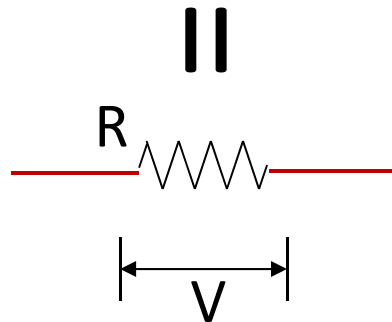
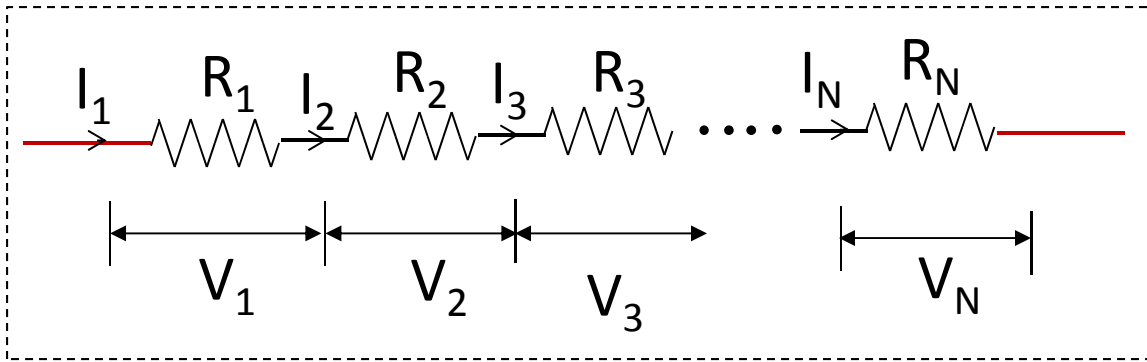


Class 13: Emf, battery, voltmeter, and ammeter

Connecting Resistors in Series



$$R_{\text{eff}} = R_1 + R_2 + R_3 + \dots + R_N$$

$$I = I_1 = I_2 = I_3 = \dots = I_N$$

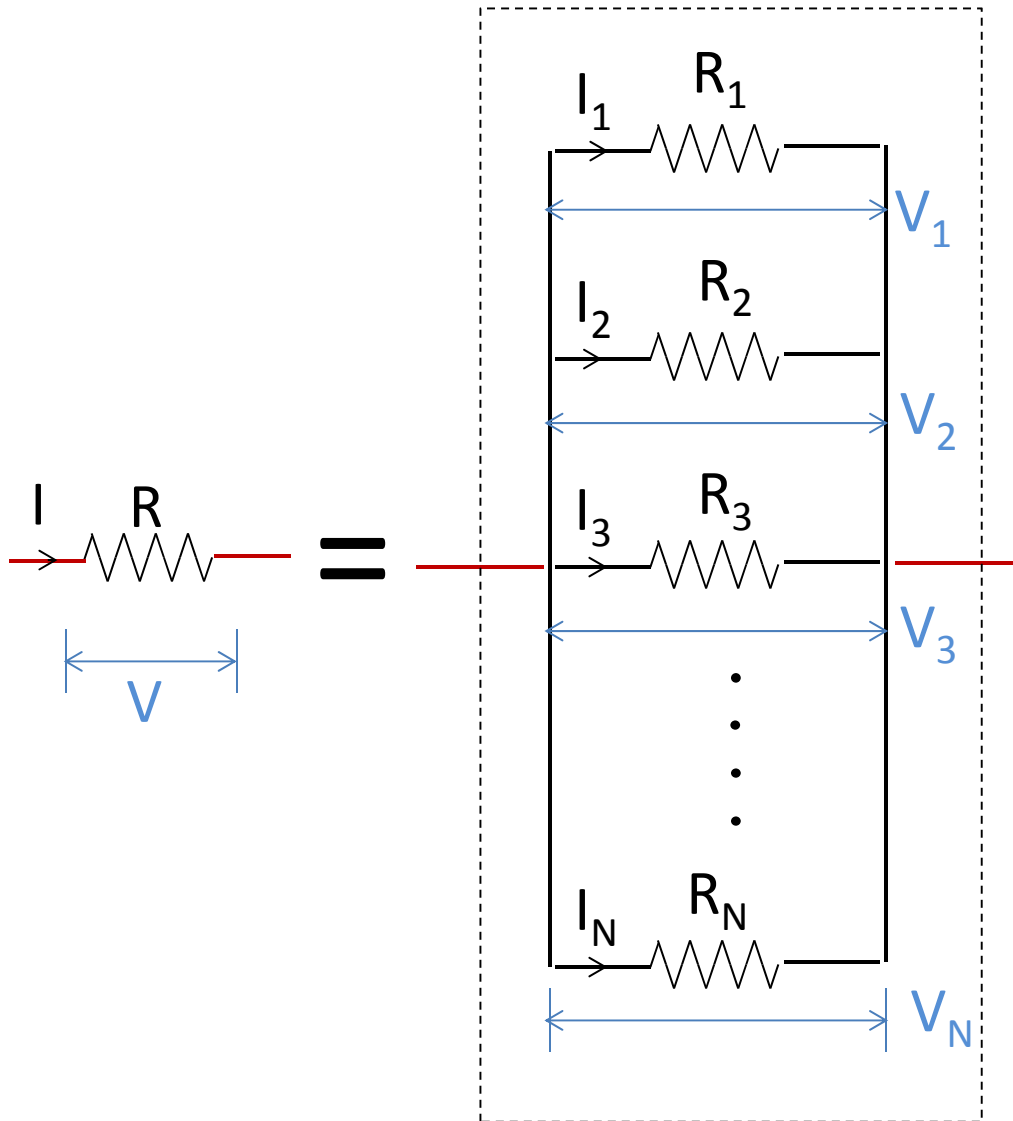
$$V = V_1 + V_2 + V_3 + \dots + V_N$$

1. Current through each individual resistor is the same: (why?)

$$I = I_1 = I_2 = I_3 = \dots = I_N$$
$$\Rightarrow \frac{V}{R} = \frac{V_1}{R_1} = \frac{V_2}{R_2} = \frac{V_3}{R_3} = \dots = \frac{V_N}{R_N}$$

2. Potential difference across each individual resistor should be different (unless they have the same resistance).

Connecting Resistors in Parallel



$$\frac{1}{R_{\text{eff}}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots + \frac{1}{R_N}$$

$$I = I_1 + I_2 + I_3 + \dots + I_N$$

$$V = V_1 = V_2 = V_3 = \dots = V_N$$

1. Potential difference across each individual resistor is the same: (why?)

$$V = V_1 = V_2 = V_3 = \dots = V_N$$

$$\Rightarrow I_1 R_1 = I_2 R_2 = I_3 R_3 = \dots = I_N R_N$$

2. Current through each individual resistor should be different (unless they have the same resistance).

Why so similar, but yet so opposite?

The formula for capacitors and resistors in parallel and series are oppositely switched:

	Resistors	Capacitors
In series	$R_{\text{eff}} = R_1 + R_2 + \dots R_N$	$\frac{1}{C_{\text{eff}}} = \frac{1}{C_1} + \frac{1}{C_2} + \dots \frac{1}{C_N}$
In parallel	$\frac{1}{R_{\text{eff}}} = \frac{1}{R_1} + \frac{1}{R_2} + \dots \frac{1}{R_N}$	$C_{\text{eff}} = C_1 + C_2 + \dots C_N$

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

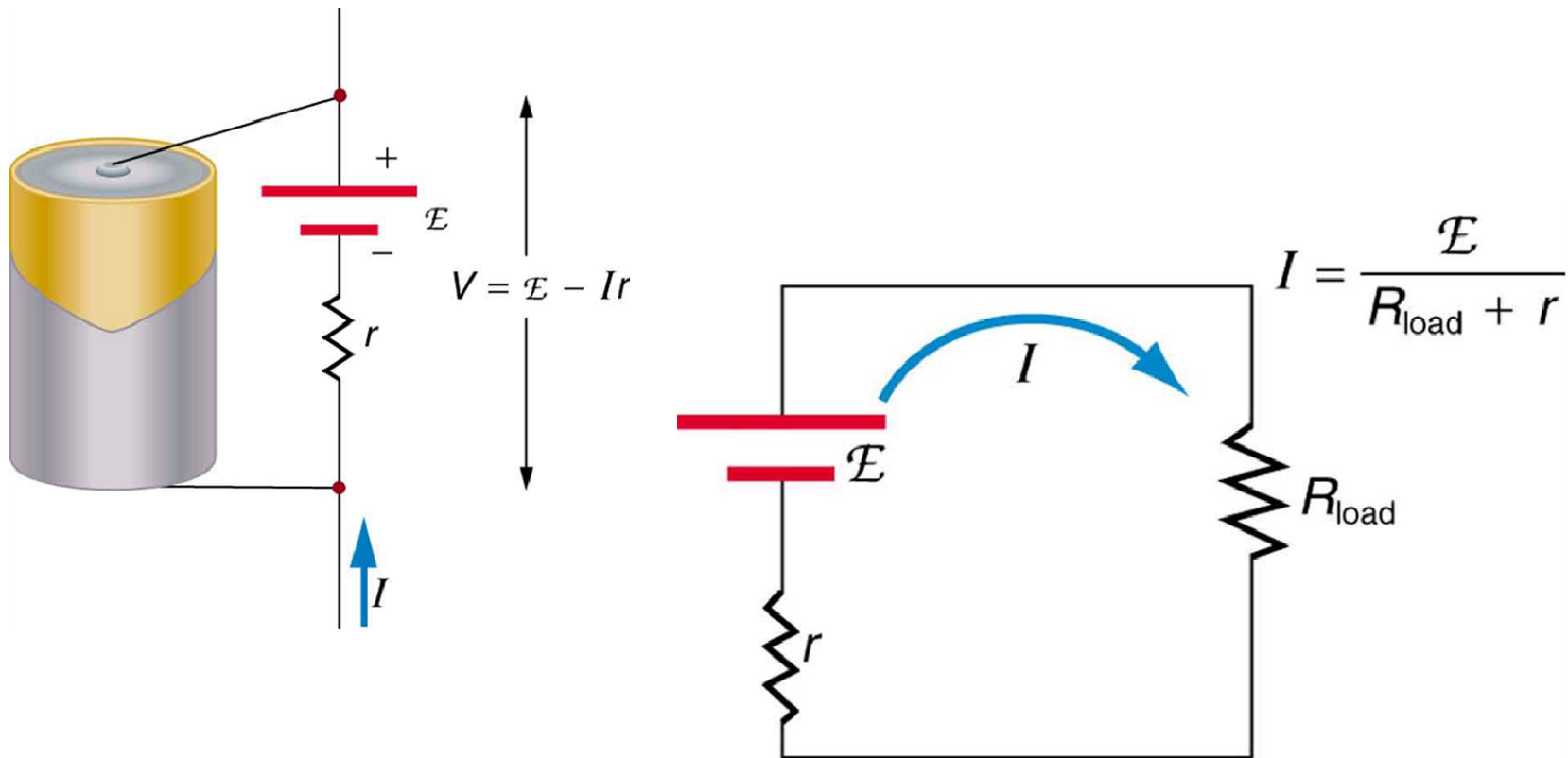


$$C = \frac{Q}{V}$$



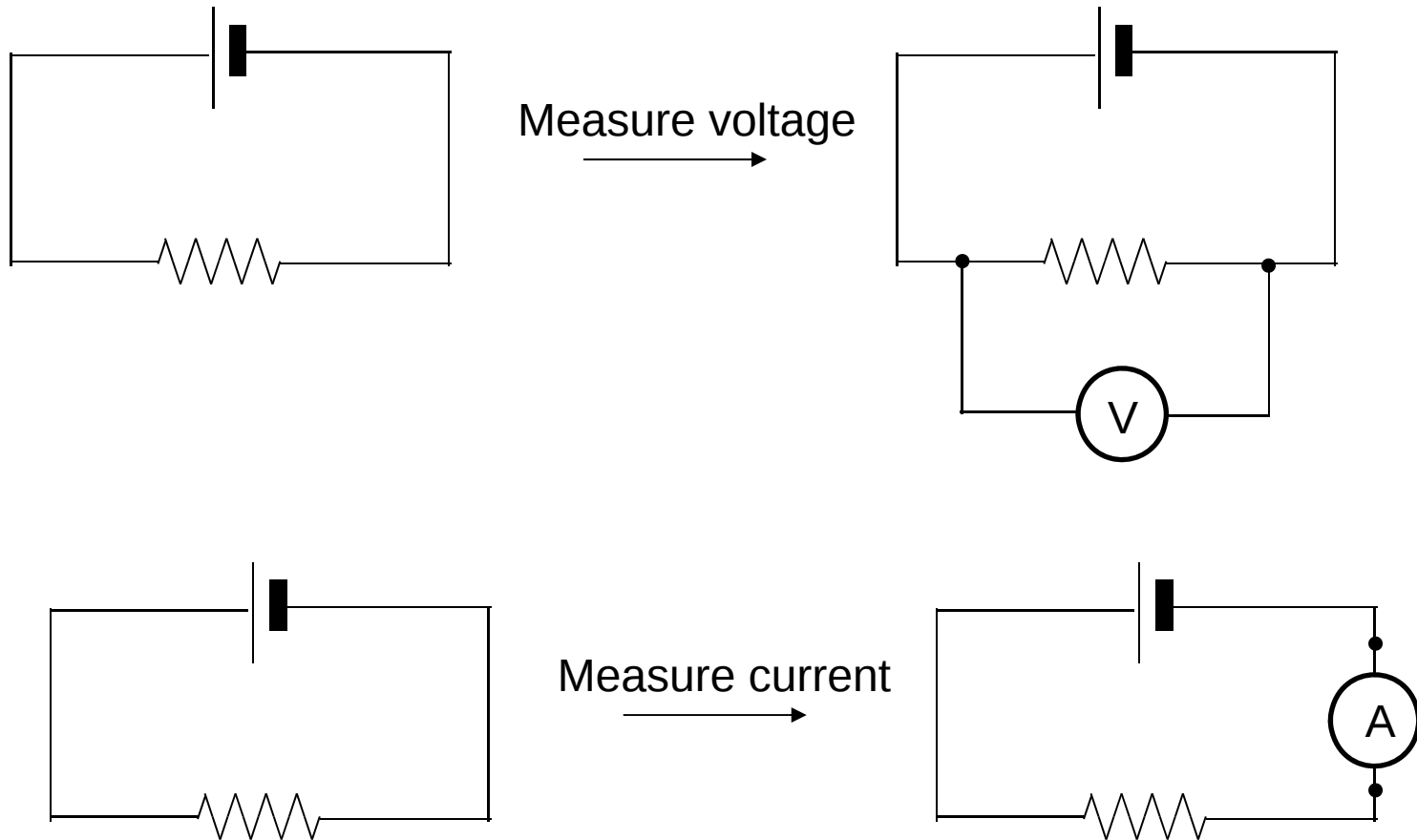
Electromotive Force (emf) and Internal Resistance

Electromotive force (emf) is the potential difference of a source when no current is flowing. Units of emf are volts. (page 815 of text)



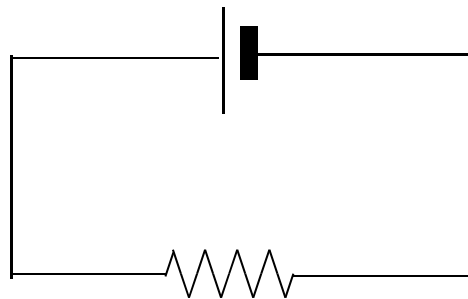
Voltmeter and Ammeter

Voltmeter is a device used to measure the potential difference between two points. Ammeter is a device used to measure current in a wire.

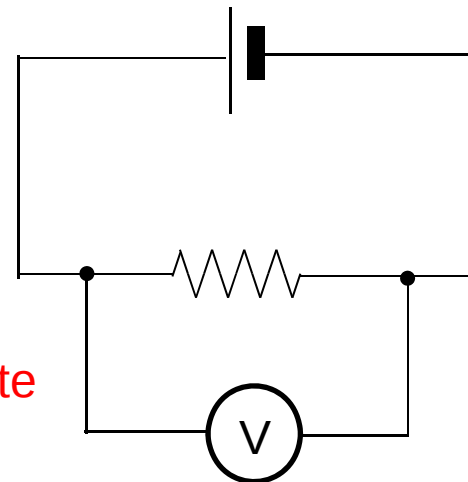


Voltmeter and Ammeter

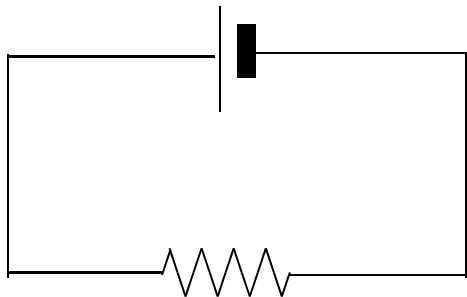
Voltmeter is a device used to measure the potential difference between two points. Ammeter is a device used to measure current in a wire.



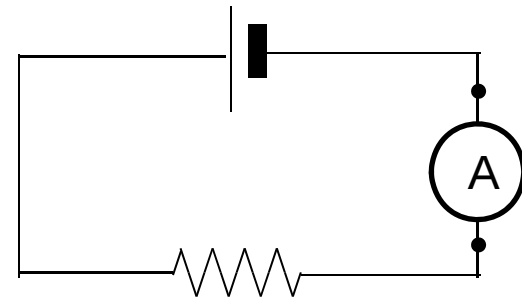
Measure voltage
→



Ideal voltmeter
should have infinite
resistance



Measure current
→



Ideal ammeter
should have 0
resistance