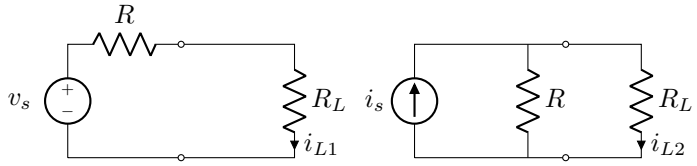
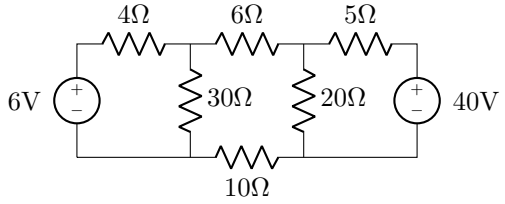
Lecture 16, Feb 16, 2022

Source Transformation

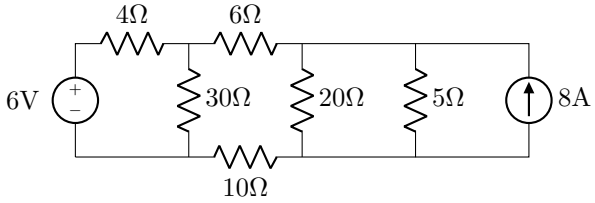
- This method is not as strong as nodal analysis or mesh analysis, but gives insight into circuit analysis
- Consider 2 circuits:



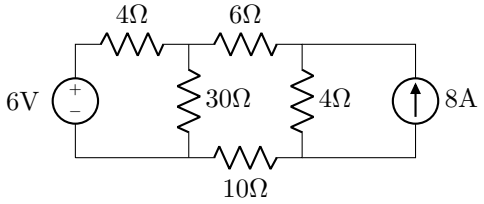
  - For circuit 1, $i_{L1} = \dfrac{v_s}{R + R_L}$ by Ohm's law
    - For circuit 2, $i_{L2} = i_s \dfrac{R}{R + R_L}$ by current division
    - If both circuits are equivalent, then we'll get $i_{L1} = i_{L2} \implies \dfrac{v_s}{R + R_L} = i_s \dfrac{R}{R + R_L} \implies v_s = i_s R$
- Source transformation: We can transform a voltage source with a resistor in series to a current source with a resistor in parallel if $v_s = Ri_s$
  - The direction of the sources do not follow PSC
- Example circuit: Find the power of the 6V source:



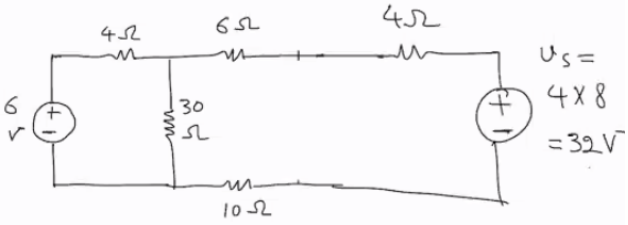
  - Convert voltage source with series resistor to current source with parallel resistor:



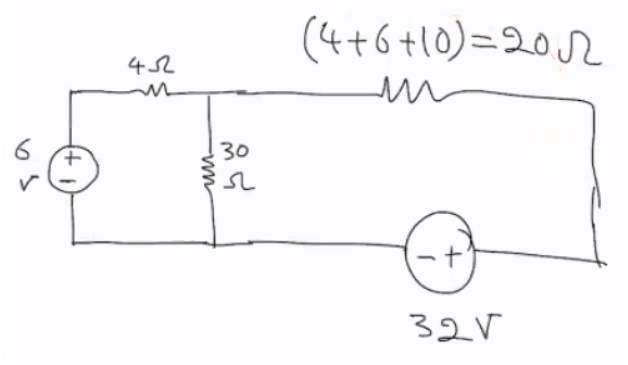
  - Now we can simplify the two resistors in parallel on the right side:



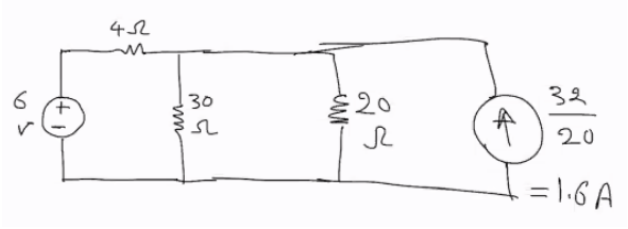
  - Now transform the current source and parallel resistor to a voltage source and a series resistor:



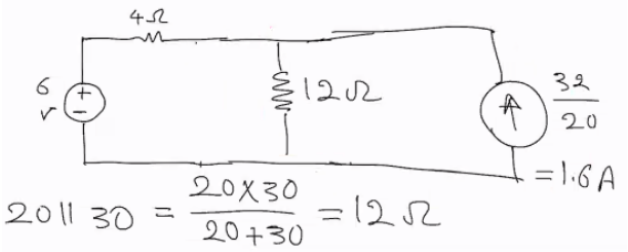
  - Simplify series resistors:



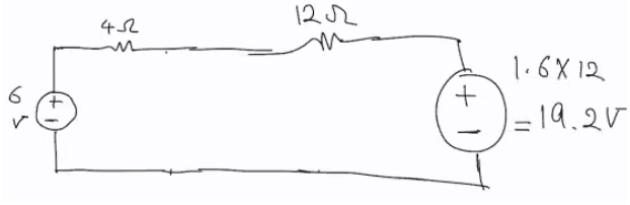
  - Convert voltage source to current source:



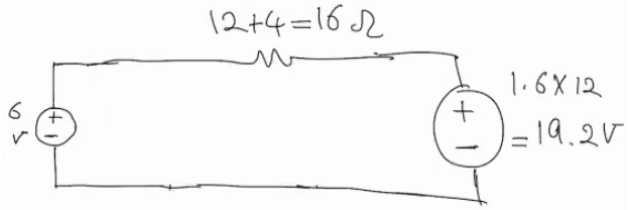
  - Simplify parallel resistors:



  - Convert current source to voltage source:



  - Simplify series resistors:



  - Now we can use KVL on this loop to find the current in this circuit and get the power
- If we have a voltage source in parallel with a resistor, the value of the resistance does not affect the voltage distributed to the rest of the circuit, so it doesn't impact the rest of the circuit
  - Since the resistor has no affect on the rest of the circuit, we can remove it altogether (open the circuit)
- If we have a current source in series with a resistor, the value of the resistance does not affect the current distributed to the rest of the circuit, so it has no impact either
  - Since it has no affect, we can remove it (short the circuit)