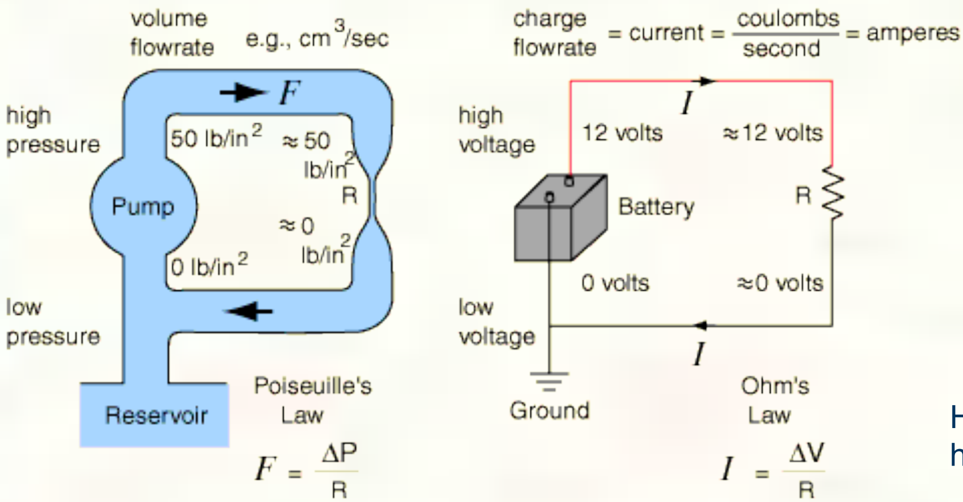
Ohm's Law and CMOS Transistors

Simple electronics

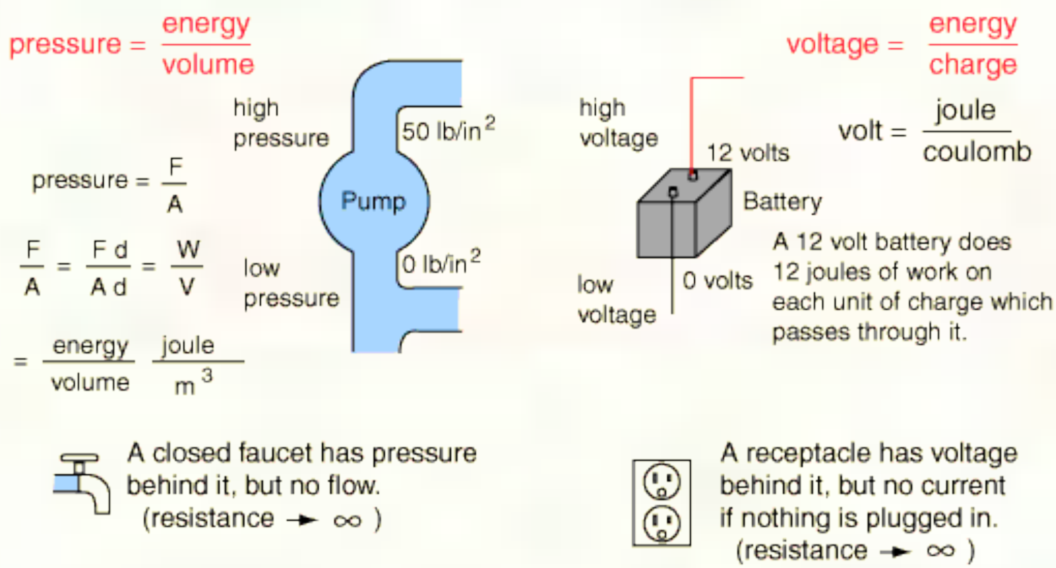
- Ohm's Law - V = IR
  - voltage (V) equals current (I) times resistance (R)
- Hydraulic Analogy
  - Charge ⇒ liquid
  - Current ⇒ flow rate
  - Voltage ⇒ water pressure
  - Resistance ⇒ related to length and radius of pipe (kL/r^4)



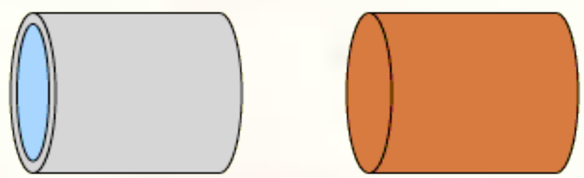
Hydraulic pictures from
http://hyperphysics.phy-astr.gsu.edu

Hydraulic analogy

- Voltage ⇒ water pressure



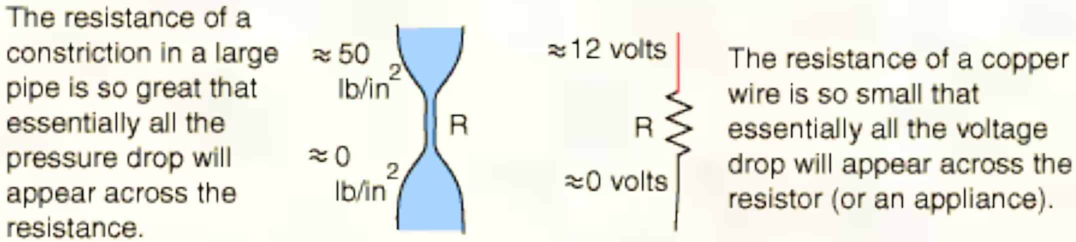
- Current ⇒ flow rate

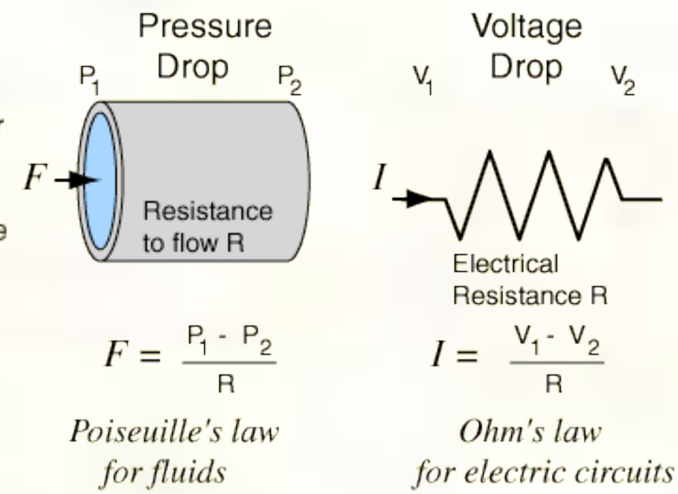


Volume flow rate in m^3/sec, etc. Current flow rate in coulombs/sec = amps

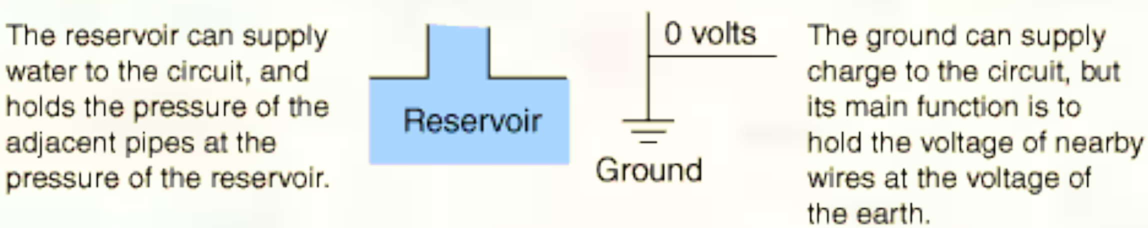
Hydraulic analogy

- Resistance ⇒ related to length and radius of pipe (kL/r^4)



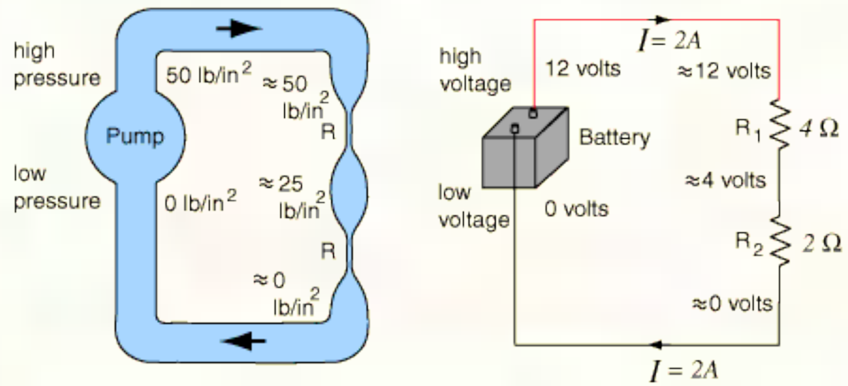


- Ground ⇒ reservoir

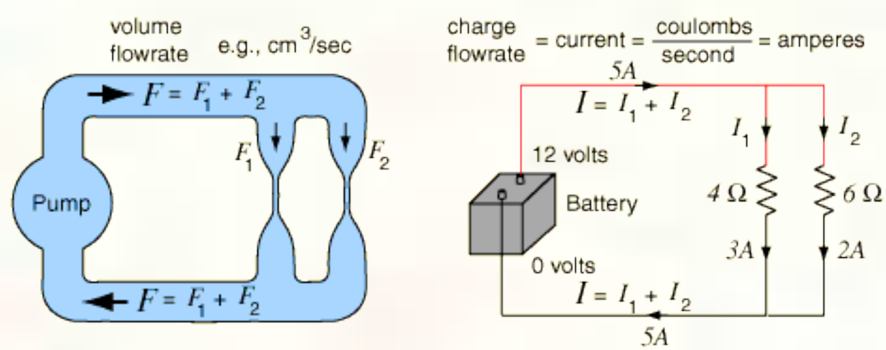


Hydraulic analogy

- Resistances in series



- Resistances in parallel



CMOS Transistors

- Need circuits to represent 2 discrete values
  - 1,0 for binary representations
  - True, False for Boolean logic
- Let high voltage (V_{dd}) represent 1, or true
- Let low voltage (0 volts or gnd) represent 0, or false
- If we have some switches to control whether or not these voltages can propagate through a circuit, we can build a computer with them
  - Note, the earliest digital computers were electromechanical, made out of relays, so this is hardly a new idea
- Our switches will be CMOS transistors