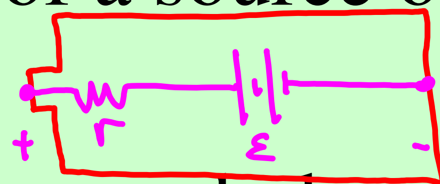
EMF, Series & Parallel Circuits

"The wireless music box has no imaginable commercial value. Who would pay for a message sent to nobody in particular?" David Sarnoff's associates (NBC) in response to his urgings for investment in the radio in the 1920s.

EMF

- A constant current can be maintained in a closed circuit through the use of a source of *emf* (battery or generator).

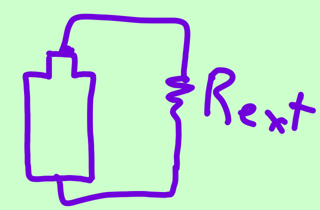


ε - emf
r - internal resistance

- The *emf*, **ε**, describes the work done per unit charge.
- The *terminal voltage* is the potential difference across the terminals of a battery. This would equal the *emf* if the battery had no internal resistance.
- Write down ΔV for a battery.

$\Delta V = \varepsilon - Ir$

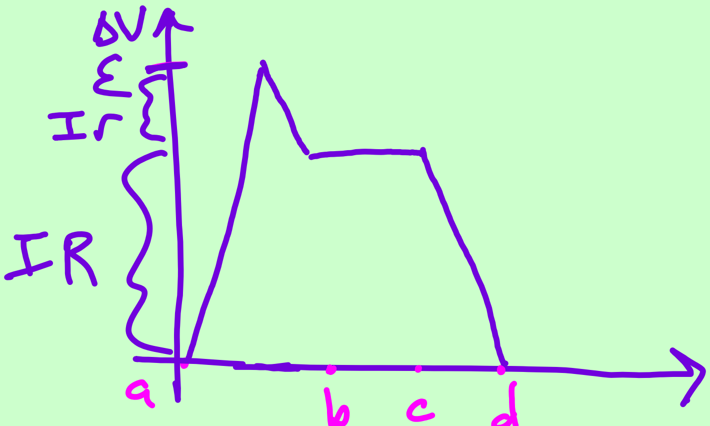
r ↑ as batteries are used

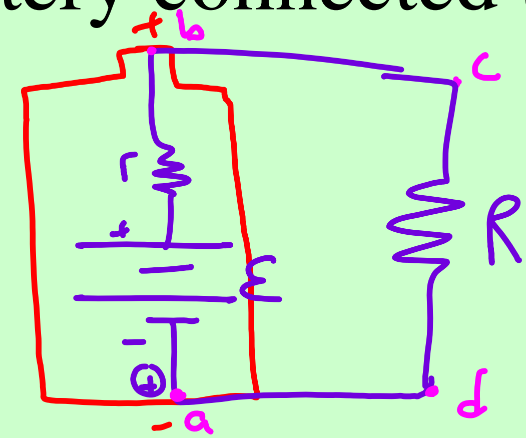


- **ε** is the **open-circuit voltage**, which is the terminal voltage when the current is zero.

EMF

- Graph V for a circuit with a battery connected to an external resistor.

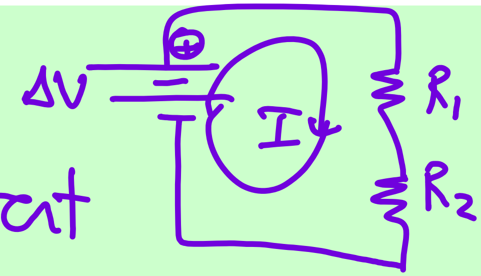




- The **load resistance** is the resistance of the external resistor.

- Most often the internal resistance is << than the external resistance.

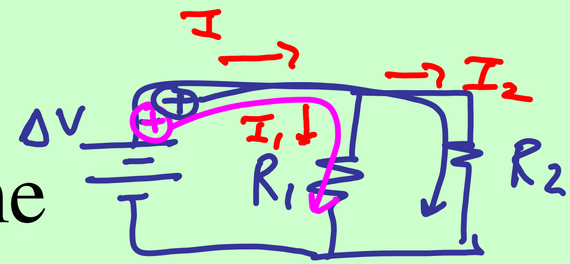
Series & Parallel



- Resistors in series have the same current
- The equivalent resistance is given by $R_{eq} = \sum_i R_i$

$\Delta V = IR_1 + IR_2 + \ldots$

$\not{I} R_{eq} = \not{I} R_1 + \not{I} R_2$



- Resistors in parallel have the same voltage

$\Delta V = \frac{\Delta U}{q} \Rightarrow \Delta U = \Delta V q$

- The equivalent resistance is given by $\frac{1}{R_{eq}} = \sum_i \frac{1}{R_i}$

$I = I_1 + I_2$

$\frac{\Delta V}{R_{eq}} = \frac{\Delta V}{R_1} + \frac{\Delta V}{R_2}$