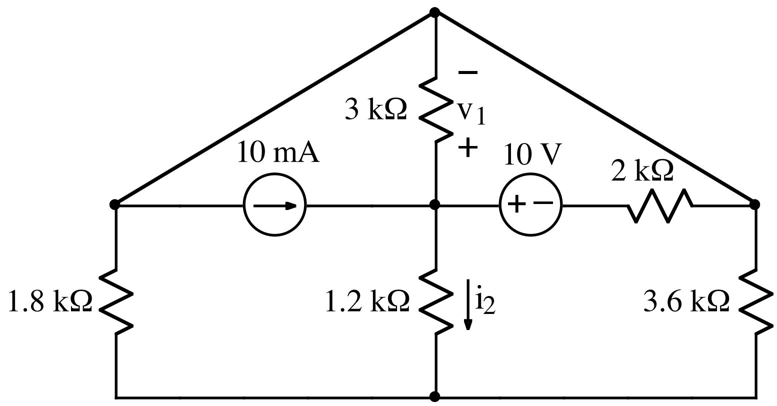
HOMEWORK #7 prob 2 solution

Ex:



a) Use the node-voltage method to calculate v_1 and i_2.
b) Calculate the power in the 2 kΩ resistor.

sol'n: Can put ref node where we like. Putting ref at top is convenient for definition of v_1. We note that all 3 nodes on top are the ref node.

v_1-node eq'n: $\frac{v_1 - 0V}{3k\Omega} - 10mA + \frac{(v_1 - 10V) - 0V}{2k\Omega} + \frac{v_1 - v_2}{1.2k\Omega} = 0A$

or $v_1\left(\frac{1}{3k\Omega} + \frac{1}{2k\Omega} + \frac{1}{1.2k\Omega}\right) + v_2\left(-\frac{1}{1.2k\Omega}\right)$

$= 10mA + \frac{10V}{2k\Omega}$

v_2-node eq'n: $\frac{v_2 - 0V}{1.8k\Omega} + \frac{v_2 - v_1}{1.2k\Omega} + \frac{v_2 - 0V}{3.6k\Omega} = 0A$

or $\quad v_1\left(\frac{-1}{1.2k\Omega}\right) + v_2\left(\frac{1}{1.8k\Omega} + \frac{1}{1.2k\Omega} + \frac{1}{3.6k\Omega}\right) = 0A$

Consider $\quad \frac{1}{3k\Omega} + \frac{1}{2k\Omega} + \frac{1}{1.2k\Omega} = \frac{1}{6k\Omega}(2+3+5) = \frac{10}{6k\Omega}$

$= \frac{5}{3k\Omega}$

and $\quad \frac{1}{1.8k\Omega} + \frac{1}{1.2k\Omega} + \frac{1}{3.6k\Omega} = \frac{1}{7.2k\Omega}(4+6+2)$

$= \frac{12}{7.2k\Omega} = \frac{10}{6k\Omega} = \frac{5}{3}k\Omega$

Our eqns become:

$v_1\left(\frac{5}{3k\Omega}\right) + v_2\left(\frac{-1}{1.2k\Omega}\right) = 15mA$

$v_1\left(\frac{-1}{1.2k\Omega}\right) + v_2\left(\frac{5}{3k\Omega}\right) = 0\ mA$

Mult both sides by $6k\Omega$:

$v_1(10) + v_2(-5) = 90\ V$

$v_1(-5) + v_2(10) = 0\ V \quad$ or $v_1 = 2v_2$

$2v_2(10) + v_2(-5) = 90\ V$

$15v_2 = 90\ V$

$v_2 = 6V \quad$ and $\quad v_1 = 12V$

b) $P_{2k\Omega} = (v_1 - 10V)^2/2k\Omega = 2\ mW$