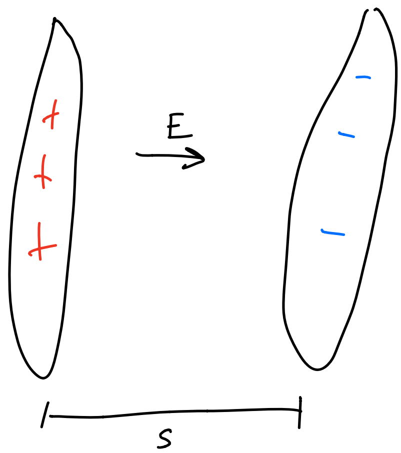
P 42:



$$E = \frac{Q/A}{\epsilon_0} \qquad A = \pi R^2 = \pi(0.12)^2$$

$$Q = 3.6 \times 10^{-8}\ C$$

$$E = 8.99 \times 10^{4}\ \frac{V}{m}$$

b) $|\Delta V| = E s = \left(8.99 \times 10^{4}\ \frac{V}{m}\right)(0.0015\ m)$

$$|\Delta V| = 135\ V$$

c) $Q = C\Delta V, \quad C = \frac{Q}{\Delta V} = 2 \times 10^{-10}\ F$

P45: $\sigma = |q| n u$

$$= (1.6 \times 10^{-19}\, C)(5.9 \times 10^{28}\, m^{-3})\left(4.3 \times 10^{-3}\, \frac{m/s}{V/m}\right)$$

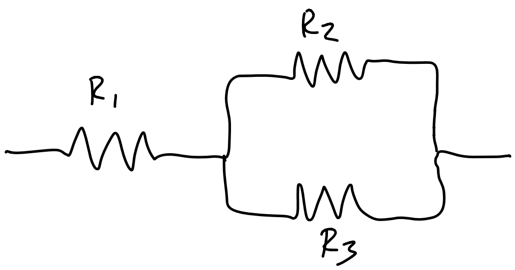
$$\sigma = 4.06 \times 10^{7}\, (\Omega m)^{-1}$$

P51: $R_1 = \dfrac{L_1}{\sigma A_1} = 40\,\Omega$

$$R_2 = \frac{L_2}{\sigma A_2} = \frac{3L_1}{\sigma(\frac{1}{2}A_1)} = 6\,\frac{L_1}{\sigma A_1} = 240\,\Omega$$

$$R_{eq} = R_1 + R_2 = 280\,\Omega$$

P54:



First combine R_2 & R_3:

$$\frac{1}{R_{23}} = \frac{1}{R_2} + \frac{1}{R_3}$$

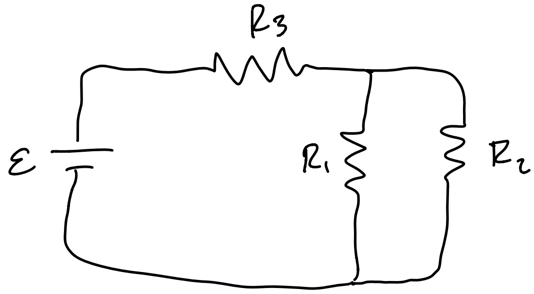
$$R_{23} = \frac{R_2 R_3}{R_2 + R_3}$$

Now:

$$R_{eq} = R_1 + R_{23} = R_1 + \frac{R_2 R_3}{R_2 + R_3}$$

$$= 10 + \frac{(5)(20)}{25} = \boxed{14\,\Omega}$$

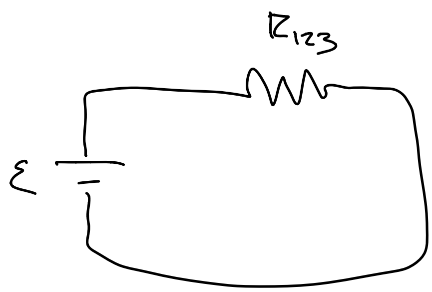
P56:



a) $R_{21} = \dfrac{R_2 R_1}{R_2 + R_1} = \dfrac{(31)(47)}{78} = 18.7\,\Omega$

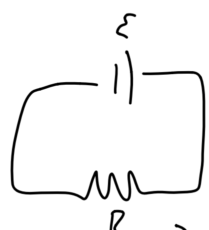
b) $R_{123} = R_3 + R_{21} = 52 + 18.7 = 70.7\,\Omega$

c)



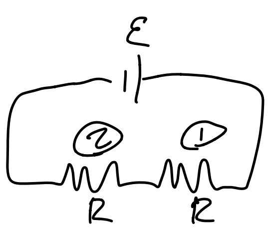
$I = \dfrac{\varepsilon}{R_{123}} = \dfrac{7.4}{70.7} = 0.105\text{ A}$

P62:



$P = P_1 = \dfrac{\varepsilon^2}{R}$

a)



$P_{R1} = I^2 R$

Loop Rule to find I

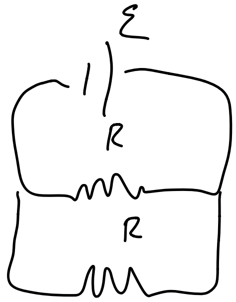
$\varepsilon - 2IR = 0$

$I = \frac{1}{2}\frac{\varepsilon}{R}$, $P = I^2 R = \frac{1}{4}\frac{\varepsilon^2}{R^2} R = \frac{1}{4}\frac{\varepsilon^2}{R} = \boxed{\frac{1}{4} P_1}$

b) $P = \frac{1}{4}P_1$ over each resistor,

so $P = \frac{1}{4}P_1 + \frac{1}{4}P_1 = \frac{1}{2}P_1$

c)



Loop rule:

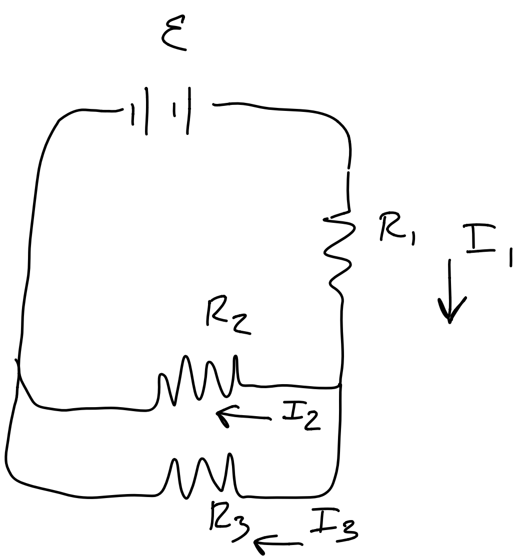
$\mathcal{E} - I_1 R = 0$

$\mathcal{E} - I_2 R = 0$

$I_1 = I_2 = \frac{\mathcal{E}}{R}$

$$P = I^2R + I^2R$$
$$= 2\left(\frac{\mathcal{E}}{R}\right)^2 R = 2\frac{\mathcal{E}^2}{R} = \boxed{2P_1}$$

P66.



Loop

$\mathcal{E} - I_1R_1 - I_2R_2 = 0$

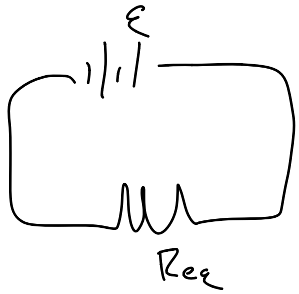
$\mathcal{E} - I_1R_1 - I_3R_3 = 0$

Node

$I_1 = I_2 + I_3$

Find R_{eq} to get I_1

$$R_{eq} = R_1 + \frac{R_2 R_3}{R_2+R_3} = 27.14\,\Omega$$



$$\varepsilon - I_1 R_{eq} = 0$$

$$I_1 = \frac{\varepsilon}{R_{eq}} = \frac{3}{27.14} = 0.11\,A$$

$$\boxed{I_1 = 0.11\,A}$$

$$\varepsilon - I_1R_1 - I_2R_2 = 0 \Rightarrow I_2 = \frac{\varepsilon - I_1R_1}{R_2} = 0.05\,A$$

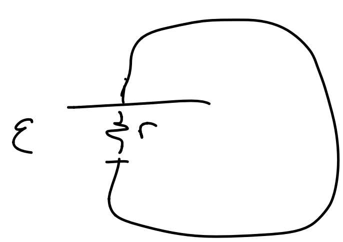
$$\varepsilon - I_1R_1 - I_3R_3 = 0$$

$$\boxed{I_2 = 0.05\,A}$$

$$\boxed{I_3 = I_1 - I_2 = 0.06\,A}$$

P67: For an ideal battery, short-circuit $I = \infty$

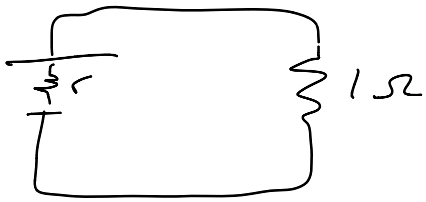
This must be a real battery



$$\varepsilon - Ir = 0$$

$$r = \frac{\varepsilon}{I} = \frac{1}{2}\,\Omega$$

$$r = \frac{1}{2}\,\Omega$$

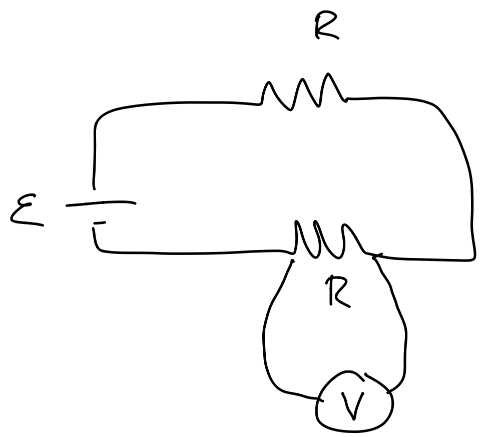


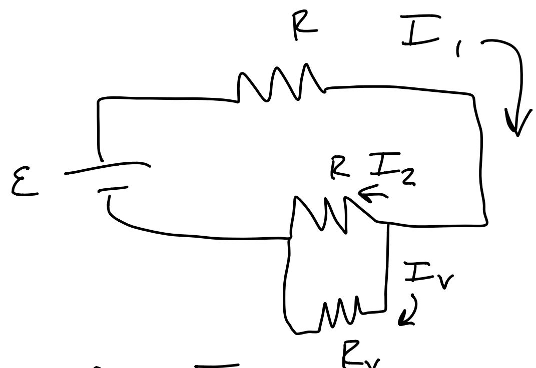
$$6V - I\left(\tfrac{1}{2}\Omega\right) - I(1\Omega) = 0$$

$$I\left(\tfrac{3}{2}\Omega\right) = 6V$$

$$\boxed{I = 4A}$$

P73:





Solve for I_v,

then $\Delta V_v = I_v R_v$

Loop

$$\mathcal{E} - I_1 R - I_2 R = 0$$

$$\mathcal{E} - I_1 R - I_v R_v = 0$$

$$I_1 = \frac{\mathcal{E}}{R_{eq}} = \frac{\mathcal{E}}{R + \frac{R R_v}{R + R_v}} = 1.25 \times 10^{-5} A$$

$$I_v R_v = \Delta V_v = \mathcal{E} - I_1 R$$

$$= 10 V$$

$$\boxed{\Delta V_v = 10 V}$$

W/O voltmeter, true value is 30 V

R_v is too small

P74:

$$I = \frac{\mathcal{E}}{R} e^{-\frac{t}{RC}}$$

$$I(0) = \frac{\mathcal{E}}{R} = 0.45 A$$

$$I(50) = \frac{\mathcal{E}}{R} e^{-\frac{50}{RC}}$$

$$= 0.45 e^{-\frac{50}{40}} = 0.129 A$$

P76:

RC

$$I(t) = \frac{\mathcal{E}}{R} e^{-\frac{t}{RC}}$$

$$C = \frac{Q}{\Delta V}$$

$$\Delta V = ?$$

$$\Delta V = \frac{Q/A}{\epsilon_0} s$$

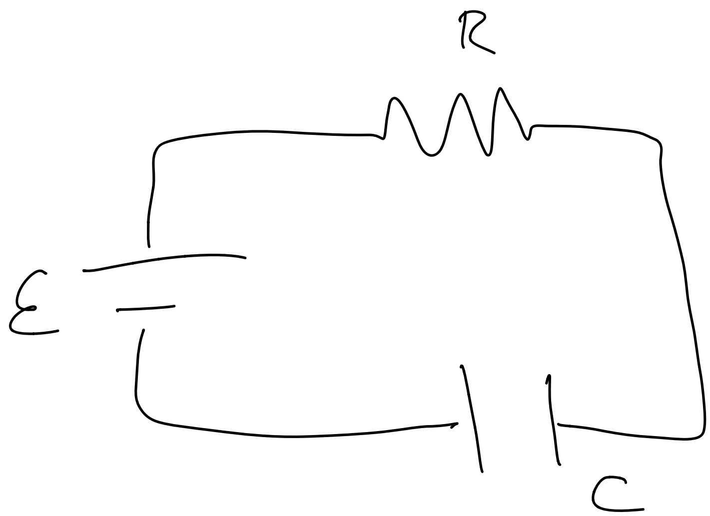
$$C = \frac{\epsilon_0 A}{s}$$

$$A = .1m \times .02m$$

$$s = .001m$$

$$\epsilon_0 = 8.85 \times 10^{-12}$$

$$C = 1.77 \times 10^{-11}\ F$$



$$\varepsilon - IR - \frac{1}{C} Q = 0$$

$$\frac{1}{C} Q = \Delta V_c = \varepsilon - IR$$

$$\Delta V_c(t) = \varepsilon \left(1 - e^{-\frac{t}{RC}}\right)$$

$$\Delta V_c(t_0) = 95 = \varepsilon \left(1 - e^{-\frac{t_0}{RC}}\right)$$

$$\frac{95}{\mathcal{E}} = 0.95 = 1 - e^{-\frac{t_0}{RC}}$$

$$e^{-\frac{t_0}{RC}} = 0.05$$

$$-\frac{t_0}{RC} = \ln(0.05)$$

$$t_0 = -RC\ln(0.05)$$

$$t_0 = -(1000\,\Omega)(1.77\times10^{-11})\ln(0.05)$$

$$t_0 = 5.3\times10^{-8}\ \mathrm{s}$$

$$t_0 = 53\ \mathrm{ns}$$