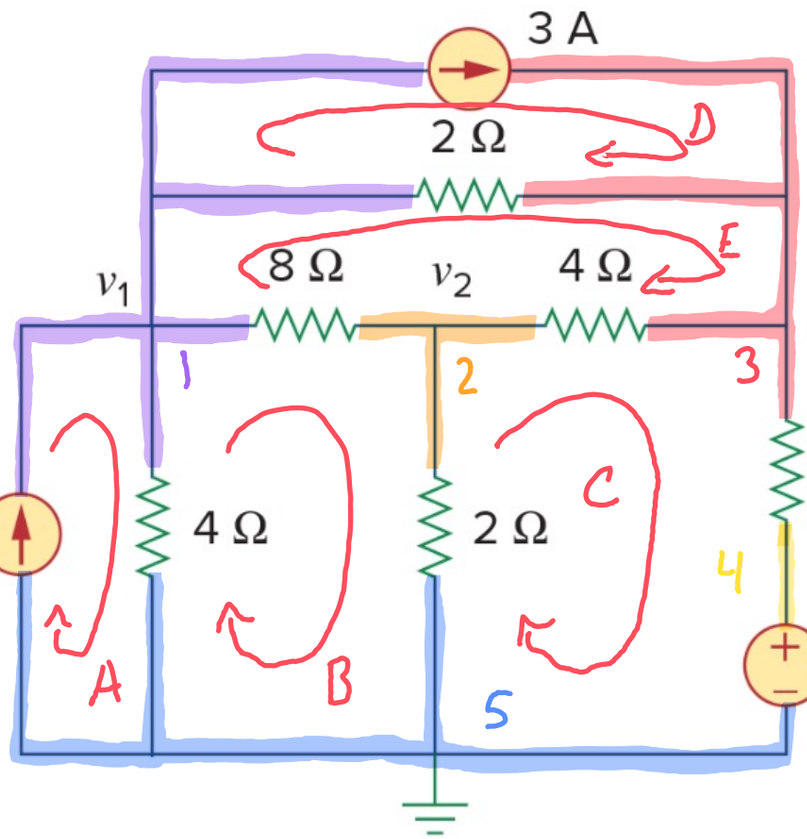
Last Class…

Will you use node-voltage analysis or mesh current analysis to solve this problem. Hint: Think about your system of equations.



NVA

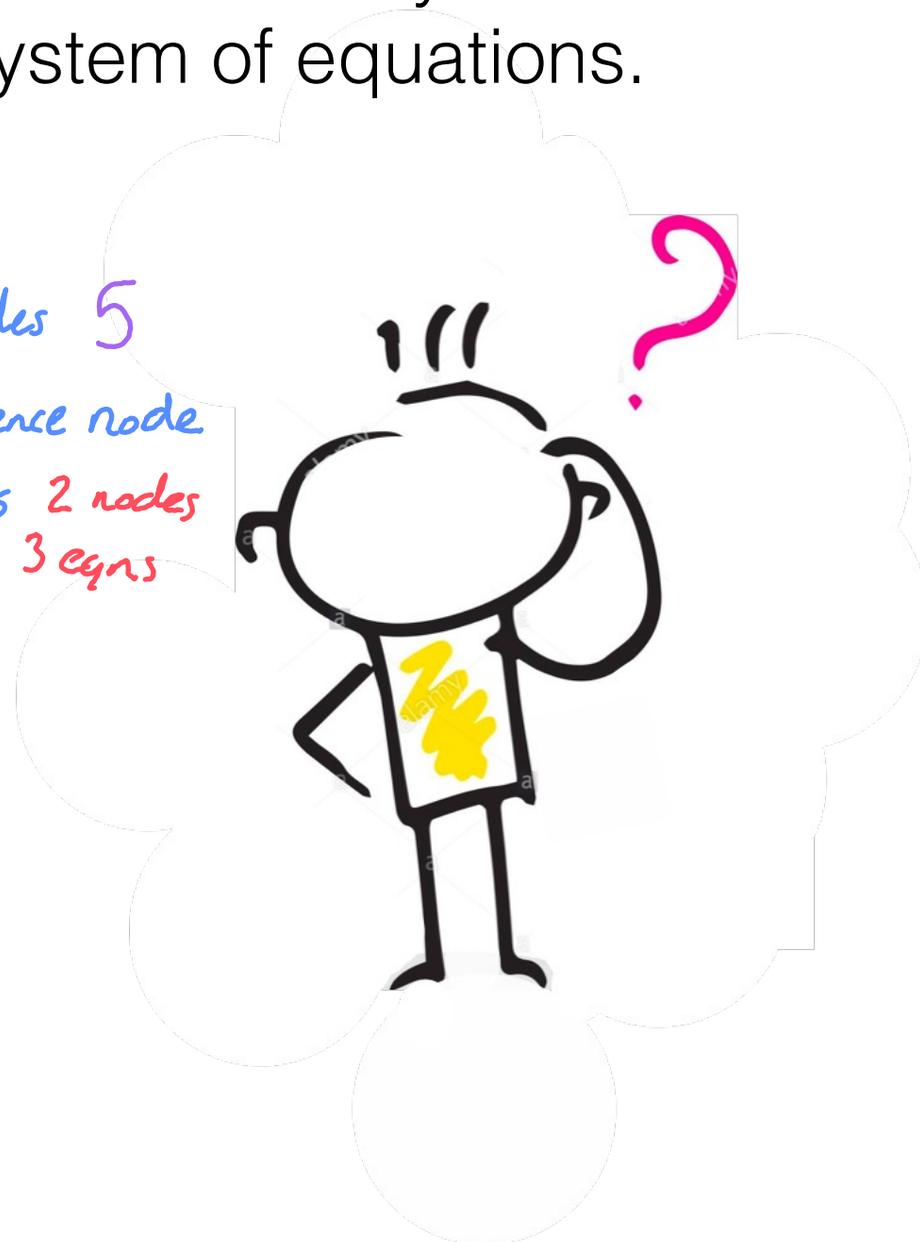
Step 1: How many nodes 5

Step 2. Assign reference node

Step 3: known voltages 2 nodes

3 eqns

$V_5 = 0v$ $V_4 = 12v$



MCA

Step 1: How many meshes 5

Step 2: known currents 2 meshes

$i_A = 5A$ $i_D = 3A$ 3 eqns

Doesn't matter, same num of equations

THE OHIO STATE UNIVERSITY

COLLEGE OF ENGINEERING

The Principle of Superposition

This Lecture…

- Learning Objectives:
  - Understand and apply the principle of superposition.

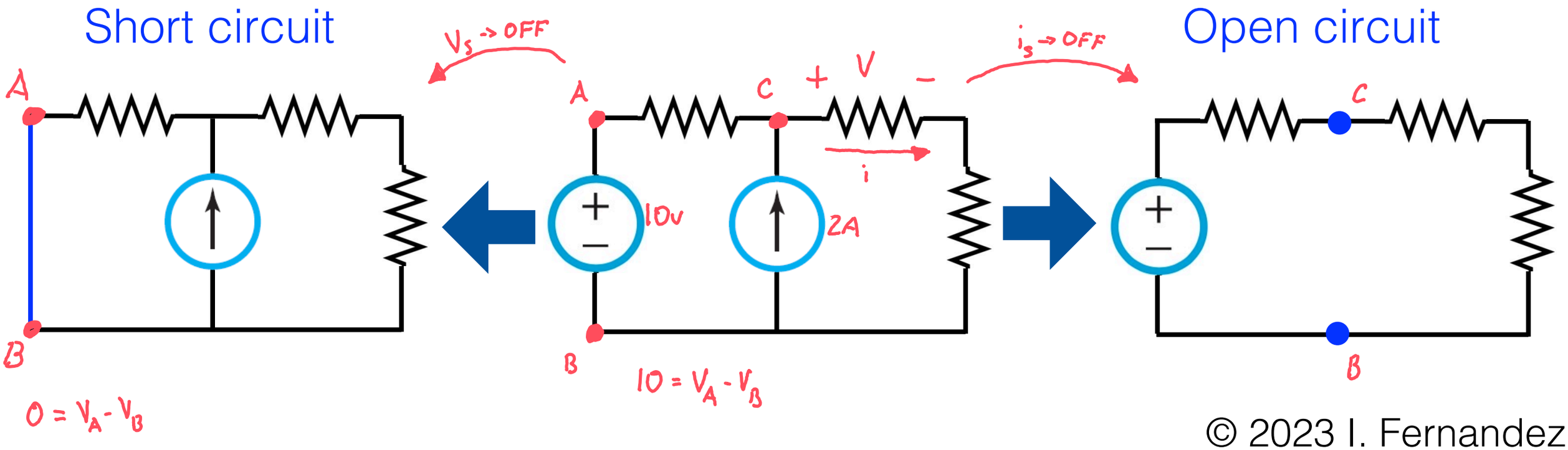
Superposition

- Each independent source contributes independently to each voltage and current in the circuit.
- Each voltage and current in a circuit with N independent sources satisfies:

$$i = i_1 + i_2 + \ldots \qquad v = v_1 + v_2 + \ldots$$

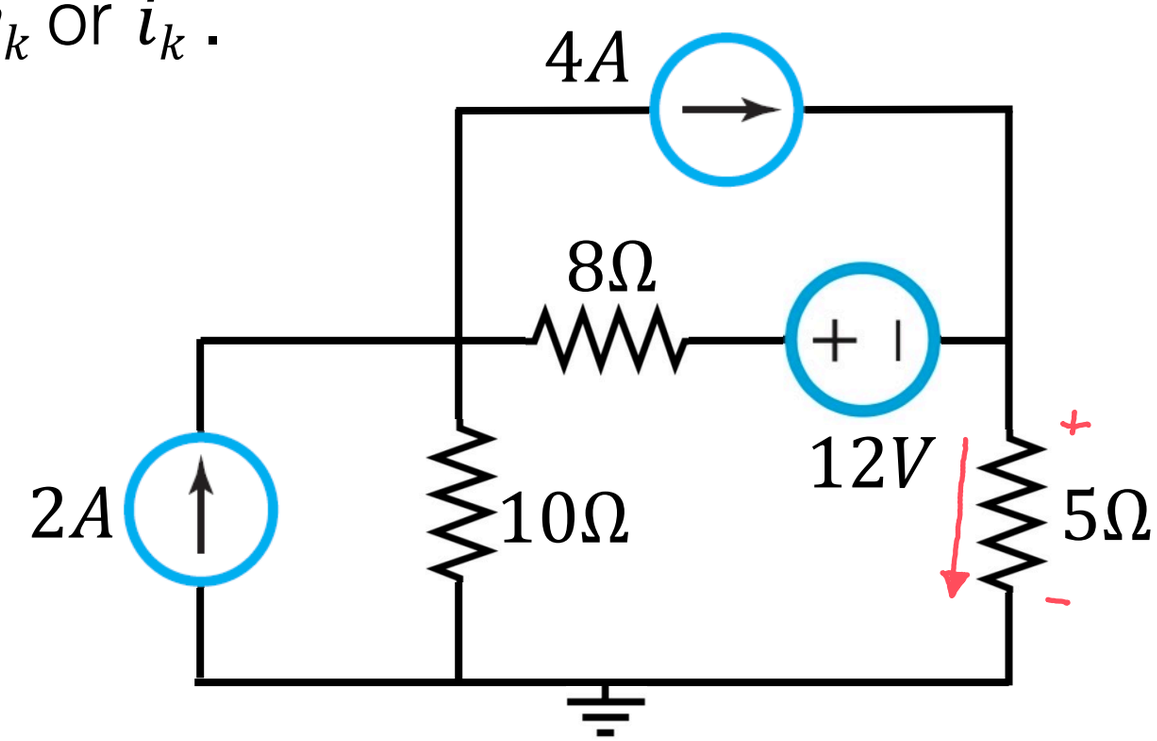
Superposition: break the circuit in two or more simpler circuits.

Turn off all independent sources except one.

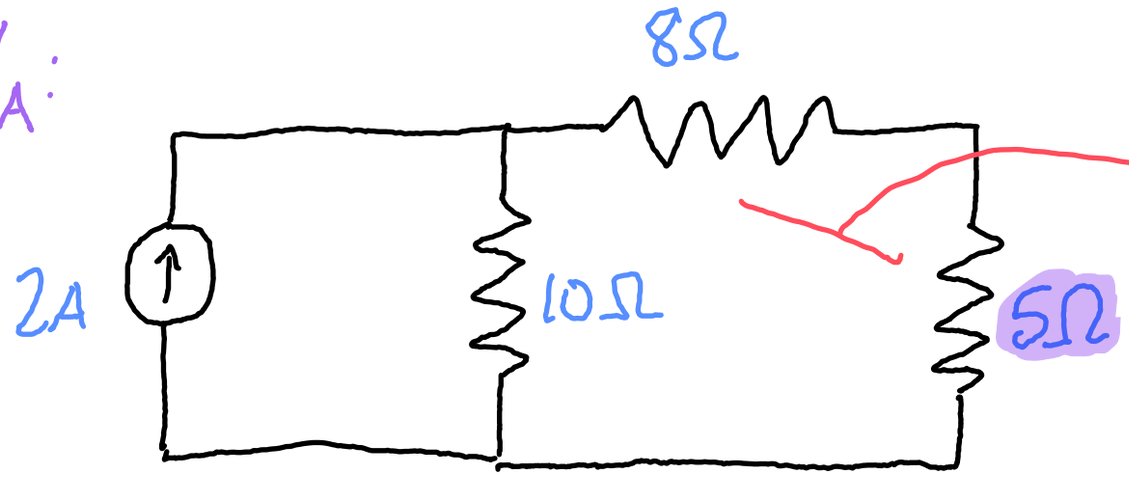


Superposition

1. Define voltage/current to be solved. V_5
2. For each of the N independent sources, define a component voltage v_k or current i_k. $V_5 = \underset{2A}{V_A} + \underset{12V}{V_B} + \underset{4A}{V_C}$
3. Turn off all independent sources except one, source s_k.
4. Apply node voltage, mesh current, or any other circuit analysis technique to solve for v_k or i_k.
5. Repeat steps 3-4 for each independent source.



Find V_A:

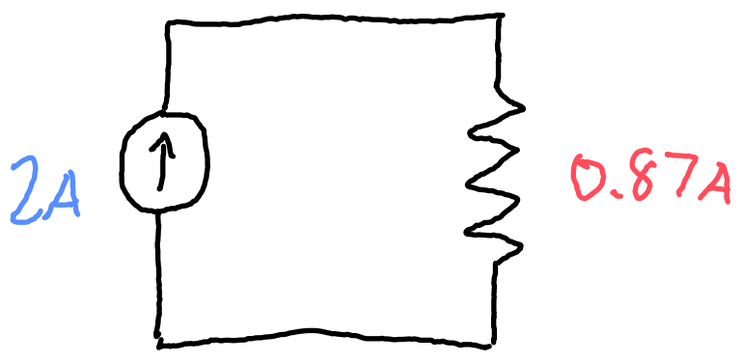


series, same current

apply current division

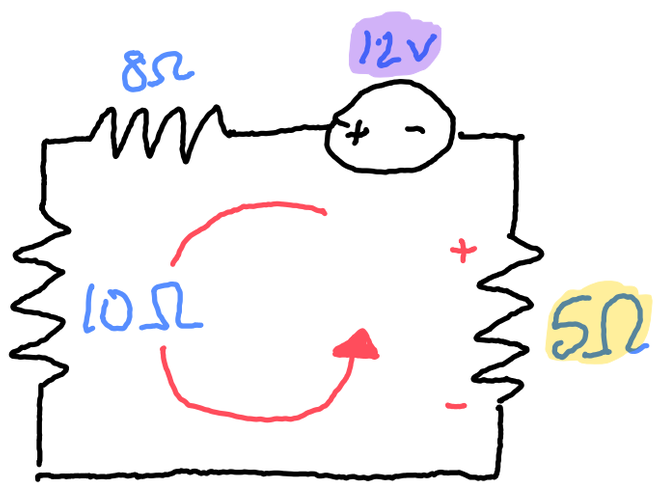
$\frac{10(13)}{10+13} = \frac{130}{23}$

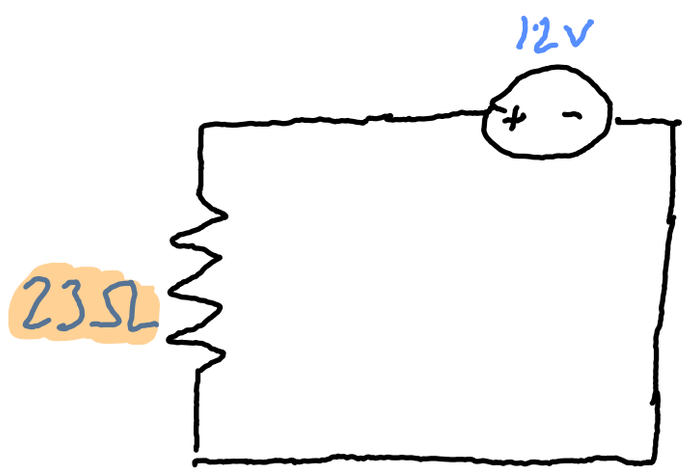
$\frac{130/23}{13} \cdot 2 = \frac{20}{23}$ A



$V_A = 5 i_5 = 5 \cdot \frac{20}{23} = \boxed{\frac{100}{23} V}$

Find V_B:

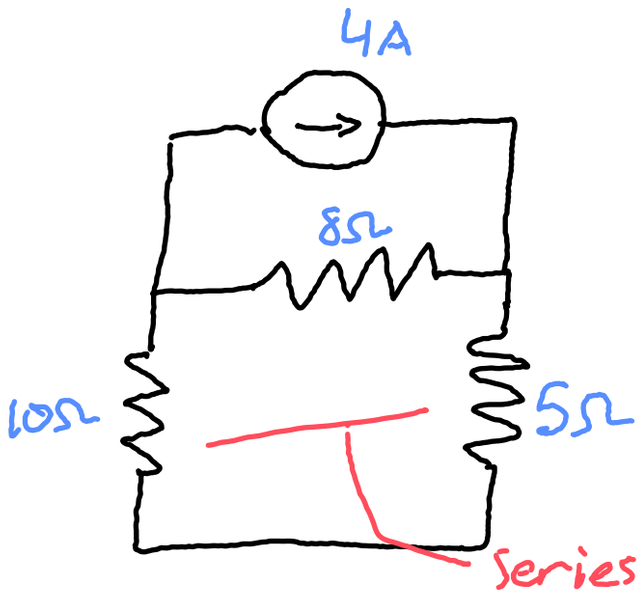


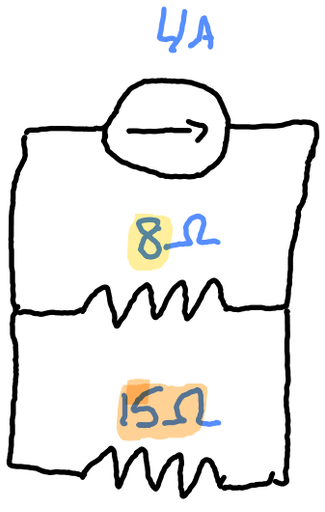


Voltage division

$V_B = -\frac{5}{23} \cdot 12 = \boxed{-\frac{60}{23} V}$

Find V_C.





Current division

$\frac{8(15)}{8+15} = \frac{120}{23}$

$\frac{120/23}{15} \cdot 4 = \frac{32}{23}$

Series, same current

$V_C = 5 i_5$

$V_C = 5 \frac{32}{23} = \boxed{\frac{160}{23} V}$

Example

In the circuit below, determine the i across the 20Ω resistor.