1. **Series and Parallel Combinations**

For the resistor network shown below, find an equivalent resistance between the terminals A and B using the resistor combination rules for series and parallel resistors.

**Goal:** equivalence

![Resistor Network Diagram]

**Parallel Combination**

\[
\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots + \frac{1}{R_n}
\]

\[
R_{eq} = \left( \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots + \frac{1}{R_n} \right)^{-1}
\]

**Series Combination**

\[
R_{eq} = R_1 + R_2 + R_3 + \ldots + R_n
\]
2. **Superposition**

For the following circuits:

i. Use the superposition theorem to solve for the voltages across the resistors.

ii. For parts (b) and (c) only, find the power dissipated/generated by all components. Is power conserved?

(a) 

\[ V = V_s + \frac{R_2}{R_1 + R_2} \]

(b) 

\[ V_{R_1} = V_s \frac{R_1}{R_1 + R_2} + I_s \frac{R_2}{R_1 + R_2} \]
\[ V_{R_2} = V_s \frac{R_2}{R_1 + R_2} - I_s \frac{R_1}{R_1 + R_2} \]
\[ V_{R_3} = I_s R_3 \]

(c) (PRACTICE) 

\[ P_s = V_{R_1} I_s \]
\[ P_s + P_{R_2} + P_{R_1} = -V_{R_1} I_s + V_{R_2} I_s + V_{R_3} (I_s - I_s) = 0 \]
3. Current Sources And Capacitors

Given the circuit below, find an expression for \( v_{\text{out}}(t) \) in terms of \( I_s \), \( C \), \( V_0 \), and \( t \), where \( V_0 \) is the initial voltage across the capacitor at \( t = 0 \).

Then plot the function \( v_{\text{out}}(t) \) over time on the graph below for the following conditions detailed below.

Use the values \( I_s = 1 \text{mA} \) and \( C = 2 \mu \text{F} \).

(a) Capacitor is initially uncharged \( V_0 = 0 \) at \( t = 0 \).

(b) Capacitor has been charged with \( V_0 = +1.5 \text{V} \) at \( t = 0 \).

(c) Practice: Swap this capacitor for one with half the capacitance \( C = 1 \mu \text{F} \), which is initially uncharged \( V_0 = 0 \) at \( t = 0 \).

HINT: Recall the calculus identity \[ \int_a^b f'(x) dx = f(b) - f(a), \text{ where } f'(x) = \frac{df}{dx}. \]