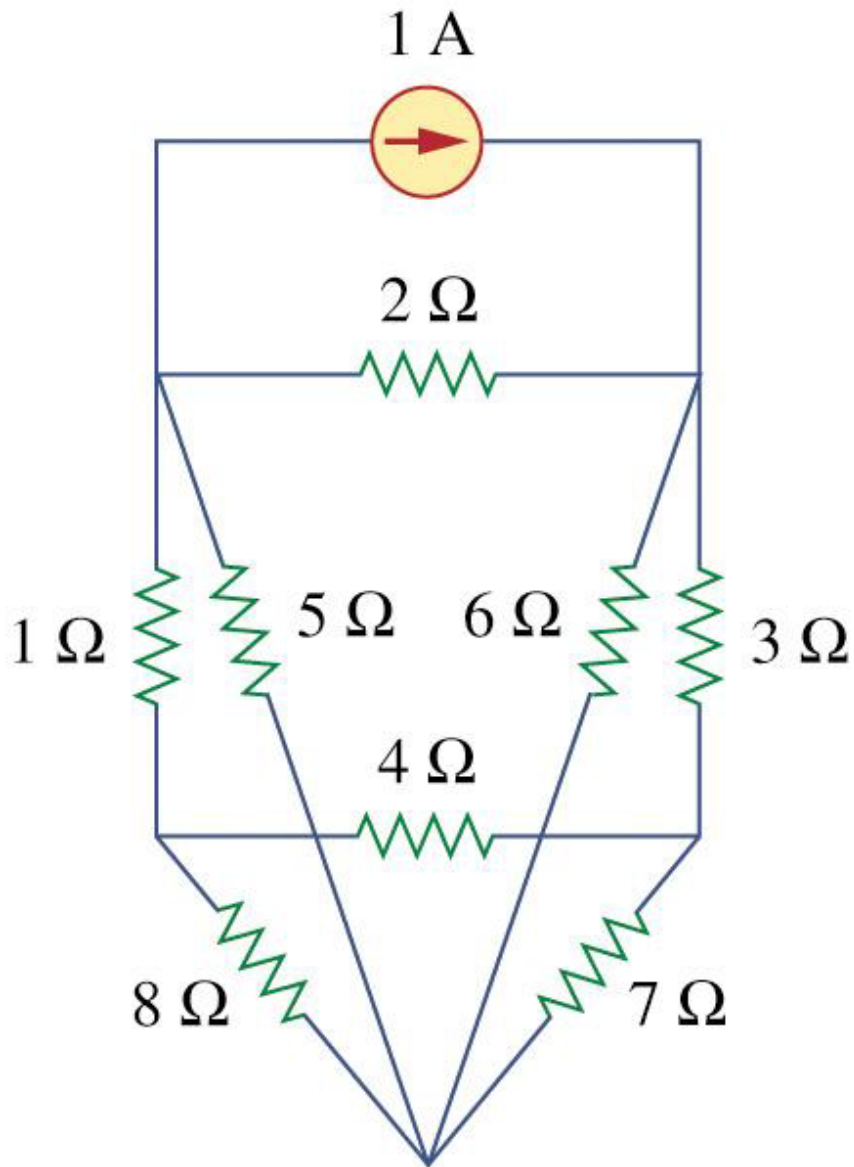# Mesh Analysis

1. Mesh analysis: another method for analyzing circuits, applicable to **planar** circuits.

2. A Mesh is a loop which does not contain any other loops within it.

3. Nodal analysis applies KCL to find voltages in a given circuit, while Mesh Analysis applies **KVL** to calculate unknown currents.
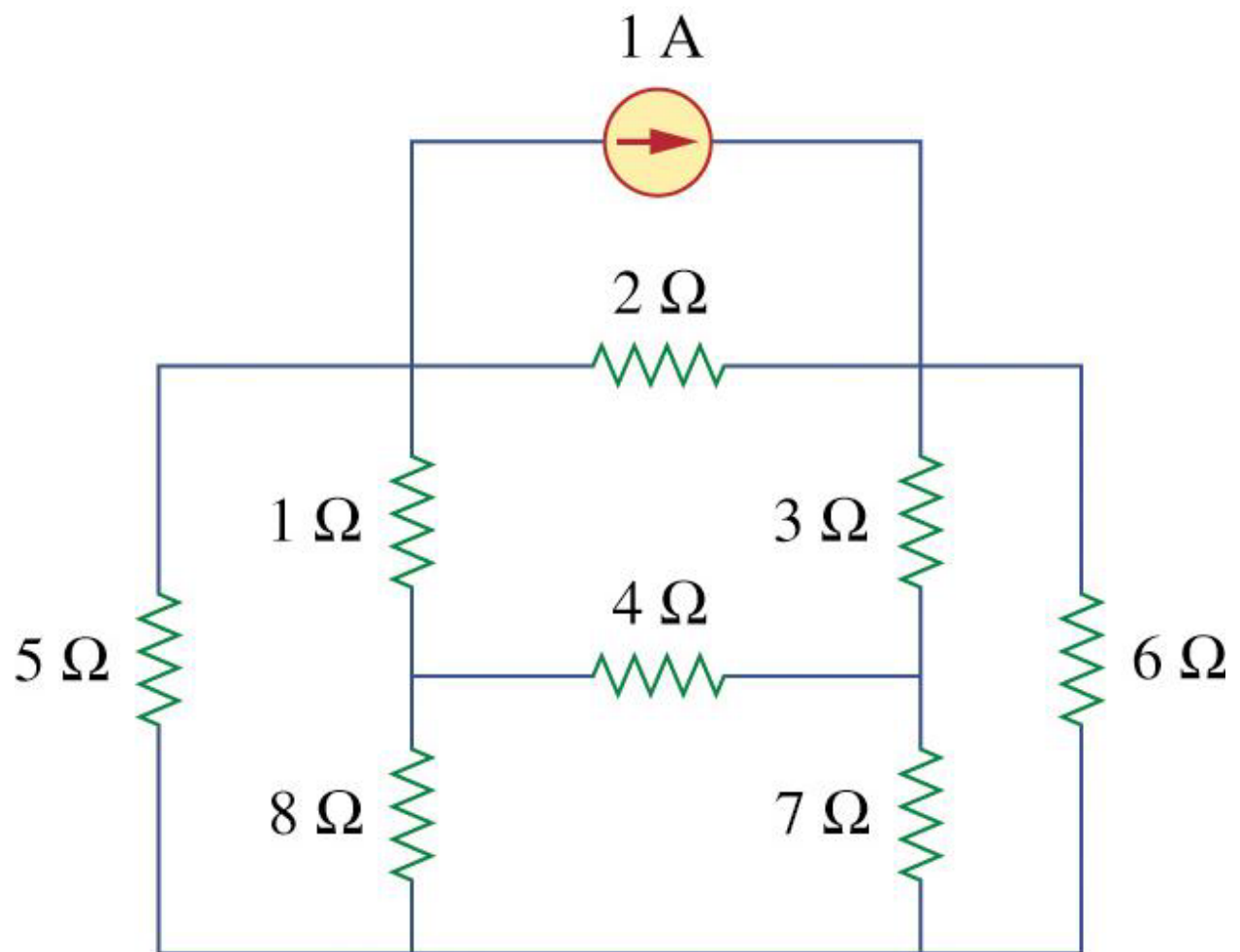
Mesh Analysis

A circuit is **planar** if it can be drawn on a plane with no branches crossing one another. Otherwise it is non planar.

The circuit in (a) is planar, because the same circuit that is redrawn(b) has no crossing branches
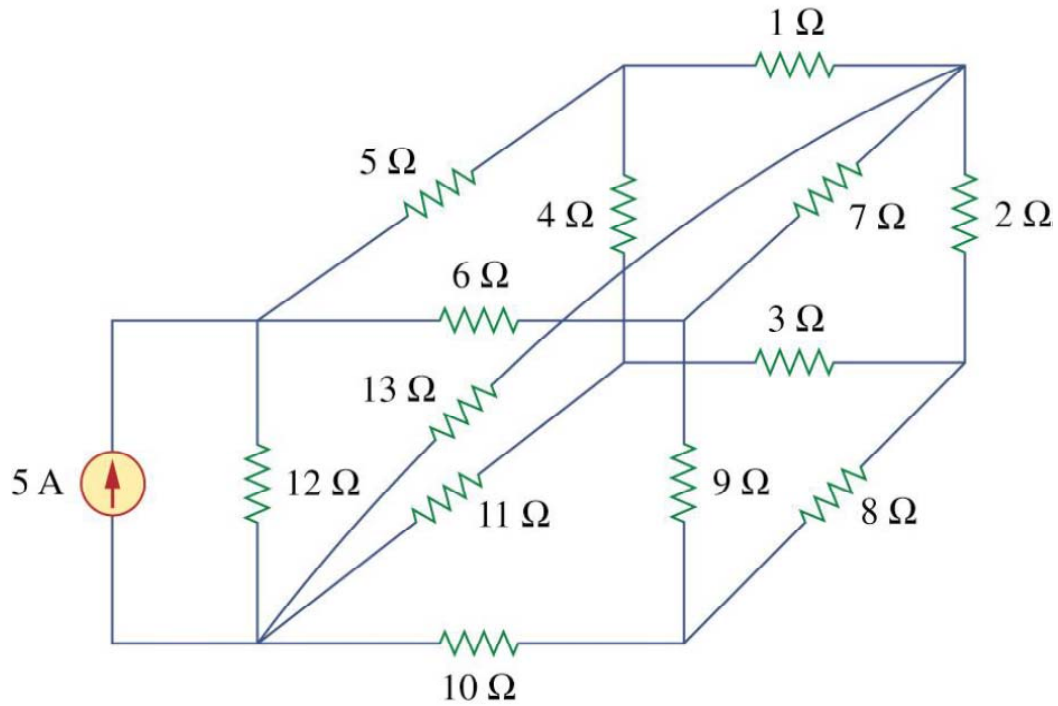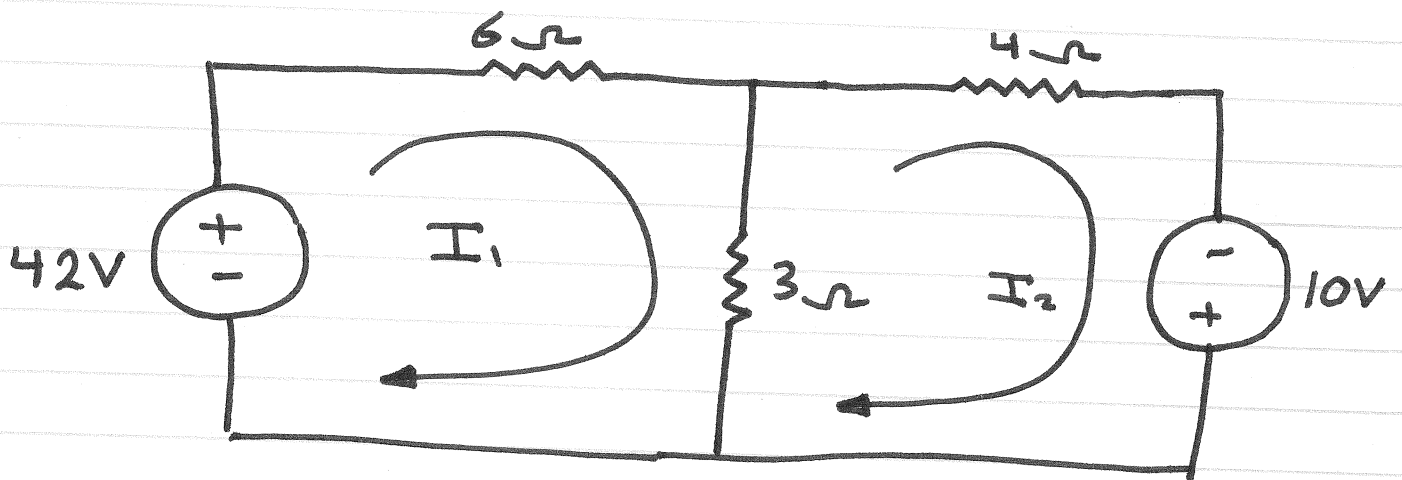

(a)

(b)

80

Mesh Analysis

A **non planar** circuit.

Mesh Analysis

KVL for mesh ① :

$$42 = 6 I_1 + 3 (I_1 - I_2)$$

$$42 = 9 I_1 - 3 I_2$$
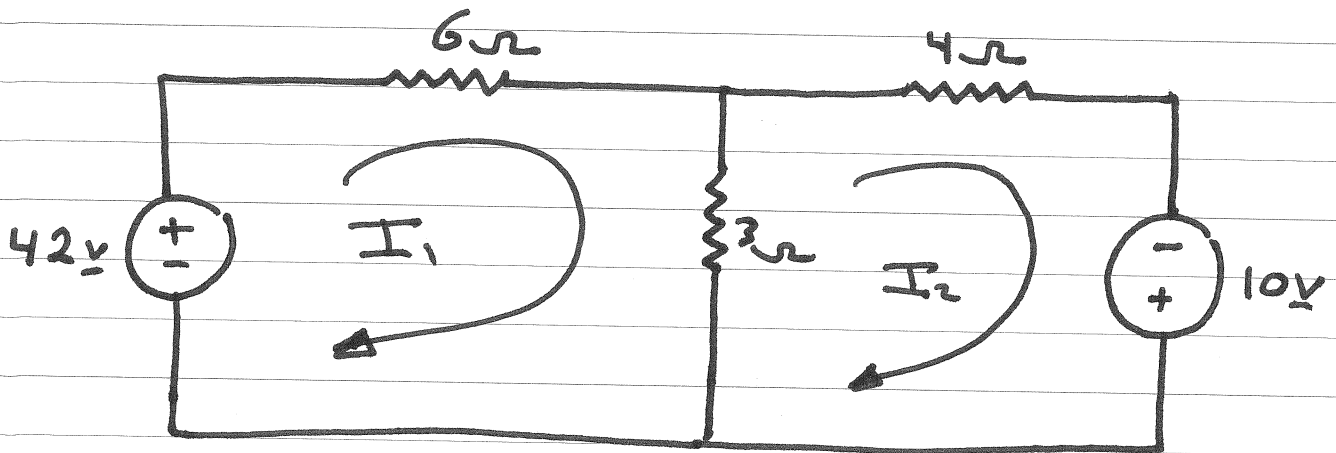
KVL for mesh ② :

$$+10 = 4 I_2 + 3 (I_2 - I_1)$$

$$10 = -3 I_1 + 7 I_2$$

$$\therefore \quad I_1 = 6A$$

$$I_2 = 4A$$

Mesh Analysis
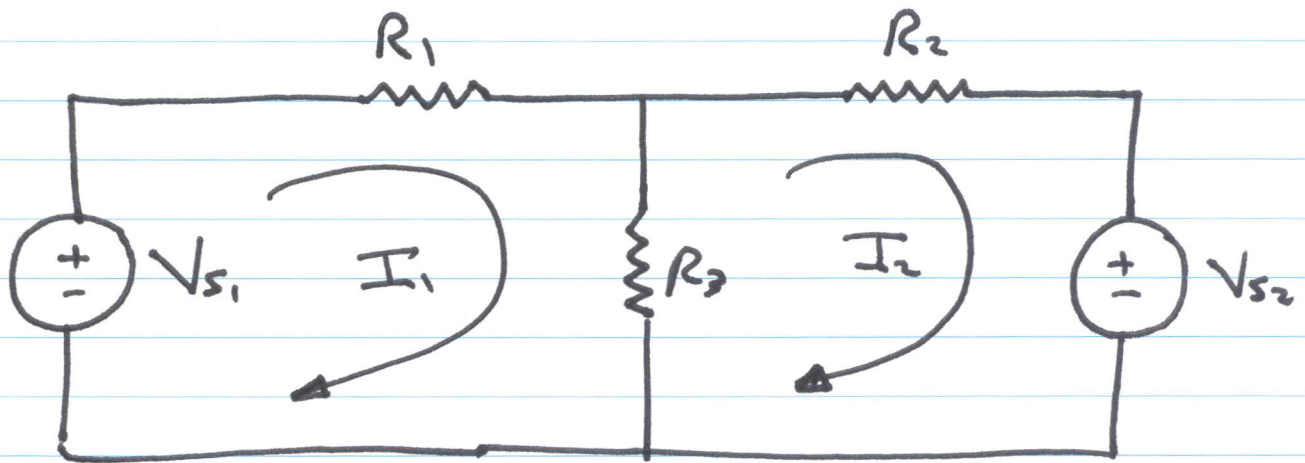

KVL for mesh ① :

$$42 = 9I_1 - 3I_2$$

KVL for mesh ② :

$$10 = -3I_1 + 7I_2$$

$$\therefore \quad I_1 = 6A$$

$$I_2 = 4A$$

Mesh Analysis

Applying KVL for mesh 1;

$$- V_{s_1} + R_1 I_1 + R_3 (I_1 - I_2) = 0$$

$$V_{s_1} = (R_1 + R_2) I_1 - R_3 I_2$$

$R_1 + R_2 \equiv$ self resistance of mesh ①

$- R_3 \equiv$ mutual resistance between meshes

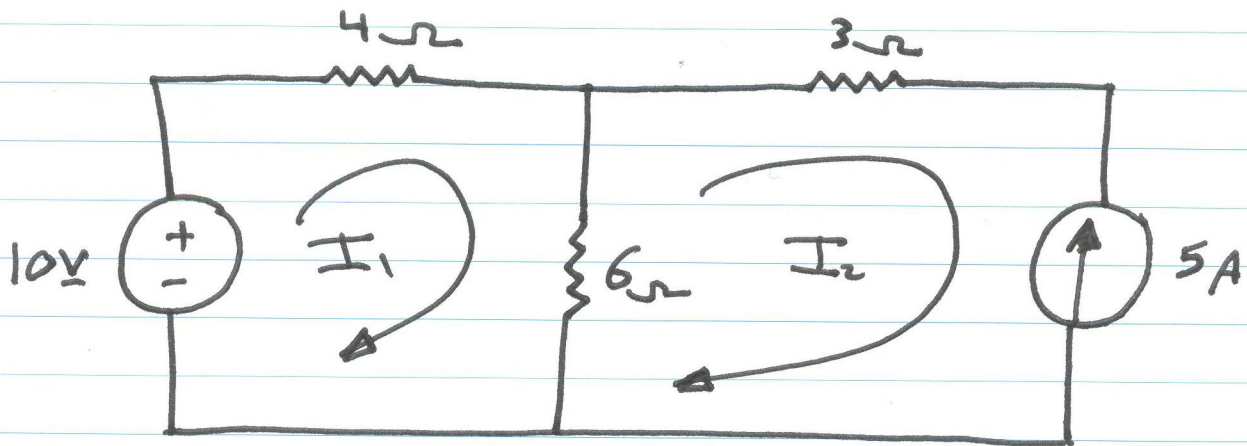① and ②

Applying KVL for mesh 2 ;

$$- V_{s_2} = - R_3 I_1 + (R_2 + R_3) I_2$$

$R_2 + R_3 \equiv$ self resistance of mesh ②.

Mesh Analysis : With Current Source

Case 1

Current source exist only in one mesh

KVL for mesh B :

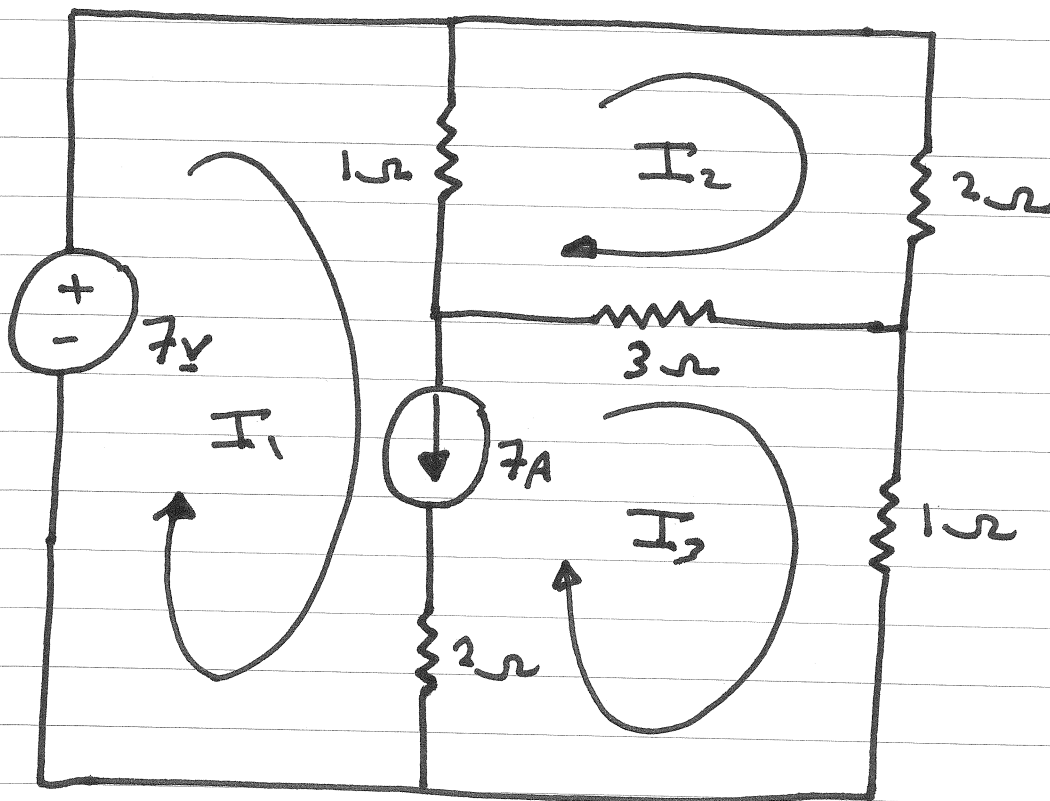$$10 = 10 I_1 - 6 I_2$$

Constrain equation :

$$I_2 = -5A$$

$$\therefore I_1 = -2A$$

Case 2

Current Source exists between two meshes, a Super mesh is obtained

Mesh Analysis : With Current sources

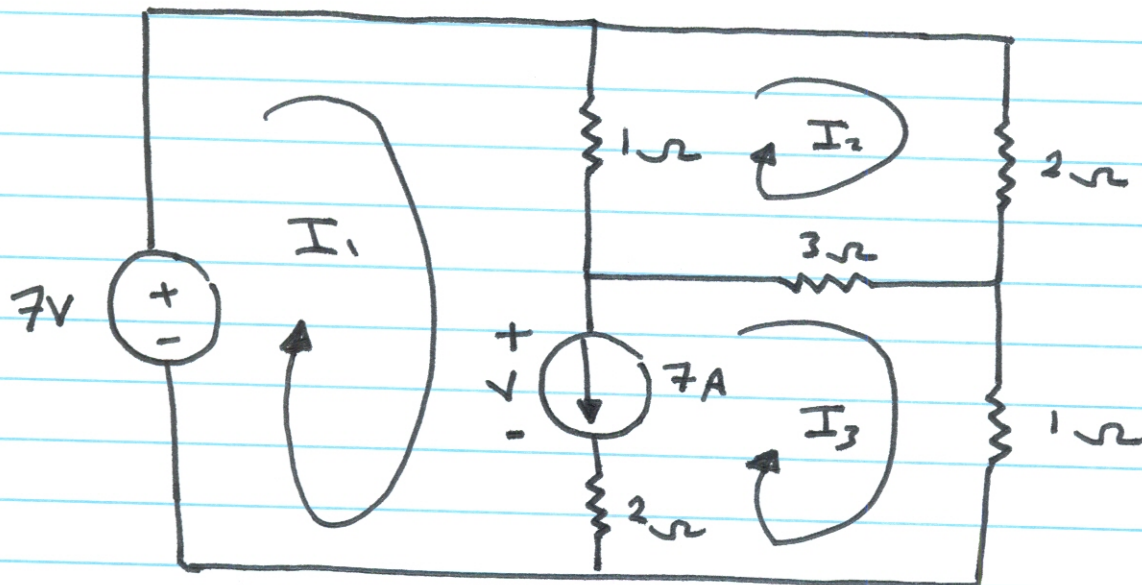KVL for mesh ② :

$$0 = 6I_2 - I_1 - 3I_3$$

Constrain equation :

$$I_1 - I_3 = 7$$

Super mesh equation :

$$7 = I_1 + 4I_3 - 4I_2$$

Supermesh equation

KVL for mesh ① :

$$-7 + 1(I_1 - I_2) + V + 2(I_1 - I_3) = 0$$

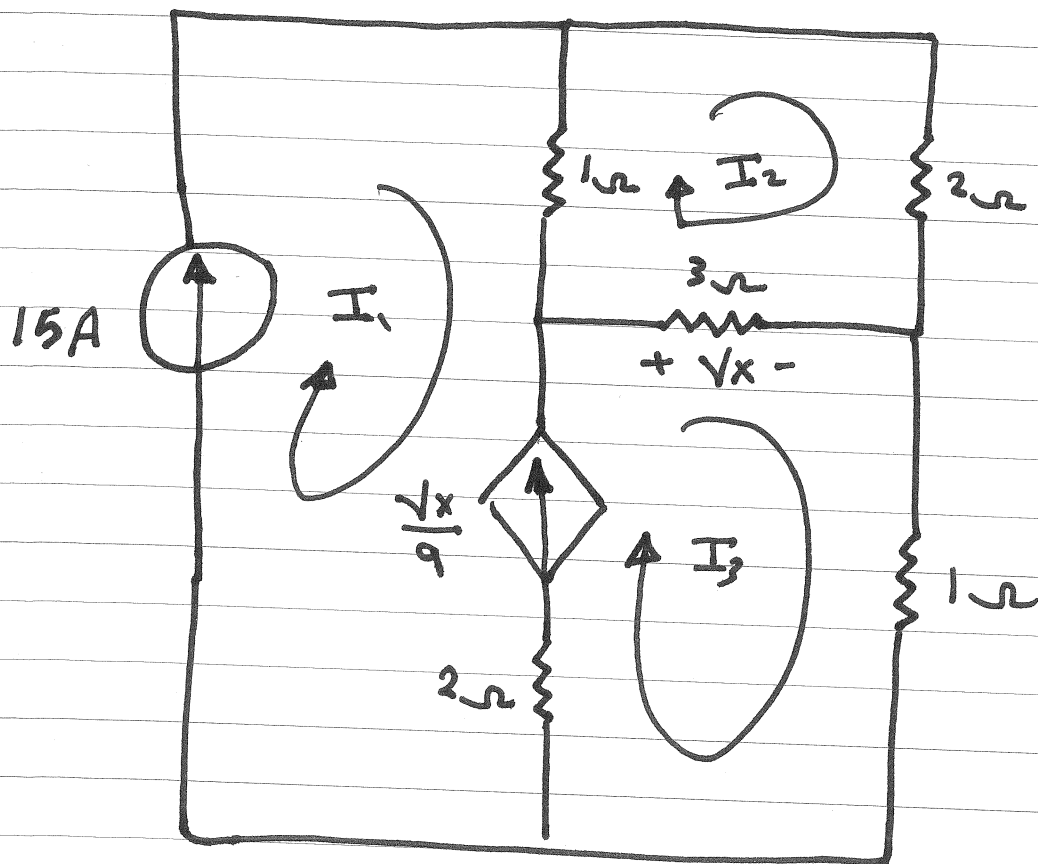$$7 = 3I_1 - I_2 - 2I_3 + V \qquad —— ①$$

KVL for mesh ③ :

$$3(I_3 - I_2) + I_3 + 2(I_3 - I_1) - V = 0$$

$$0 = -2I_1 - 3I_2 + 6I_3 - V \qquad —— ②$$

adding ① + ②

$$7 = I_1 - 4I_2 + 4I_3$$

Mesh Analysis: With dependent Sources

KVL for mesh ②:

$$0 = -I_1 + 6I_2 - 3I_3$$

Constrain equation:

$$I_1 = 15A$$

Constrain equation:

$$I_3 - I_1 = \frac{V_x}{9}$$

$$V_x = 3(I_3 - I_2)$$

$\therefore\quad I_1 = 15A$

$\quad\quad I_2 = 11A$

$\quad\quad I_3 = 17A$

Node or Mesh : How to choose?

- Use the one with fewer equations

- Use the method you Like best