PHYS 222 - HOMEWORK 01:

PROBLEM 01:

a) Let's Consider the first row in the table:

- Diameter $= 0.0201 \text{ inch} \left(\frac{0.0254 \text{ m}}{1 \text{ inch}}\right)$

$$= 5.1054 \times 10^{-4} \text{ m}$$

- We know that $\rightarrow R = \rho \frac{L}{A}$

$$R = \frac{(1.724 \times 10^{-8}\ \Omega \cdot m) L}{\frac{\pi}{4}(5.1054 \times 10^{-4} \text{ m})^2} = 0.0842 \frac{\Omega}{m}$$

$$\frac{R}{L} = 0.0842 \frac{\Omega}{m}$$

As we can see, the resistance per unit length is $0.0842\ \Omega/m$. Assuming a sample length of 1000 m (or 1000 ft with the right units) then we get the value in the table:

$$\boxed{R(L = 1000 \text{ m}) = 84.2\ \Omega}$$

This is just an indicator of the resistance of the AWG 24 wire per 1000 m, and is used as a reference to determine the resistance of larger/shorter wires of this type easily, like considering a 'density of resistance' or simply resistance per unit length.

b) For the AWG-26 $\rightarrow R = 40.81 \frac{\Omega}{1000 \text{ ft}}$

$$R(4 \text{ inch}) = 4 \text{ inch}\left(\frac{1 \text{ ft}}{12 \text{ inch}}\right)\left(\frac{40.81\ \Omega}{1000 \text{ ft}}\right)$$

$$= 0.0136\ \Omega = 13.6 \text{ m}\Omega$$

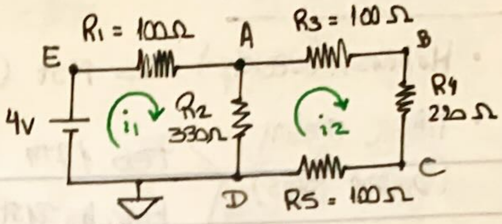
c) For N AWG-26 jumpers connected in series:

$$R = \sum_i^N R_{i\,AWG} = 1\ \Omega$$

$$= N R_{AWG} = N(0.0136) = 1\ \Omega$$

$N \simeq 74$ AWG jumpers.

PROBLEM 02:



- MESH 1: $4 - 100 i_1 - 330 i_1 + 330 i_2 = 0$

$$430 i_1 - 330 i_2 = 4$$

- MESH 2: $-100 i_2 - 220 i_2 - 100 i_2 - 330 i_2 + 330 i_1 = 0$

$$330 i_1 - 750 i_2 = 0$$

$$\rightarrow \begin{pmatrix} 430 & -330 \\ 330 & -750 \end{pmatrix}\begin{pmatrix} i_1 \\ i_2 \end{pmatrix} = \begin{pmatrix} 4 \\ 0 \end{pmatrix}$$

$$\begin{pmatrix} i_1 \\ i_2 \end{pmatrix} = \begin{pmatrix} 14.04 \\ 6.18 \end{pmatrix} \text{ mA}$$

IN NODE A: $\xrightarrow{i_1} A \xrightarrow{i_2}$, $\downarrow i_A$

$i_1 = i_2 + i_A$

$i_A = i_1 - i_2 = 7.86 \text{ mA}$

a) $I_{R1} = i_1 = 14.04 \text{ mA}$

$I_{R2} = i_A = 7.86 \text{ mA}$

$I_{R3} = I_{R4} = I_{R5} = i_2 = 6.18 \text{ mA}$

b) $\Delta V_{EG} = V_E - \cancel{V_G}$ Ground $= V_E = 4V$

- $\Delta V_{EA} = V_E - V_A = 4 - V_A = 100(14.04 \times 10^{-3})$

$$V_A = 4 - 1.404 = 2.596 \text{ V}$$

- $V_D = 0 \text{ V (Ground)}$
- $\Delta V_{AB} = V_A - V_B = 2.596 - V_B = 100(6.18 \times 10^{-3})$

$$V_B = 2.596 - 0.618 = 1.978 \text{ V}$$

- $\Delta V_{BC} = V_B - V_C = 1.978\text{V} - V_C = (220)(6.18 \times 10^{-3})$

$$V_C = 1.978 - 1.3596 = 0.62 \text{ V}$$

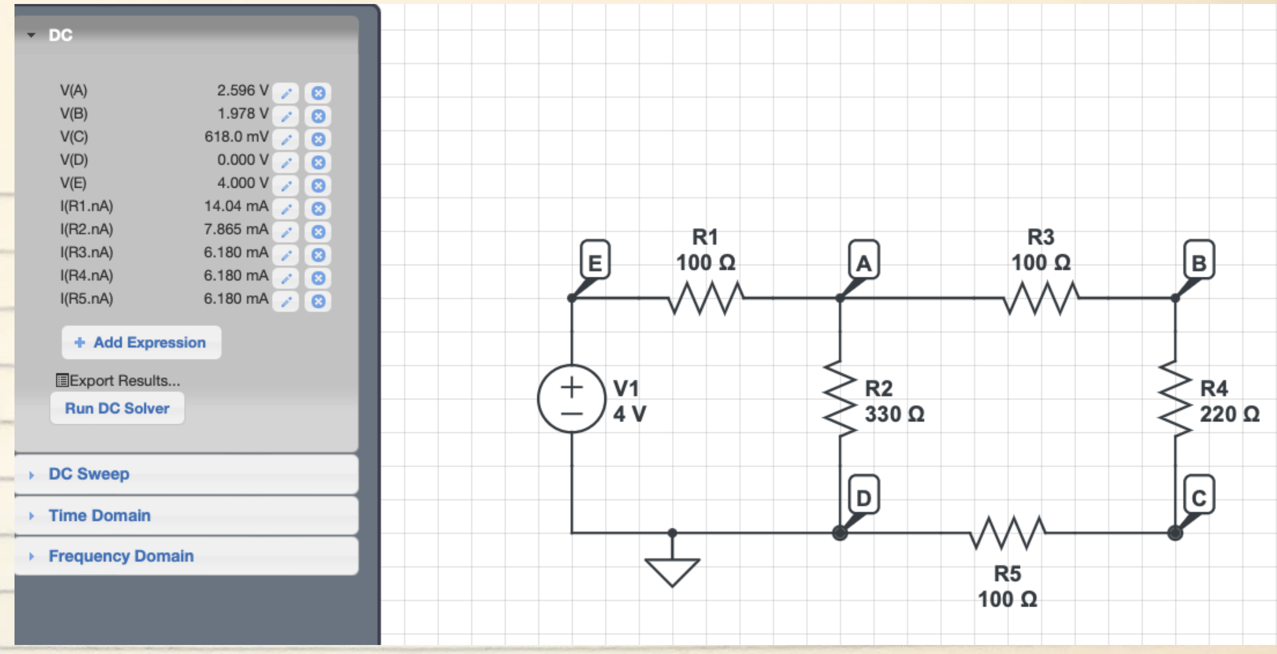
Summary

$V_A = 2.596\text{V}$, $V_B = 1.978\text{V}$

$V_C = 0.62\text{V}$, $V_D = 0\text{V}$

$V_E = 4\text{V}$

PROBLEM 03:



PROBLEM 04:

a) Area of the Plate :

$$A = (8.5\,\text{in})(11\,\text{in})\left(\frac{2.54\,\text{cm}}{1\,\text{in}}\right)^2$$

$$= 0.0603\ m^2$$

Assuming the thickness d of a piece of paper as $\rightarrow$ $d = 10^{-3}\,m$

$$\Rightarrow C = \frac{\epsilon_0 A}{d}$$

$$= \frac{(8.85\times 10^{-12}\ F\cdot m^{-1})(0.0603\ m^2)}{10^{-3}\,m}$$

$$= 5.34\times 10^{-10}\ F$$

$$= 0.534\ nF$$

b) We know that $\tau = RC$

$$R = \frac{\tau}{C} = \frac{10^{-3}\,s}{0.534\times 10^{-9}\,F}$$

$$= 1.87\times 10^{6}\ \Omega$$