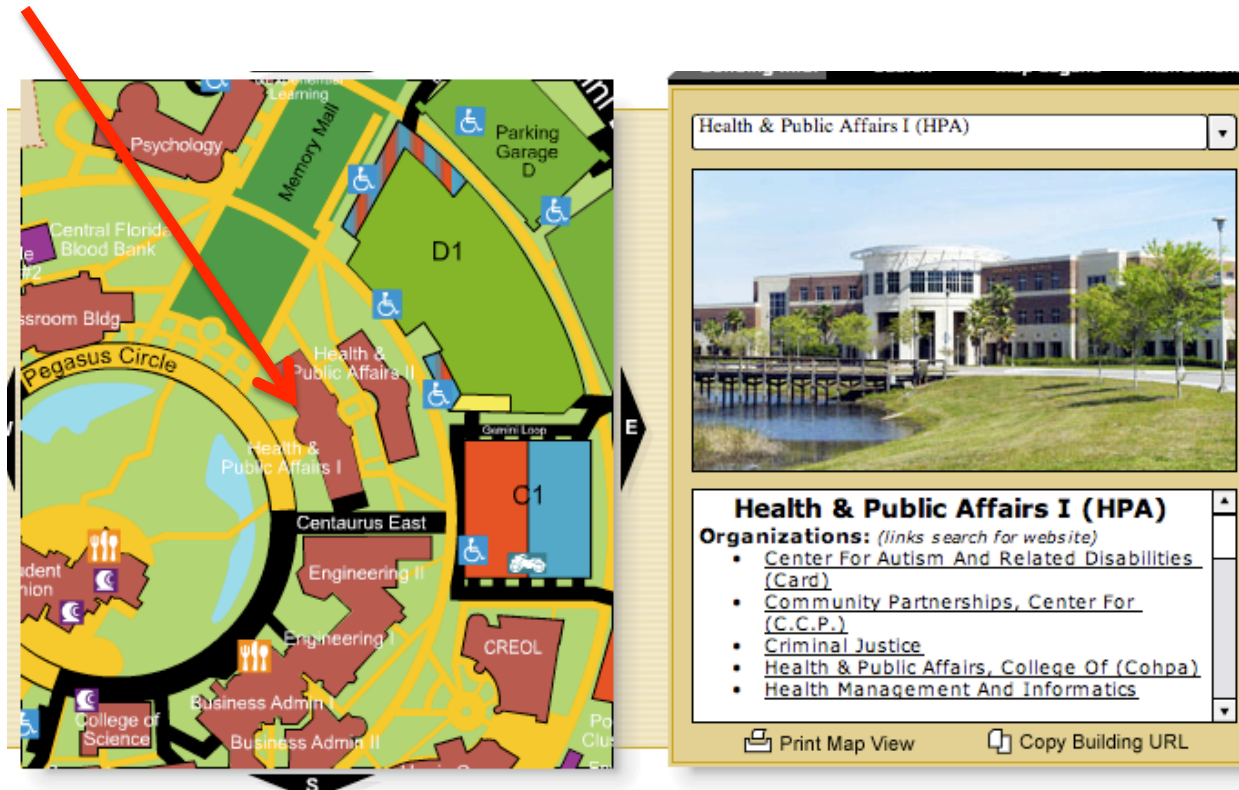


Announcement: Review Session  
Tonight 7:30-9 pm  
HPA 112 [Health and Public Affairs]



Webassign due Wednesday

How to study for exam: go over examples in the textbook  
do extra problems in the book [[especially ch. 24, 25]  
look at the practice exams, do them

**Go to SI sessions**

Exam 1: Thursday: bring your student ID and a pen  
5 written problems  
covers ch 23-26  
no formula sheets allowed  
one equation given : permittivity of free space

Pencil response will not be given altered partial credits

Current: charge per unit time

$$I = \frac{dQ}{dt}$$

$$1 \text{ Amp} = 1 \text{ C/sec}$$

What is the speed of electrons?



Potential energy: 1 electron volt

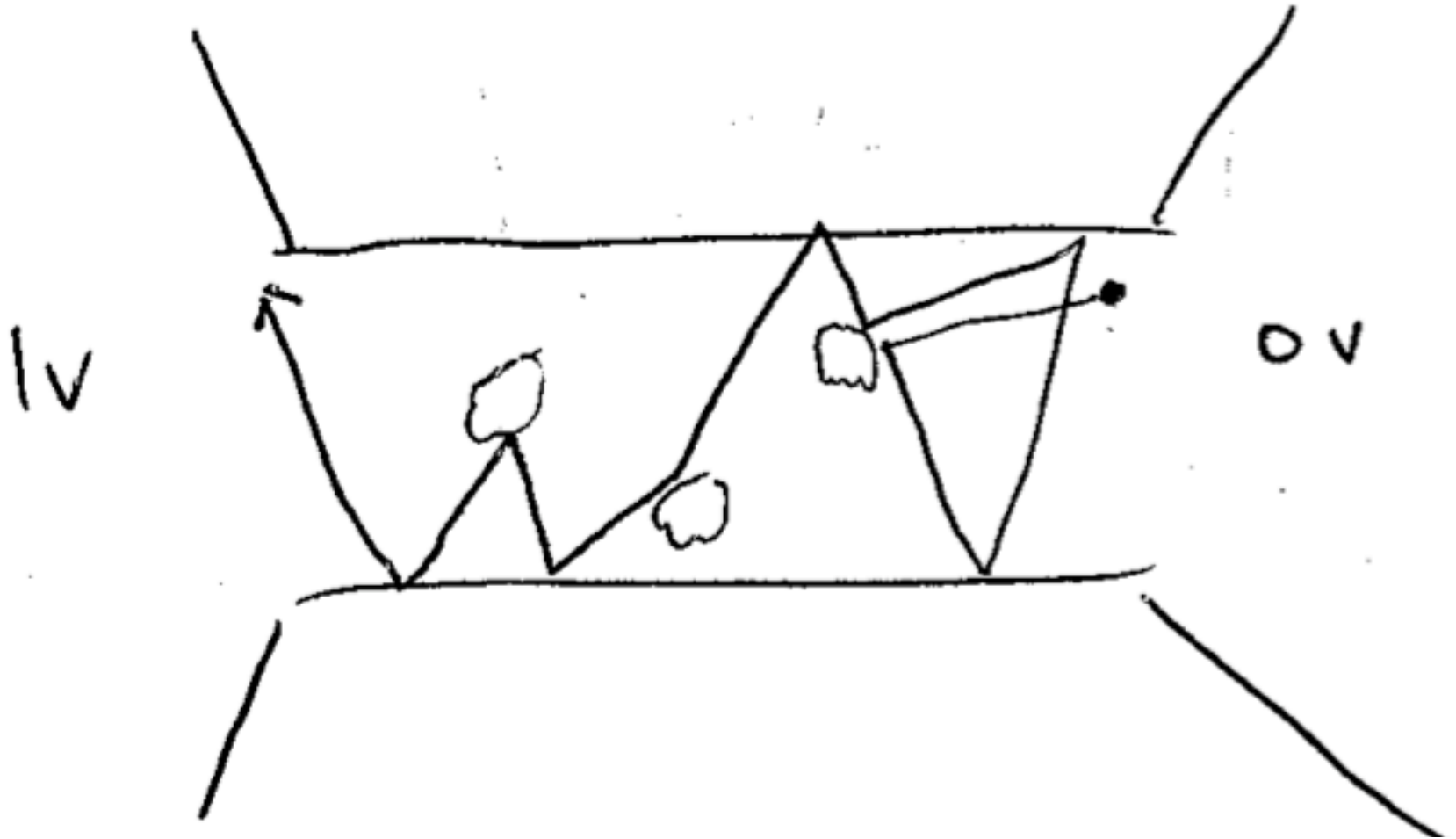
$$U = \frac{1}{2}mv^2$$

$$1.6 \times 10^{-19} J = \frac{1}{2} \times 9.109 \times 10^{-31} kg \times v^2$$

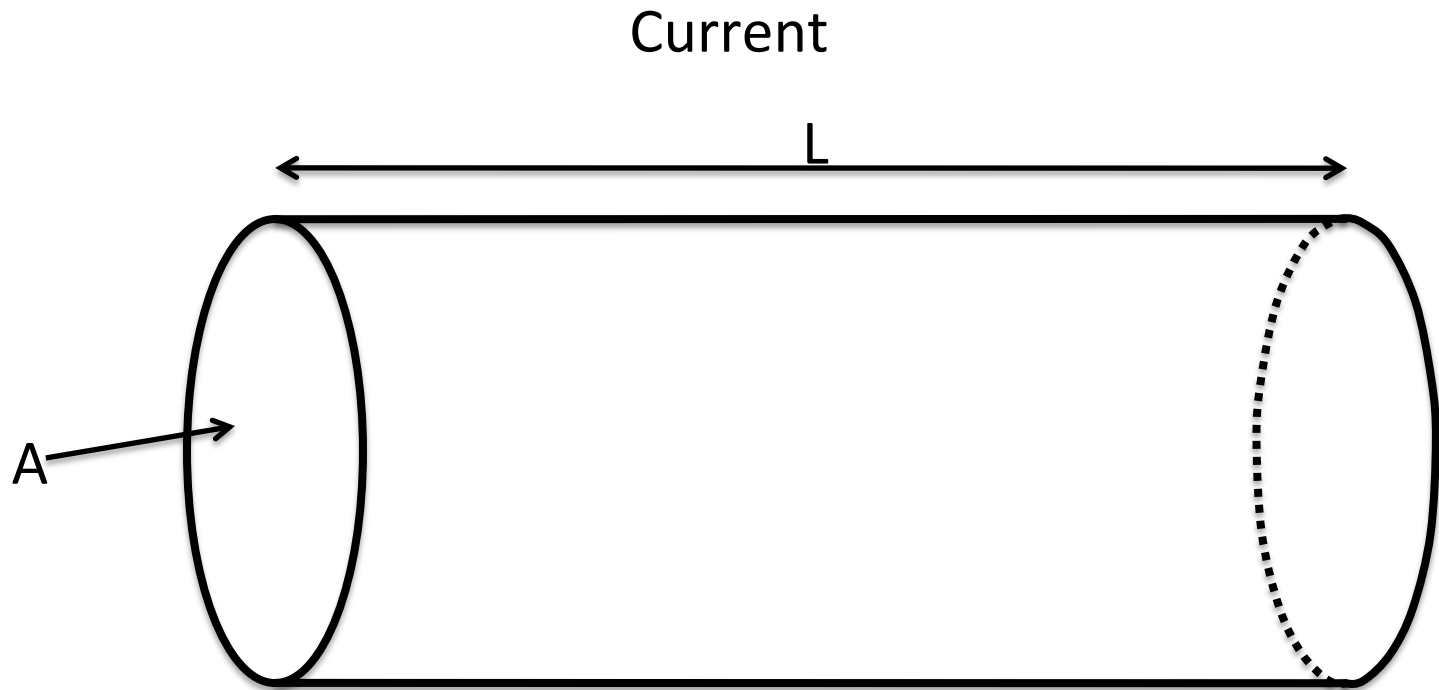
$$v = \sqrt{\frac{3.2 \times 10^{-19}}{9.109 \times 10^{-31}}} m / s = 0.35 \times 10^6 m / s$$

But in reality, charge carriers diffuse at mm/sec, why?

Carrier velocity small because of scattering



$v_d$  : "Drift velocity"

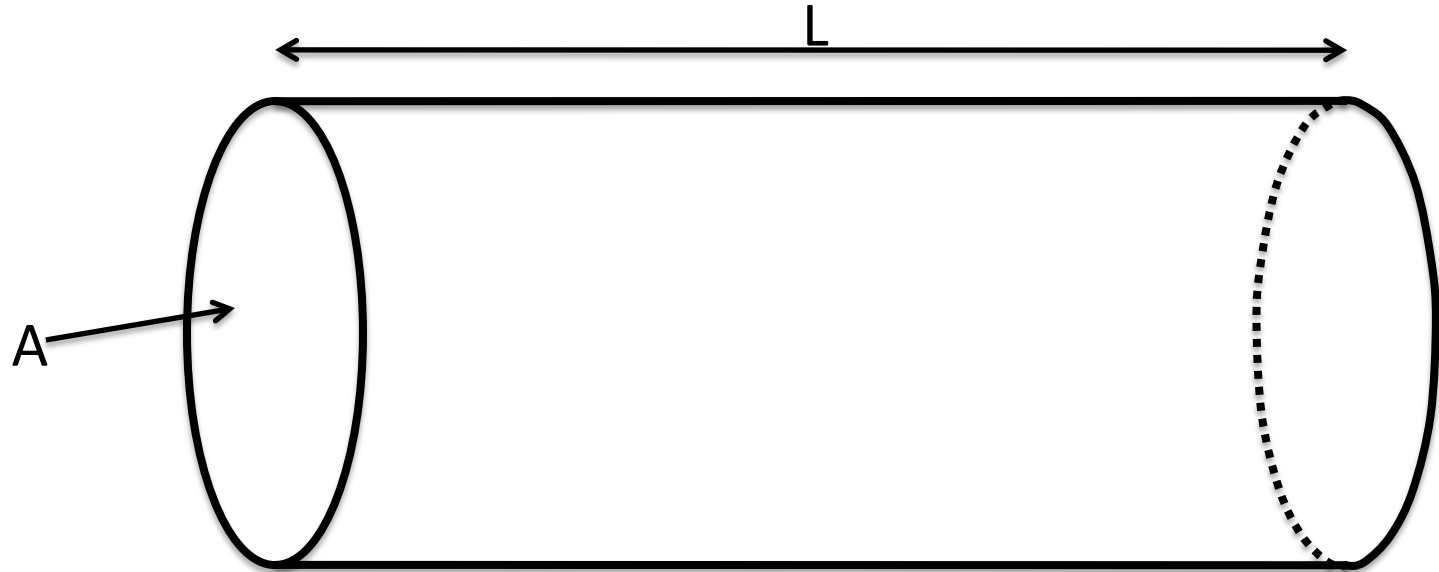


$n$ : volume density of electrons

$$Q = neAL$$

$$I = \frac{dQ}{dt} = neA \frac{dL}{dt} = neAv_d$$

Current Density



$$J = \frac{I}{A}$$

Ohm's Law

$$\vec{J} = \sigma \vec{E}$$

$\sigma$ : conductivity

# Ohm's Law



Ohm's Law  $\vec{J} = \sigma \vec{E}$

$$\frac{1}{\sigma} \vec{J} = \vec{E}$$

$$\frac{L}{\sigma} J = LE$$

$$\frac{L}{\sigma} \frac{I}{A} = LE = V$$

$$\frac{L}{\sigma A} I = V$$

$$\frac{L}{\sigma A} = R$$

$$RI = V$$



# Conductivity, Resistance and Resistivity

$$R = \frac{L}{\sigma A}$$

Resistance :  $\Omega$

$$\rho = \frac{1}{\sigma}$$

Resistivity :  $\Omega \text{ m}$

$$R = \frac{\rho L}{A}$$

Resistivity

Silver:  $1.59 \times 10^{-8} \Omega \text{ m}$

Copper:  $1.7 \times 10^{-8} \Omega \text{ m}$

Gold:  $2.44 \times 10^{-8} \Omega \text{ m}$

Glass:  $10^{10} \sim 10^{14} \Omega \text{ m}$