

① Phys 2426 2017-07-10 Lec 4

HWZ Due Sun Night Ch 27-28  
Quiz 2 Monday

Electric Current - Flow rate of charge  
Current ( $I$ ) in amperes (A)

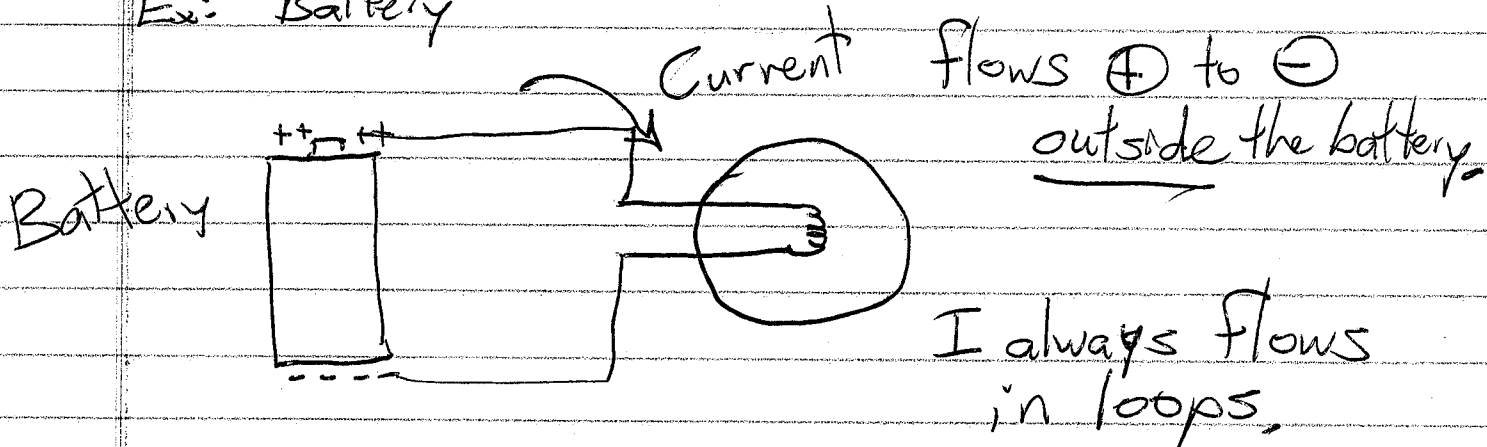
Definition  $I = \frac{dQ}{dt}$   $Q =$  charge  
arriving at  
point from  
one side

$Q = 1.0 \text{ C}$  is huge in statics.  
 $I = 100 \text{ A}$  is perfectly fine.

Note  $dQ/dt$  is usually a flow, not  
a rate of change.

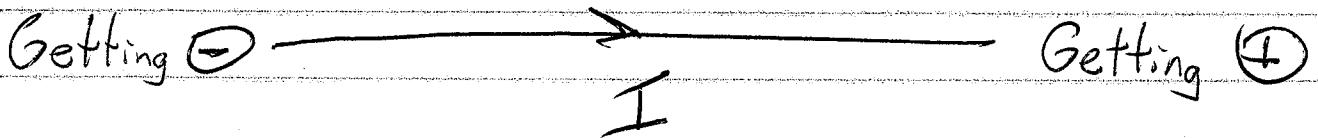
What motivates  $I$ ? Voltage.

Ex: Battery

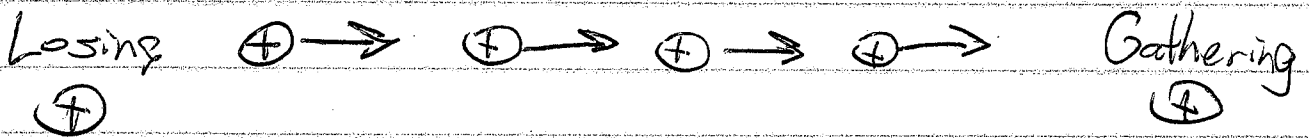


(2)

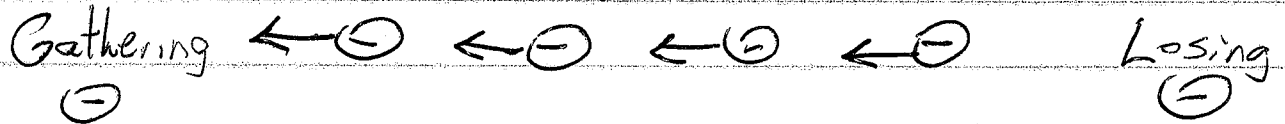
# Model For Current



Ex:  $\oplus$  ion current. (in liquids & gasses)

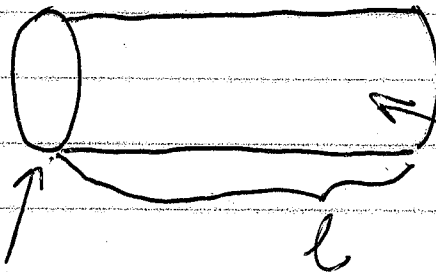


Ex: Electron flow



## How much charge vs. How fast

Drift Velocity



$A$  = cross-section  
 $l$  = length of slug

$$Q = \rho l A$$

$\rho$  = charge density

$$\Delta Q = I \Delta t$$

$$l = v \Delta t$$

$v$  = velocity

$$v = \frac{l}{\Delta t} = \frac{Q}{\rho A \Delta t} = \frac{I \Delta t}{\rho A \Delta t}$$

$$v = \frac{I}{\rho A} = \frac{(1.0 A)}{(-1.6 \times 10^{19})(\pi \cdot 0.001^2)}$$

$$= -0.0002 \text{ m/s} = -0.2 \text{ mm/s}$$

(Copper  $10^{28} \text{ e}^-/\text{m}^3$ )  
 $\rho = 10^{28} (1.6 \times 10^{-19} \text{ C})$   
 $= -1.6 \times 10^9 \text{ C/m}^3$

③

Resistance - Difficulty of pushing current.

$$\text{Effort} = \text{Result} \cdot \text{Difficulty}$$

$$V = I R$$

We typically call  $R$  a constant. Is it?  
What affects  $R$ ?

Geometry, Material  $\rightarrow l, A, \rho = \text{resistivity}$

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

Temperature

$$\left(\frac{\Delta R}{R}\right) = \alpha \Delta T$$

Fractional  
change

thermal  
coefficient

temperature  
change