

Class Note 2: Example Problems ---Application of Ohms'Law, KCL, and KVL

General Procedure

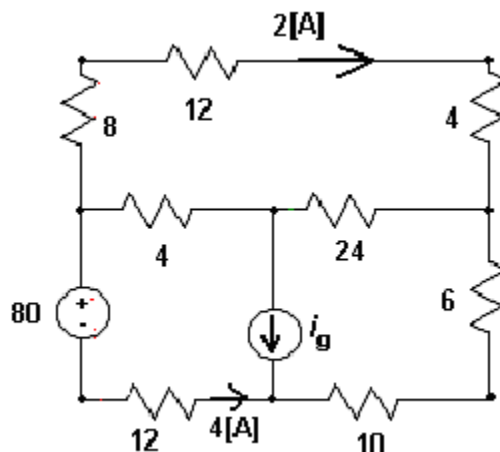
Unfortunately there is no "The method" but here is an experienced way to solve circuit problem:

1. Mark all the nodes
2. Draw directions of the currents through elements (You have full freedom!)
3. Mark voltage polarity **based on** the current direction
4. Find known values
5. Draw hidden values
6. Chain of unknowns, way back to the knowns.

We continue our discussion on the following circuit.

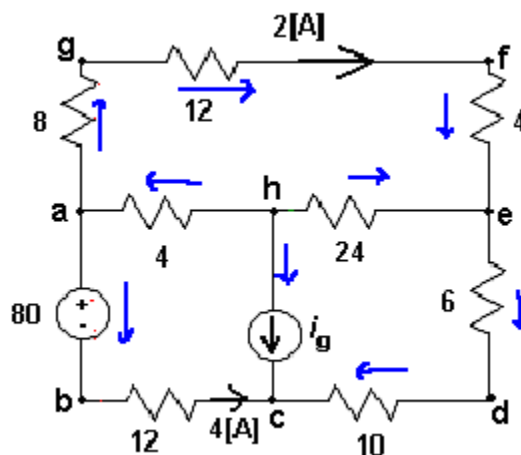
Example 1:

If the current in the 12 ohm resistor above is 2 [A] and the current through the 12 ohm resistor at the bottom is 4 [A], (1)what must be the value of the current source i_g and (2) power delivered (or absorbed) by the current source?

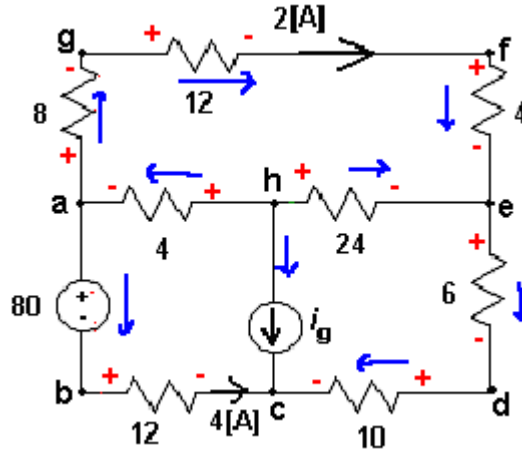


SOLUTION:

(1) Let's mark all nodes and current flow directions



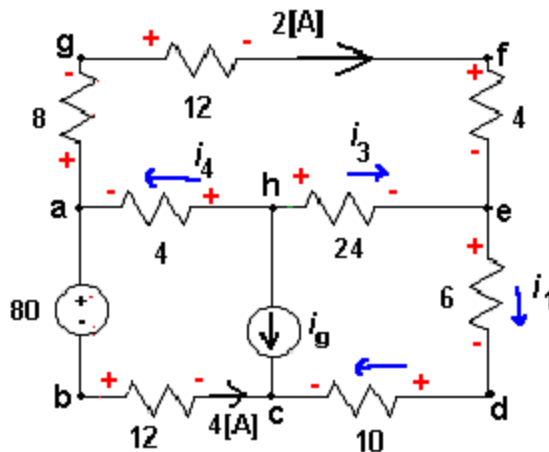
(2) Let's mark voltage polarity marks according to the passive/positive convention.



(3) Let's stop here to find a strategy to answer the question. We know that:

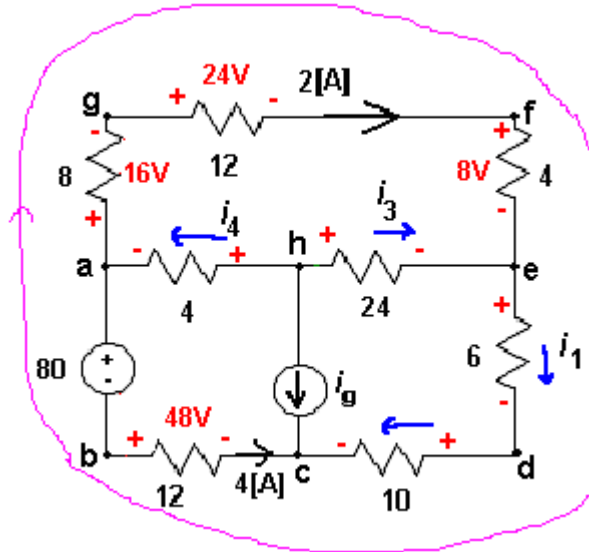
- (a) To calculate power we have to know the voltage across the current source
- (b) To find the current i_g , with KCL in mind, we have to know either
 - (1) the current through 10 ohm resistor, or
 - (2) currents through 4 and 24 ohm resistors, respectively.
- (c) To find the voltage across the current source, KVL in mind, we may have to find the all the currents mentioned above in (b).

(4) So, let's mark the currents of our interests.



(5) Since the upper branch and the lower left branch have know current values, we can find the current i_1 by applying KVL in the outer loop which surround the circuit.

- (a) Currents through 8 ohm and 4 ohm are all 2 [A]. Why?
- (b) We also can some voltages by applying Ohm's law.



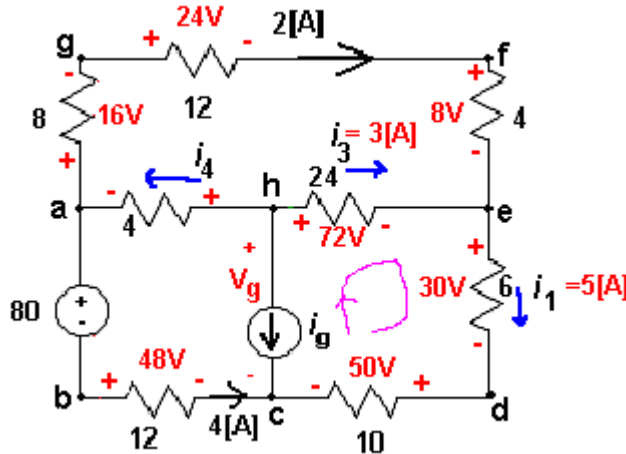
(6) Starting from the voltage source, let's add all the voltage's in clockwise direction. Remember to check the voltage polarity according to the passive/positive convention.

$$(-80V) + (16V) + (24V) + (8V) + (i_1)(6\Omega) + (i_1)(10\Omega) + (-48V) = 0$$

$$\text{-----} \rightarrow 16i_1 = 80 \rightarrow i_1 = \frac{80}{16} = 5[A]$$

(7) KCL @ node e: $2 + i_3 = i_1 \Rightarrow i_3 = 5 - 2 = 3[A]$

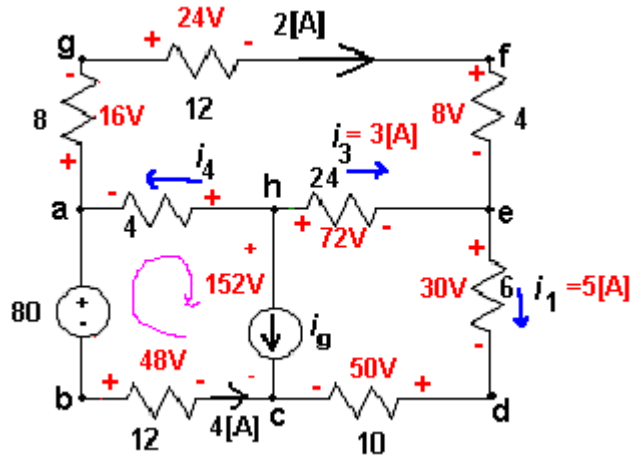
(8) Now we can find the voltage across the current source by KVL around a small loop:



Starting from the voltage at the current source, in the clockwise direction, the KVL equation goes like this:

$$(-V_g) + 72 + 30 + 50 = 0 \text{ -----} \rightarrow V_g = 152 [V]$$

(9) To find the current of the current source, KCL in mind, we want to find the current i_4 . To find the current, we have to know the voltage across the 4 ohm resistor. This can be found by applying KVL around another smaller loop:



Starting from the voltage source in clockwise direction, we have:

$$-80 - (4)(i_4) + 152 - 48 = 0 \implies i_4 = 6[A]$$

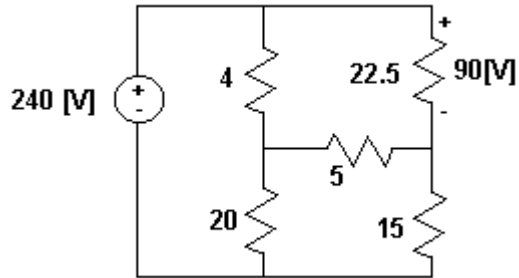
(10) KCL @ node h: $0 = i_4 + i_3 + i_g \implies i_g = -6 - 3 = -9[A]$

(11) Power Calculation: $P = (152)(-9) = -1368 [W]$ Supplying power

(12) Then, is the 80V source supplying or absorbing power? How much?

Exercise Example 2:

Find power dissipated (or generated) at all the elements if the voltage across the 22.5Ω resistor is 90 [V] . Also, check if the generated power is the same as the dissipated power. Then, **what are the targets?**



SOLUTION: