

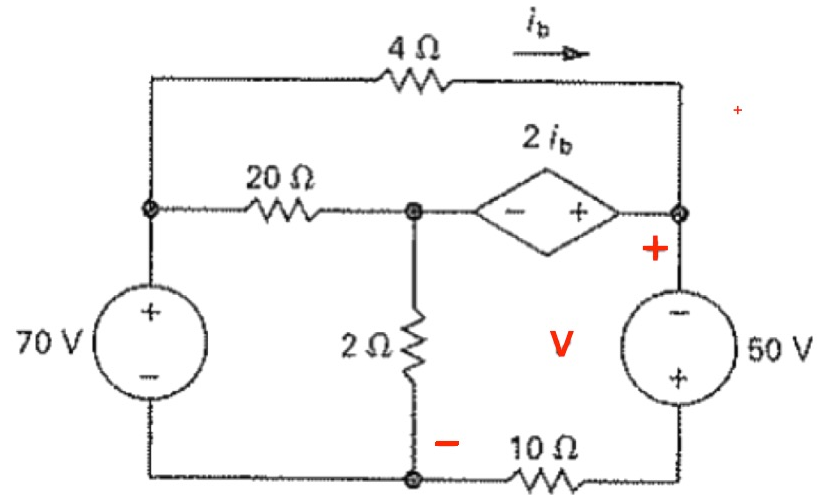
Lecture 39

Mesh Analysis

concept; examples

General Methods to Analyze Circuits

- What to do first?
 - KVL?
 - KCL?
 - Ohm's Law?



- We need a more direct approach:
 - Nodal analysis (KCL based)
 - Mesh analysis (KVL based, **NOW**)

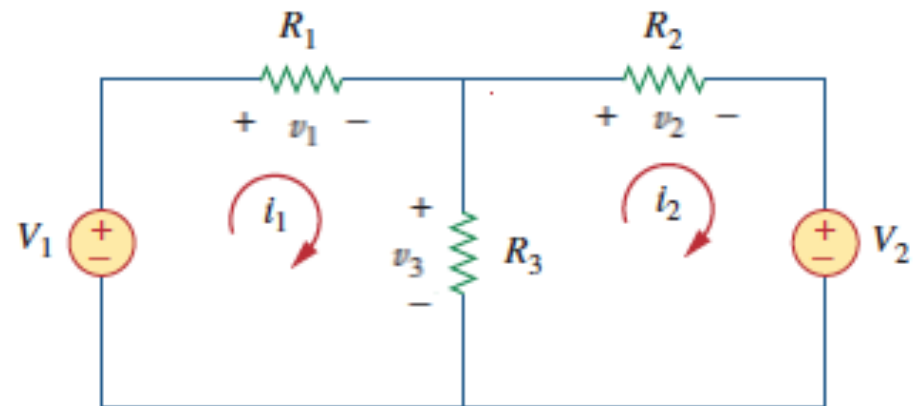
Mesh Analysis

- Mesh refers to the simple loops visible in a circuit
- Define the “mesh” currents
- Write KVL on these meshes

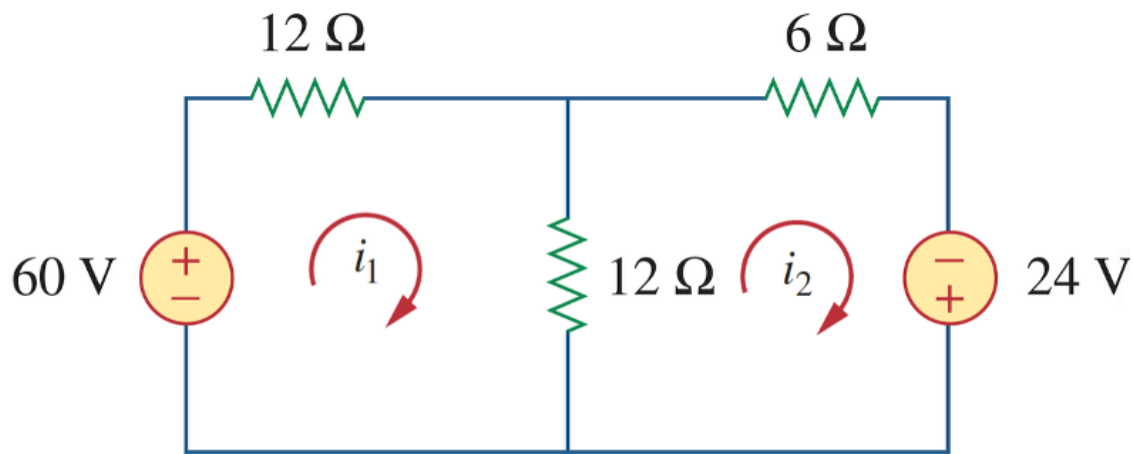
$$v_1 + v_3 = V_1$$

$$v_3 = v_2 + V_2$$

- Solve



Example:



$$60 - 12i_1 - 12(i_1 - i_2) = 0$$

$$-12(i_2 - i_1) - 6i_2 + 24 = 0$$

$$24i_1 - 12i_2 = 60$$

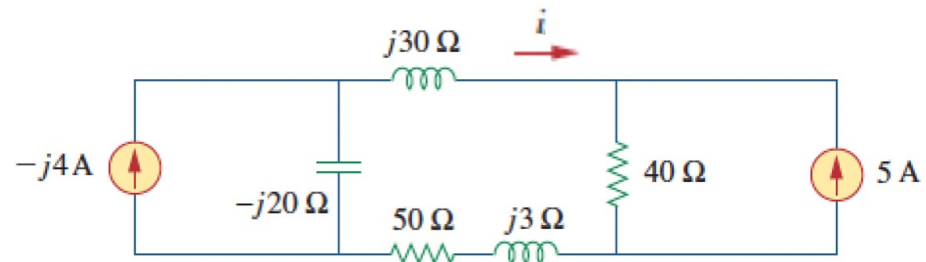
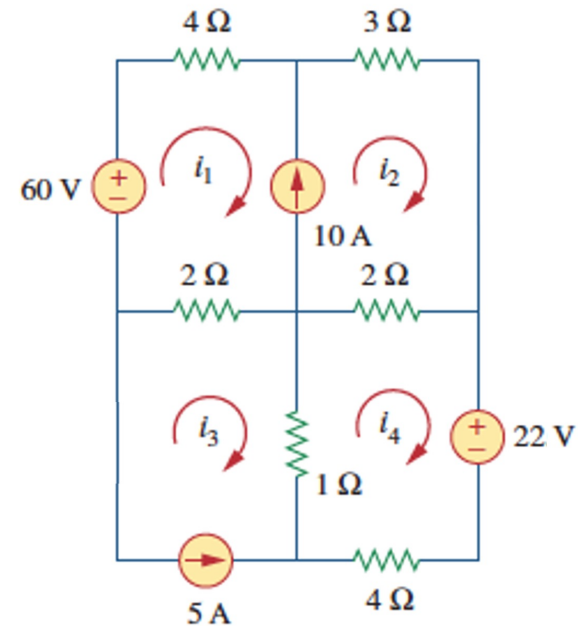
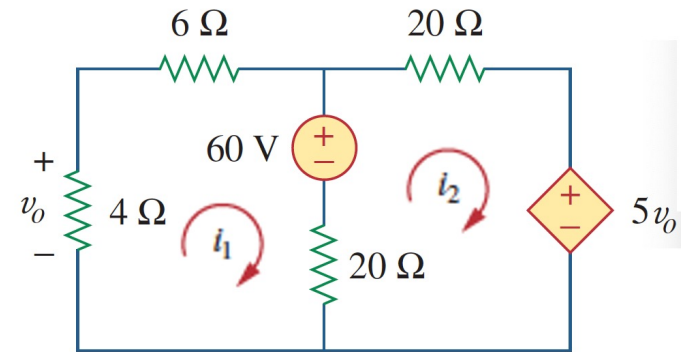
$$-12i_1 + 18i_2 = 24$$

$$i_1 = \frac{\begin{vmatrix} 60 & -12 \\ 24 & 18 \end{vmatrix}}{\begin{vmatrix} 24 & -12 \\ -12 & 18 \end{vmatrix}} = \frac{1368}{288} = 4.75 \text{ amps}$$

$$i_2 = \frac{\begin{vmatrix} 24 & 60 \\ -12 & 24 \end{vmatrix}}{\begin{vmatrix} 24 & -12 \\ -12 & 18 \end{vmatrix}} = \frac{1296}{288} = 4.5 \text{ amps}$$

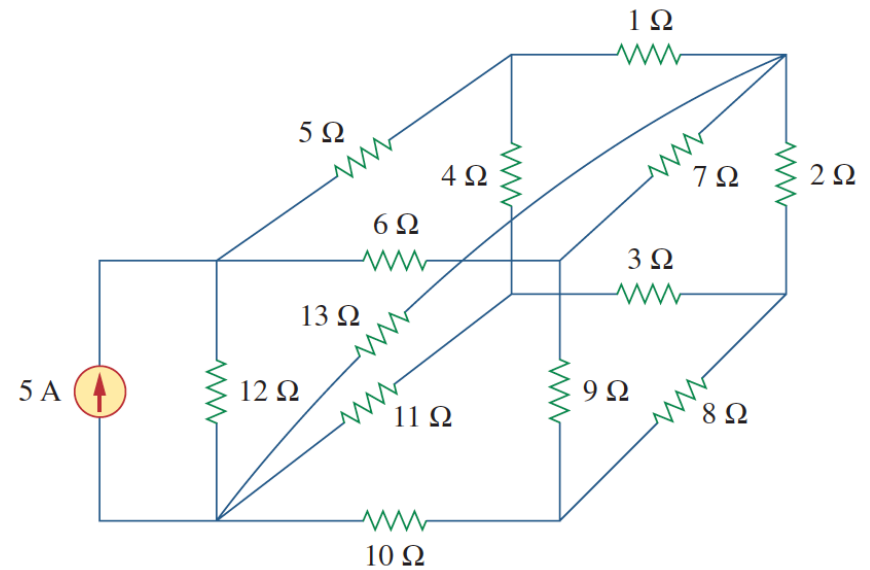
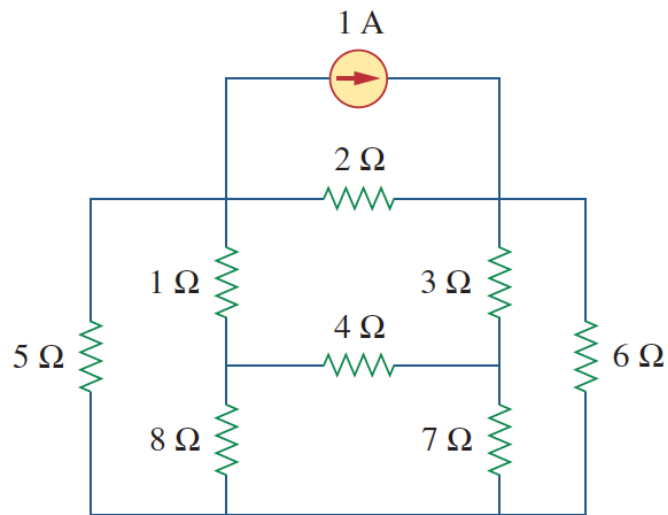
Extensions

- Treat dependent sources the same way as in node analysis
- Current sources are either trivial or require a “supermesh”
- Works for phasors



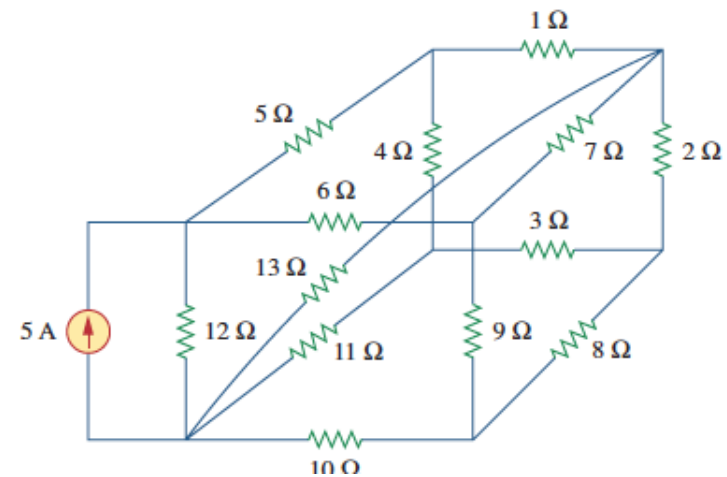
Limitation

- Circuit must be “planar”



Node vs Mesh?

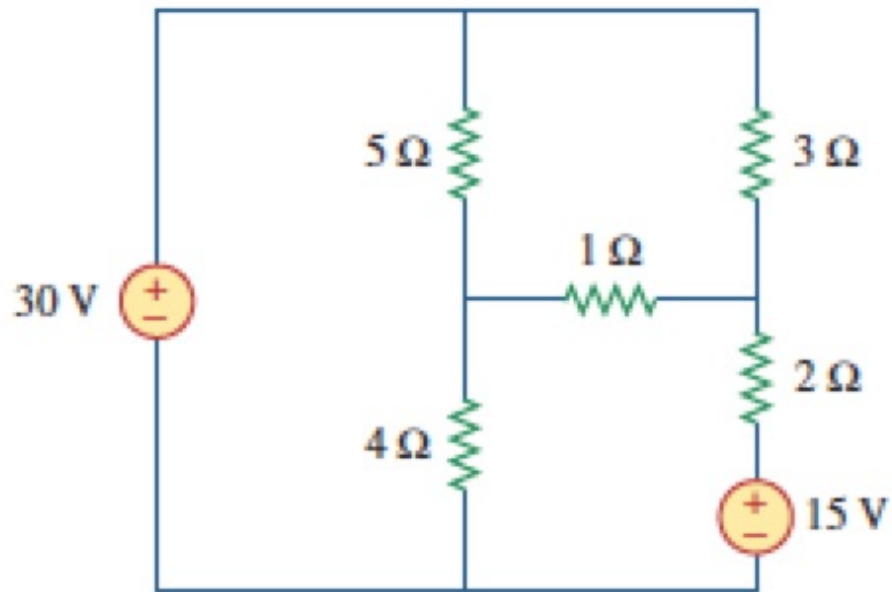
- Non-planar \rightarrow node only



- Could count # of nodes/loops; select smaller
- Personal preference

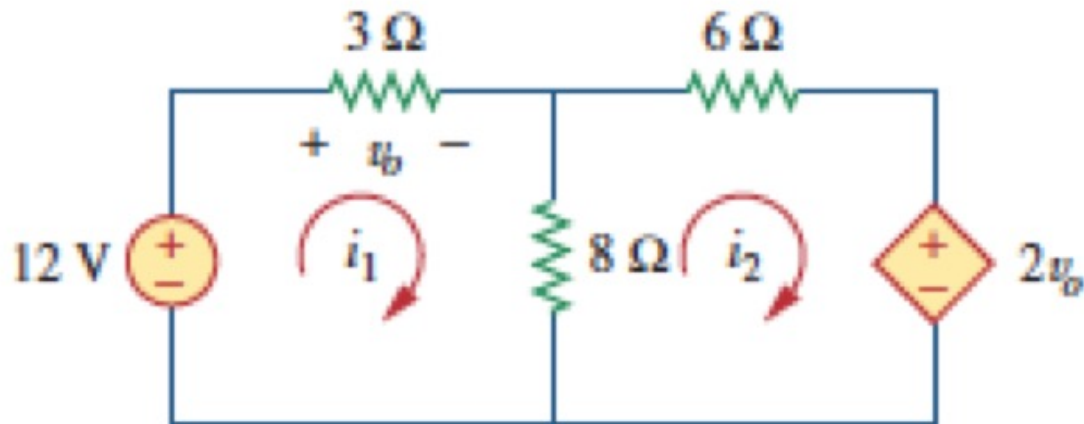
Practice problem:

$$i_L = 6.26 \text{ A}, i_T = 3.69 \text{ A}, i_B = 1.96 \text{ A}$$



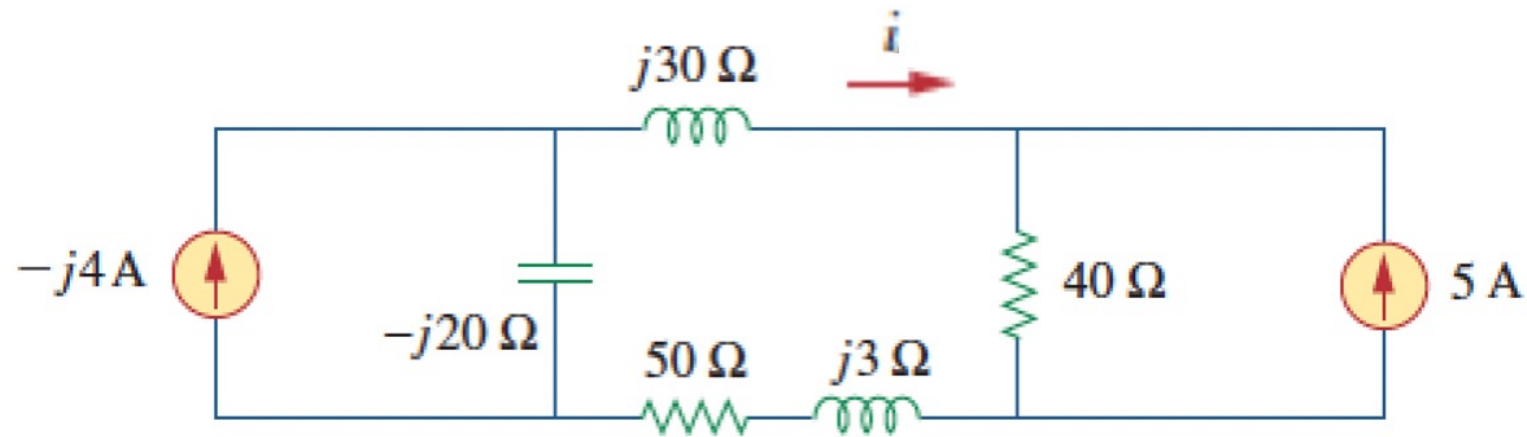
Practice problem:

$$i_1 = 1.22 \text{ A}, i_2 = 0.174 \text{ A}$$

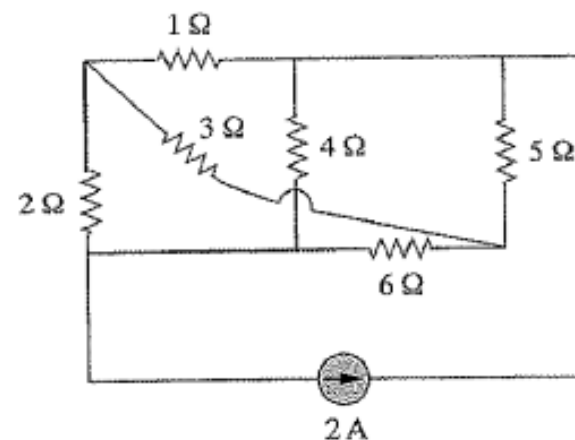
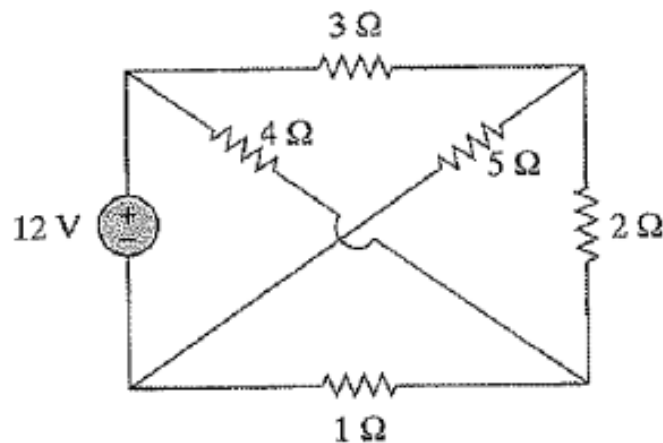
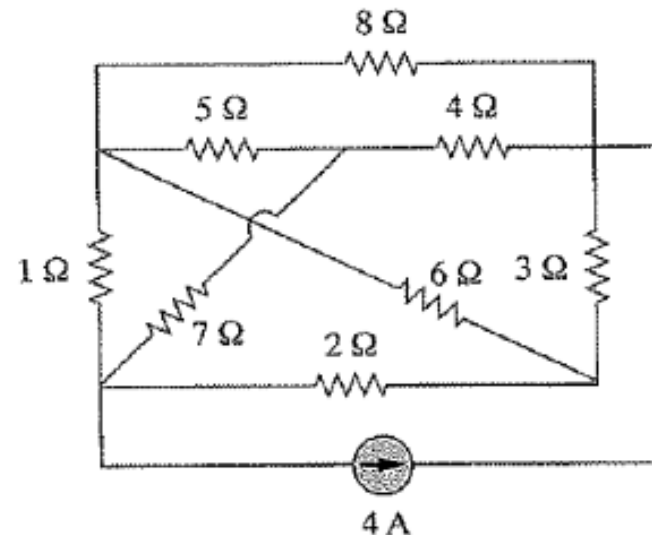
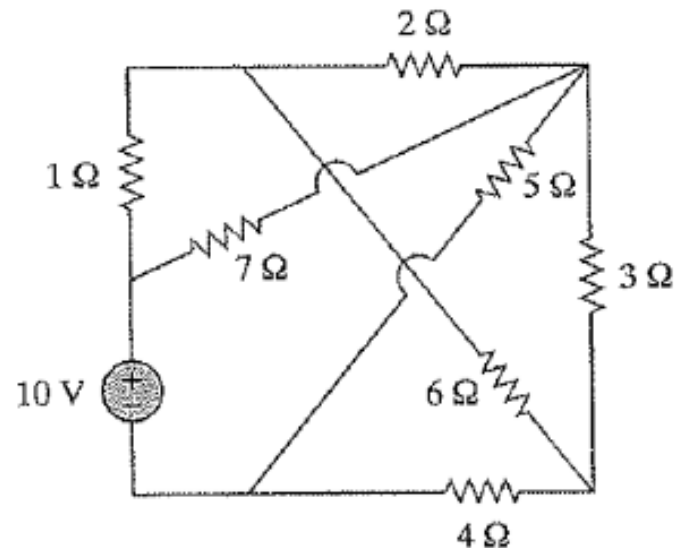


Practice problem: find i

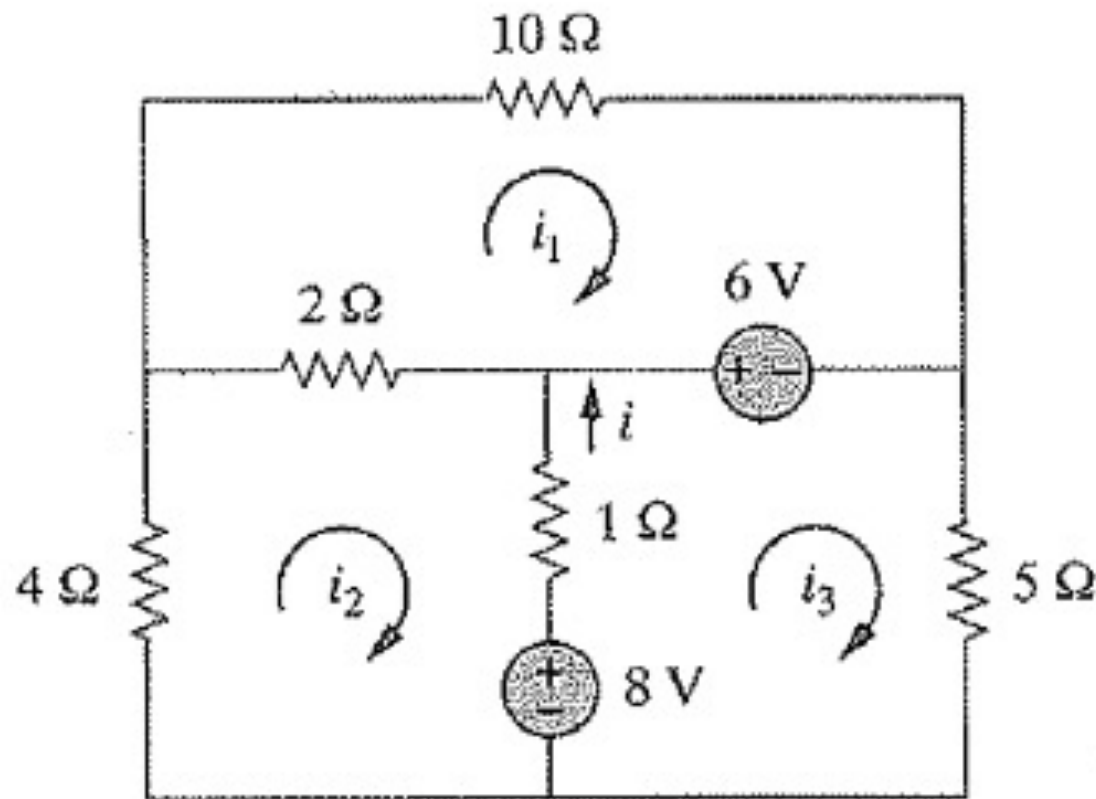
$$i = -\frac{112}{17} + \frac{j28}{17} \text{ A}$$



Practice problem: Which of these circuits are planar (i.e. would allow for mesh analysis)?



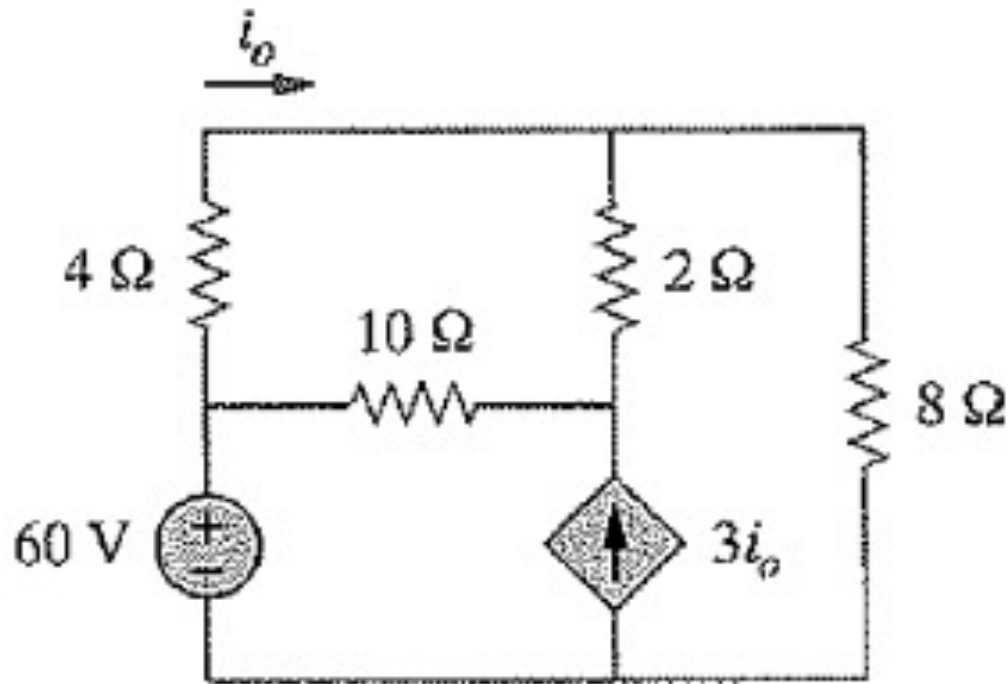
Practice problem: Find the currents i_1 , i_2 , and i_3 .



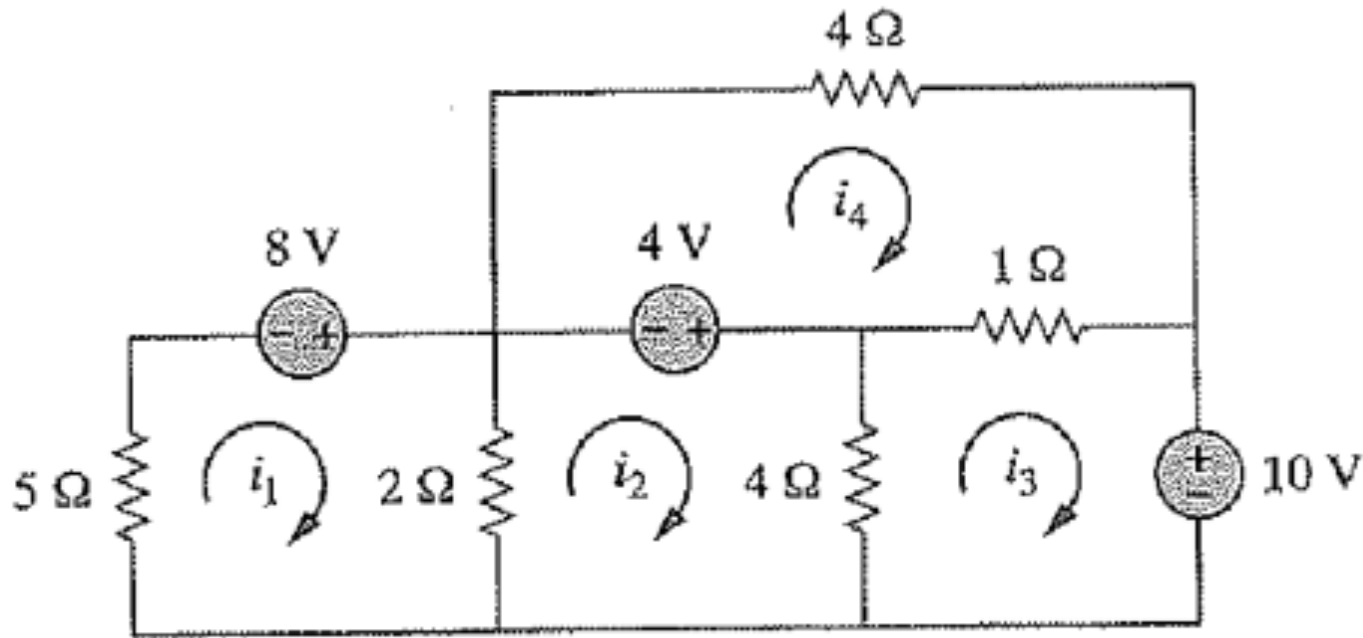
$$\begin{aligned} i_1 &= \frac{77}{234}\text{ A} \\ i_2 &= -\frac{240}{234}\text{ A} \\ i_3 &= \frac{38}{234}\text{ A} \end{aligned}$$

Practice problem: Find the current i_o

$$i_o = \frac{45}{26} \text{ A}$$



Practice problem: Find the currents i_1 , i_2 , i_3 , and i_4



$$i_1 = \frac{68}{88} \text{ A}$$

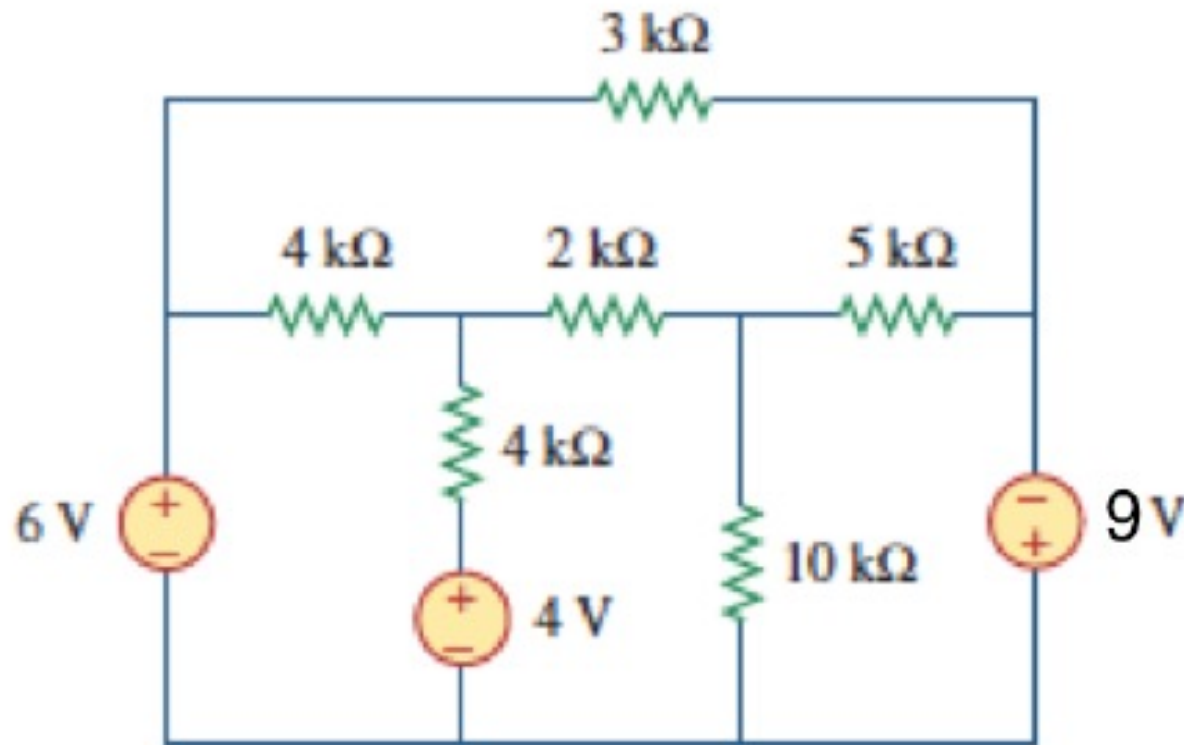
$$i_2 = -\frac{114}{88} \text{ A}$$

$$i_3 = -\frac{293}{88} \text{ A}$$

$$i_4 = -\frac{129}{88} \text{ A}$$

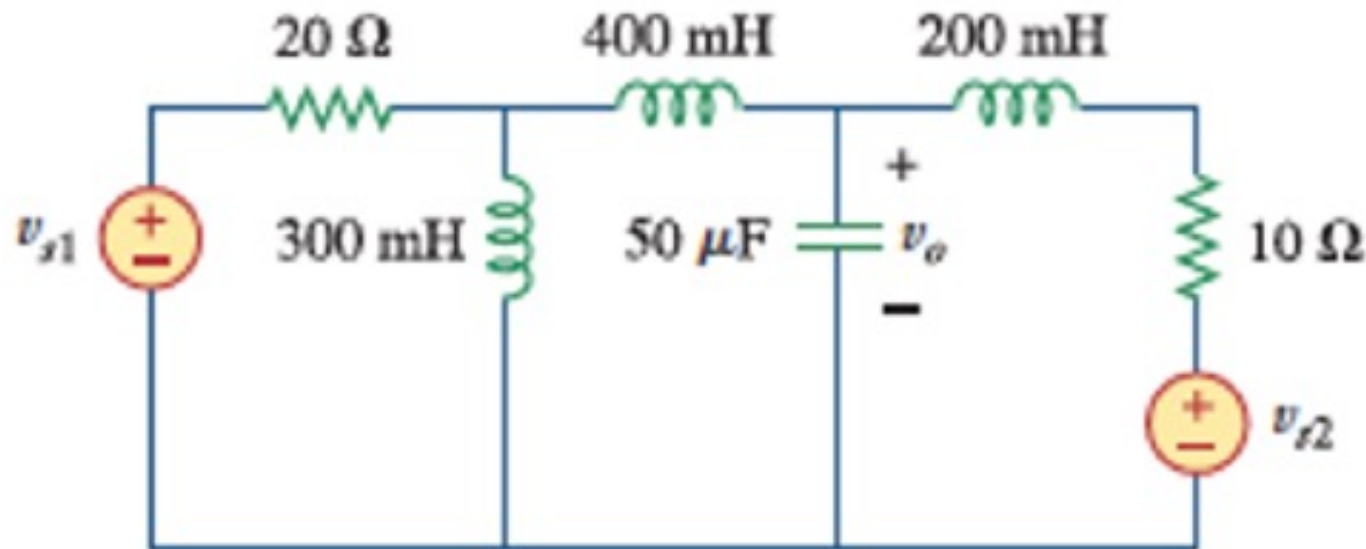
Practice problem: For the circuit below which method appears easier, mesh or node? Use your preference to find the power dissipated in the $10\text{ k}\Omega$ resistor.

$100\text{ }\mu\text{W}$



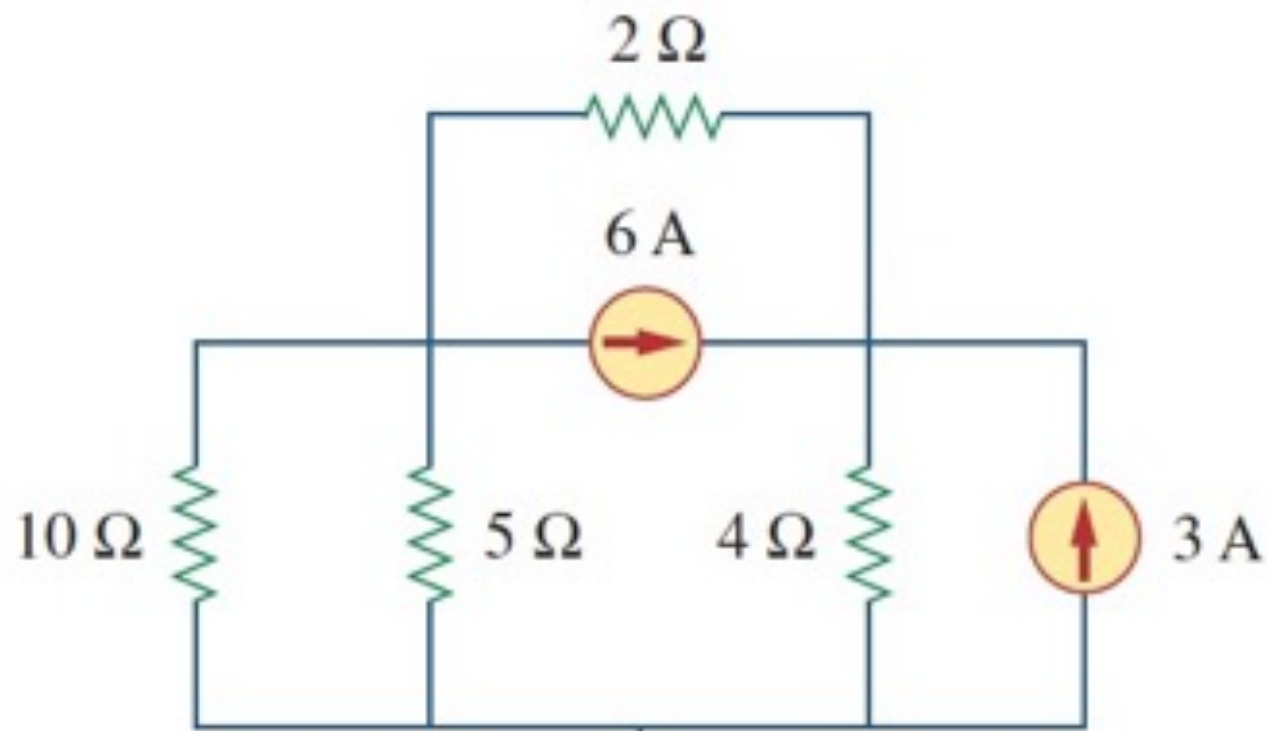
Practice problem: Find $v_o(t)$ assuming that $v_1(t) = 120 \cos(100t + 90^\circ)$ V and $v_2(t) = 80 \cos 100t$ V

$$v_o(t) = 29.9 \cos(100t + 46^\circ) \text{ V}$$



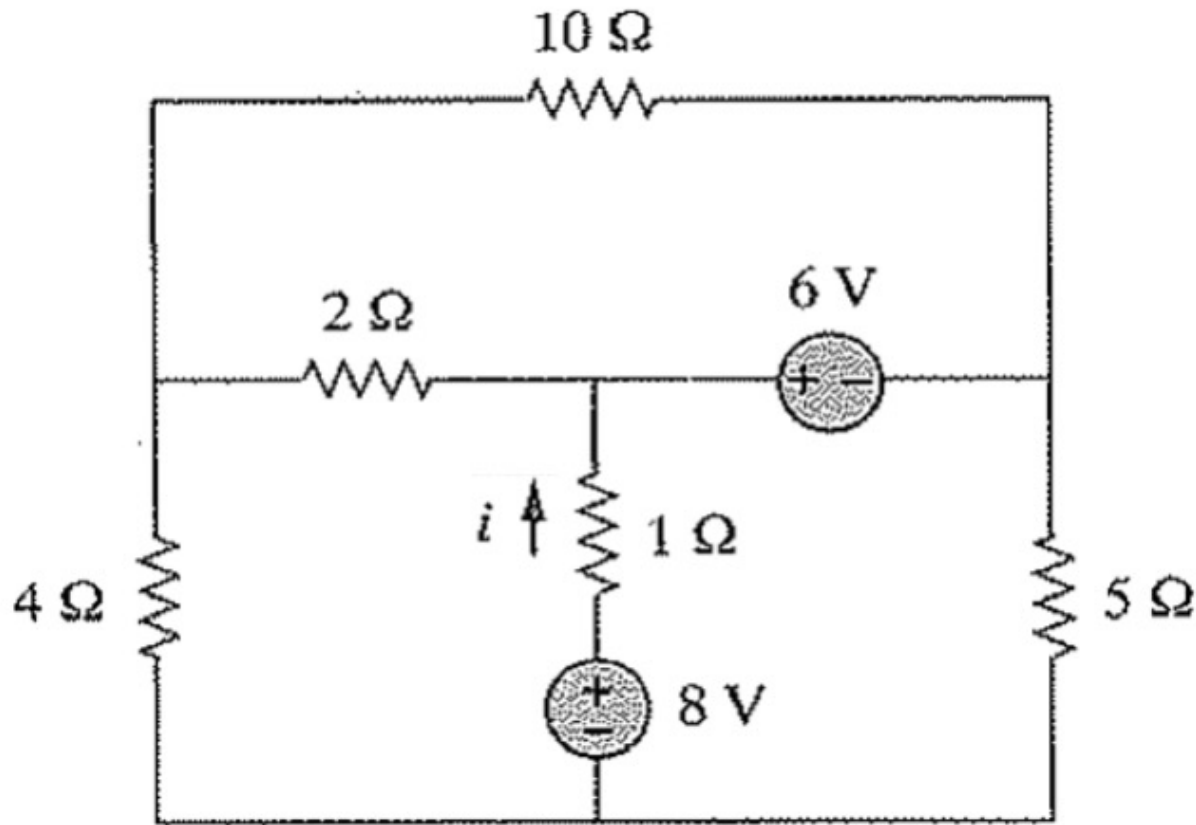
Practice problem: Find the power in the $10\ \Omega$ resistor

$0\ W$



Practice problem: Find i

$$i = 1.18 \text{ A}$$



Practice problem: Find i_o

$$i_o = 0.4 \text{ A}$$

