Problem 1

This problem will walk you through the derivation for the voltage divider/series circuit.

1. Convince yourself that the current is constant through each element by writing KCL equations for nodes A, B and C.
2. Replace all the currents with the variable, i.
3. Write the KVL equation for the circuit.
4. Use Ohm’s Law to express $V_{R1}$ and $V_{R2}$ in terms of the current and resistances.
5. Algebraically solve for the current, i.
6. Solve for the voltage drop across each resistor in terms of the voltage source, $V_S$ and the resistances by substituting, the current found in part five back into Ohm’s Law.
7. What is the equivalent resistance? Or, what one resistor could you use to replace $R_1$ and $R_2$ that would result in the same current?

Problem 2

This problem will walk you through the derivation for the current divider/parallel circuit.

1. Convince yourself that the same across each element i by writing KVL equations for all three loops.
2. Replace all the voltages with the variable, V.
3. Write the KCL equation for the circuit.
4. Use Ohm’s Law to express $i_1$ and $i_2$ in terms of the voltage and resistances.
5. Algebraically solve for the voltage, V.
6. Solve for the current through each resistor in terms of the current source, $I_S$ and the resistances by substituting the voltage found in part five back into Ohm’s Law.
7. What is the equivalent resistance? Or, what one resistor could you use to replace $R_1$ and $R_2$ that would result in the same current?
**Problem 3**

Given:
- $R_1 = 10 \, \Omega$
- $R_2 = 40 \, \Omega$
- $R_3 = 20 \, \Omega$
- $R_4 = 30 \, \Omega$
- $I_S = 20 \, A$

Find:
- The equivalent resistance as seen by the source.
- The current through each resistor.
- The voltage across each resistor.
- Voltage across the source.

**Problem 4**

Given:
- The circuit diagrams

Find:
- The current through each element as a function of $R$, $\alpha$ and $V_S$
- $V_o$ as a function of $\alpha$ and $V_S$
- Plot $V_o$ as a function of $\alpha$ as $\alpha$ varies from 0 to 1.

**Problem 5**

Given:
- $R_1 = 10 \, \Omega$, $R_2 = 25 \, \Omega$
- $R_3 = 60 \, \Omega$, $R_4 = 20 \, \Omega$
- $R_5 = 24 \, \Omega$, $R_6 = 20 \, \Omega$
- $R_7 = 50 \, \Omega$, $R_8 = 30 \, \Omega$
- $V_S = 15 \, V$

Find: $i$, $v$

**Problem 6**

Given:
- $R_1 = 14 \, \Omega$, $R_2 = 15 \, \Omega$
- $R_3 = 10 \, \Omega$, $V_S = 40 \, V$

Find:
- Voltage across all the resistors
- Current through each element.
Problem 7

Find the current, $i$, the current through the source, and $V_{R4}$

Given:

$R_1 = 70 \, \Omega$
$R_2 = 30 \, \Omega$
$R_3 = 20 \, \Omega$
$R_4 = 5 \, \Omega$