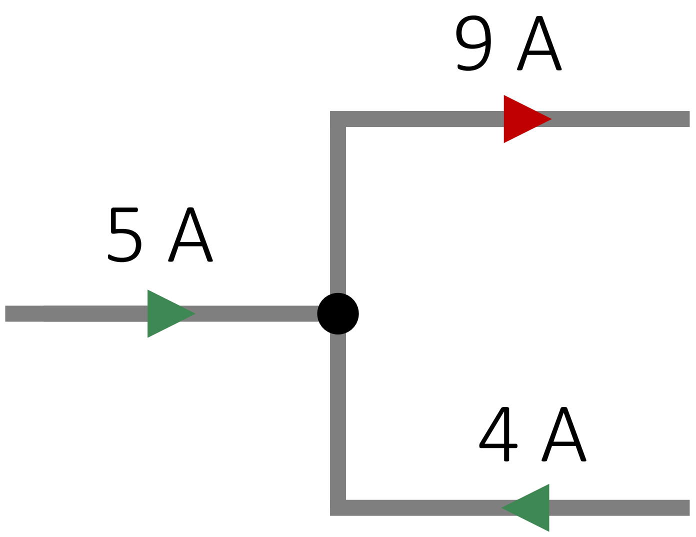
$$\Sigma I = 0 \;\; (junction)$$

Entering Junction	→●	Positive
Exiting Junction	●→	Negative

(   ) + (   ) + (   ) = 0



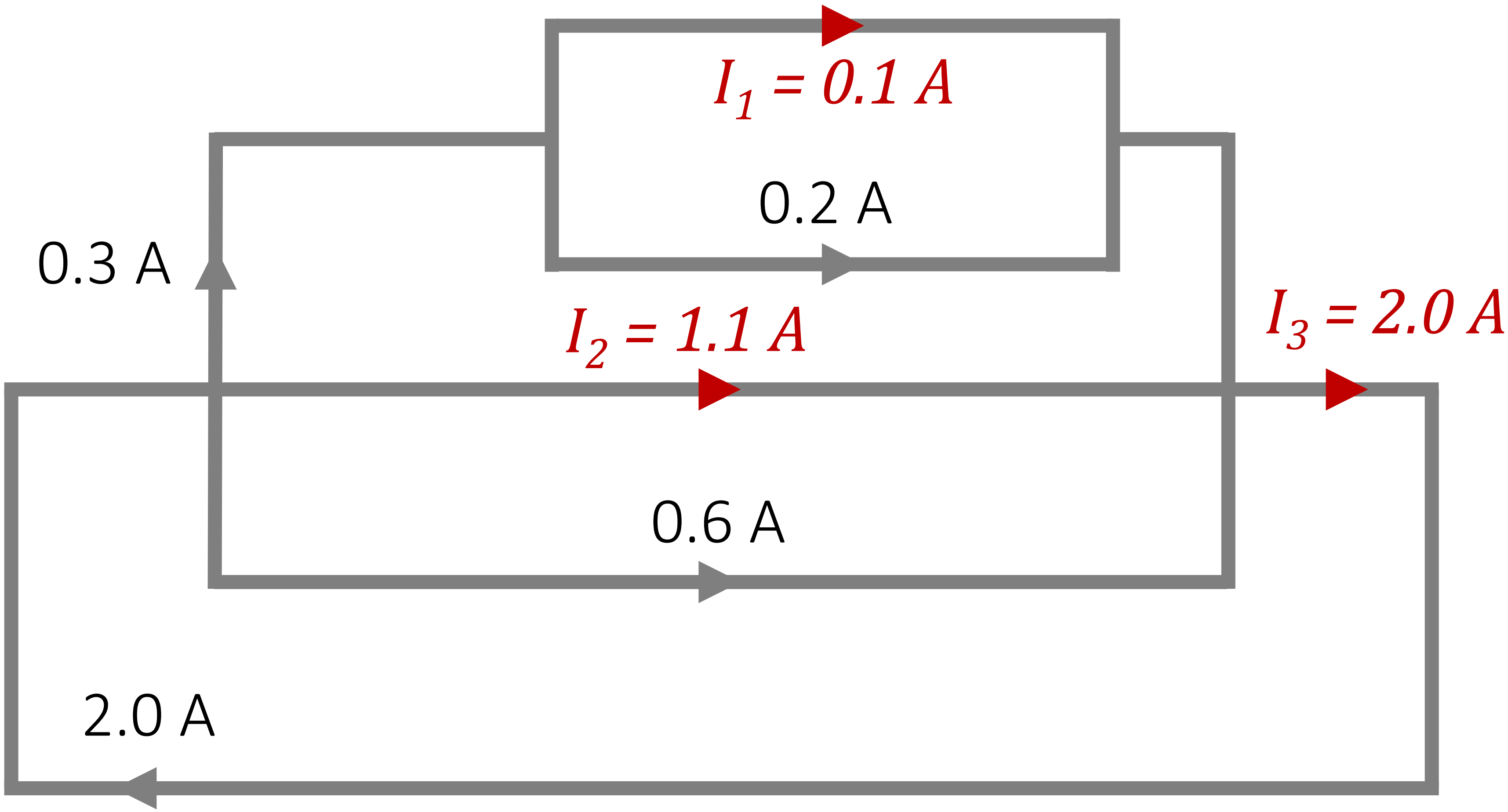
(   ) + (   ) + (   ) = 0



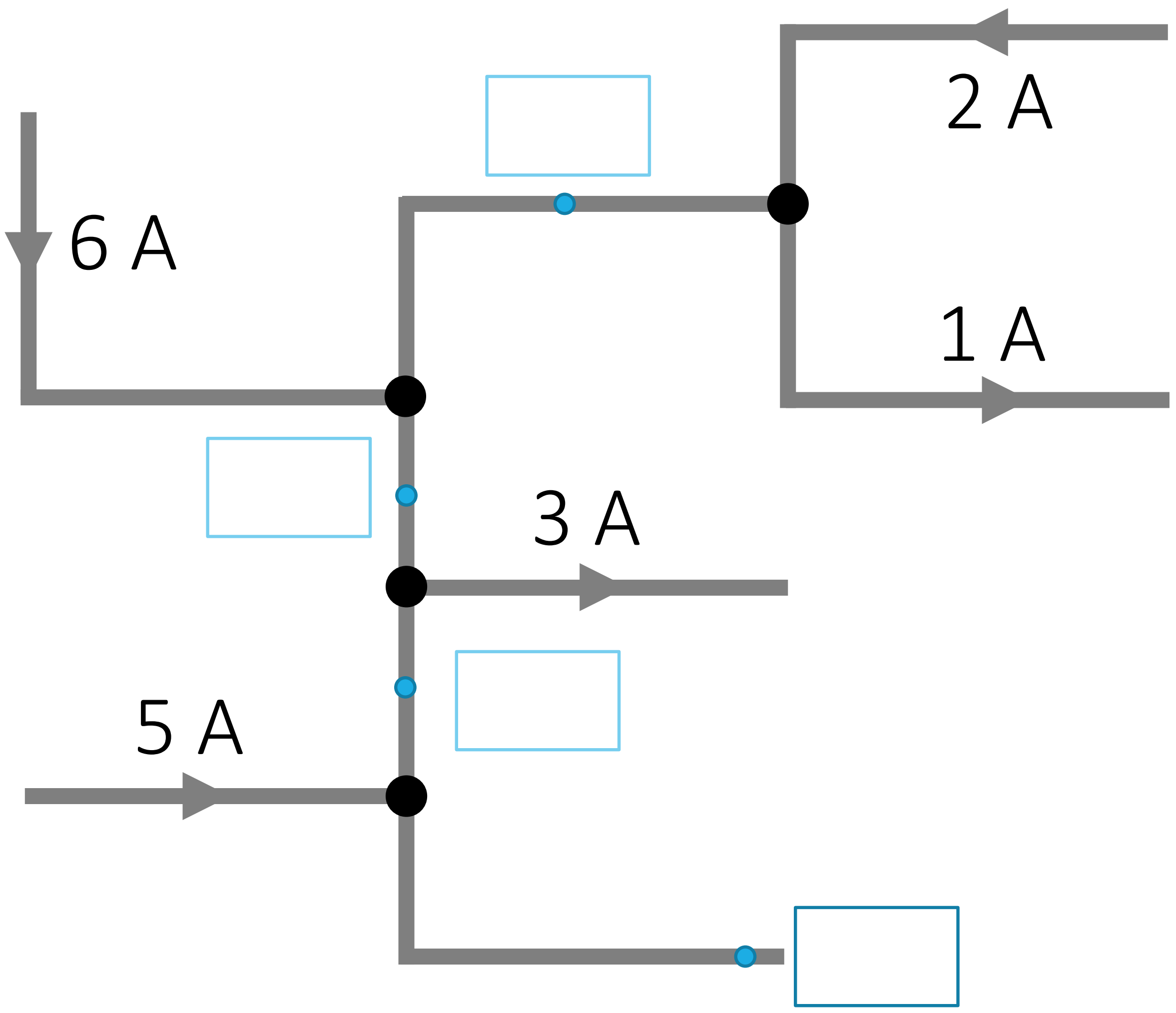
IB Physics Data Booklet

Sub-topic 5.1 – Electric fields	Sub-topic 5.2 – Heating effect of electric currents
$I = \frac{\Delta q}{\Delta t}$ $F = k\frac{q_1 q_2}{r^2}$ $k = \frac{1}{4\pi\varepsilon_0}$ $V = \frac{W}{q}$ $E = \frac{F}{q}$ $I = nAvq$	Kirchhoff's circuit laws: $\Sigma V = 0$ (loop) $\boxed{\Sigma I = 0 \text{ (junction)}}$ $R = \frac{V}{I}$ $P = VI = I^2 R = \frac{V^2}{R}$ $R_{\text{total}} = R_1 + R_2 + \cdots$ $\frac{1}{R_{\text{total}}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$ $\rho = \frac{RA}{L}$
Sub-topic 5.3 – Electric cells	**Sub-topic 5.4 – Magnetic effects of electric currents**
$\varepsilon = I(R + r)$	$F = qvB\sin\theta$ $F = BIL\sin\theta$

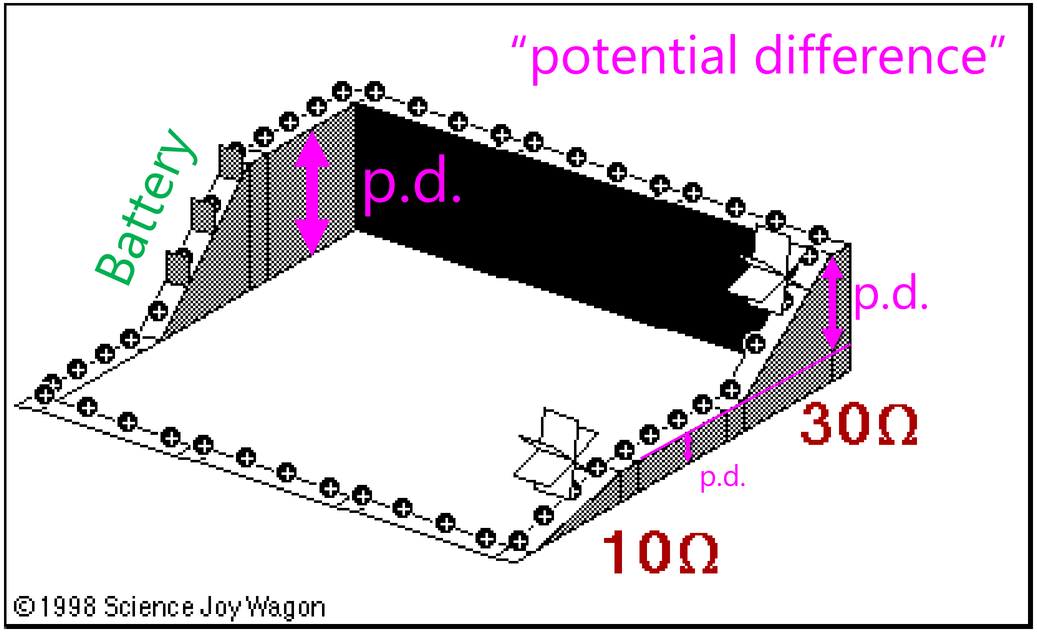
Find the Missing Currents



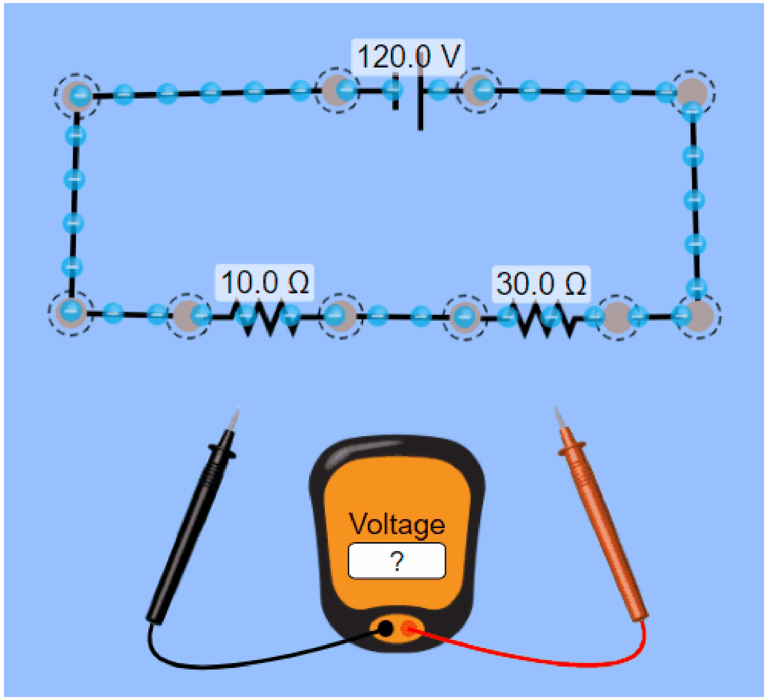
Follow the Current...



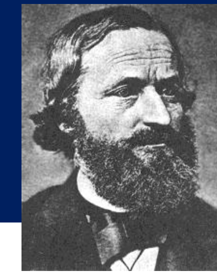
Review of the Water Flow Model



Each resistor has a "voltage drop"



Kirchhoff's Second Law



The sum of the voltages (potential differences) provided must equal the voltages dissipated across components

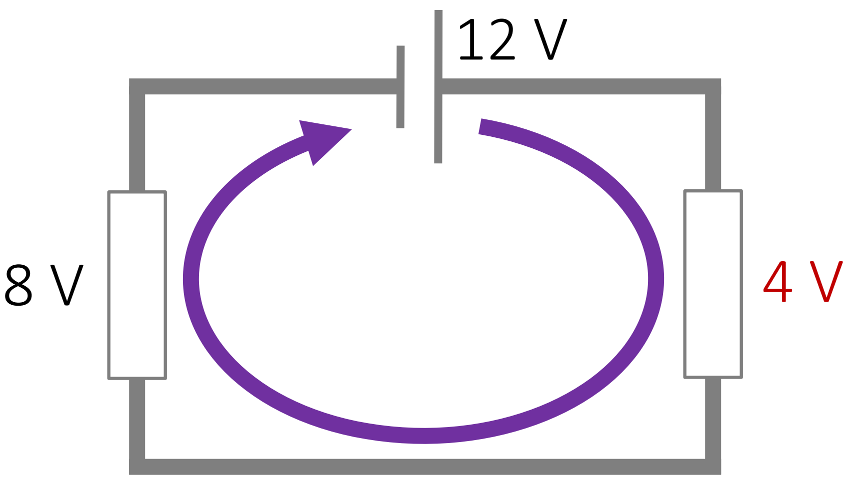
$$\Sigma V = 0 \ \ (loop)$$

Across Batteries

Negative to Positive	→ ⊣⊢	Positive
Positive to Negative	→ ⊢⊣	Negative

Over Resistors:

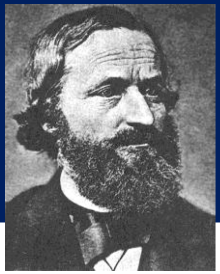
Always Negative



$$(+12) + (-4) + (-8) = 0$$

Resistor

Kirchhoff’s Second Law



$$\Sigma V = 0 \ \ (loop)$$

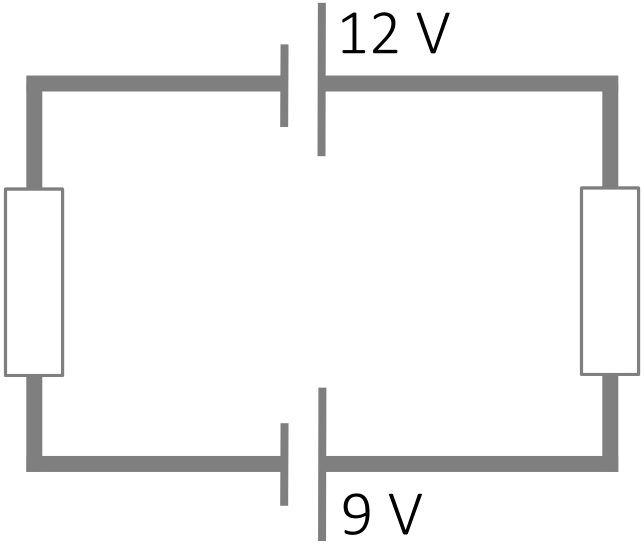
Across Batteries

Negative to Positive	$\rightarrow$ ⊣⊢	Positive
Positive to Negative	$\rightarrow$ ⊣⊢	Negative

Over Resistors:

Always Negative

$$(\quad\quad) + (\quad) + (\quad\quad) + (\quad) = 0$$



IB Physics Data Booklet

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Sub-topic 5.3 – Electric cells	**Sub-topic 5.4 – Magnetic effects of electric currents**
$\varepsilon = I(R + r)$	$F = qvB\sin\theta$ $F = BIL\sin\theta$

The Tools for your Toolbox ☺

Ohm's Law: If you know two of the three electrical properties: V, I, or R

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

Kirchhoff's Voltage Law	Kirchhoff's Current Law
$\Sigma V = 0 \ \ (loop)$	$\Sigma I = 0 \ \ (junction)$

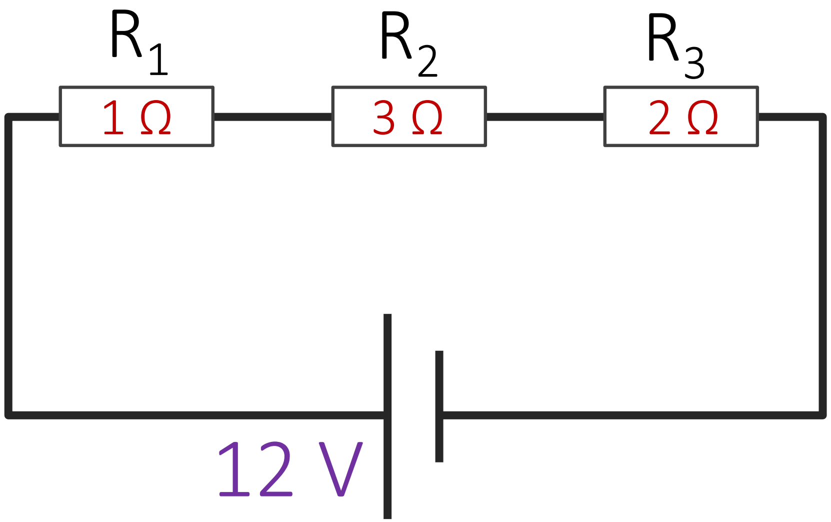
Series Combination

$$R_{total} = R_1 + R_2 + \cdots$$

Parallel Combination

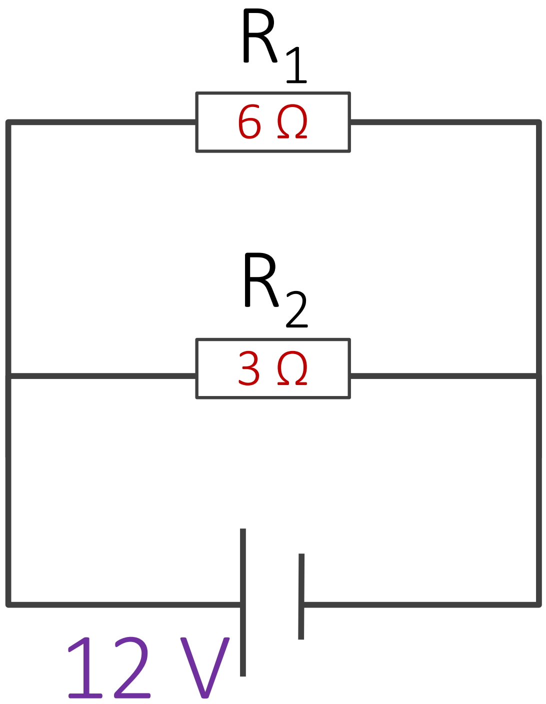
$$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$$

Calculating Circuits - Series



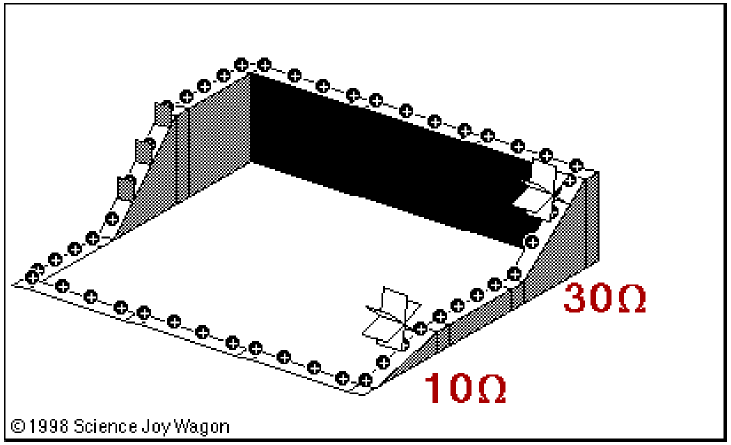
	V	I	R
R_1			1 Ω
R_2			3 Ω
R_3			2 Ω
Total	12 V		

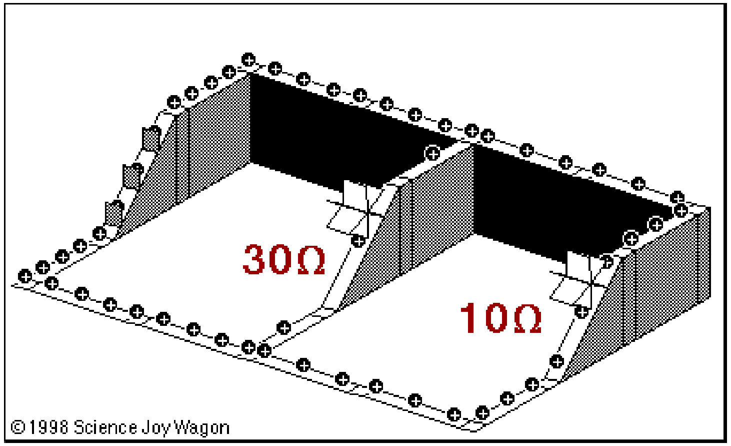
Calculating Circuits - Parallel



	V	I	R
R_1			6 Ω
R_2			3 Ω
Total	12 V		

Patterns


30Ω
10Ω
©1998 Science Joy Wagon


30Ω
10Ω
©1998 Science Joy Wagon

Lesson Takeaways

- ❑ I can use Kirchhoff's First Law to determine an unknown current at a junction
- ❑ I can use Kirchhoff's Second Law to determine an unknown voltage drop in a loop
- ❑ I can calculate voltage, current, and resistance for every component in a simple series or parallel circuit
- ❑ I can compare and contrast the properties for simple series and parallel circuits