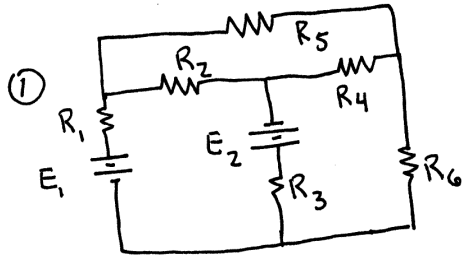
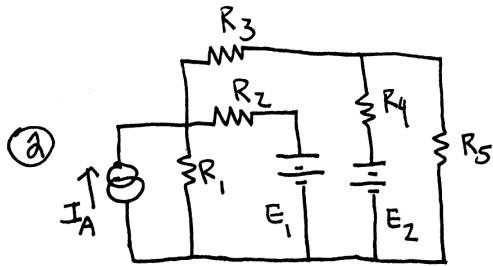


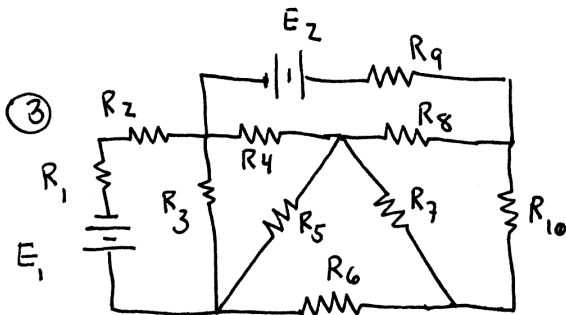
- solve each circuit below using mesh + nodal -



$$\begin{array}{lll}
 E_1 = 10\text{V} & R_1 = 1\text{k} & R_4 = 4\text{k} \\
 E_2 = 20\text{V} & R_2 = 2\text{k} & R_5 = 5\text{k} \\
 & R_3 = 3\text{k} & R_6 = 6\text{k}
 \end{array}$$



$$\begin{array}{lll}
 I_A = 50\text{mA} & R_1 = 5\text{k} & R_4 = 2\text{k} \\
 E_1 = 5\text{V} & R_2 = 4\text{k} & R_5 = 1\text{k} \\
 E_2 = 15\text{V} & R_3 = 3\text{k} &
 \end{array}$$

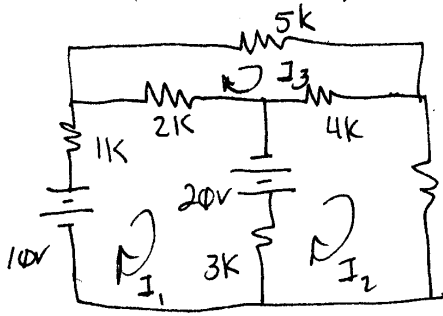


$$\begin{array}{lll}
 E_1 = 6\text{V} & R_1 = 100 & R_6 = 800 \\
 & R_2 = 300 & R_7 = 600 \\
 E_2 = 4\text{V} & R_3 = 200 & R_8 = 50 \\
 & R_4 = 500 & R_9 = 1\text{k} \\
 & R_5 = 400 & R_{10} = 700
 \end{array}$$



— AND NO COOKIES UNTIL YOU FINISH!

# ① Mesh - format complete



$$\text{Loop 1: } 10V + 20V = I_1(1k + 2k + 3k) - I_2 3k - I_3 2k$$

$$\text{Loop 2: } -20V = -I_1 3k + I_2(3k + 4k + 6k) - I_3 4k$$

$$\text{Loop 3: } 0 = -I_1 2k - I_2 4k + I_3(2k + 4k + 5k)$$

$$30 = 6kI_1 - 3kI_2 - 2kI_3$$

$$-20 = -3kI_1 + 13kI_2 - 4kI_3$$

$$0 = -2kI_1 - 4kI_2 + 11kI_3$$

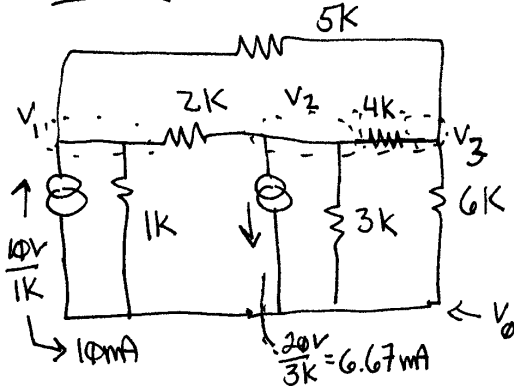
$$\text{for } I_1 = \begin{array}{ccc|ccc} 30 & -3k & -2k & & & \\ -20 & 13k & -4k & & & \\ 0 & -4k & 11k & & & \\ \hline 6k & -3k & -2k & & & \\ -3k & 13k & -4k & & & \\ -2k & -4k & 11k & & & \end{array}$$

$$I_1 = 5.31 \text{ mA}$$

$$I_3 = .959 \text{ mA}$$

$$I_2 = -17.76 \mu\text{A}$$

# NODAL - format complete



$$\#1: 10 \text{ mA} = V_1 \left( \frac{1}{1k} + \frac{1}{2k} + \frac{1}{5k} \right) - V_2 \frac{1}{2k} - V_3 \frac{1}{5k}$$

$$\#2: -6.67 \text{ mA} = -V_1 \frac{1}{2k} + V_2 \left( \frac{1}{2k} + \frac{1}{3k} + \frac{1}{4k} \right) - V_3 \frac{1}{4k}$$

$$\#3: 0 = -V_1 \frac{1}{5k} - V_2 \frac{1}{4k} + V_3 \left( \frac{1}{6k} + \frac{1}{4k} + \frac{1}{5k} \right)$$

$$10 \text{ mA} = 1.7E-3 V_1 - .5E-3 V_2 - .2E-3 V_3$$

$$-6.67 \text{ mA} = -.5E-3 V_1 + 1.083E-3 V_2 - .25E-3 V_3$$

$$0 = -.2E-3 V_1 - .25E-3 V_2 + .6167E-3 V_3$$

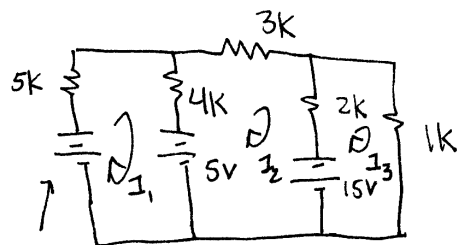
$$\text{for } V_1 = \begin{array}{ccc|ccc} 10E-3 & -.5E-3 & -.2E-3 & & & \\ -6.67E-3 & 1.083E-3 & -.25E-3 & & & \\ 0 & -.25E-3 & .6167E-3 & & & \\ \hline 1.7E-3 & -.5E-3 & -.2E-3 & & & \\ -.5E-3 & 1.083E-3 & -.25E-3 & & & \\ -.2E-3 & -.25E-3 & .6167E-3 & & & \end{array}$$

$$V_1 = 4.687V$$

$$V_3 = -1.097V$$

$$V_2 = -4.02V$$

## ② Mesh -format setup



$$50\mu\text{A} \cdot 5\text{k} = 25\text{V}$$

$$\#1: 25\text{V} - 5\text{V} = I_1(5\text{k} + 4\text{k}) - I_2 4\text{k}$$

$$\#2: 5\text{V} - 15\text{V} = -I_1 4\text{k} + I_2(4\text{k} + 3\text{k} + 2\text{k}) - I_3 2\text{k}$$

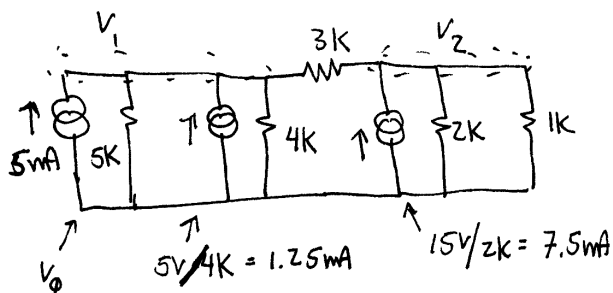
$$\#3: 15\text{V} = -I_2 2\text{k} + I_3(2\text{k} + 1\text{k})$$

$$2\phi = 9\text{k}I_1 - 4\text{k}I_2 \quad \phi$$

$$-1\phi = -4\text{k}I_1 + 9\text{k}I_2 - 2\text{k}I_3$$

$$15 = \phi - 2\text{k}I_2 + 3\text{k}I_3$$

## NODAL -format setup



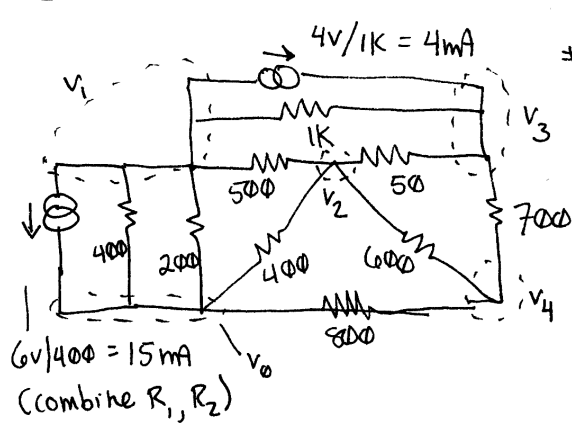
$$\#1: 5\text{mA} + 1.25\text{mA} = V_1\left(\frac{1}{5\text{k}} + \frac{1}{4\text{k}} + \frac{1}{3\text{k}}\right) - V_2\left(\frac{1}{3\text{k}}\right)$$

$$\#2: 7.5\text{mA} = -V_1\frac{1}{3\text{k}} + V_2\left(\frac{1}{3\text{k}} + \frac{1}{2\text{k}} + \frac{1}{1\text{k}}\right)$$

$$6.25\text{E-}3 = .783\text{E-}3V_1 - .333\text{E-}3V_2$$

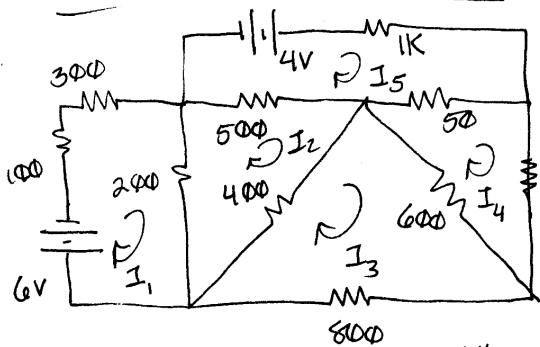
$$7.5\text{E-}3 = -.333\text{E-}3V_1 + 1.833\text{E-}3V_2$$

### ③ NODAL - format setup (PARTIAL)



$$\begin{aligned} \#1 \quad -15mA - 4mA &= V_1 \left( \frac{1}{400} + \frac{1}{200} + \frac{1}{500} + \frac{1}{1K} \right) - V_2 \frac{1}{500} - V_3 \frac{1}{1K} \\ \#2 \quad \emptyset &= -V_1 \frac{1}{500} + V_2 \left( \frac{1}{500} + \frac{1}{400} + \frac{1}{600} + \frac{1}{50} \right) - V_3 \frac{1}{50} - V_4 \frac{1}{600} \\ \#3 \quad 4mA &= -V_1 \frac{1}{1K} - V_2 \frac{1}{50} + V_3 \left( \frac{1}{50} + \frac{1}{1K} + \frac{1}{700} \right) - V_4 \frac{1}{700} \\ \#4 \quad \emptyset &= -V_2 \frac{1}{600} - V_3 \frac{1}{700} + V_4 \left( \frac{1}{800} + \frac{1}{600} + \frac{1}{700} \right) \end{aligned}$$

### MESH - format setup (PARTIAL)



$$\begin{aligned} \#1: \quad -6V &= I_1 (100 + 200 + 300) - I_2 200 \\ \#2: \quad \emptyset &= -I_1 200 + I_2 (200 + 500 + 400) - I_3 400 - I_5 500 \\ \#3: \quad \emptyset &= -I_2 400 + I_3 (400 + 600 + 800) - I_4 600 \\ \#4 \quad \emptyset &= -I_3 600 + I_4 (600 + 50 + 700) - I_5 50 \\ \#5 \quad 4V &= -I_2 500 - I_4 50 + I_5 (1K + 500 + 50) \end{aligned}$$

(lots of zero terms!)