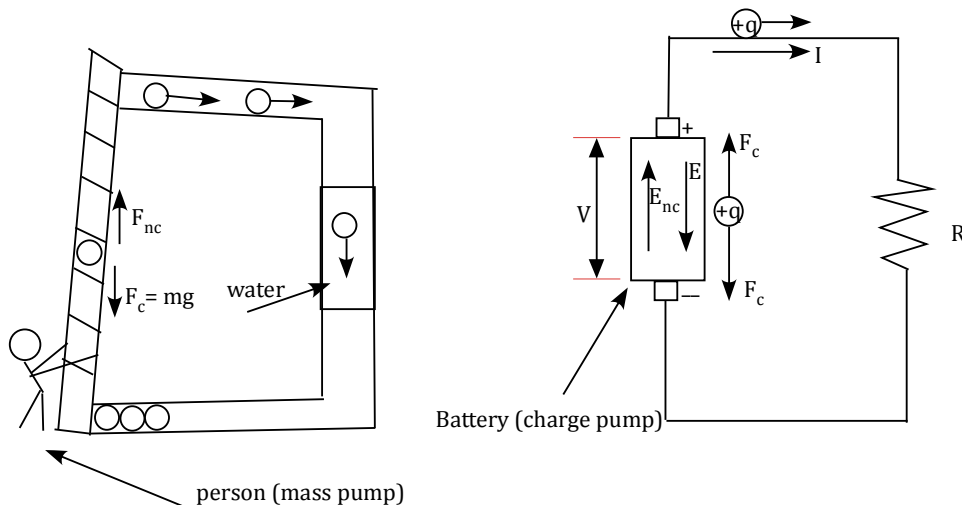


DC Circuits

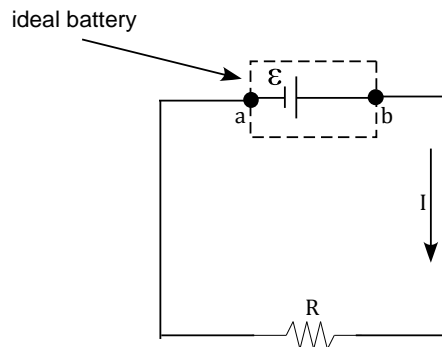
1. Basics Requirements

- Closed loop to allow charge to flow.
- Need a source of energy to establish a current.
- A source of energy in a circuit is called an EMF (electromotive force). This is a poor term to use since it is not a force). An EMF provides a constant potential difference in a circuit to establish a current. Ex. Battery, power supply, generator, solar cell
- You can think of an EMF as a “**charge pump**” that maintains a constant potential between two points on a circuit.

Example of an EMF



2. Ideal Source (Battery)



$\epsilon = \text{EMF} = \text{electromotive force}$

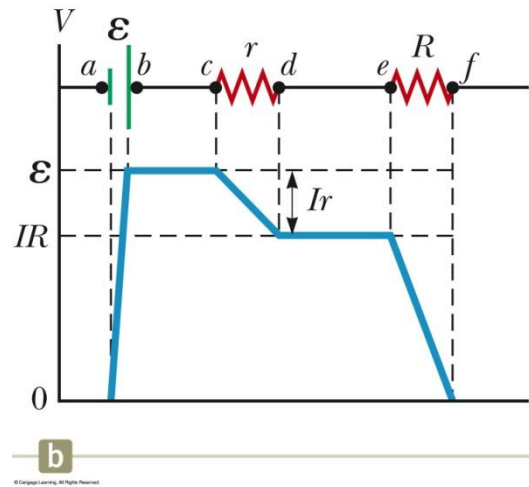
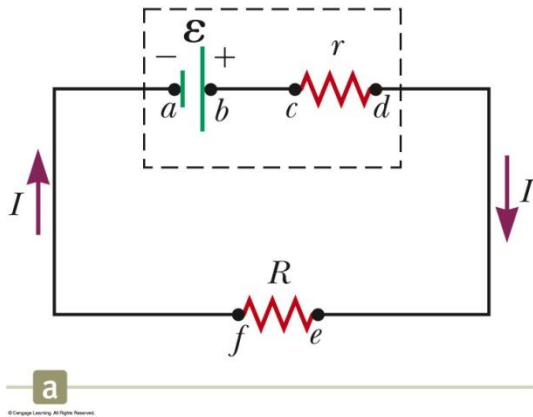
$$V_{ab} = IR$$

$$\epsilon = IR$$

$$\boxed{V_{ab} = \epsilon} \text{ Ideal Battery}$$

*In an ideal battery the terminal voltage is equal to the EMF

3. Real Source (Battery)



r = internal resistance of battery

$$V_{ab} = IR$$

$$\boxed{V_{ab} = \varepsilon - Ir}$$
 Terminal voltage is NOT equal to the EMF

$$IR = \varepsilon - Ir$$

$$IR + Ir = \varepsilon$$

$$\boxed{I = \frac{\varepsilon}{R + r}}$$
 Current with a real battery

$$I\varepsilon = I^2R + I^2r$$

Power delivered to internal resistance

Power delivered by battery

Power delivered to load resistor