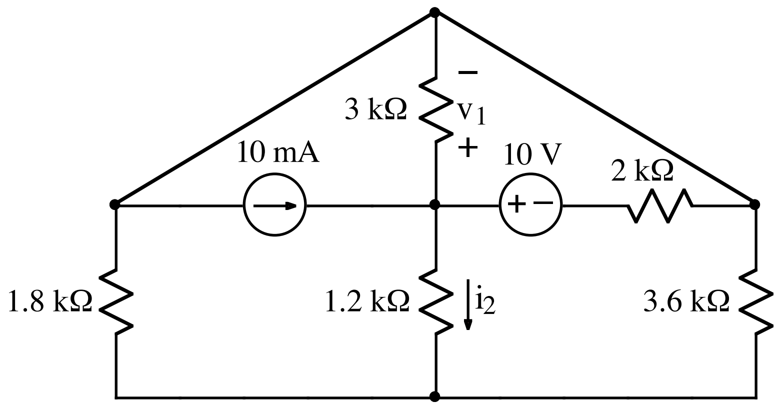
HOMEWORK #7 solution

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 $V_1\left(\frac{-1}{1.2k\Omega}\right) + V_2\left(\frac{1}{1.8k\Omega} + \frac{1}{1.2k\Omega} + \frac{1}{3.6k\Omega}\right) = 0A$

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

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

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

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

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 $6k\Omega$:

$$V_1(10) + V_2(-5) = 90\ V$$

$$V_1(-5) + V_2(10) = 0\ V \quad \text{or} \quad V_1 = 2V_2$$

$$2V_2(10) + V_2(-5) = 90\ V$$

$$15V_2 = 90\ V$$

$$V_2 = 6V \quad \text{and} \quad V_1 = 12V$$

b) $P_{2k\Omega} = (V_1 - 10V)^2/2k\Omega = 2\ mW$