

PHYS 1444 – Section 004

Lecture #12

Wednesday, Mar. 26 2007

Dr. Andrew Brandt

- EMF and Terminal Voltage
- Resistors in Series and Parallel
- Energy loss in Resistors

HW6 due Fri 3/30 at 8 pm



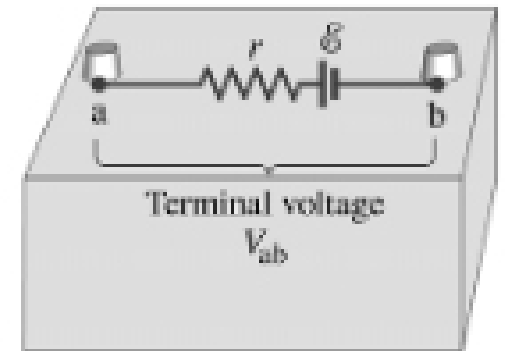
EMF and Terminal Voltage

- What do we need to have current in an electric circuit?
 - A device that provides a potential difference, such as battery or generator
 - typically it converts some type of energy into electric energy
 - These devices are called sources of electromotive force (*emf*)
 - This does NOT refer to a real “force”.
- The potential difference between terminals of the source, when no current flows to an external circuit, is called the *emf* (ε) of the source.
- A battery itself has some **internal resistance** (r) due to the flow of charges in the electrolyte
 - Why do headlights dim when you start the car?
 - The starter needs a large amount of current but the battery cannot provide charge fast enough to supply current to both the starter and the headlights



EMF and Terminal Voltage

- Since the internal resistance is inside the battery, we cannot separate the two.
- So the terminal voltage difference is $V_{ab} = V_a - V_b$.
- When no current is drawn from the battery, the terminal voltage equals the *emf* which is determined by the chemical reaction; $V_{ab} = \varepsilon$.
- However when the current I flows from the battery, there is an internal drop in voltage which is equal to Ir . Thus the actual **delivered** terminal voltage is



$$V_{ab} = \varepsilon - Ir$$