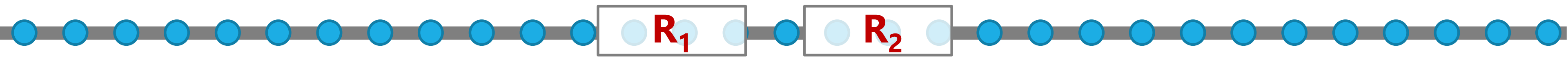
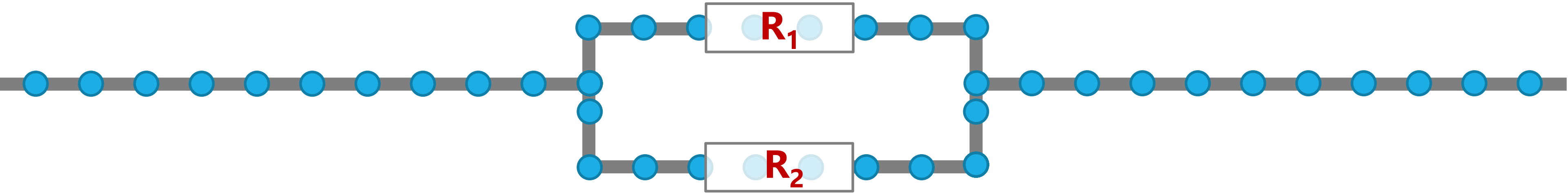
Equivalent Resistance

IB PHYSICS | ELECTRICITY

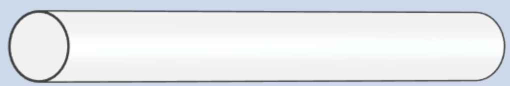
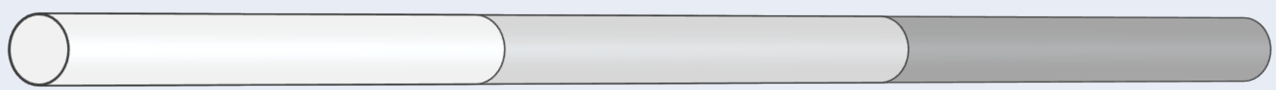
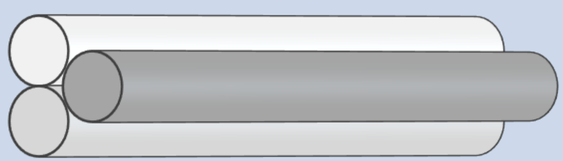
Series and Parallel



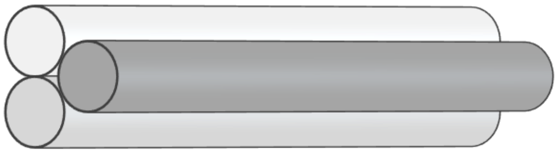


Straw "Resistor"

A good physical model for current travelling through resistors is blowing through a straw.

1 resistor	
3 resistors in series	
3 resistors in parallel	

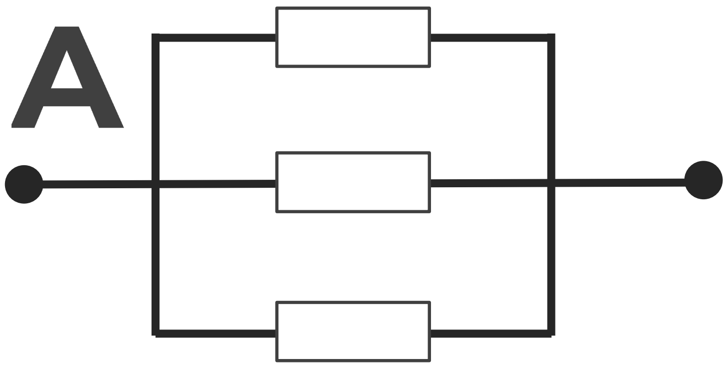
Combining Resistors



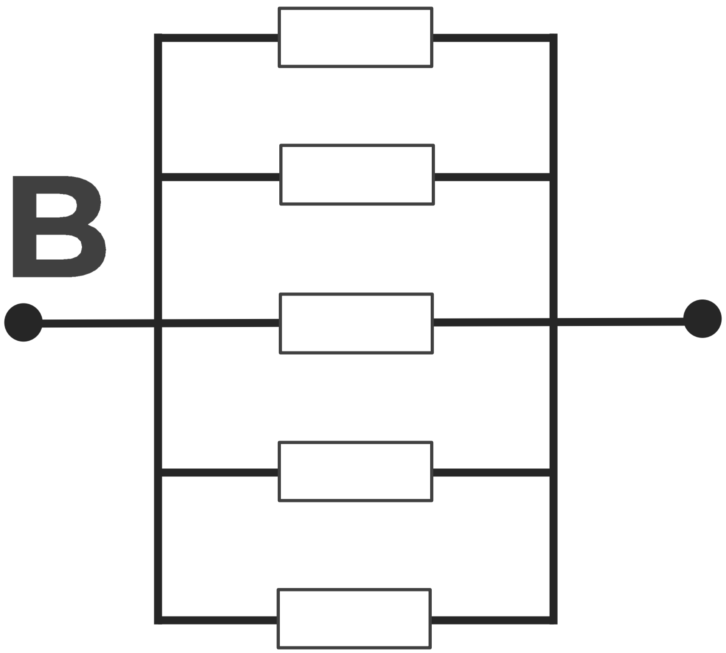
Compare these Combos…

Which example has the lowest overall resistance?
Assume that every resistor is the same.

A



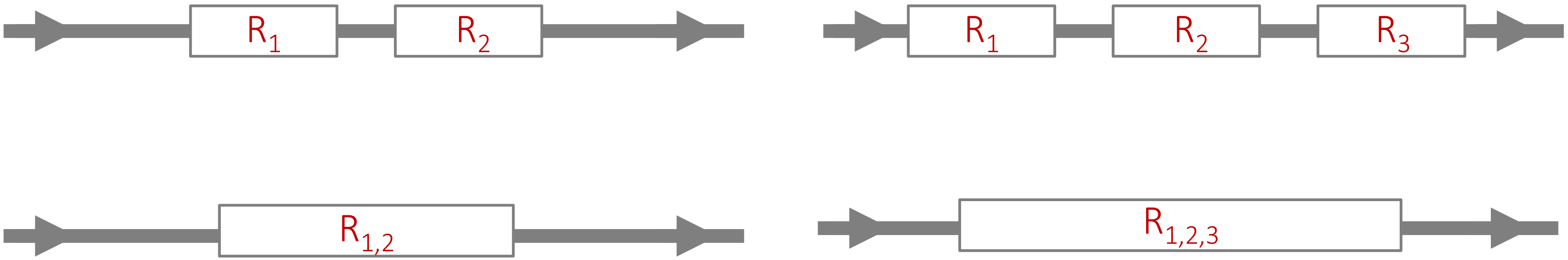
B



Combining Resistors | Series

When combining resistors in series, the resistances are simply added up as if they were one large resistor

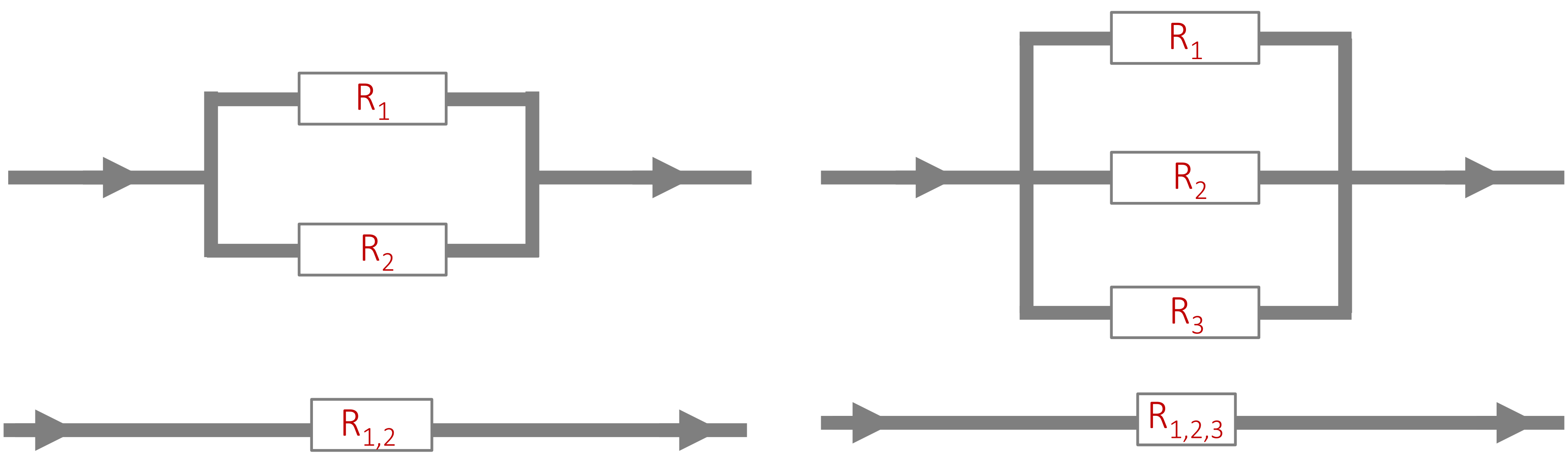
$$R_{total} = R_1 + R_2 + \cdots$$



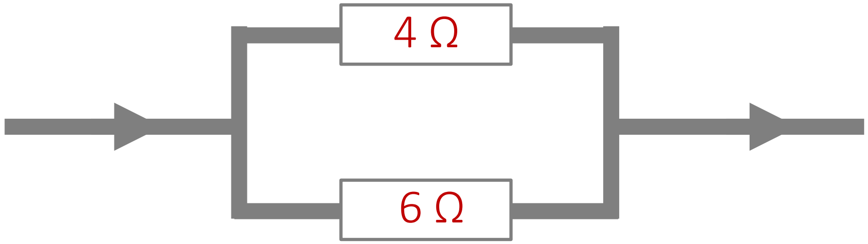
Combining Resistors | Parallel

When combining resistors in parallel, the overall resistance decreases to produce a smaller equivalent resistance

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



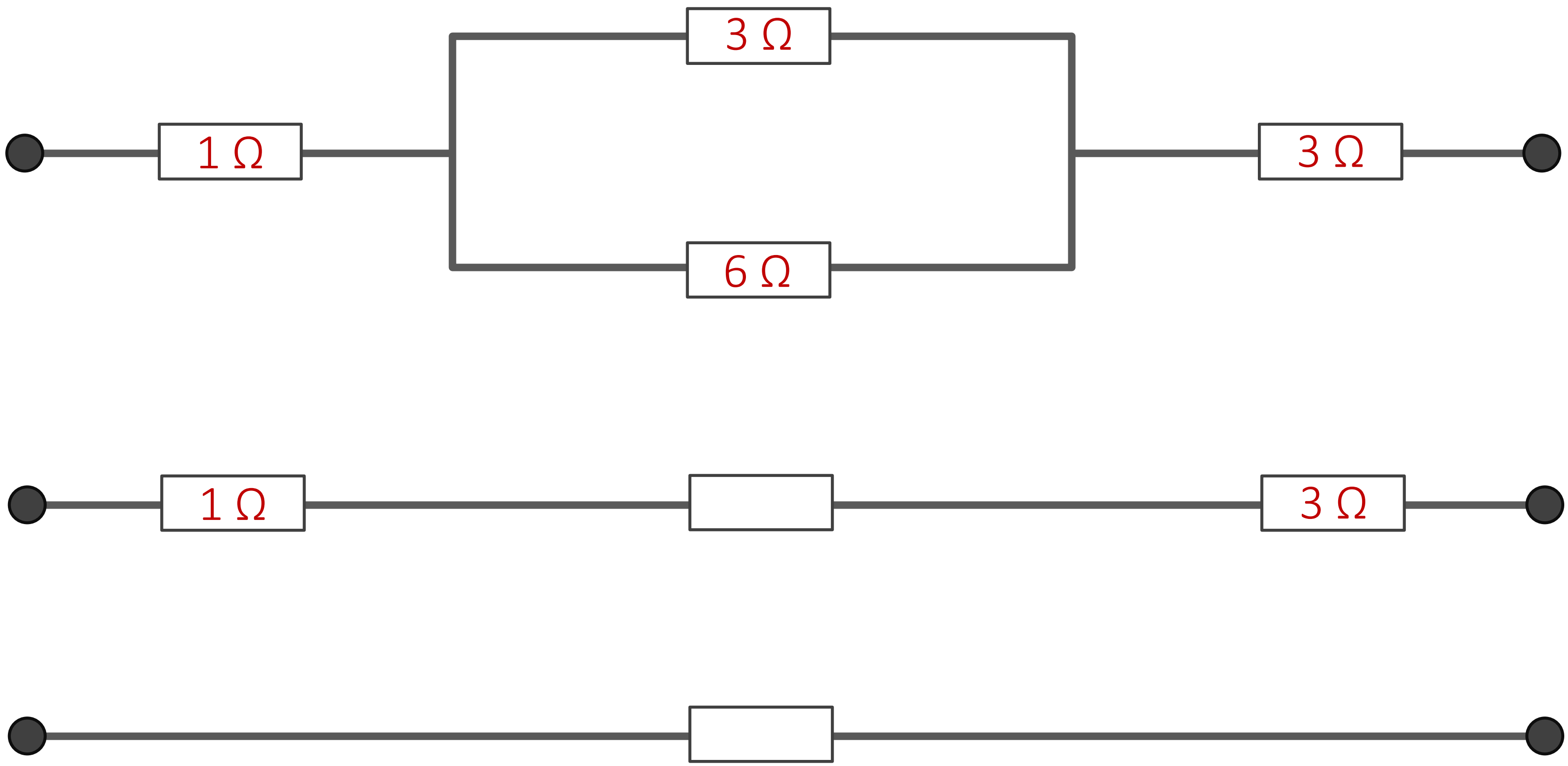
Combining Resistors – Try This



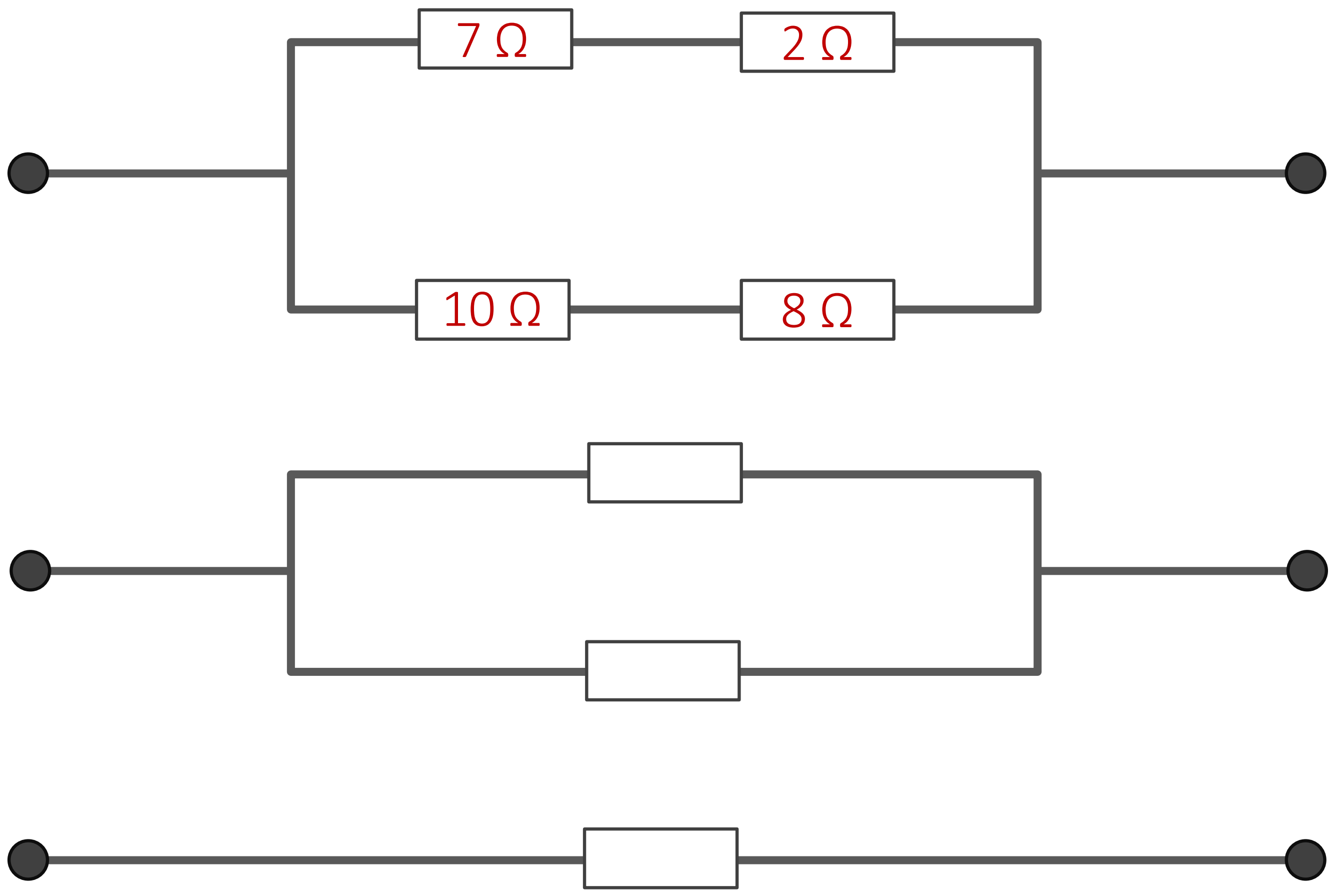
IB Physics Data Booklet

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) $\Sigma I = 0$ (junction) $R = \frac{V}{I}$ $P = VI = I^2R = \frac{V^2}{R}$ $R_{\text{total}} = R_1 + R_2 + \cdots$ $\frac{1}{R_{\text{total}}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$ $\rho = \frac{RA}{L}$
Sub-topic 5.3 – Electric cells	**Sub-topic 5.4 – Magnetic effects of electric currents**
$\varepsilon = I(R + r)$	$F = qvB\sin\theta$ $F = BIL\sin\theta$

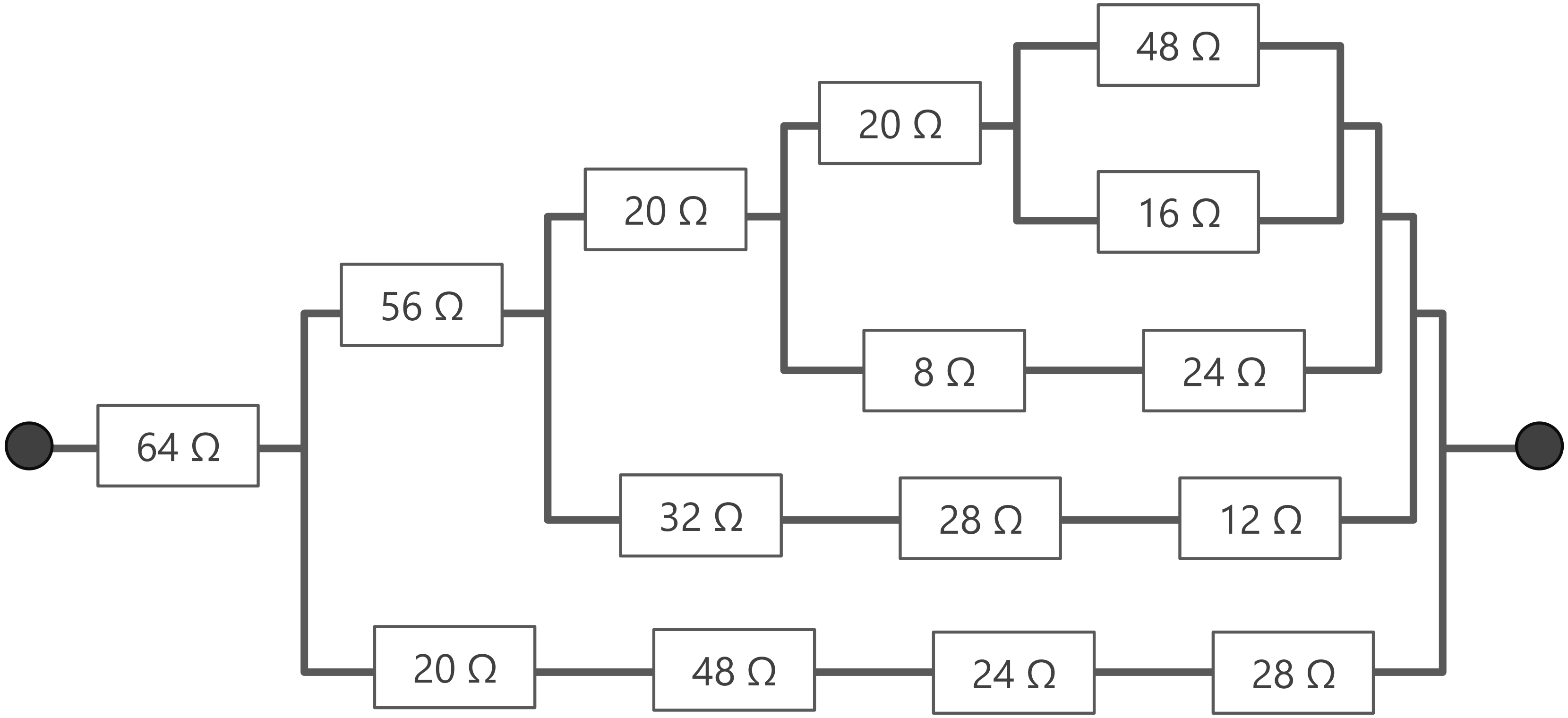
Equivalent Resistance



Try This | Equivalent Resistance



This could be bigger…



Lesson Takeaways

- ❑ I can calculate the equivalent resistance for combinations of resistors in series and parallel
- ❑ I can systematically step through the calculation of the equivalent resistance for a complex combination