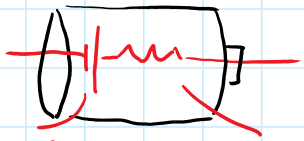
Internal Resistance & Terminal Voltage

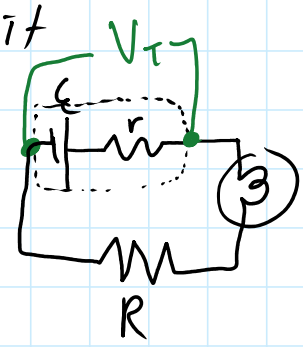
Tuesday, May 22, 2018 12:37 PM

In a battery, the material that produces Emf (Voltage) has some resistance. This reduces the output voltage of the battery when current flows thru it



Emf, $\mathcal{E}$ produced by the chemicals

internal resistance (r)



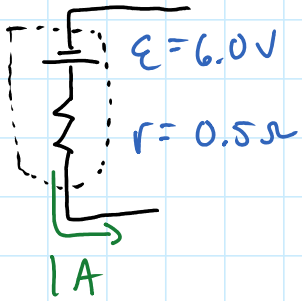
$$V_T = \mathcal{E} \pm Ir$$

(+) used when charging the battery

(−) used when powering a device

Terminal Voltage

ex



Find V_T

$V_T = \mathcal{E} - Ir$

$= 6.0V - (1A)(.5\Omega)$

$= 5.5V$

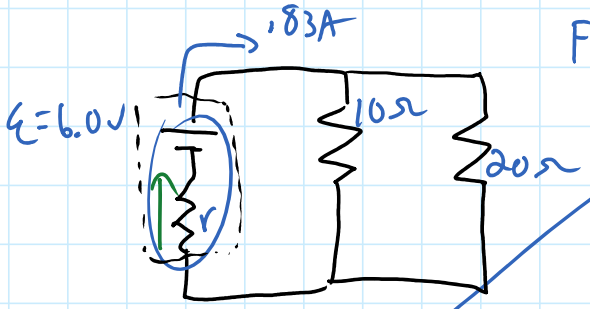
ex: A cell phone battery is charged using 200mA (0.20 A) and has $r = 0.8\Omega$. Find $\mathcal{E}$ if $V_T = 6.0V$.

$V_T = \mathcal{E} + Ir$

$6.0V = \mathcal{E} + (0.20A)(.8\Omega)$

$\mathcal{E} = 5.84\,V$

Ex



Find $r = ?$, V_T ← Treat as just another resistor

$V_0 = 6.0V$ I_0 .83A $R_{eq} = 7.2\Omega$

$V_1 = 5.58$ I_1 $R_1 = 10\Omega$ $\frac{1}{10} + \frac{1}{20}$

$V_2 = 5.58$ I_2 $R_2 = 20\Omega$ $\frac{2}{20} + \frac{1}{20} = \frac{3}{20}$

6.0V $\frac{20}{3} = 6.7\Omega$

V_3 .42V I_3 .83A $r = 0.5\Omega$

$V_T = \mathcal{E} - Ir$

$= 6.0V - (.83A)(.5\Omega)$

$= 5.58\,V$