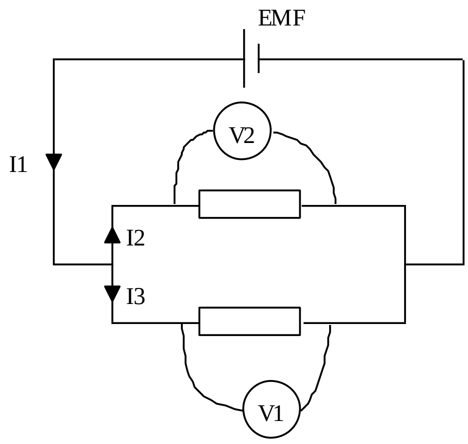
E.8.2 Parallel Circuits

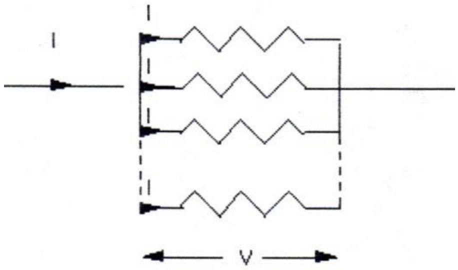
Video: Hewitt Drew it – Bulbs in parallel



$I_2 + I_3 = I_1$ In parallel the currents add up

$V_1 = V_2$ In parallel potential differences are the same

In a parallel circuit the current splits up into two or more components while the voltage across each element in the parallel connection is constant.



Thus $I_T = I_1 + I_2 + I_3 + \ldots\ldots\ldots\ldots$

From $V = I R$

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

substituting we get

$$\frac{V}{R_T} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3} + \cdots$$

Since V is the same for all resistances

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots$$

Video: Hewitt Drew it – Equivalent Resistance

Example

Two pieces of nichrome wire (as used in heater elements) are found to have resistances of 10 Ω and 20 Ω.
a If they are connected in parallel what is their effective resistance?
b What total current will flow through them and what power will be produced if the combination is placed across a 12 V battery?

Solution
a The effective resistance is found from

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{R_T} = \frac{1}{10} + \frac{1}{20}$$

$$\frac{1}{R_T} = \frac{3}{20}$$

Thus $R_T = \frac{20}{3}$ = 6.7 Ω.

b The total current is given by

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

$$I = \frac{12}{6.7}$$

= 1.8 A

The power is therefore
$P = VI$
= 12 × 1.8
= 21.6 W

Problem Set #5: Text Section 4.1 Page 137 All Questions