Lecture 8

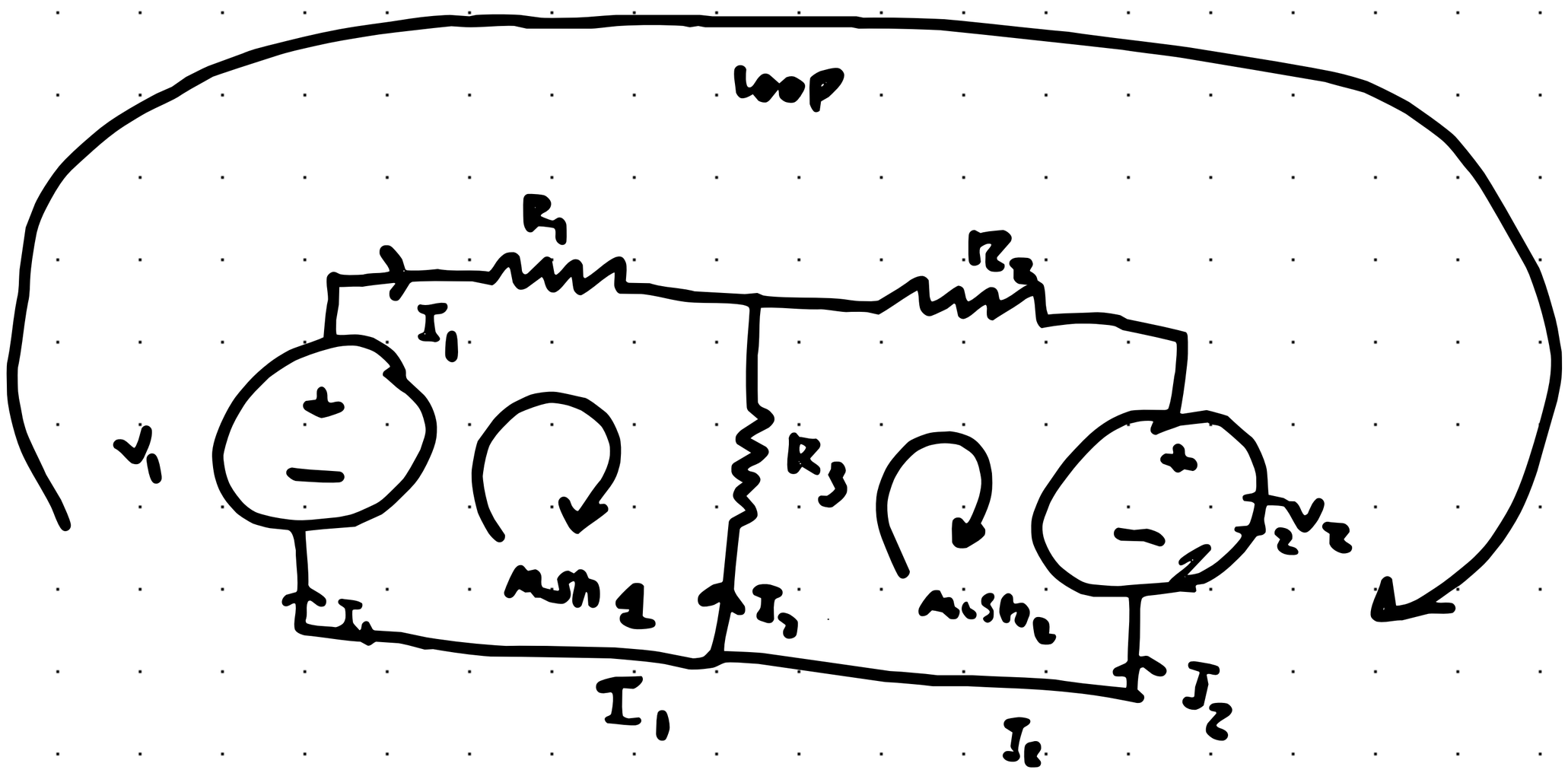
ECED 2□□□

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 current.

(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.

$I_3 = (I_1 - I_2)$

$$\sum V = 0 \quad \text{mesh 1}$$

$$V_1 - I_1 R_1 - (I_1 - I_2) R_3 = 0$$

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

$$\sum V = 0 \quad \text{mesh 2}$$

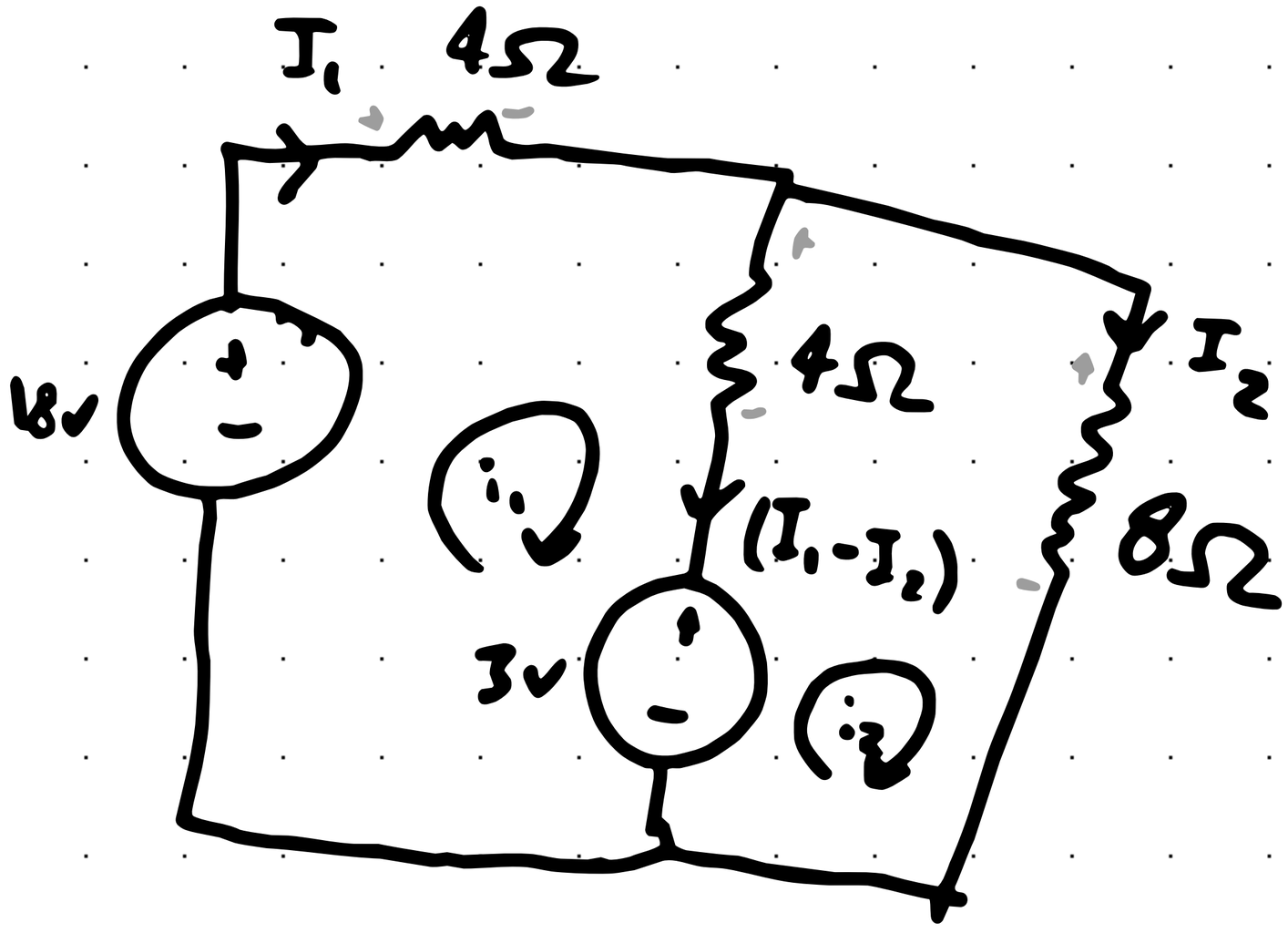
$$(I_1 - I_2) R_3 - R_2 I_2 - V_2 = 0$$

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

Example 1

Use Mesh Analysis

to Calculate I_2



$\sum_{\text{mesh 1}} V = 0$

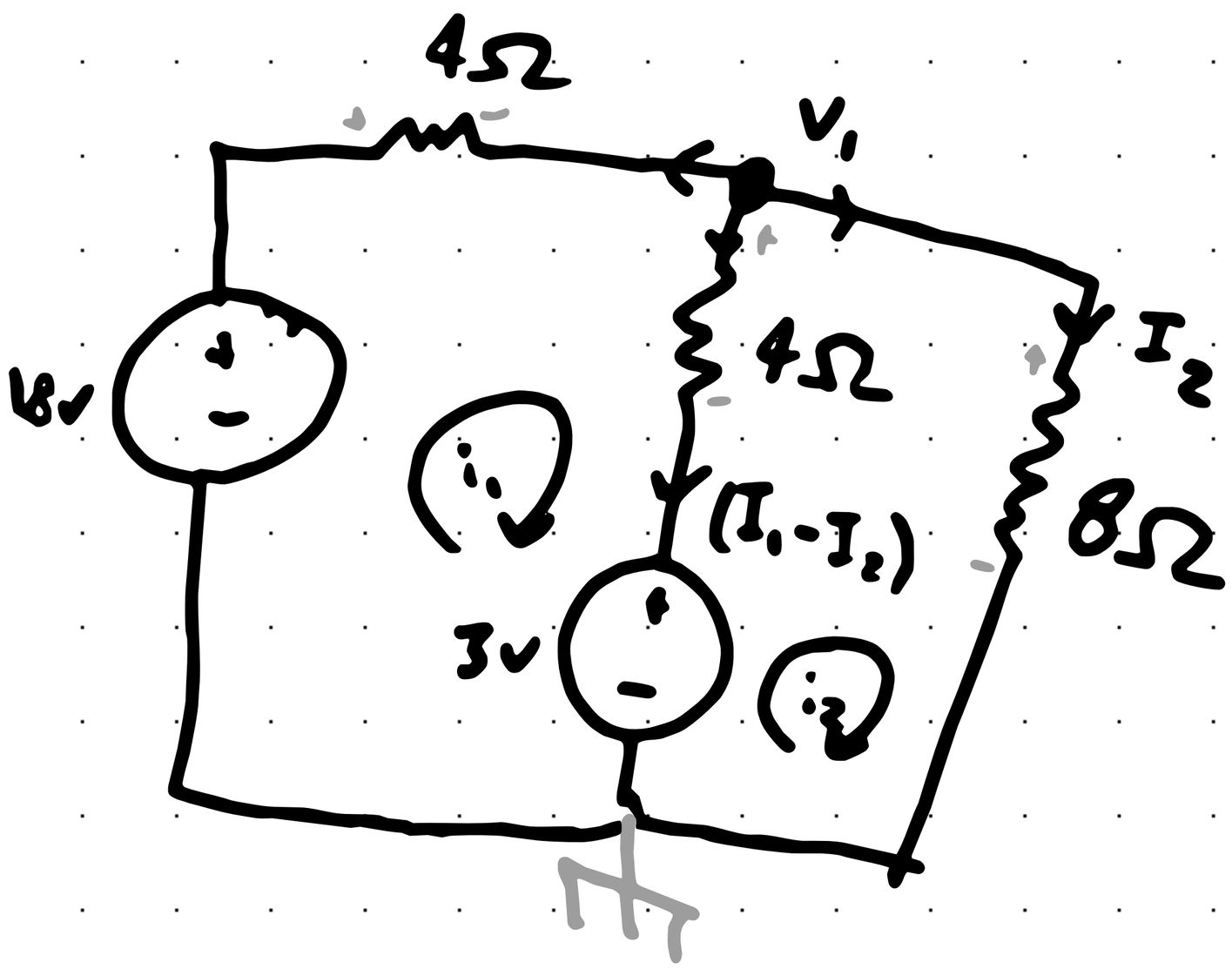
$18 - 4i_1 - 4(i_1 - i_2) - 3 = 0$ (1)

$\sum_{\text{Mesh 2}} V = 0$

$3 + 4(i_2 - i_1) - 8i_2 = 0$ (2)

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

If we tried to repeat that problem using Nodal Analysis...



$\sum I = 0$

Node 1 $\quad \frac{V_1-18}{4} + \frac{V_1-3}{4} + \frac{V_1}{8}$

$2(V_1-18) + 2(V_1-3) + V_1$

$2V_1-36 + 2V_1-6 + V_1$

$5V_1 = 42$

$V_1 = 8.4$

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

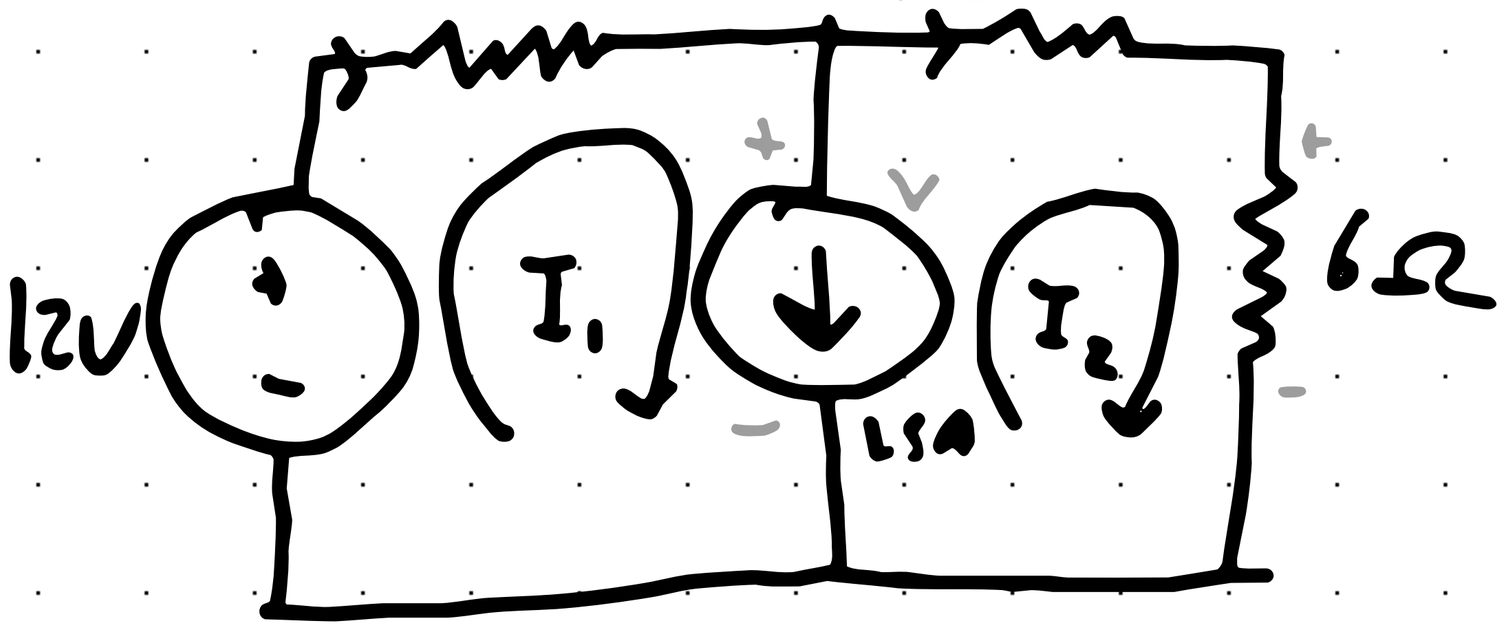
$i_1 = 1.05A$

* One equation, but needs an extra step!

SuperMesh:

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

↓ Does not matter if it is dependent, or independent!



$\sum V = 0$ mesh 1

$12 - 9i_1 - V = 0$ ①

$\sum V = 0$ mesh 2

$V - 3i_2 - 6i_2 = 0$ ②

Sub Eqn ② into ① to get Eqn ③

$V = 3i_2 - 6i_2$

New Eqn ! → $12 - 9i_1 - 3i_2 - 6i_2 = 0$ ③

$i_1 - i_2 = 1.5$ ④

Solve Eqn 3 and 4

$i_1 = 1.917A \qquad i_2 = -83.3mA$

However, We Can Save A LOT OF TIME by Using the Super Mesh!

$\sum V = 0$

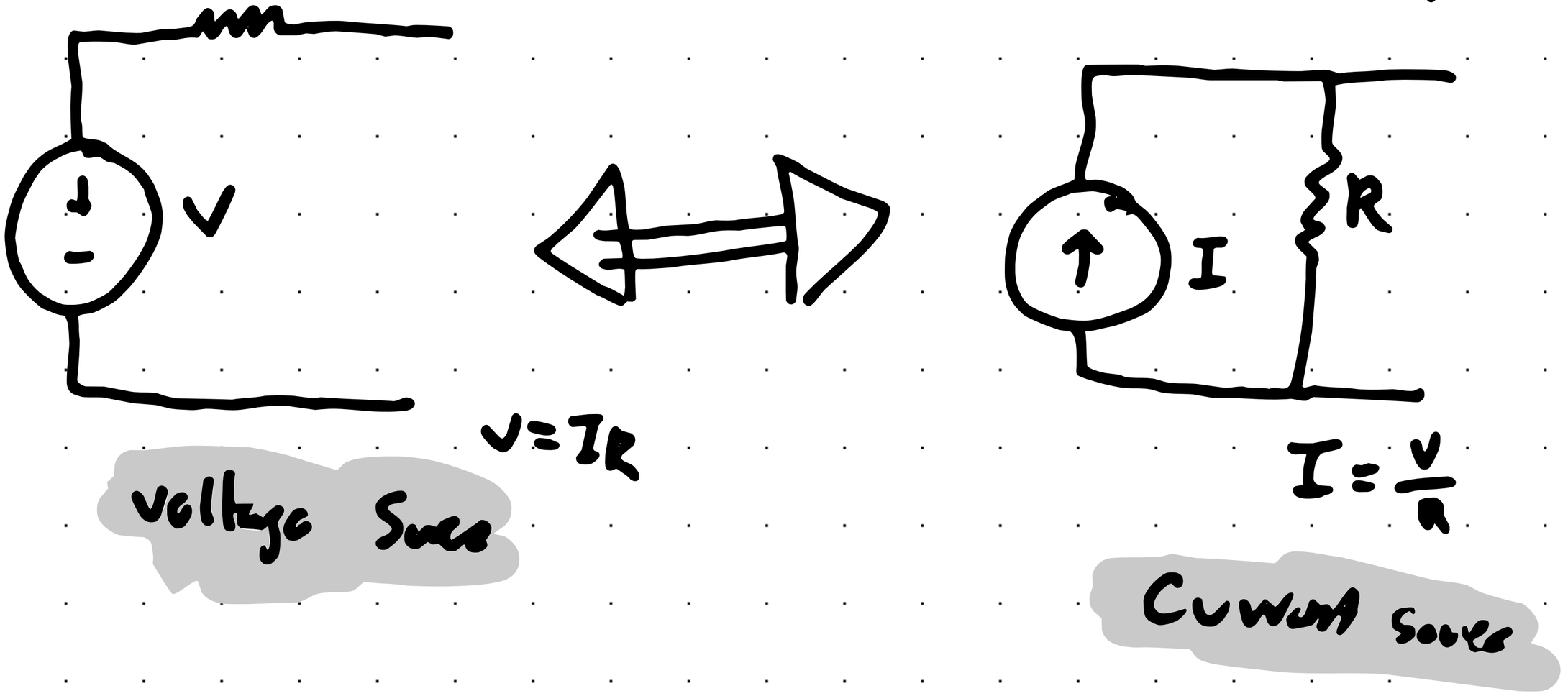
Supermesh

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

$i_1 - i_2 = 1.5A$

Source Transformation (Conversion) (Substitution)

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

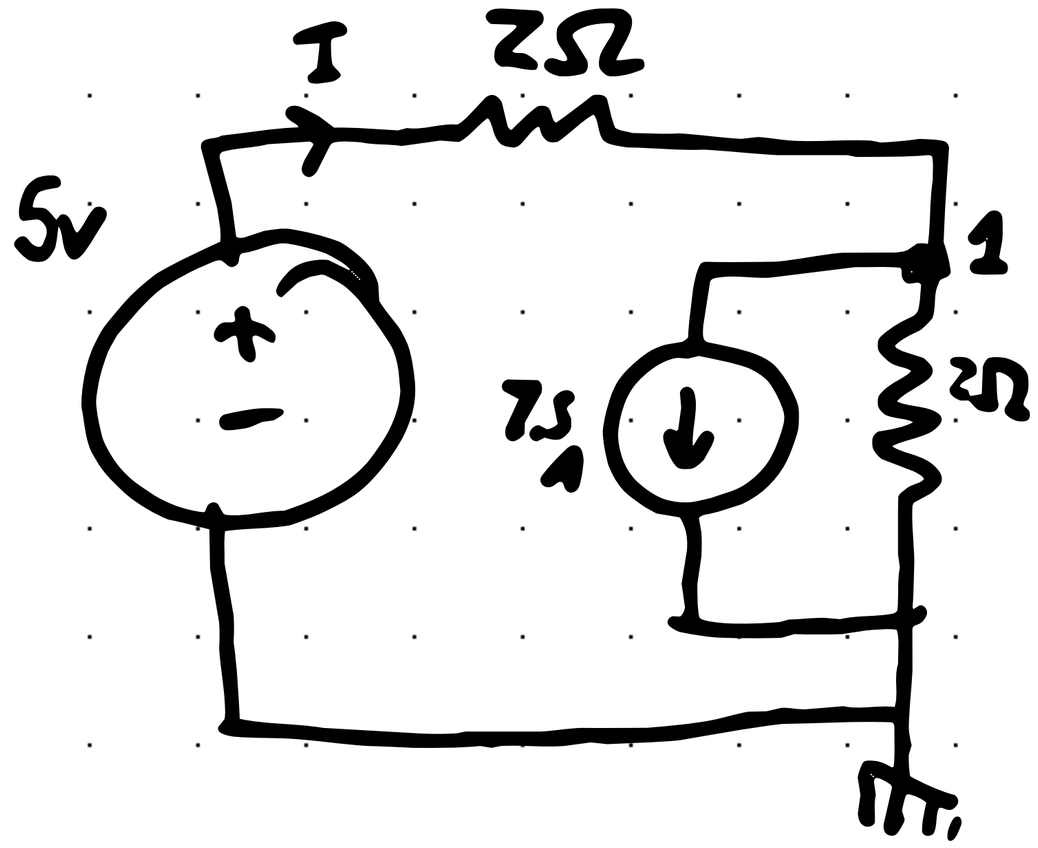


Voltage Source

Current Source

Example 2

Solve the following Circuit to Calculate I

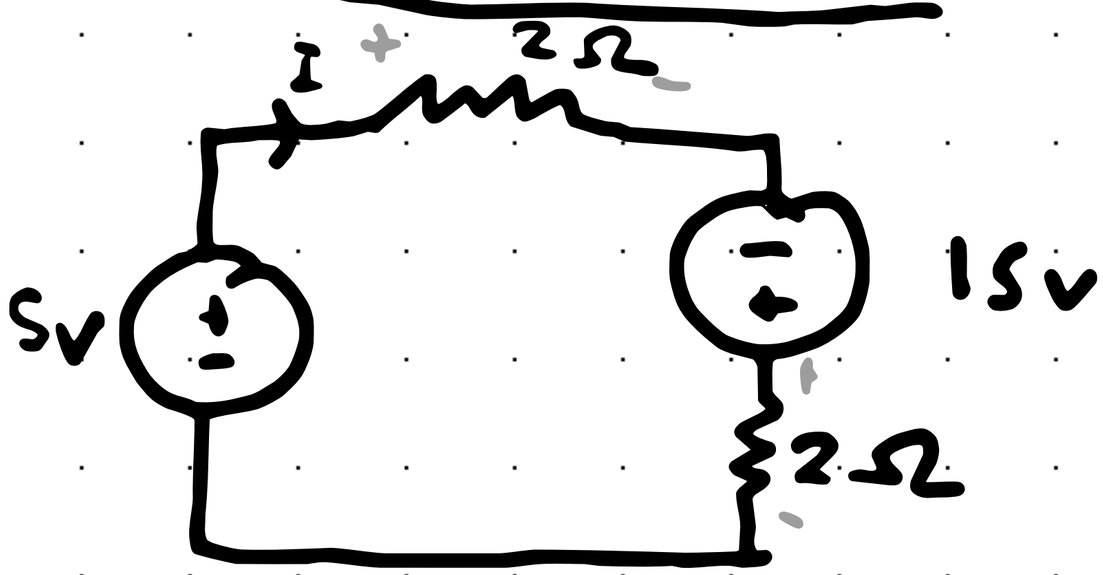


Nodal Analysis

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

Solve for V_1

Source Transformation



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

KCL and KVL

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

$$\sum_{\text{node 1}} I = 0 \qquad I - 7.5 - I_1 = 0$$

Solve for I