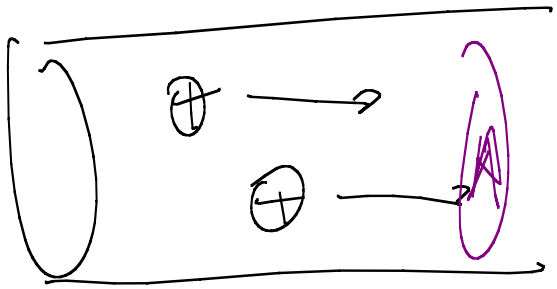
Phys 2120-4 9/24/12

Note Title 9/24/2012

Electric Current

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



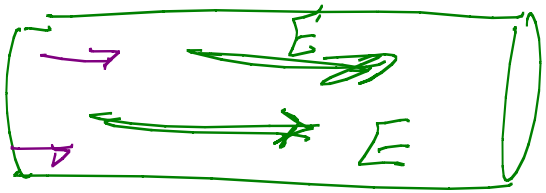
Current density, $J = \frac{I}{A}$ Amp/m²

$\vec{J} = nq\vec{v}_d$

v_d = drift velocity

n = # density

q = charge



$J \propto E$

$\vec{J} = \sigma \vec{E}$ σ is characteristic of material

= conductivity

Units are $\frac{[J]}{[E]} = \frac{A/m^2}{V/m} = \frac{Amp}{Volt \cdot m}$

Use reciprocal of σ $\rho = \frac{1}{\sigma}$ resistivity

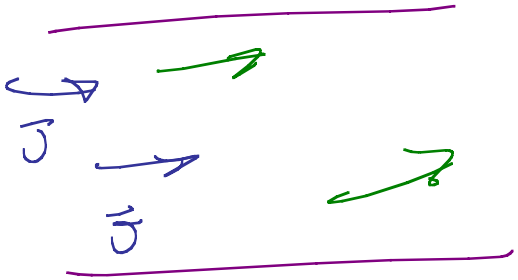
Read book

Units $\frac{Volt \cdot m}{Amp} = \Omega \cdot m$

Ω ← Ohm

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

"Ohm's Law"



Macroscopic Version

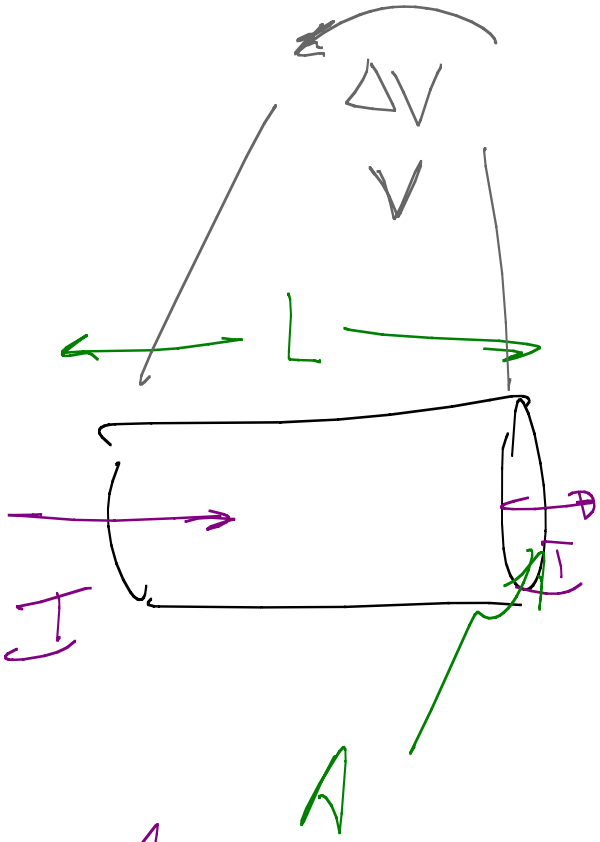
Also true: Current I is prop to the pot'l difference.

$I \propto V$

Ohm's Law

$$V = IR$$

R is resistance of the device



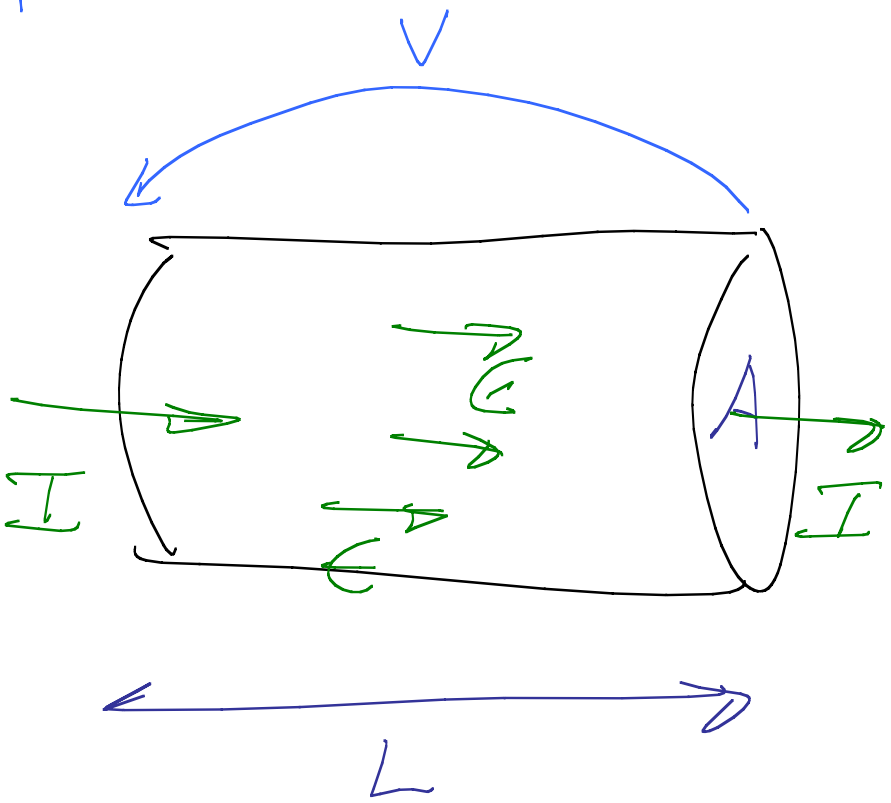
$$I = \frac{V}{R} \qquad R = \frac{V}{I} = \frac{\text{Volt}}{\text{Amp}} = \Omega \qquad V = IR$$

Relate the two pictures

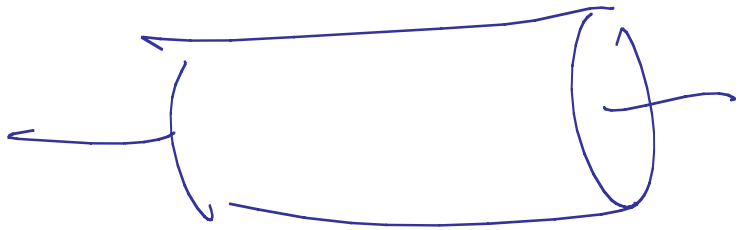
$$V = EL \qquad I = JA$$

$$I = \frac{V}{R} \qquad V = EL$$

$$JA = \frac{EL}{R} = \frac{E}{\rho} A$$



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

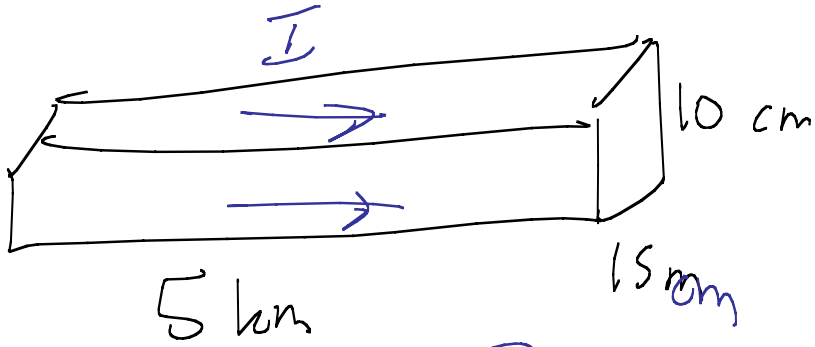


Resistance $\propto L$

$\propto \frac{1}{A}$

ρ resistivity property of material

24.25 Third rail... x-sec is 10 cm × 15 cm and 5.0 km long (iron bar). Find its resistance.



$A = (0.15\ m)(0.10\ m)$

$= 1.5 \times 10^{-2}\ m^2$

$L = 5 \times 10^3\ m$

$R = \rho \frac{L}{A} = (9.71 \times 10^{-8}\ \Omega m) \frac{(5 \times 10^3\ m)}{1.5 \times 10^{-2}\ m^2}$

$= 3.2 \times 10^{-2}\ \Omega$

R

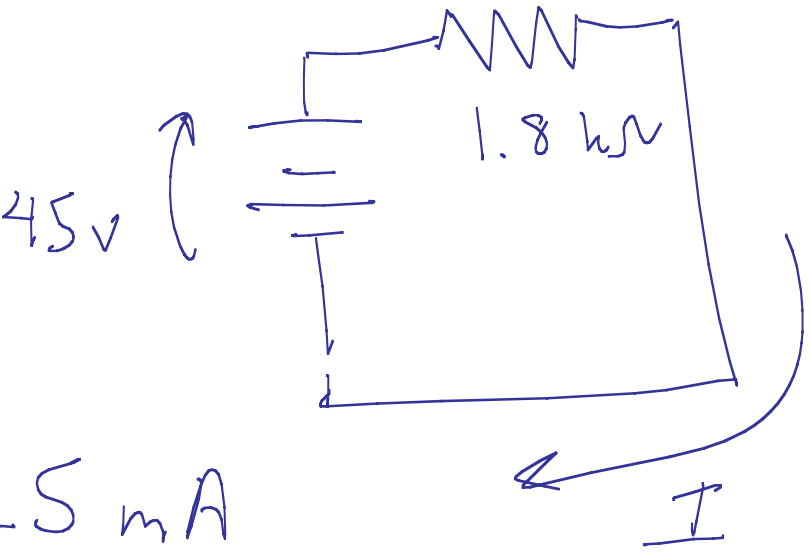
32 mΩ

24.26 What current flows when a 45 V potential difference is imposed across a 1.8 kΩ resistor!

$$V = IR$$

$$I = \frac{V}{R} = \frac{45\ \text{V}}{1.8 \times 10^3\ \Omega}$$

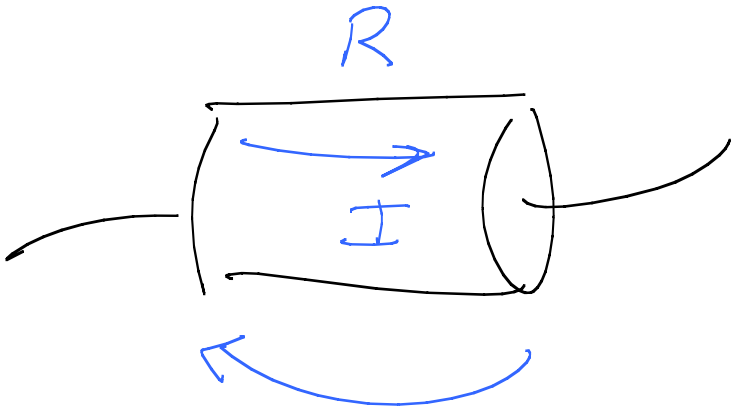
$$= 2.5 \times 10^{-2}\ \text{A} = 25\ \text{mA}$$



Charges $U = qV$

lose energy in going

thru drop elec. pot'l.



I = rate of charge flow = $\frac{\text{Charge}}{\text{time}}$

V = Elec pot'l

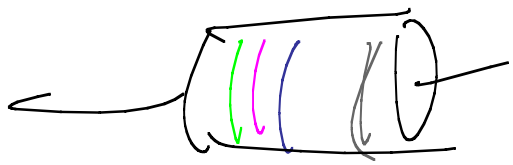
$V = IR$

VI = Rate at which charges lose energy to matl making it warm

= power dissipated in resistor = P

$$P = VI$$

$$V = IR$$



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

$$[P] = \frac{\text{Energy}}{\text{time}} = \text{Watt} = J/s$$

24.29 A 4.5 W flashlight bulb draws 750 mA. a) Voltage it op's at. b) Resistance

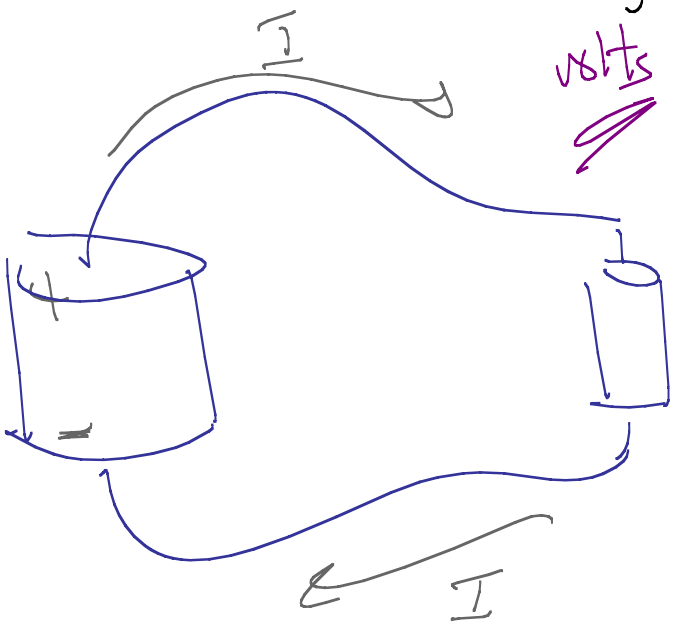
$P = 4.5\text{ W}$ $\quad P = IV \quad V = \frac{P}{I} = \frac{4.5\text{ W}}{0.750\text{ A}} = 6.0\text{ V}$

$V = IR \quad R = \frac{6\text{V}}{0.750\text{ A}} = 8.00\ \Omega$

Chap 25 Electric Circuits

Put batteries & resistors together, discuss the Systems ...

Circuit:



volts

electromotive force,

$\mathcal{E}$