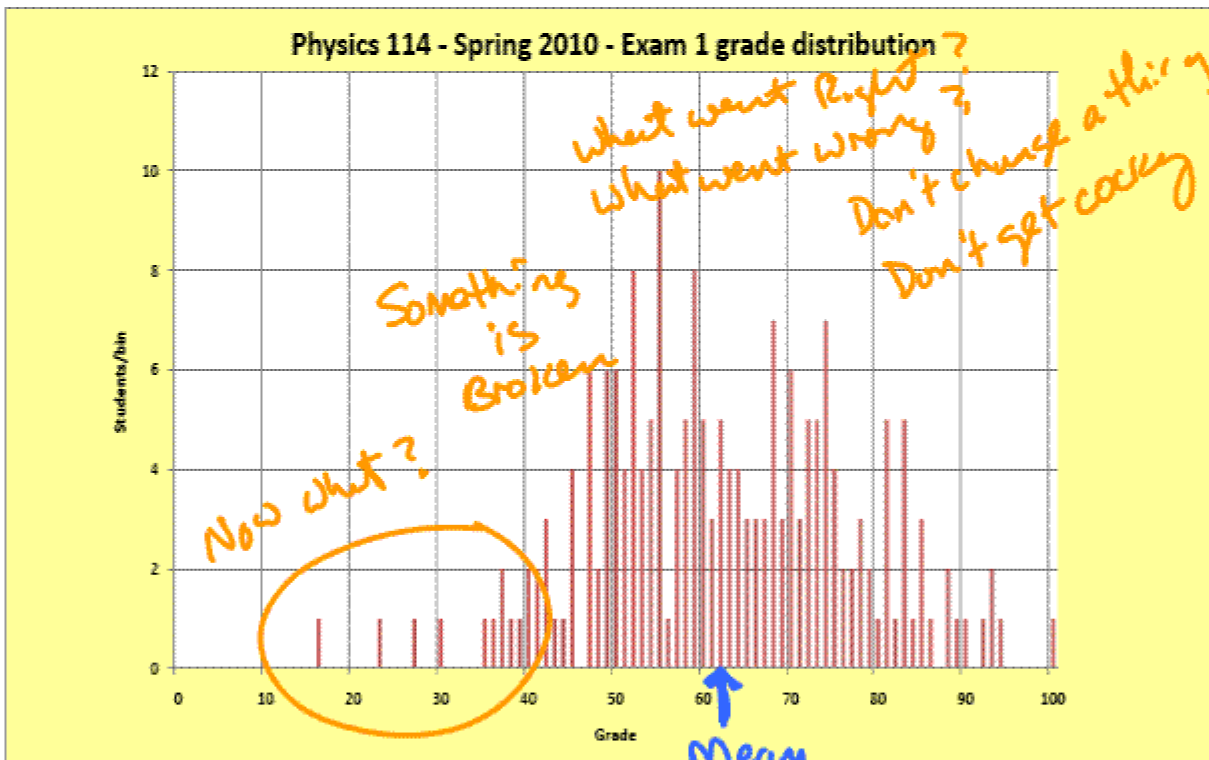
Physics 114 - February 18, 2010

- Feb 16 online lecture ... problems?
- Exam 1 graded - Pick up at end of class

Mean ~ 62



- Solutions posted
- Trouble-shooting guide
- Regrade policy

on web

- Exams not picked up here → in box by my office
- Syllabus provides some flexibility but if change needed change now

Last Time

$$\boxed{\text{Energy required to charge a capacitor} = \frac{Q^2}{2C} = \frac{1}{2}CV^2 = \frac{1}{2}QV = U}$$

Energy density in Electric field

$$\boxed{u = \frac{\epsilon_0}{2}E^2}$$

Linear dielectrics

$$\vec{E}_{\substack{\text{in}\\ \text{Material}}} = \frac{\vec{E}_{\text{external}}}{K}$$

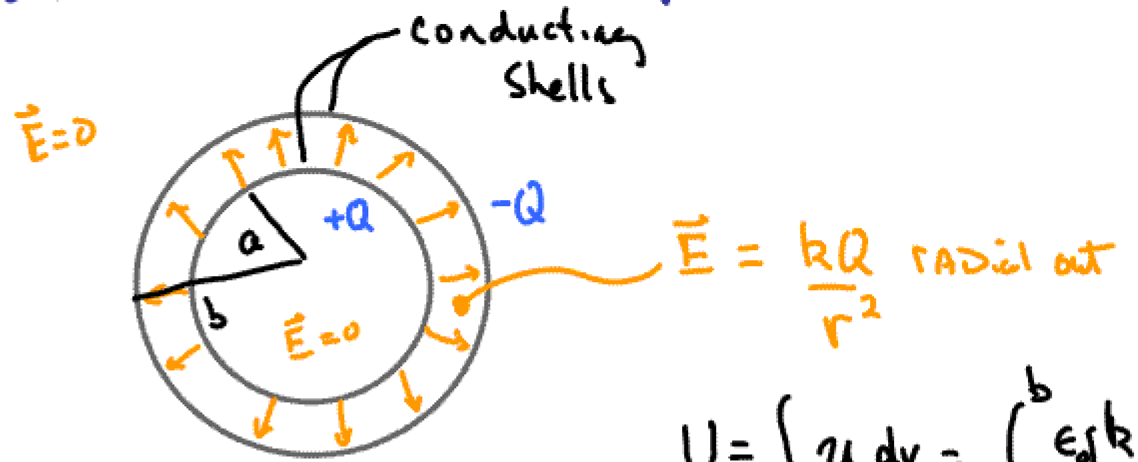
$K > 1$ Dielectric constant

Permittivity of free space

$$K\underbrace{\epsilon_0} \equiv \epsilon \equiv \text{Permittivity}$$

K, ϵ are material dependent

Was Mistake in this example – fixed Now



Total Energy Stored in this configuration

$$= U = \int_{vol} u\, dv = \int_a^b \frac{\epsilon_0}{2}\left[\frac{kQ}{r^2}\right]^2 4\pi r^2 dr$$

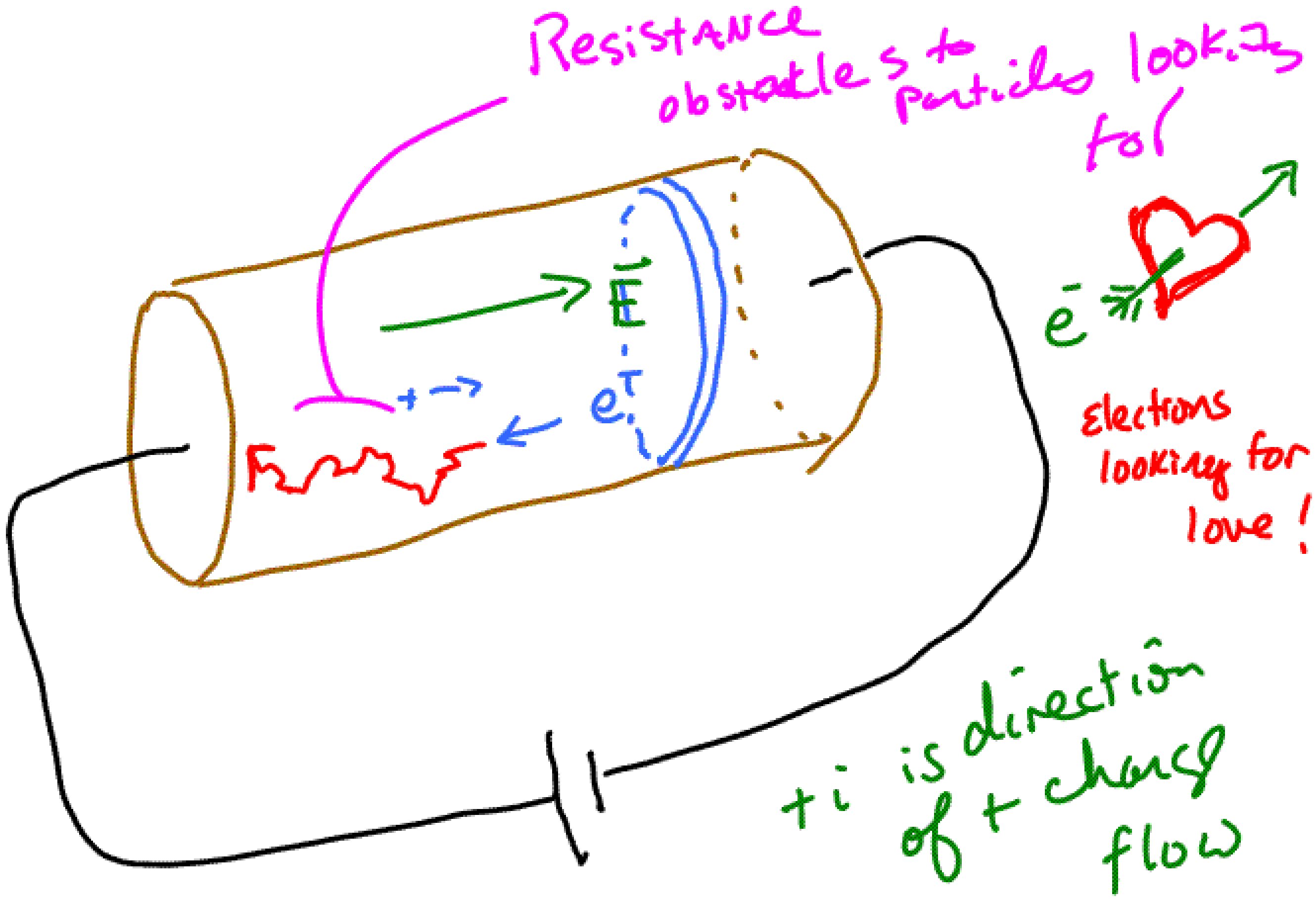
$$U = \frac{\epsilon_0}{2} k^2 Q^2 4\pi \int_a^b r^{-2} dr$$

$$U = \frac{\epsilon_0}{2} k^2 Q^2 4\pi \left[-r^{-1}\right]_a^b$$

$$U = \frac{\epsilon_0}{2} k^2 Q^2 4\pi \left(\frac{1}{a} - \frac{1}{b}\right)$$

use $k = \frac{1}{4\pi\epsilon_0}$

$$U = \frac{kQ^2}{2}\left(\frac{1}{a} - \frac{1}{b}\right)$$



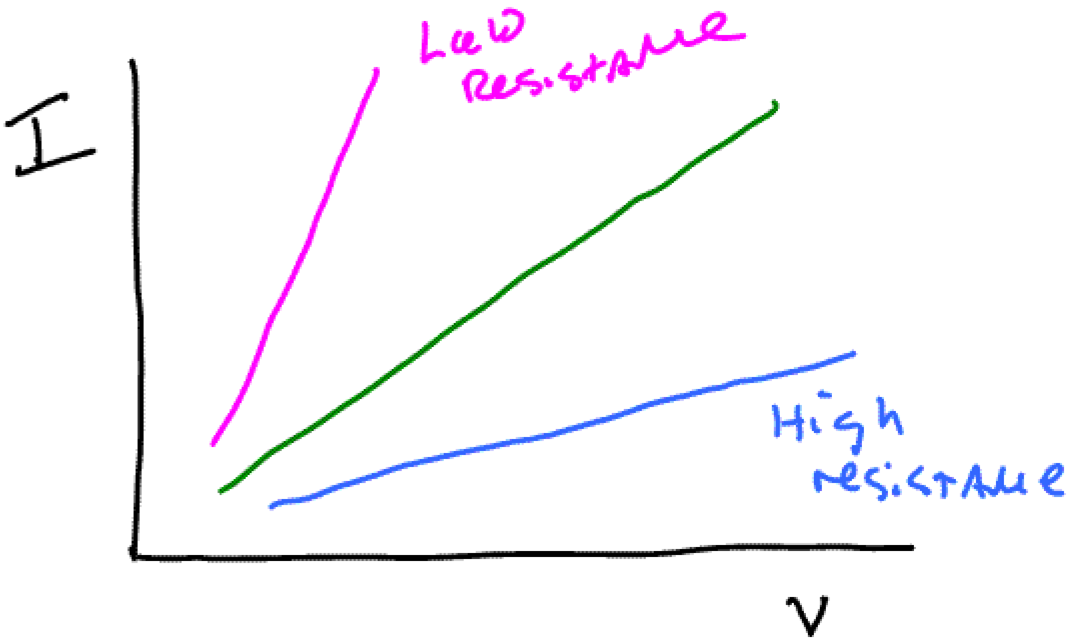
$$\text{charges flow} = \frac{dq}{dt} \equiv i \equiv \text{current}$$

or I

$$\text{unit of Ampere} \equiv \frac{1\ \text{coul}}{1\ \text{second}}$$

André Marie Ampère
(1775 - 1836)

French
- Mathematician
- Chemist
- physicist



$I \propto V$

$RI = V$

$V = I\underbrace{R}_{\text{const of Proport.}}$

$R = \Omega \equiv \text{ohm}$

ohm's law

$V = IR$

Ohm's Law

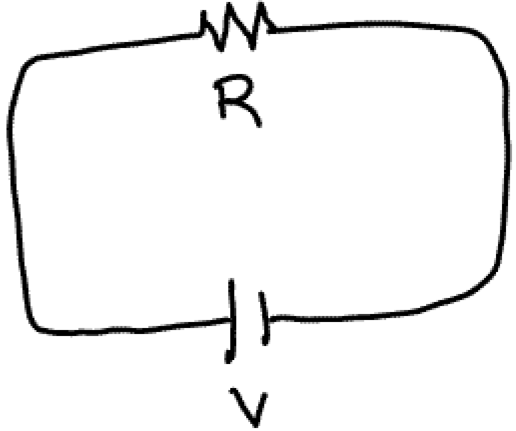
Resistance
Measured
in
Ohms

Georg
Ohm

1789-1854
German

$1\,\text{ohm} = 1\ \frac{\text{volt}}{\text{Ampere}}$

Ω



$V = iR$

$v = \frac{w}{q}$ To get q across resistor

Voltage drop across resistor

$w = qV$ i thru resistor

$$\underbrace{P}_{\text{Power}} = \underbrace{\frac{dw}{dt}}_{\text{rate work done to shove } i \text{ thru resistor}} = \frac{dq}{dt} V = iV$$

Power spent in resistor $\longrightarrow$ heat and/or light

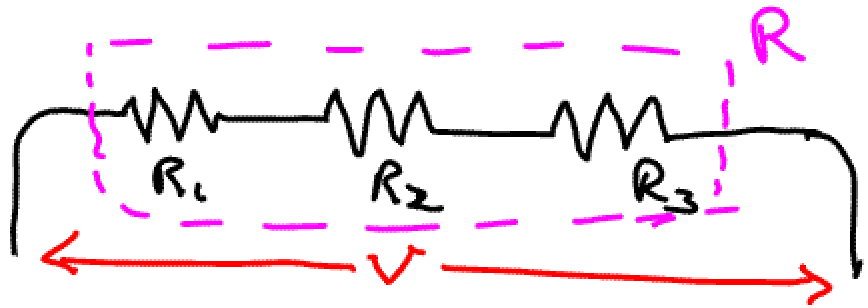
$P = iV$

$V = iR$

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

$P = i^2 R$

Resistors in Series



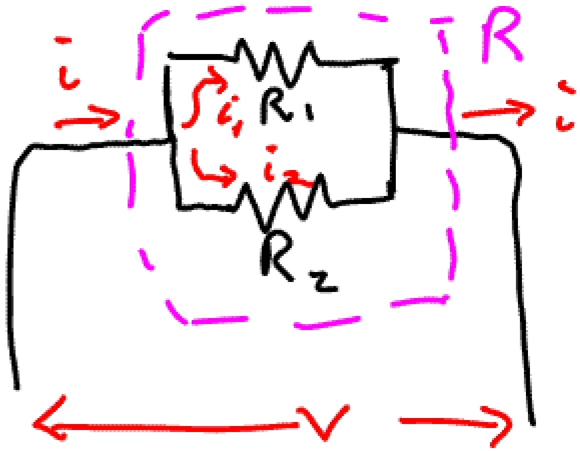
$$V = V_1 + V_2 + V_3 = iR_1 + iR_2 + iR_3 = i(R_1 + R_2 + R_3)$$

$$V = iR$$

$$R = R_1 + R_2 + R_3$$

$$\boxed{R = \sum_i R_i}$$

resistors in series



$$V = iR$$

$$V = i_1 R_1$$

$$V = i_2 R_2$$

$$i = i_1 + i_2$$

$$\frac{V}{R} = \frac{V}{R_1} + \frac{V}{R_2} \qquad \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\boxed{\frac{1}{R} = \sum_i \frac{1}{R_i}}$$

Resistors in Parallel

Gotcha

Capacitors

Series

Resistors

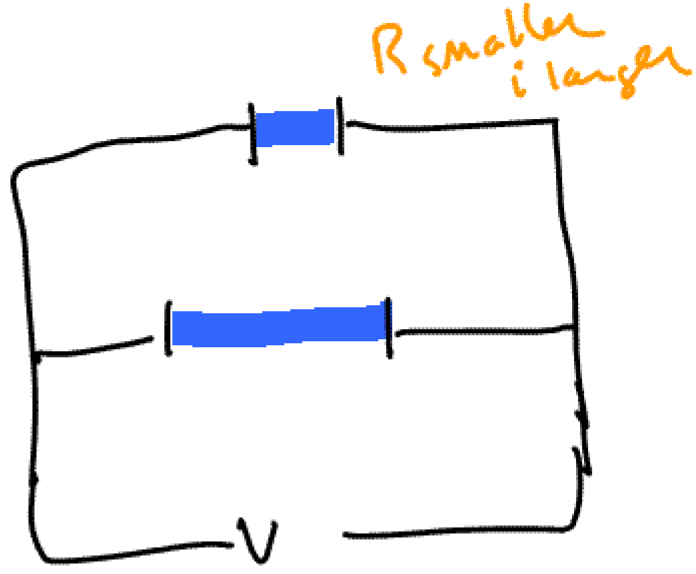
$$\frac{1}{C} = \sum_i \frac{1}{C_i}$$

$$R = \sum R_i$$

$$C = \sum_i C_i$$

$$\frac{1}{R} = \sum \frac{1}{R_i}$$

Parallel



$V = iR$

$P = i^2 R$

Make V large — which resisor (Nail)
melts 1st ?