

II. PART 2

Solve Problems

4. (18 pts) Use nodal analysis.

- a. How many nodal equations are needed to solve the circuit below?

Two are trivial: $V_A = 30V$, $V_D = -15V$.

- b. Write the nodal equations.

We offer two are:

$$\frac{V_A - V_B}{1k\Omega} - \frac{V_B}{4k\Omega} - 6mA - \frac{V_B - V_C}{2k\Omega} = 0 \quad \text{and} \quad \frac{V_B - V_C}{2k\Omega} + 6mA - \frac{V_C}{5k\Omega} - \frac{V_C - V_D}{3k\Omega} = 0$$

- c. Solve the equations and calculate the current
- i_o
- .

$$\begin{aligned} i_o &= 4.06 \text{ mA} \\ \begin{pmatrix} V_B \\ V_C \end{pmatrix} &= \begin{pmatrix} 16.2V \\ 8.82V \end{pmatrix} \Rightarrow i_o = \frac{V_B}{4k\Omega} \\ &\left(\begin{array}{cc|c} -\frac{1}{1k\Omega} & -\frac{1}{4k\Omega} & -\frac{1}{2k\Omega} \\ \frac{1}{2k\Omega} & -\frac{1}{2k\Omega} & -\frac{1}{5k\Omega} \\ -1.75mS & 500\mu S & \\ 500\mu S & -1.033mS & \end{array} \right) \begin{pmatrix} V_B \\ V_C \end{pmatrix} = \begin{pmatrix} -\frac{V_A + 6mA}{1k\Omega} \\ -6mA - \frac{V_D}{3k\Omega} \end{pmatrix} \\ &\begin{pmatrix} V_B \\ V_C \end{pmatrix} = \begin{pmatrix} -24mA \\ -1mA \end{pmatrix} \end{aligned}$$

- d. Calculate the power supplied by the 15 V. source.

$$P_{15V} = 119.1 \text{ mW}$$

$$I_{S_2} = \frac{-V_D + V_C}{3k\Omega} = +7.94mA$$

$$P_{S_2} = V_{S_2} I_{S_2}$$

