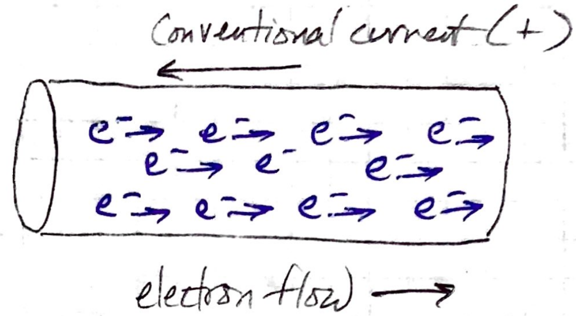
9.23

Number of e^- through a point in a wire in 3.00s of current $I = 4.00A$?



I (current) $= \frac{\Delta Q}{\Delta t}$

so

$\Delta Q = I \Delta t$

$= (4.00 \text{ Amps})(3.00s)$

$\Delta Q = 12.0$ Coulombs

$12.0C \times \frac{1e^-}{1.602e{-19}C} = \boxed{7.49e19 \text{ electrons}}$

9.28 14-gauge wire of Aluminum is 1.628mm in diam, so $r = 1.628e{-3}/2 = 8.14e{-4}\,m$, & cross-sectional area $A = \pi r^2 = 2.08e{-6}\,m^2$. $I = 3.00\,Amps = 3.00\,C/s$

a) Find charge density in the wire, ie. how many electrons in a given volume of wire? (Chemistry! Info to help solve the problem is listed farther down in problem.

$Al = \rho = 2.70\,g/cm^3$, with molar mass of $26.98\,g/mol$.

We're looking for e^-/m^3, assuming $1\,e^-$ free/atom.

$$\frac{6.02e23\,e^-}{1\,mol} \times \frac{1\,mol}{26.98\,g} \times \frac{2.70\,g}{1\,cm^3} \times \frac{(100\,cm)^3}{1\,m^3} = \boxed{\frac{6.02e28\,e^-}{m^3}}$$

b) What is v_{drift} of electrons?

As developed in text, v_{drift} is how fast an average e^- moves through the wire (m/s).

If $I = \frac{\Delta Q}{\Delta t}$ & total charge passing a point

$$\frac{\Delta Q}{\Delta t} = n\,q\,A\,v_d$$

cross-sectional area

drift v.

charge on one carrier

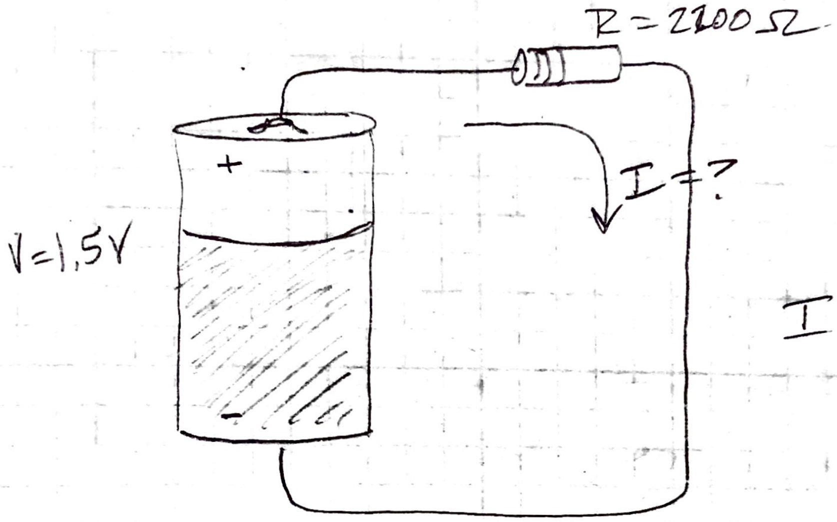
number of charge carriers

$$I = nqAv_d$$

$$3\,\frac{C}{s} = \left(\frac{6.02e28\,e^-}{m^3}\right)(1.602e{-19}\,C)(2.08e{-6})\,v_d$$

$$v_d = \boxed{1.50e{-4}\ m/s}$$

9.50 A 2.2 kΩ resistor (2200 Ω) is connected across a D-cell (1.5 Volts). I = ?

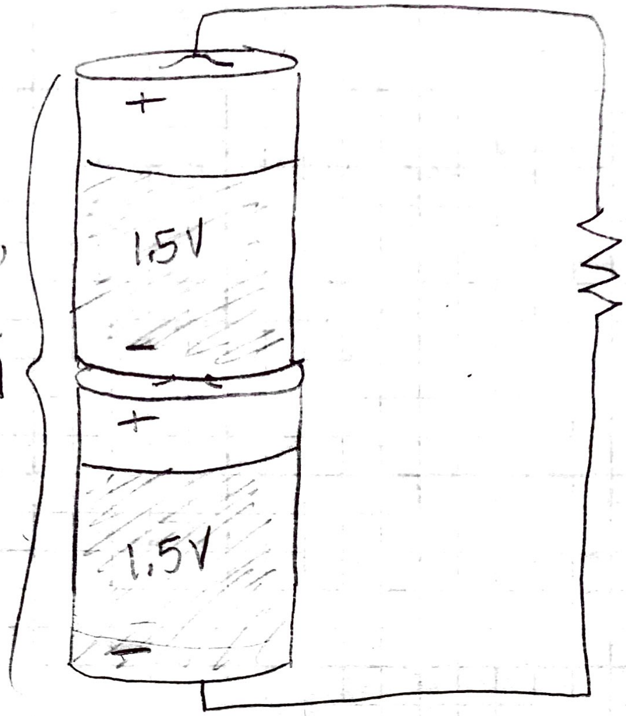


$$I = \frac{V}{R} = \frac{1.5V}{2200\,\Omega}$$

$$= \boxed{6.8e-4\,A}$$

$$= \boxed{0.68\,mA}$$

9.51 $R = 250\,k\Omega = 2.50e5\,\Omega \pm 5\%$



In series, $V = V_1 + V_2$
$= 3.00V$

$R = 2.50e5 \times 0.95 = 237500\,\Omega$
$2.50e5 \times 1.05 = 262500\,\Omega$

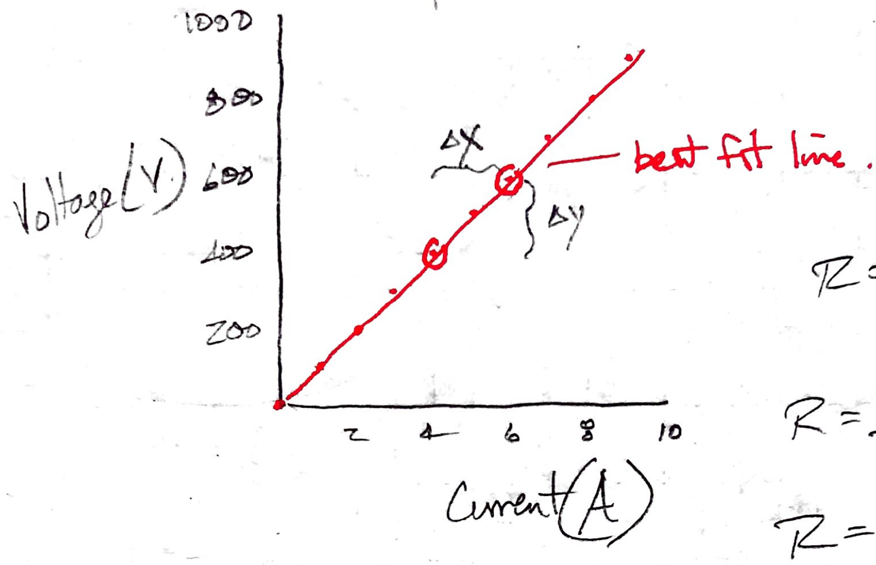
Max & Min resistances, $\pm 5\%$ of $250\,k\Omega$

So...

$$I_{max} = \frac{V}{R_{min}} = \frac{3.00V}{237500} = \boxed{1.26e{-5}A}$$

$$I_{min} = \frac{V}{R_{max}} = \frac{3.00V}{262500} = \boxed{1.14e{-5}A}$$

9.53 Resistor placed in circuit w/ adjustable voltage. V vs I plotted here. Find R.



$R = \frac{\Delta V}{\Delta I}$ = slope of V/I graph.

$$R = \frac{V_f - V_i}{I_f - I}$$

$$R = \frac{600 - 400}{6 - 4} = \frac{200}{2} = \boxed{100\,\Omega}$$