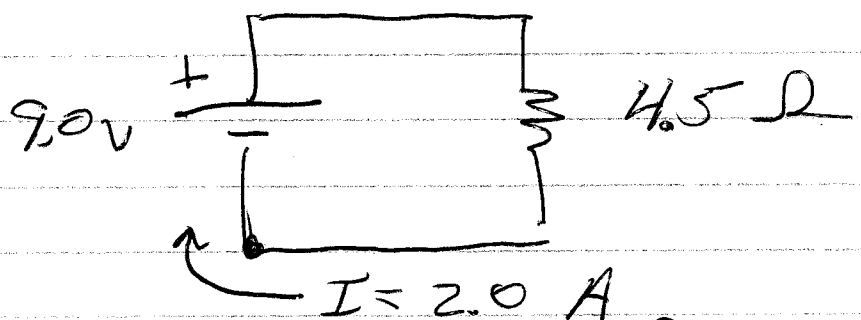
 Phys 1402 2015-09-24 Lec 9

Exam 1 Tue 9/29
My Calendar: tinyurl.com/spirkocal

Topics:
Electrostatics, charge, E-Field
Elec Potential, Batteries & Capacitors
DC Current, Ohm's Law
Complex DC Circuits, Equivalent R.
Measuring DC Values: V I R
RC Circuits, Discharging.

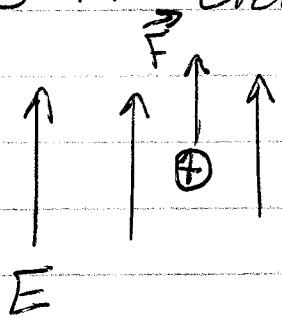
Definition $V = \frac{\text{Energy}}{\text{Charge}}$



The 2.0 A is formed from charges.
Starting at L.L., each ⊕ goes:
- Thru batt gains 9.0 J/C.
  $P = (9\ J/C)(2\ C/s) = 18\ J/s$
- Thru R, Lose 9.0 J/C

1402 (2)

Charge in elec field



$\vec{F} = q\vec{E}$ is up

As the charge is pushed up it gains Kinetic Energy.
Where does that KE come from?
It was potential energy.

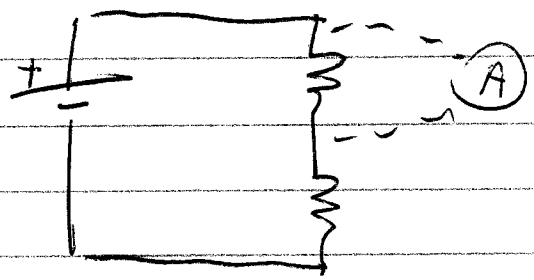
$$|\Delta PE| = F \cdot Dist$$

$$\frac{|\Delta PE|}{q} = \frac{F}{q} \cdot Dist$$

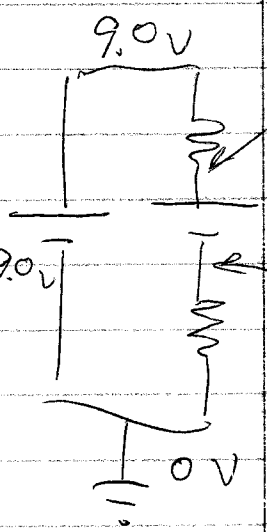
$$|V| = E \cdot Dist$$

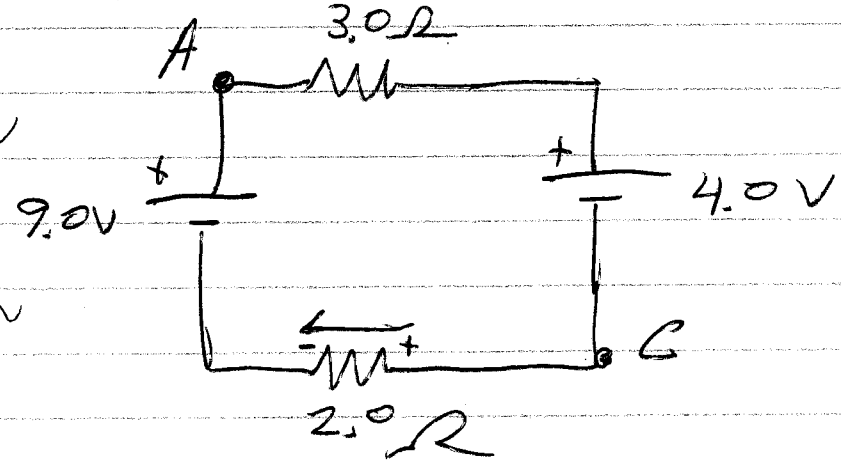
E points "downhill", toward lower (or negative) V.

Series DC Circuit



What if (A) is placed across one bulb.
What if (V) is hooked in series?



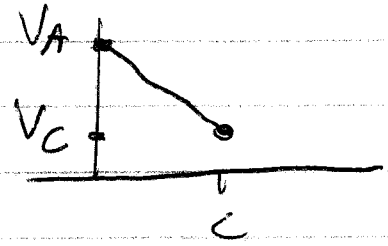


How much current flows?

- 9/5 A
- 3 A
- 1 A
- 13/5 A

What is $V_A - V_C$?

+7 V



Steps: $+9 - I \cdot 3 - 4 - I \cdot 2 = 0$

$(9-4) = I \cdot 5$

$(5V) = I \cdot (5\Omega) \Rightarrow I = 1.0A$

1402 (4)

A capacitor (4 μF) is charged to 9.0 V. What R will drain it halfway in 10.0 s?

$V = V_0 e^{-t/\tau}$

$\tau = RC$

$(4.5) = (9.0) e^{-10/\tau}$

Half →

$0.5 = e^{-10/\tau}$

$\ln(0.5) = \frac{-10}{\tau}$

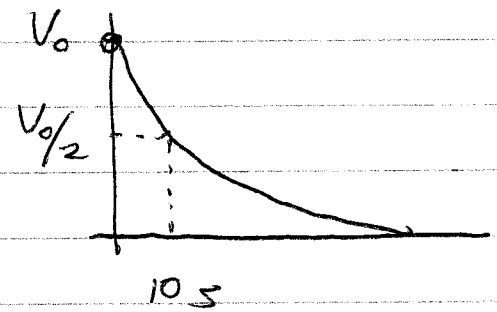
$-0.693\,\tau = -10$

$\tau = 14.4$ s

$(14.4) = R\,(4 \times 10^{-6})$

$R = 3.6 \times 10^{6}\ \Omega$

$= 3.6\ M\Omega$



After 1 time const how much charge is left (as a % of full).

$Q = Q_0 e^{-t/\tau}$

$\frac{Q}{Q_0} = e^{-t/\tau}$

Answer $e^{-\tau/\tau} = e^{-1} = 0.37$

Answer = 37%

After 2τ? $e^{-2\tau/\tau} = e^{-2} = 0.14 \rightarrow 14\%$

1402 (5)

If you use a light bulb for 4 hours/day and electricity costs $0.12/kWh, how much is saved in a year by using a 13 W CFL vs 60 W incandescent?

Total hours: $4 \frac{h}{day} \cdot 365 \text{ day} = 1460 \text{ h}$

$$\text{Cost} = \frac{\text{cost}}{\text{item}} (\text{items})$$

$$= \left(\$0.12 \frac{1}{\text{kWh}}\right)(0.013 \text{ kW})(1460 \text{ h})$$

$$= \$2.28$$

Incandescent

$$\left(\$0.12/\text{kWh}\right)(0.060 \text{ kW})(1460 \text{h})$$

$$\$10.51$$