

Lecture 8

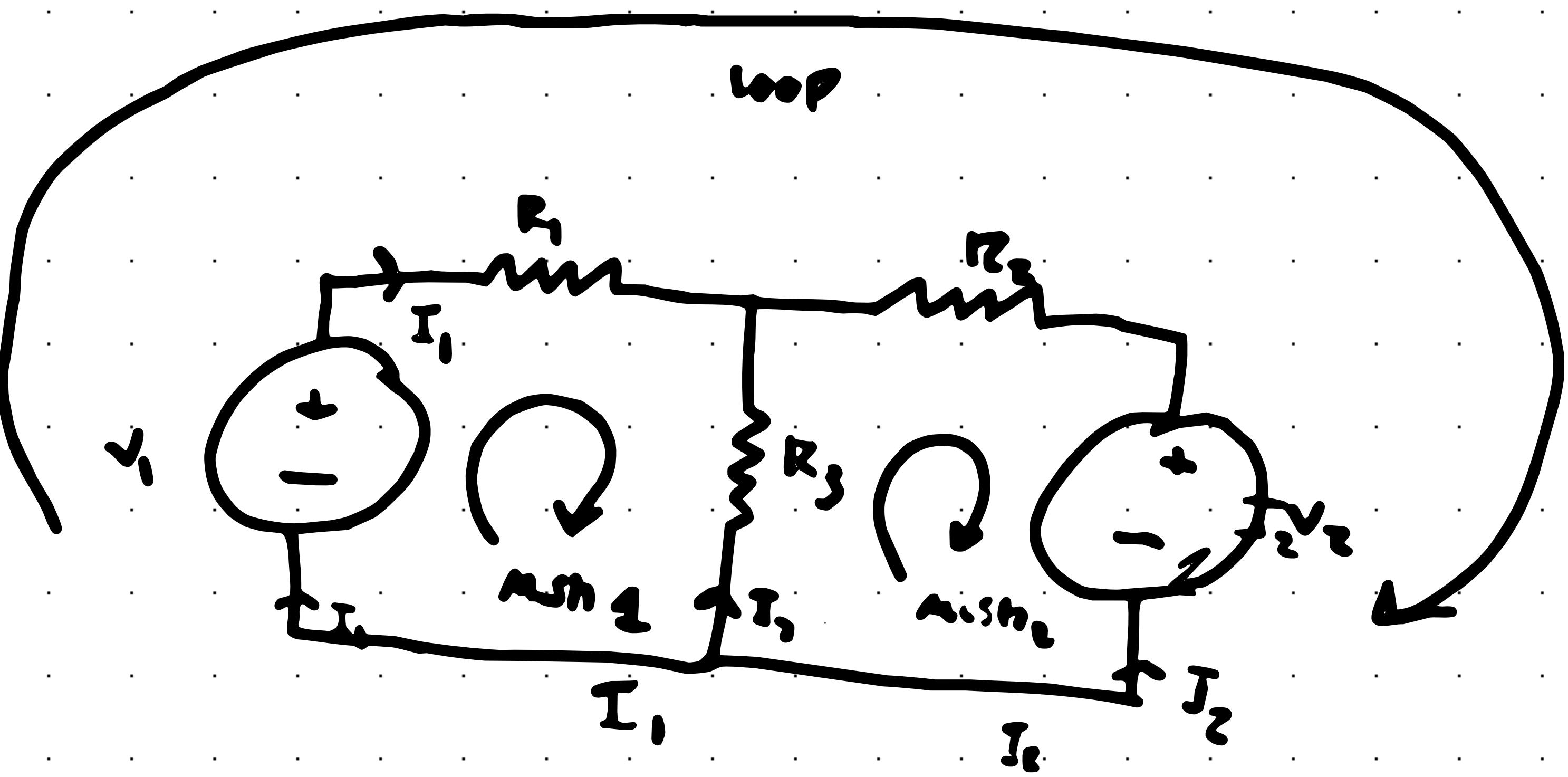
ECED 2000

Midterm 1 will cover everything from
Lecture 1-7, and Assignment 1-3

Mesh Analysis

also known as "Mesh Current Method"

- Mesh is a small loop in a circuit
- Loop is a larger one



$$I_3 = (I_1 - I_2)$$

① Define meshes and mesh currents.

② Write $\sum V=0$ for each mesh, and then solve!

Mesh analysis aims to simplify the problem by reducing the number of equations by the number of loops.

$$I_3 = (I_1 - I_2)$$

$$\sum_{\text{node 1}} V = 0 \quad V_1 - I_1 R_1 - (I_1 - I_2) R_3 = 0$$

$$V_1 - I_1 (R_1 + R_3) + I_2 R_3 = 0 \quad (1)$$

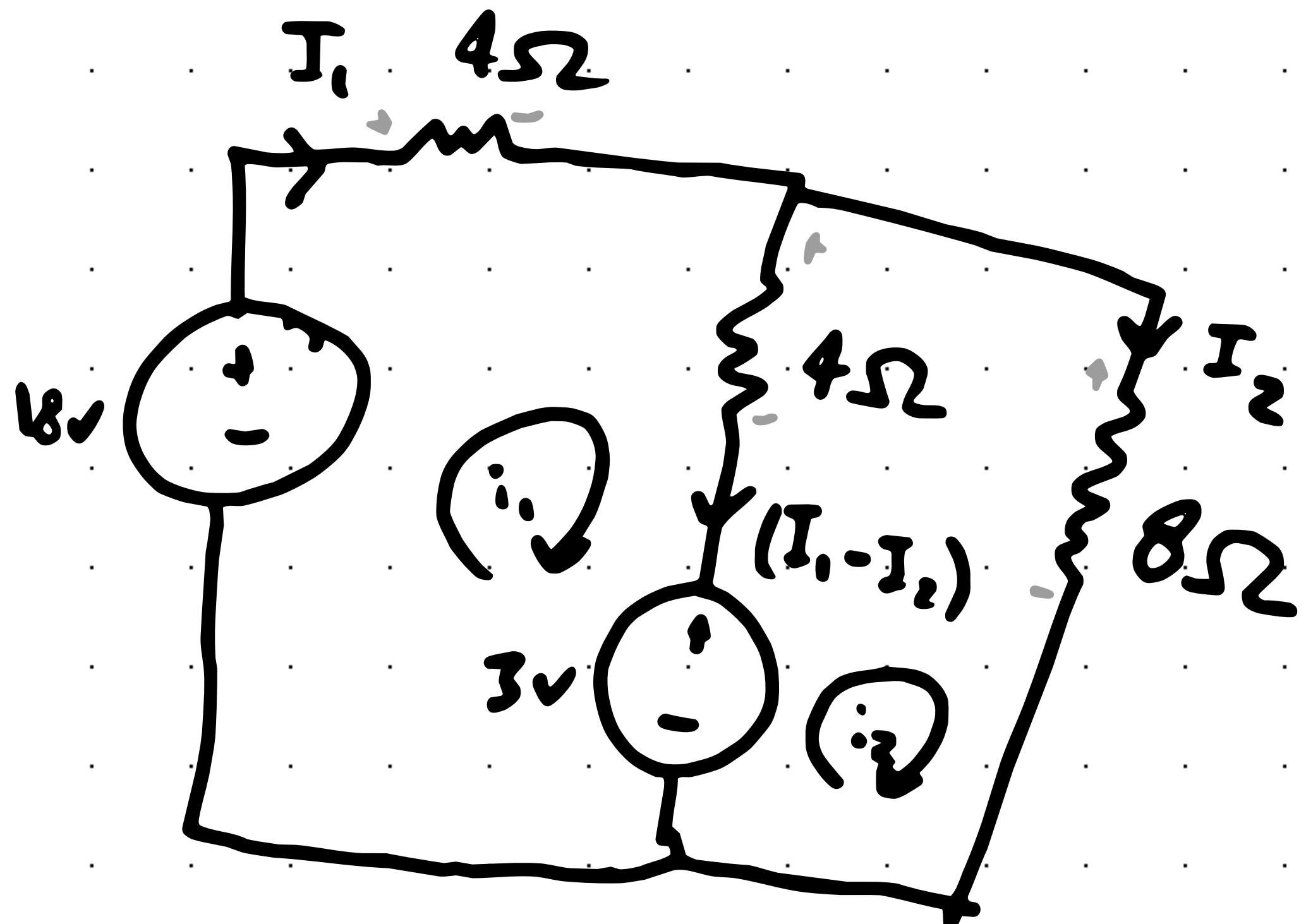
$$\sum_{\text{node 2}} V = 0 \quad (I_1 - I_2) R_3 - R_2 I_2 - V_2 = 0$$

$$I_1 (R_3) - I_2 (R_3 + R_2) - V_2 = 0 \quad (2)$$

Example 1

Use Mesh Analysis

To Calculate I_2



$$\sum V = 0$$

Mesh 1

$$18 - 4i_1 - 4(i_1 - i_2) - 3 = 0$$

1

$$\sum V = 0$$

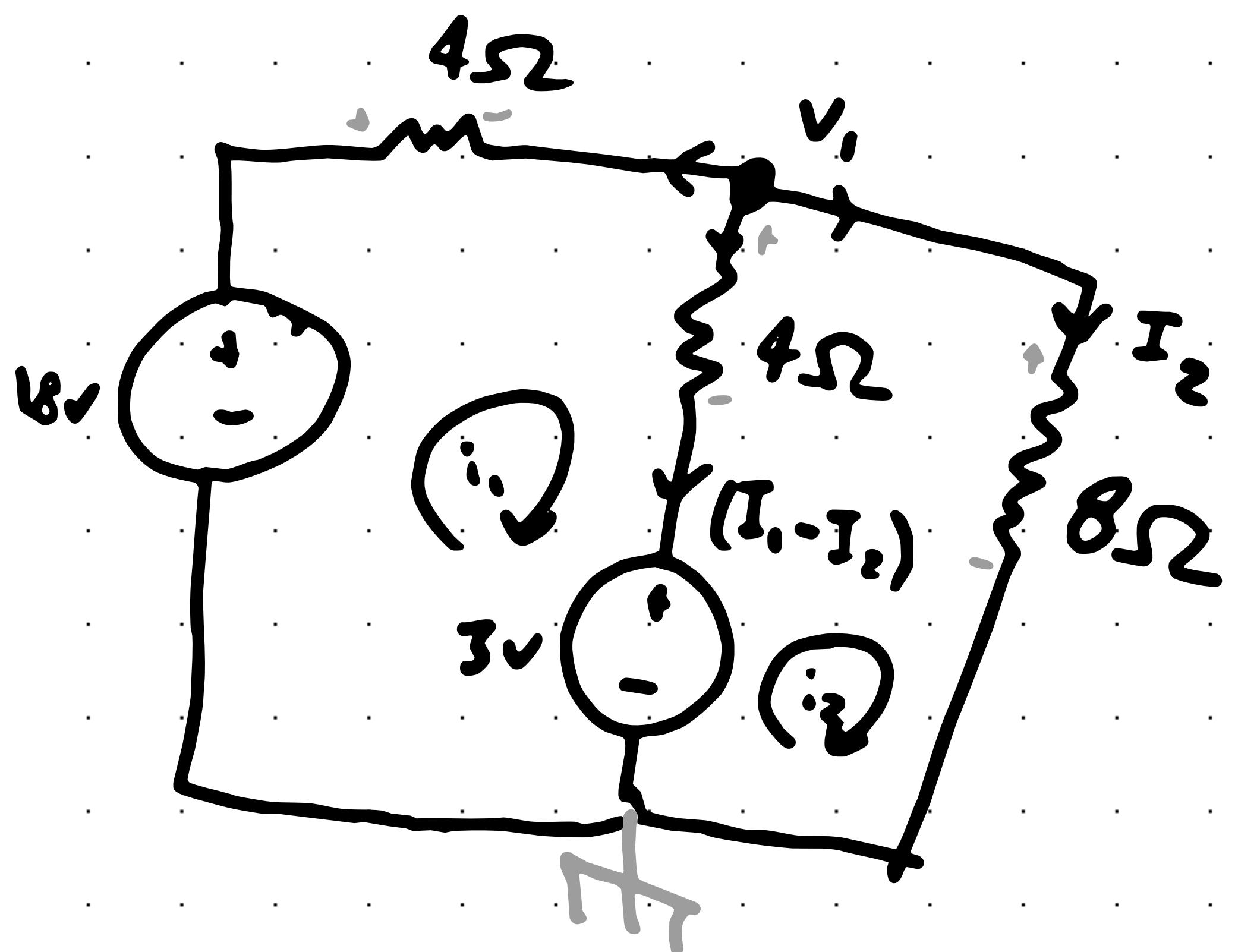
Mesh 2

$$3 + 4(i_1 - i_2) - 8i_2 = 0$$

2

$$i_2 = \frac{21}{20}$$

If we tried to repeat that problem using
nodal analysis...



$$\sum I = 0$$

Nodal 1

$$\frac{V_1 - 18}{4} + \frac{V_1 - 3}{4} + \frac{V_1}{8}$$

$$2(V_1 - 18) + 2(V_1 - 3) + V_1 \\ 2V_1 - 36 + 2V_1 - 6 + V_1$$

$$5V_1 = 42$$

$$V_1 = 8.4$$

$$i_1 = \frac{V_1}{8}, \frac{8.4}{8}$$

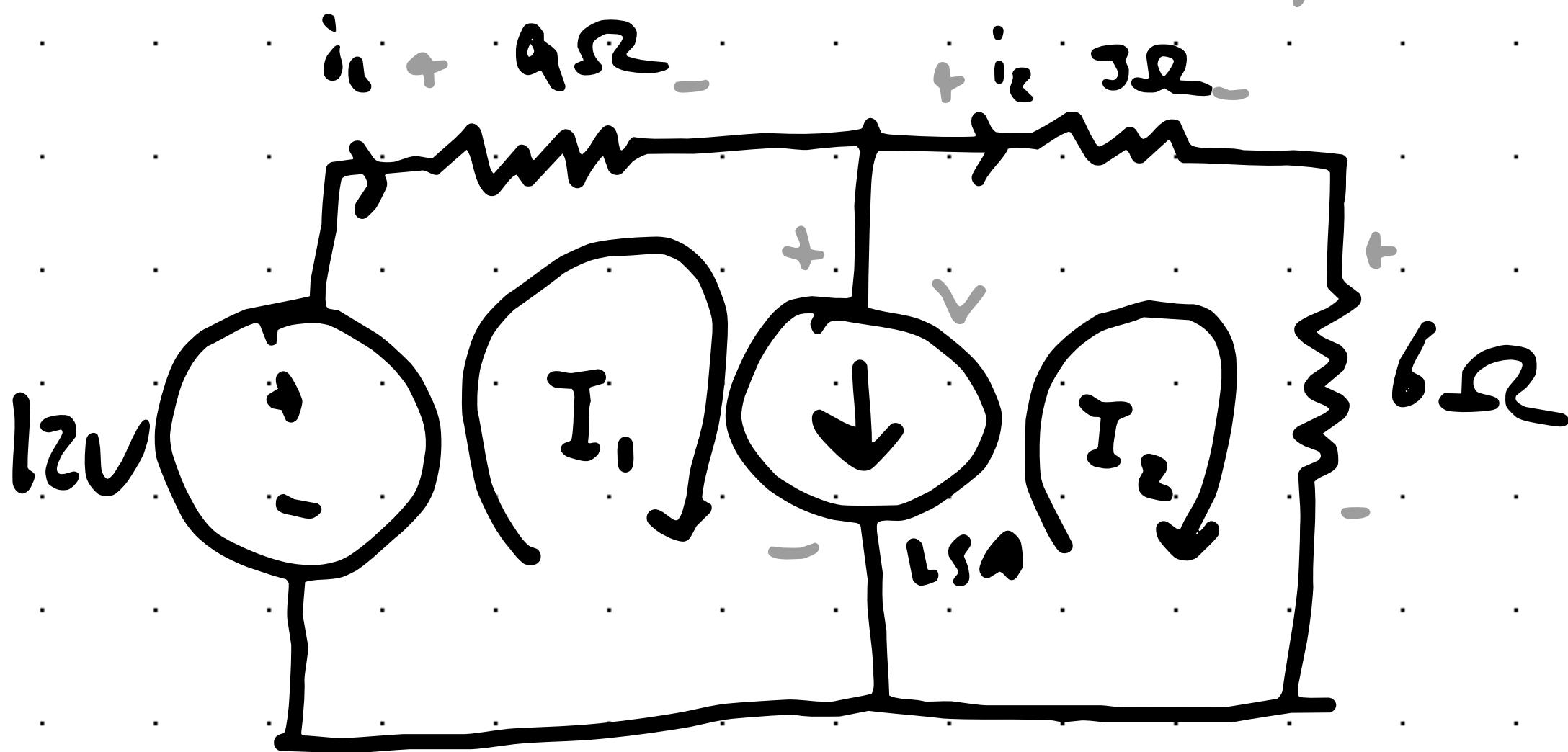
$$i_1 = 1.05A$$

* One equation, but needs an extra step!

Super Mesh:

We have two meshes and they are sharing a branch that has current.

↳ Does not matter if it is dependent or independent!



$$\sum V = 0 \quad 12 - q_1 - v = 0 \quad \text{eqn } 1$$

$$\sum V = 0 \quad v - 3i_2 - 6i_2 = 0 \quad \text{eqn } 2$$

Sub from eqn 2 into eqn 1,

$$v = 3i_2 - 6i_2$$

Now eqn 1 $\rightarrow i_1 - i_2 = 1.5$ 3 1

Solve 3 2 1 4

$$i_1 = 1.417A \quad i_2 = -83.3mA$$

However, we can save A LOT OF
TIME by using the Super mesh!

$$\sum V = 0$$

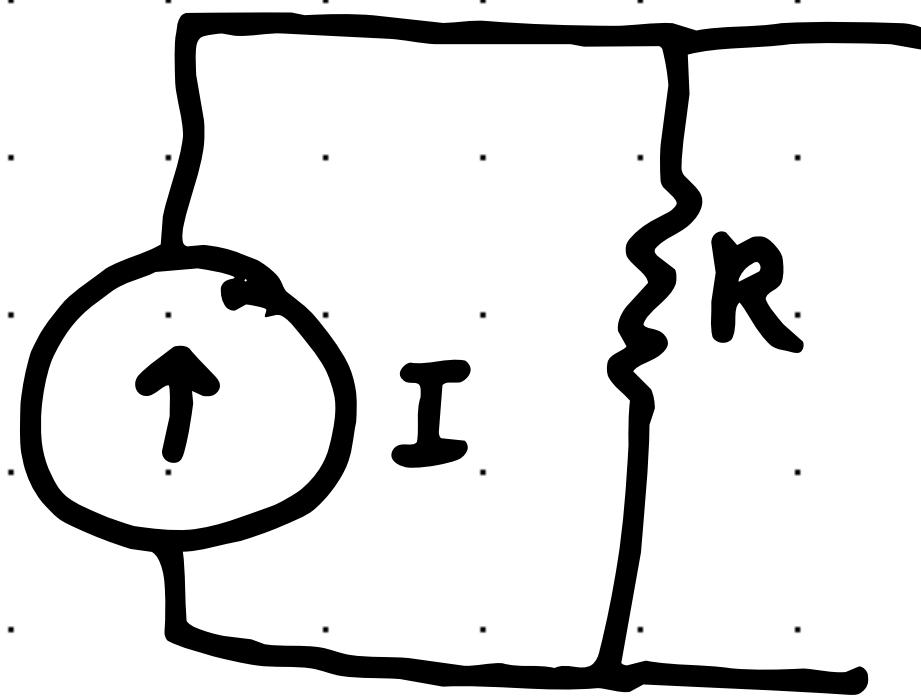
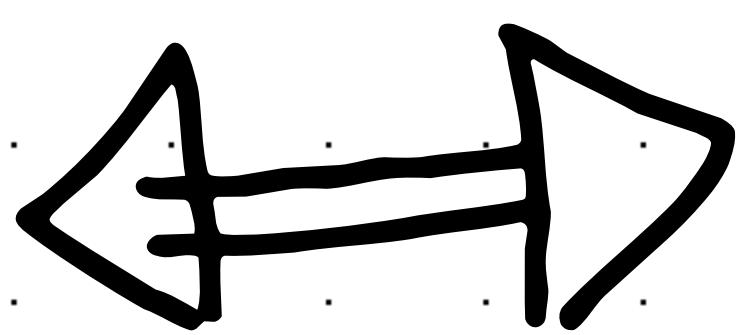
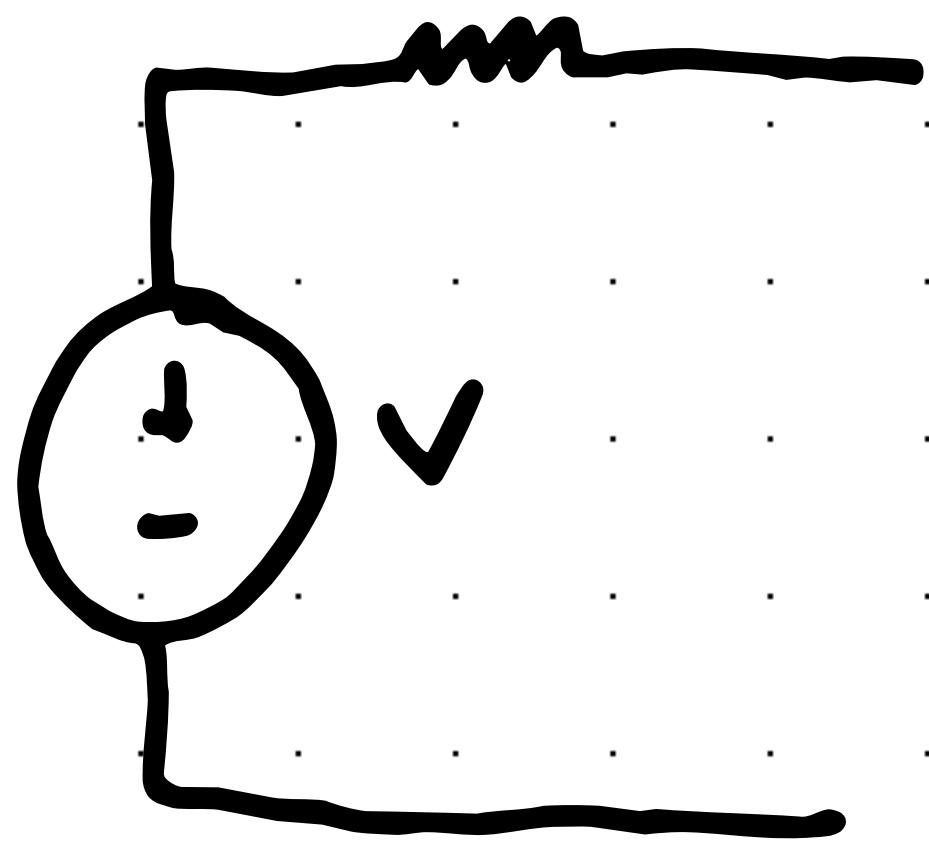
Super mesh

$$12 - 9i_1 - 3i_2 - 6i_3 = 0$$

$$i_1 - i_2 = 1.5A$$

Source Transformation (Conversion) (Substitution)

- Any Voltage Source Can be replaced by a Current Source, or vice versa!



$$V = IR$$

voltage source

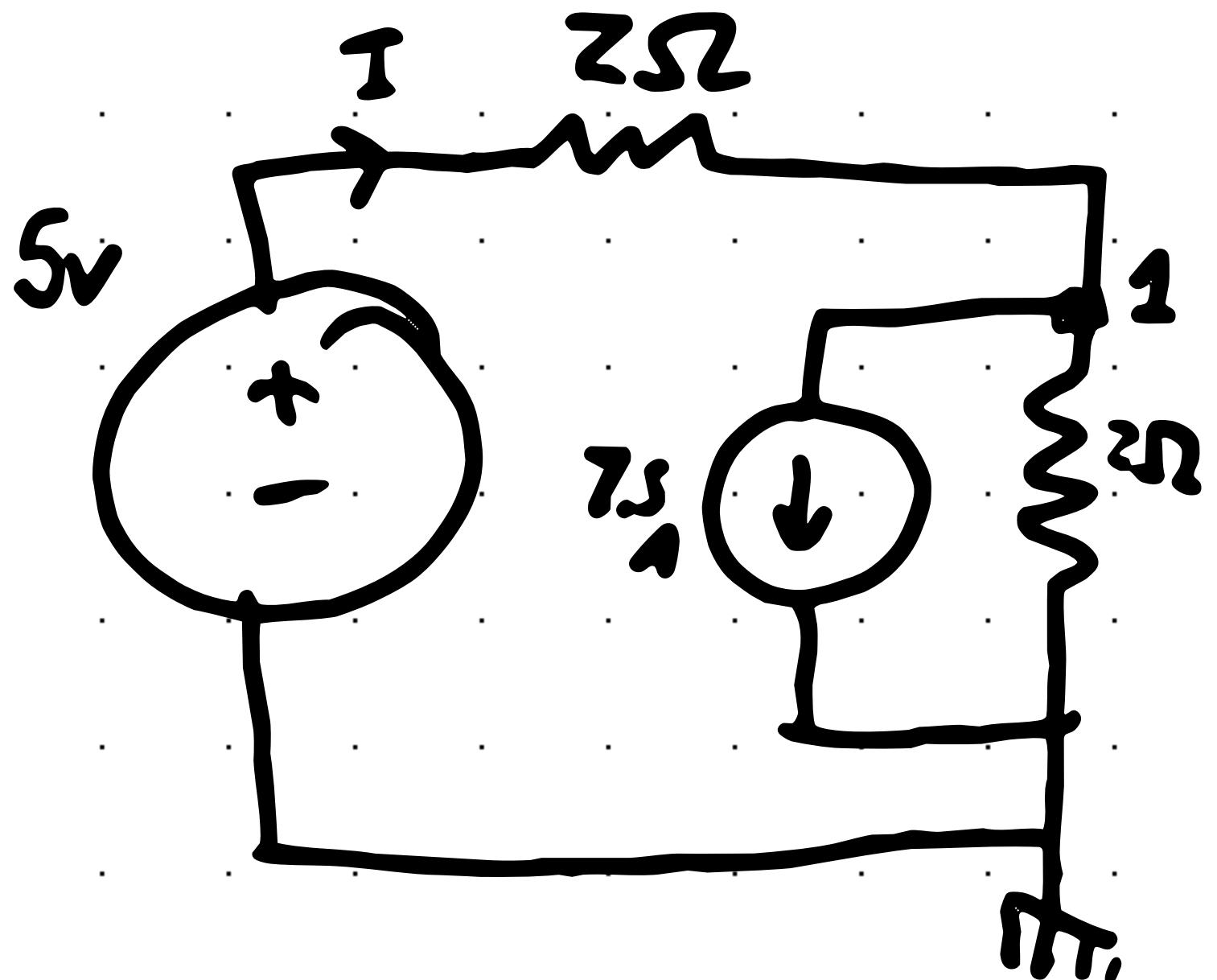
$$I = \frac{V}{R}$$

Current source

Example 2

Solve the following
Circuit to calculate

I



Nodal Analysis

$$\sum_{\text{node 1}} I = 0 \quad \frac{V_1 - 5}{2} + \frac{V_1}{2} + 7.5 = 0$$

Solve for V_1

Source Transformation



$$I = \frac{5 + 15}{2 + 2} = 5A$$

KCL and KVL

$$\sum V = 0 \quad 5 - 2I - 2I_1 = 0$$

$$\sum I = 0 \quad I - 7.5 - I_1 = 0$$

Solve for I