Name: _____ Phys 12

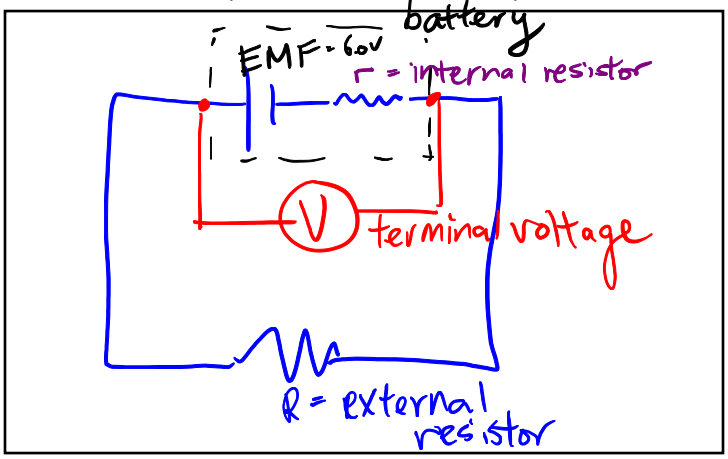
**6.3 Electromotive force**

Your electrical power source can generate a potential difference called the _electromotive force_ (EMF).
Be careful, this is not actually a _force_, it's a _potential difference_.

*Over time your battery loses its power. Why?*

From a chemical perspective, your positive terminal (cathode) acquires too many electrons that it can no longer accept electrons. This slows down the electrochemical reactions from generating more free electrons to the negative terminal.

From the physics perspective, we think of the battery containing an _internal_ resistor that increases until the potential difference drop inside the battery is the same as battery's EMF itself.




$V_T = \mathcal{E} - Ir$

$\mathcal{E}$ = EMF

$V_T$ = terminal voltage (V)

$\mathcal{E}$ = EMF (V)

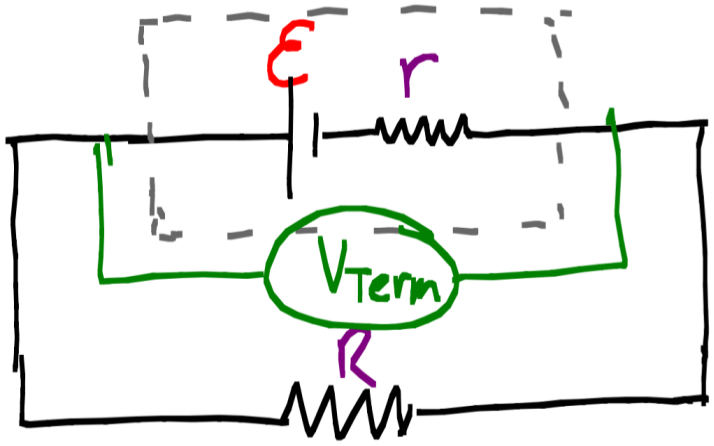
$I$ = current (A)

$r$ = internal resistor ($\Omega$)

To recharge your battery, you need to change the _direction_ of your current, so: →

$V_T = \mathcal{E} + Ir$

Ex. 1: Calculate the following if the EMF of the battery is 9.0V and the internal resistance is 0.220Ω:
a) The current through the battery if the terminal voltage is 8.8V. (ANS: 0.91A)
b) The current if R = 5.5Ω. (ANS: 1.6A)




1) a) $V_T = \mathcal{E} - Ir \Rightarrow$

$\frac{Ir}{r} = \frac{\mathcal{E} - V_T}{r}$

$I = \frac{\mathcal{E} - V_T}{r} = \frac{9.0V - 8.8V}{0.220\Omega}$

$= \boxed{0.91A}$

b) $V_T = IR = \mathcal{E} - Ir$

* $V_T$ not the same as a) b/c current is different.

$\Rightarrow IR + Ir = \mathcal{E}$

$I(R + r) = \mathcal{E}$

$I = \frac{\mathcal{E}}{R+r} = \frac{9.0}{5.5\Omega + 0.220\Omega} = \boxed{1.6A}$

HW: Worksheet 6.3 ALL, Package #13, 15, 16, 17, 18, 19, 23, 24,