TEST

- Conceptual
  - electric force
  - connecting ammeters and voltmeters
  - circuits
- Problems
  - Coulomb's Law
  - Series-only circuit(s)
  - Parallel-only circuit(s)

Review

- Electric force
  - Like charges repel; unlike charges attract
  - Coulomb's Law:

magnitude $F = \frac{k q_1 q_2}{r^2}$

direction comes from drawing

$$k = 9E9 \frac{N \cdot m^2}{C^2}$$

- Circuits
  - Ohm's Law → $V = IR$
  - Electric Power

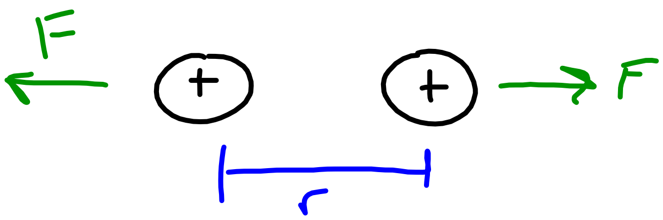
$$P = IV = I^2R = \frac{V^2}{R}$$

  - Equivalent Resistance
    - Series → $R_{eq} = R_1 + R_2 + \ldots$
    - Parallel → $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$

- Variables: [Units]
  - F → force [newtons → N]
  - q → charge [coulombs → C]
  - r → distance between the charges [meters → m]
  - V → electric potential, voltage, voltage drop, potential difference [volts → V]
  - I → current [amperes → A]
  - R → resistance [ohms → Ω]
  - P → power [watts → W]
  - R_{eq} → equivalent resistance [ohms → Ω]

Problems

1)



$q_1 = 4E-6\,C$

$q_2 = 4E-6\,C$

$F = 105\,N$

$k = 9E9\,\frac{N \cdot m^2}{C^2}$

$r = ?$

$$F = \frac{k q_1 q_2}{r^2}$$

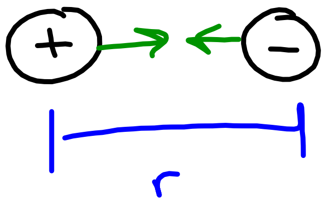
$$r^2 = \frac{k q_1 q_2}{F}$$

$$r = \sqrt{\frac{k q_1 q_2}{F}}$$

$$= \sqrt{\frac{(9E9\,\frac{N \cdot m^2}{C^2})(4E-6\,C)(4E-6\,C)}{105\,N}}$$

$$= 0.037\,m$$

Two charges, separated by a distance of 0.05 m, exert a force of 20 N on each other. One charge has a value of -6E-6 C; what is the charge of the other one if this charge is positive?



$F = 20N$
$q_1 = -6E-6C$
$q_2 = ?$
$k = 9E9 \frac{N \cdot m^2}{C^2}$
$r = 0.05m$

$$\left(\frac{r^2}{kq_1}\right) F = \frac{kq_1q_2}{r^2} \left(\frac{r^2}{kq_1}\right)$$

$$q_2 = \frac{Fr^2}{kq_1}$$

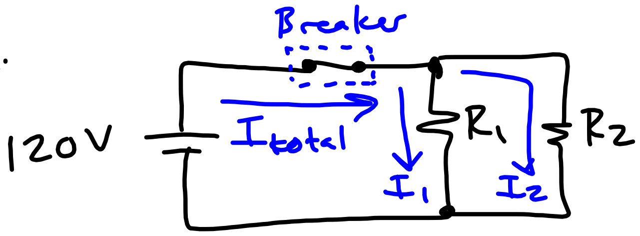
- Make the force negative to make q_2 positive

$$= \frac{(-20N)(0.05m)^2}{(9E9 \frac{N \cdot m^2}{C^2})(-6E-6C)}$$

$$= 9.26E-7C$$

Circuits

7) a.



$R_1 \rightarrow$ blender

$R_2 \rightarrow$ coffee maker

Breaker opens when $I_{total} > 15\,A$

$V_1 = V_2 = 120\,V$

$P_1 = 400\,W$

$P_2 = 900\,W$

$P_1 = I_1 V_1$

$I_1 = \frac{P_1}{V_1}$

$= \frac{400\,W}{120\,V}$

$= 3.33\,A$

$P_2 = I_2 V_2$

$I_2 = \frac{P_2}{V_2}$

$= \frac{900\,W}{120\,V}$

$= 7.5\,A$

$I_{total} = I_1 + I_2 = 10.83\,A$

add a device $\rightarrow$ $15\,A - 10.83\,A = 4.17\,A$

$P_{extra\ device} = I_{extra\ device} V$

$= (4.17\,A)(120\,V)$

$= 500\,W$