

Lecture 8

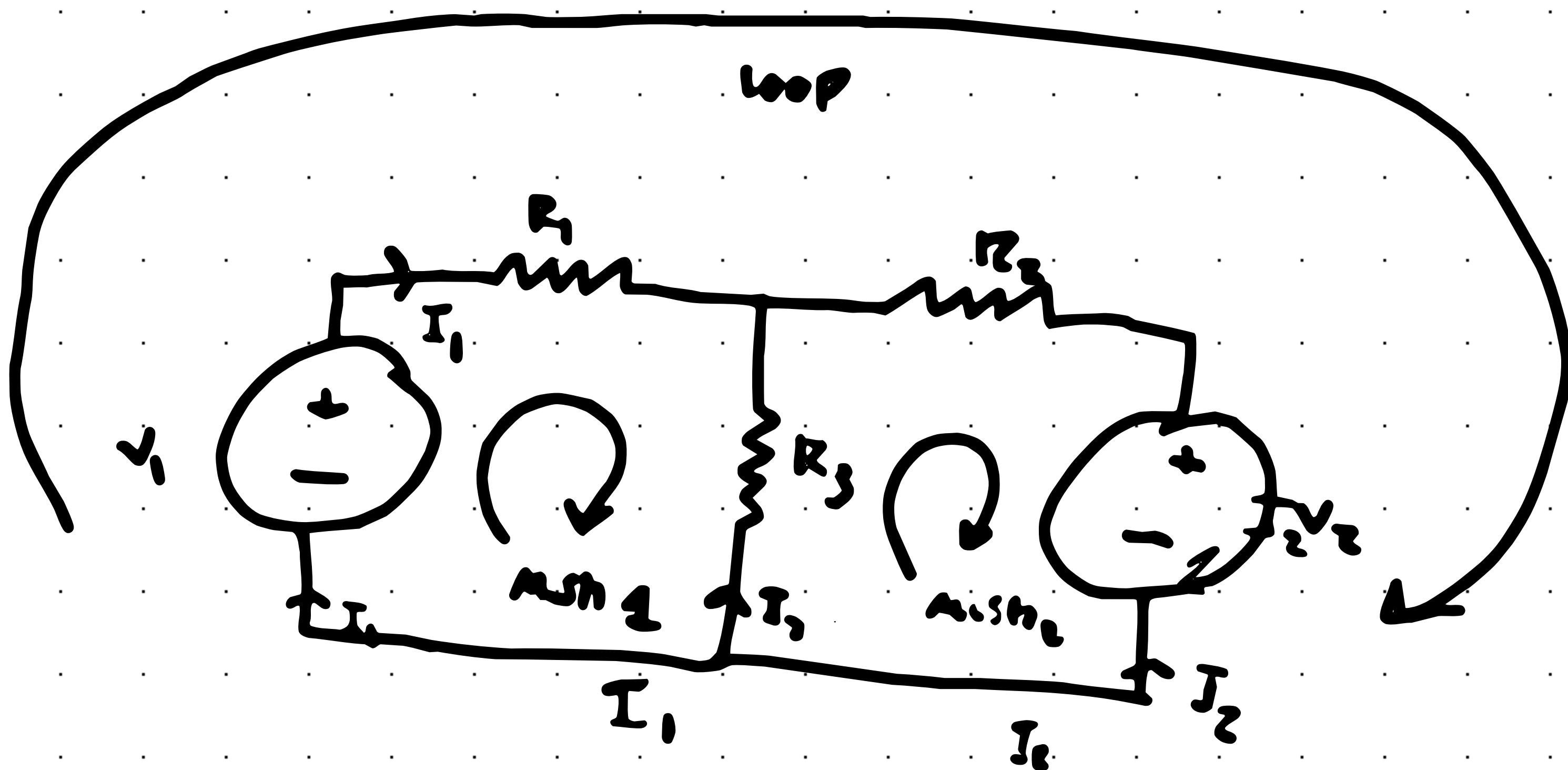
ECED 2000

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.

$$I_3 = (I_1 - I_2)$$

$$\sum_{\text{msn1}} v = 0$$

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

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

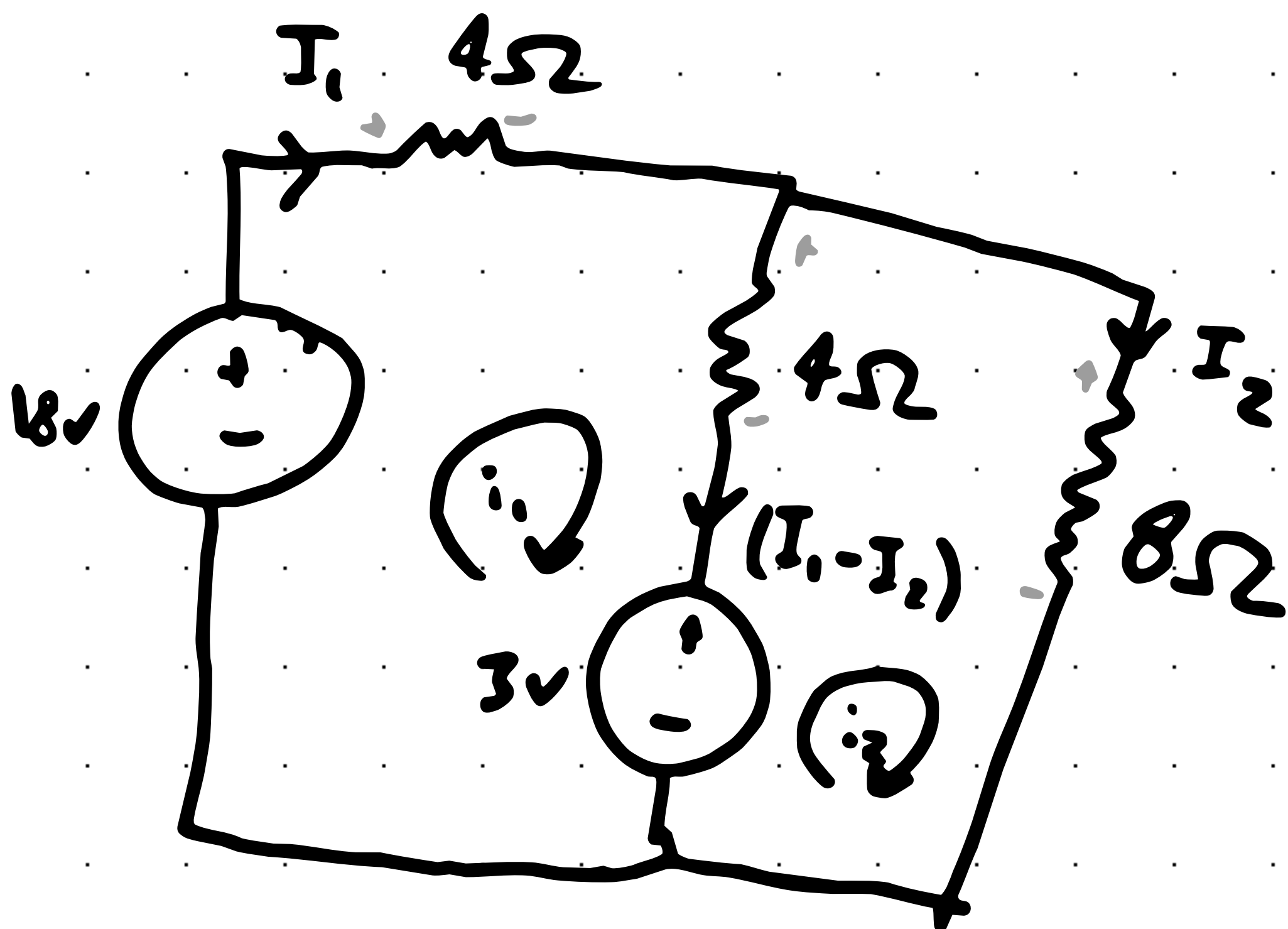
$$\sum_{\text{msn2}} v = 0$$

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

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

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

$$\sum V = 0$$

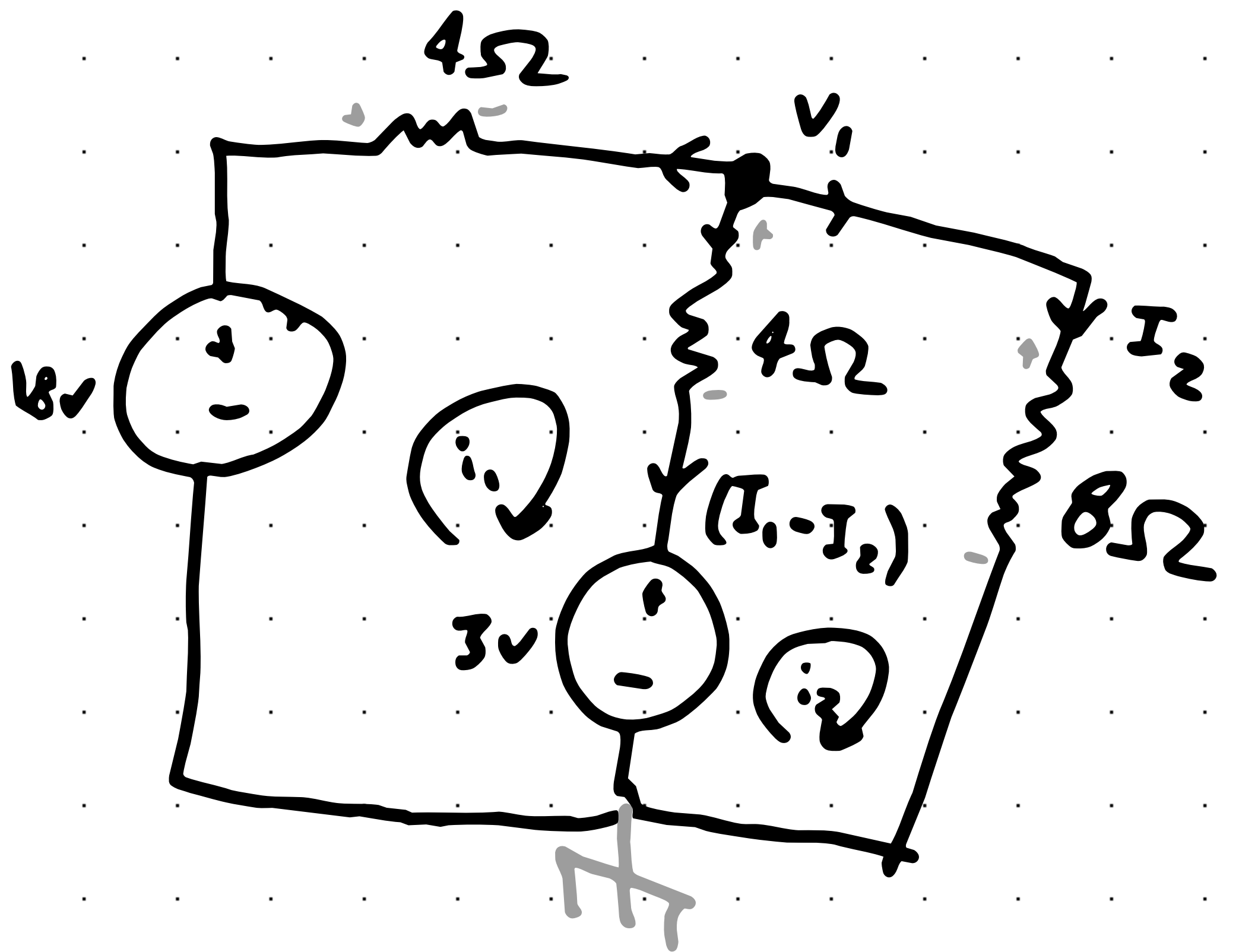
mesh 2

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

②

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

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



$$\sum I = 0$$

Note 1

$$\frac{v_1 - 18}{4} + \frac{v_1 - 3}{4} + \frac{v_1}{8}$$

$$2(v_1 - 18) + 2(v_1 - 3) + v_1$$

$$2v_1 - 36 + 2v_1 - 6 + v_1$$

$$5v_1 = 42$$

$$v_1 = 8.4$$

$$i_1 = \frac{v_1}{8} = \frac{8.4}{8}$$

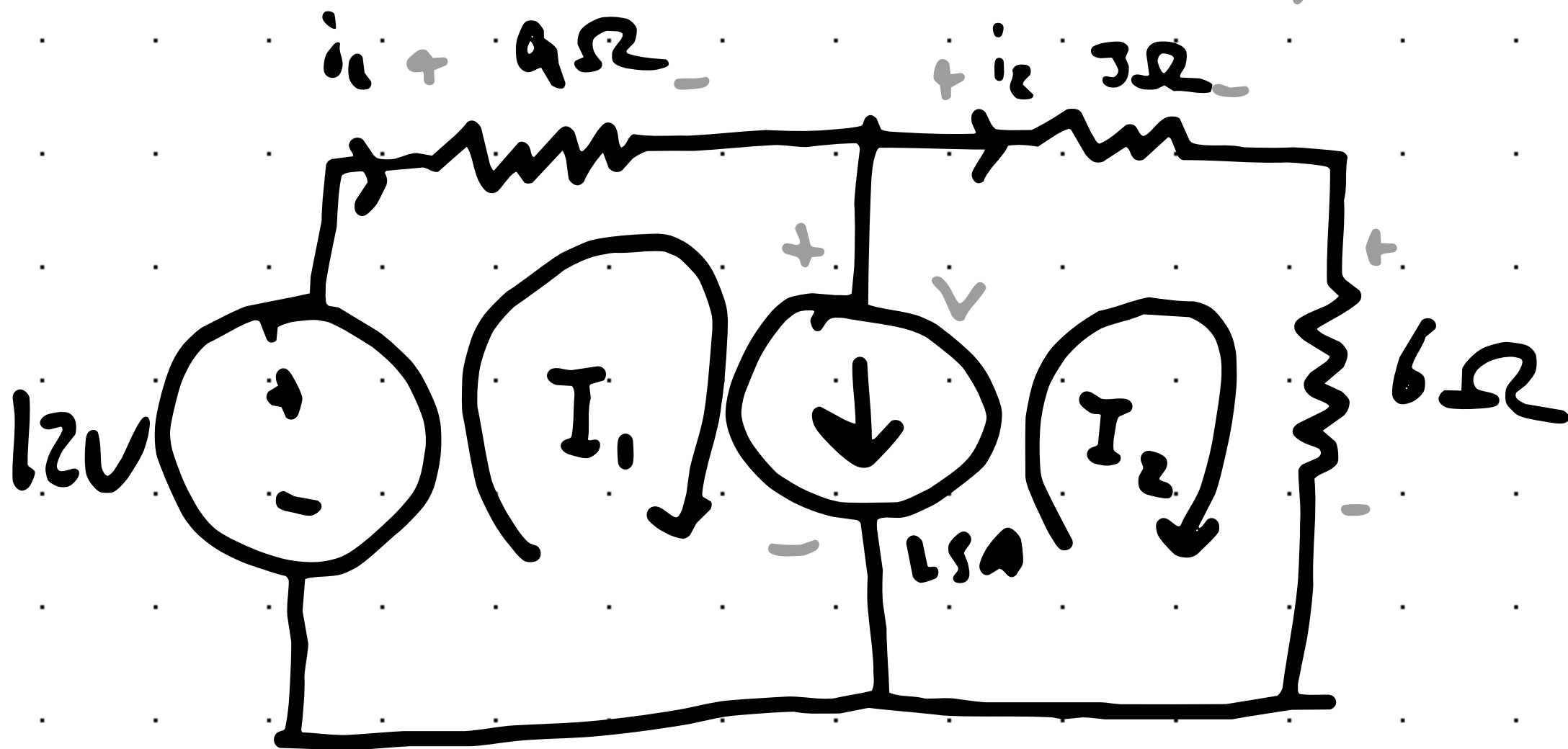
$$i_1 = 1.05A$$

One equation, but needs an extra step!

SuperMesh:

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

Does that matter if it is dependent, or independent!



$$\sum V = 0$$

mesh 1

$$12 - 9i_1 - V = 0 \quad (1)$$

$$\sum V = 0$$

mesh 2

$$V - 3i_2 - 6i_2 = 0 \quad (2)$$

Sub Eqn (2) into Eqn (1) by

$$V = 3i_2 - 6i_2$$

New Eqn! $\rightarrow 12 - 9i_1 - 3i_2 - 6i_2 = 0$ (3)

$$i_1 - i_2 = 1.5 \quad (4)$$

Solve Eqn 3 and 4

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

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

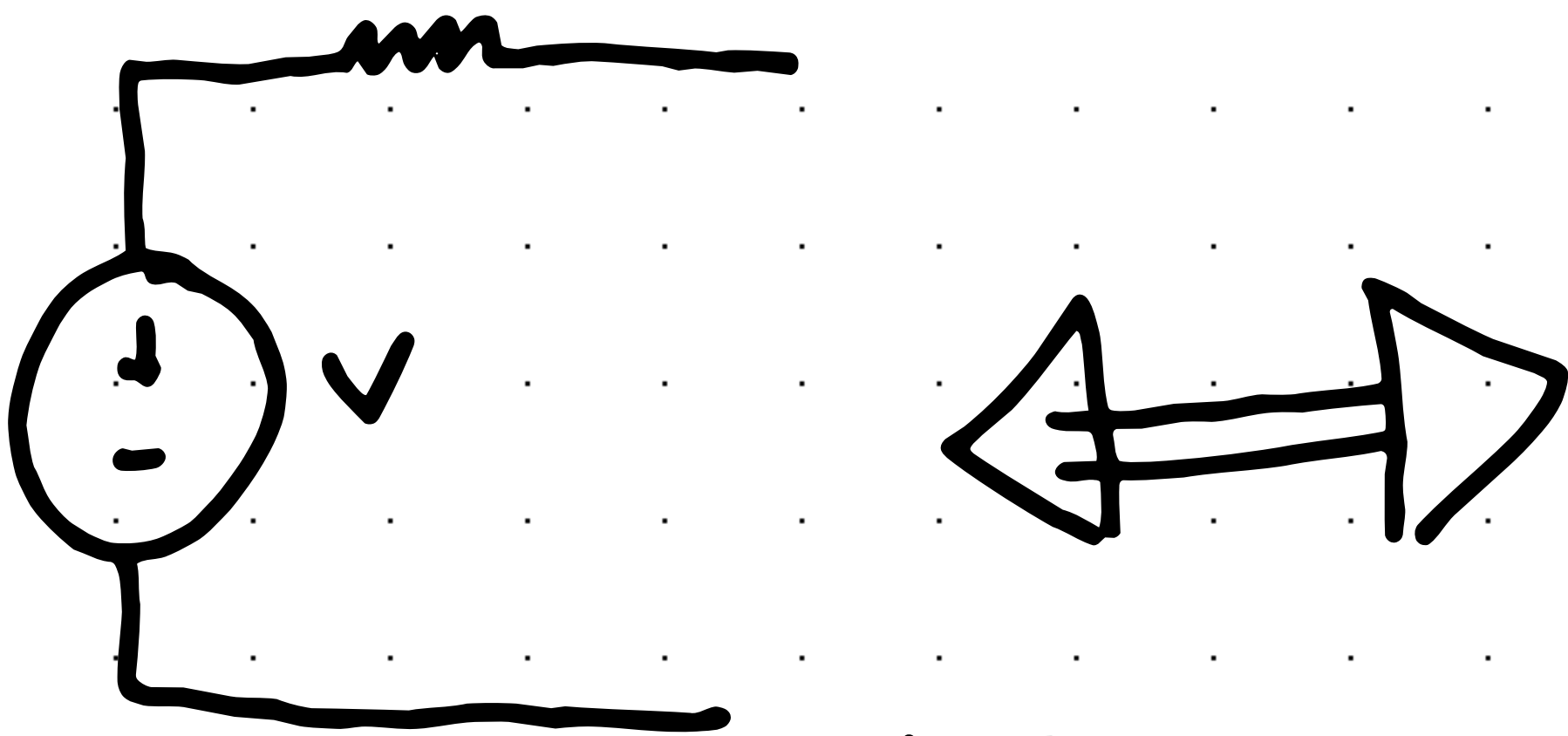
$$\sum_{\text{Super mesh}} V = 0$$

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

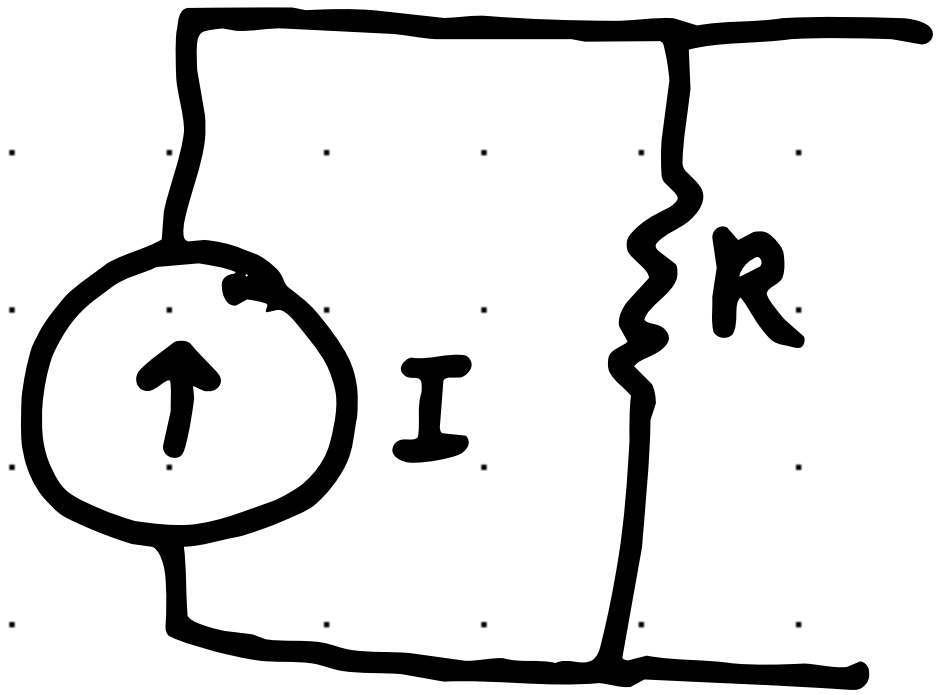
$$i_1 - i_2 = 1.5A$$

Source Transformation (Conversion) (Substitution)

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



voltage source $V = IR$



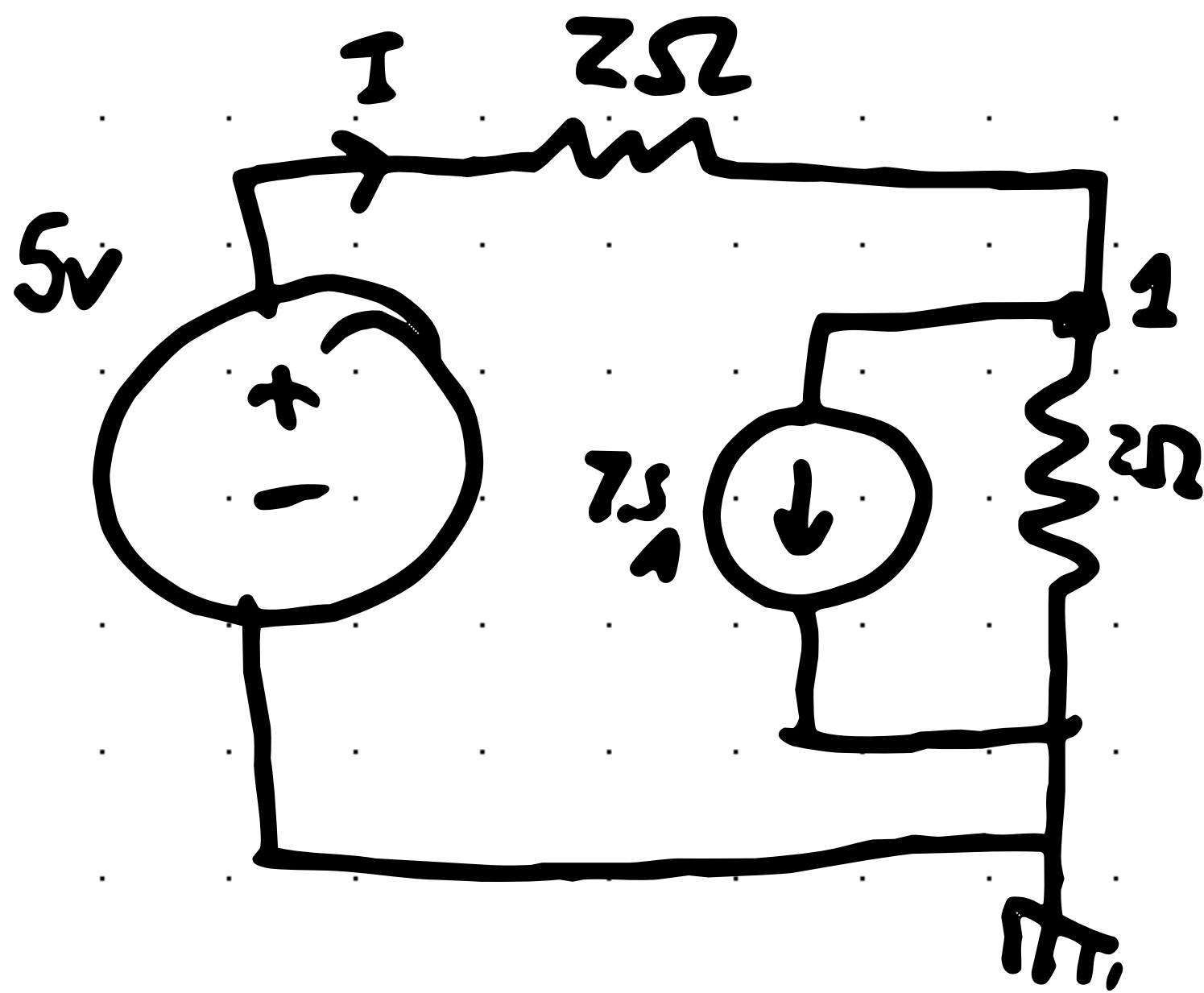
$$I = \frac{V}{R}$$

current source

Example 2

Solve the following circuit to calculate

I

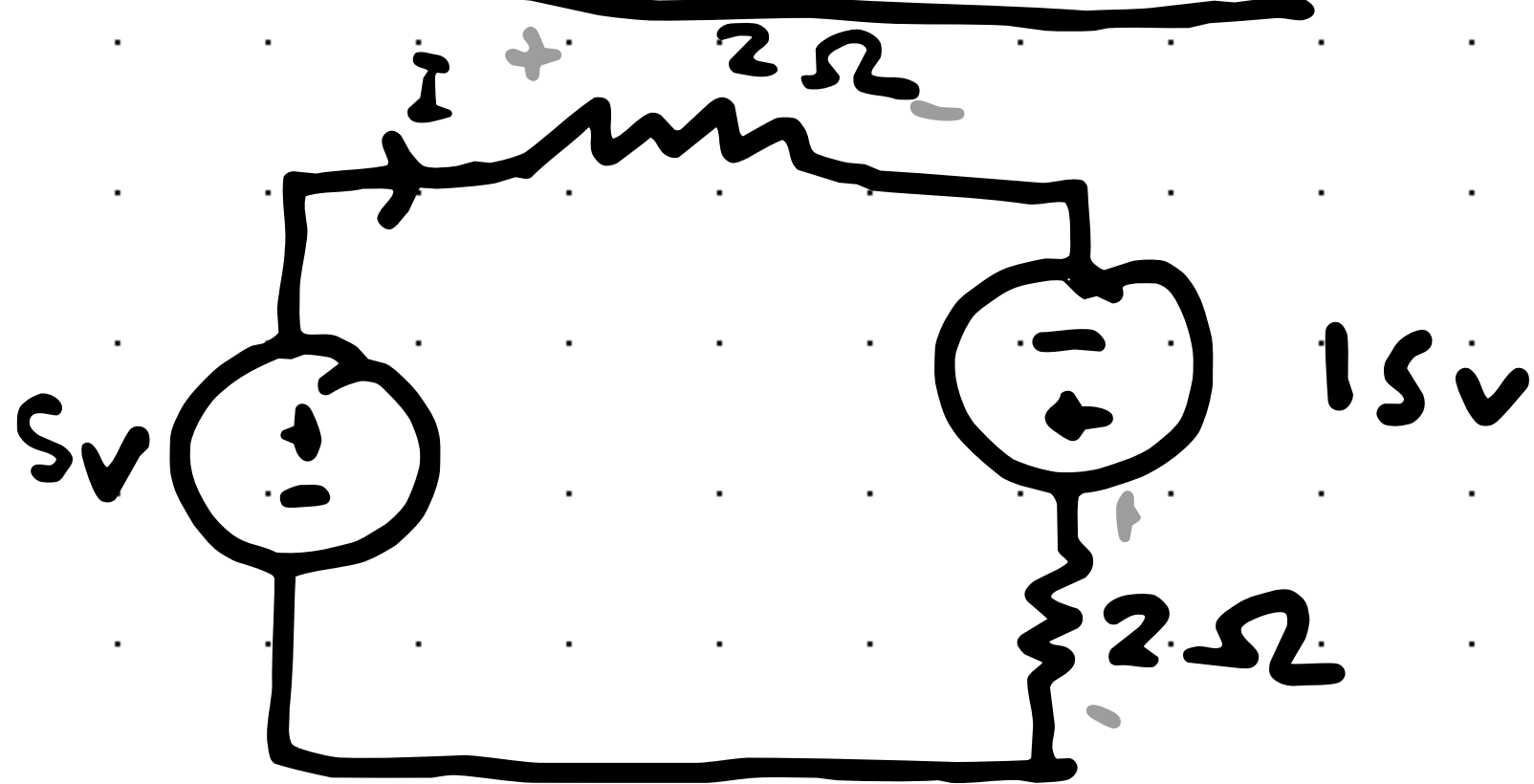


Nodal Analysis

$$\sum I = 0 \quad \frac{V_1 - 5}{2} + \frac{V_1}{2} + 7.5 = 0$$

Solve for V_1

Source Transformation



$$I = \frac{5 + 1.5}{2 + 2} = \boxed{5A}$$

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