c. I_1: $P = V_1 I_1 = (4.8\text{ V})(4\text{ A}) = \mathbf{19.2\ W}$
I_2: $P = \left|(V_1 - V_2)I_2\right| = \left|(4.8\text{ V} - 6.4\text{ V})(2\text{ A})\right| = \mathbf{3.2\ W}$

44. a. V_1 V_2

At V_1: $\Sigma I_i = \Sigma I_o$

$$0 = 6\text{ A} + \frac{V_1}{5\ \Omega} + \frac{V_1 - V_2}{3\ \Omega} + \frac{V_1 - V_2}{2\ \Omega}$$

At V_2: $\Sigma I_i = \Sigma I_o$

$$7\text{ A} + \frac{V_1 - V_2}{3\ \Omega} + \frac{V_1 - V_2}{2\ \Omega} = \frac{V_2}{4\ \Omega} + \frac{V_2}{8\ \Omega}$$

so that $V_1\left[\frac{1}{5\ \Omega} + \frac{1}{3\ \Omega} + \frac{1}{2\ \Omega}\right] - V_2\left[\frac{1}{3\ \Omega} + \frac{1}{2\ \Omega}\right] = -6\text{ A}$

$$V_2\left[\frac{1}{4\ \Omega} + \frac{1}{8\ \Omega} + \frac{1}{3\ \Omega} + \frac{1}{2\ \Omega}\right] - V_1\left[\frac{1}{3\ \Omega} + \frac{1}{2\ \Omega}\right] = 7\text{ A}$$

or $1.03V_1 - 0.833V_2 = -6$
$-0.833V_1 + 1.21V_2 = 7$

b. $V_1 = \mathbf{-2.59\ V}$, $V_2 = \mathbf{4\ V}$

c. $V_{2\Omega} = V_{3\Omega} = V_2 - V_1 = 4\text{ V} - (-2.59\text{ V}) = \mathbf{6.59\ V}$
$V_{5\Omega} = V_1 = \mathbf{-2.59\ V}$
$V_{4\Omega} = V_{8\Omega} = V_2 = \mathbf{4\ V}$

45. a. V_1 V_2

Source conversion: $I_3 = \frac{12\text{ V}}{4\ \Omega} = 3\text{ A}$, $R_p = R_3 = 4\ \Omega$

At V_1: $\Sigma I_i = \Sigma I_o$

$$0 = \frac{V_1}{3\ \Omega} + \frac{V_1}{6\ \Omega} + 5\text{ A} + \frac{V_1 - V_2}{4\ \Omega} + 3\text{ A}$$

At V_2: $\Sigma I_i = \Sigma I_o$

$$3\text{ A} + \frac{V_1 - V_2}{4\ \Omega} = \frac{V_2}{8\ \Omega} + 4\text{ A}$$

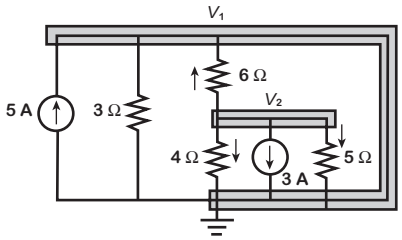
Rewritten: $V_1\left[\frac{1}{3\ \Omega} + \frac{1}{6\ \Omega} + \frac{1}{4\ \Omega}\right] - \frac{V_2}{4\ \Omega} = -5\text{ A} - 3\text{ A}$

$$-V_1\left[\frac{1}{4\ \Omega}\right] + V_2\left[\frac{1}{4\ \Omega} + \frac{1}{8\ \Omega}\right] = -4\text{ A} + 3\text{ A}$$

b. $V_1 = \mathbf{-14.86\ V}$, $V_2 = \mathbf{-12.57\ V}$

c. $I_{6\Omega}\uparrow = \frac{14.86\text{ V}}{6\ \Omega} = \mathbf{2.48\ A}$

46. a. Source conversion: $I_s = \dfrac{15\text{ V}}{3\ \Omega} = 5\text{ A}$, $R_p = 3\ \Omega$



b. $V_1 = \mathbf{0\ V}$ (tied to ground)

$\Sigma I_i = \Sigma I_o$

$$0 = \frac{V_2}{6\ \Omega} + \frac{V_2}{4\ \Omega} + \frac{V_2}{5\ \Omega} + 3\text{ A}$$

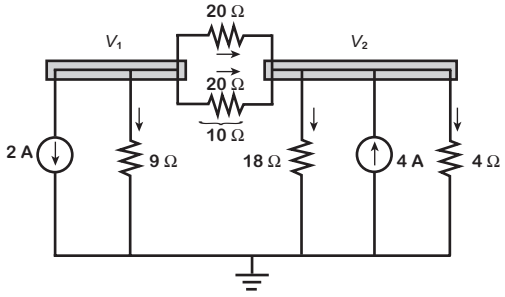
and $$V_2\left[\frac{1}{6\ \Omega} + \frac{1}{4\ \Omega} + \frac{1}{5\ \Omega}\right] = -3\text{ A}$$

$$V_2[616.67\text{ mS}] = -3\text{ A}$$

$$V_2 = -\frac{3\text{ A}}{616.67\text{ mS}} = \mathbf{4.86\ V}$$

c. $V_{2-}^{+} = \mathbf{-4.86\ V}$

47. a.



V_1: $\Sigma I_i = \Sigma I_o$

$$0 = 2\text{ A} + \frac{V_1}{9\ \Omega} + \frac{V_1 - V_2}{10\ \Omega}$$

V_2: $\Sigma I_i = \Sigma I_o$

$$\frac{V_1 - V_2}{10\ \Omega} + 4\text{ A} = \frac{V_2}{18\ \Omega} + \frac{V_2}{4\ \Omega}$$

———————————————————

$0.211\ V_1 - 0.1\ V_2 = -2$

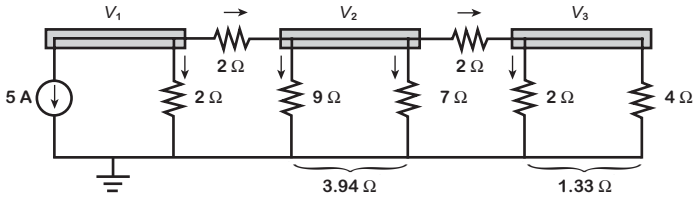
$-0.1\ V_1 + 0.405\ V_2 = 4$

———————————————————

b. $V_1 = \mathbf{-5.43\ V}$, $V_2 = \mathbf{8.53\ V}$

c. $V_{R_4} = V_1 - V_2$
$+ \quad -$
$= (-5.43\text{ V}) - (8.53\text{ V})$
$= \mathbf{-13.96\text{ V}}$

48. a.



V_1: $\Sigma I_i = \Sigma I_o$

$$0 = 5\text{ A} + \frac{V_1}{2\ \Omega} + \frac{V_1 - V_2}{2\ \Omega}$$

V_2: $\Sigma I_i = \Sigma I_o$

$$\frac{V_1 - V_2}{2\ \Omega} = \frac{V_2}{3.94\ \Omega} + \frac{V_2 - V_3}{2\ \Omega}$$

V_3: $\Sigma I_i = \Sigma I_o$

$$\frac{V_2 - V_3}{2\ \Omega} = \frac{V_3}{1.33\ \Omega}$$

b. $V_1 = \mathbf{-6.556\text{ V}}$, $V_2 = \mathbf{-3.113\text{ V}}$
$V_3 = \mathbf{-1.245\text{ V}}$

c. $I_{9\Omega} = \dfrac{V_2}{9\ \Omega} = \dfrac{3.113\text{ V}}{9\ \Omega} = \mathbf{0.346\text{ A}}\uparrow$

49. a. $\circ V_1$ $\circ V_2$

$\circ V_3$

At V_1: $\Sigma I_i = \Sigma I_o$

$$0 = 5\text{ A} + \frac{V_1}{2\ \Omega} + \frac{V_1 - V_3}{6\ \Omega}$$

At V_2: $\Sigma I_i = \Sigma I_o$

$$5\text{ A} = 2\text{ A} + \frac{V_2}{4\ \Omega}$$

At V_3: $\Sigma I_i = \Sigma I_o$

$$\frac{V_1 - V_3}{6\ \Omega} + 2\text{ A} + \frac{V_3}{5\ \Omega}$$

Rewritten:

$$V_1\left[\frac{1}{2\,\Omega}+\frac{1}{6\,\Omega}\right]-\frac{1}{6\,\Omega}V_3 = -5\text{ A}$$

$$V_2\left[\frac{1}{4\,\Omega}\right] = 5\text{ A} - 2\text{ A}$$

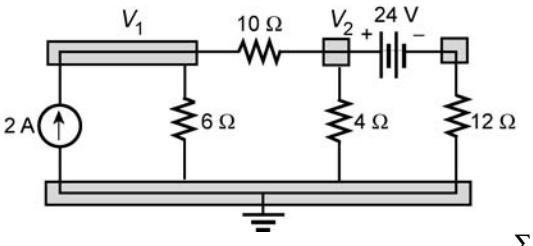
$$V_3\left[\frac{1}{6\,\Omega}+\frac{1}{5\,\Omega}\right]-\frac{1}{6\,\Omega}V_1 = 2\text{A}$$

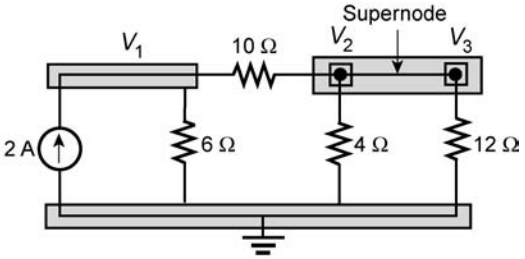
---

b. $V_1 = \mathbf{-6.92\ V}$, $V_2 = \mathbf{12\ V}$, $V_3 = \mathbf{2.3\ V}$

c. $I_{4\Omega} = \dfrac{V_1}{4\,\Omega} = \dfrac{12\text{ V}}{4\,\Omega} = \mathbf{3\ A}$

50. a.





$$\Sigma I_i = \Sigma I_o$$

Node V_1:

$$2\text{ A} = \frac{V_1}{6\,\Omega}+\frac{V_1-V_2}{10\,\Omega}$$

Supernode V_2, V_3:

$$0 = \frac{V_2-V_1}{10\,\Omega}+\frac{V_2}{4\,\Omega}+\frac{V_3}{12\,\Omega}$$

Independent source:

$$V_2 - V_3 = 24\text{ V or } V_3 = V_2 - 24\text{ V}$$

2 eq. 2 unknowns:

$$\frac{V_1}{6\,\Omega}+\frac{V_1-V_2}{10\,\Omega} = 2\text{ A}$$

$$\frac{V_2-V_1}{10\,\Omega}+\frac{V_2}{4\,\Omega}+\frac{V_2-24\text{ V}}{12\,\Omega} = 0$$

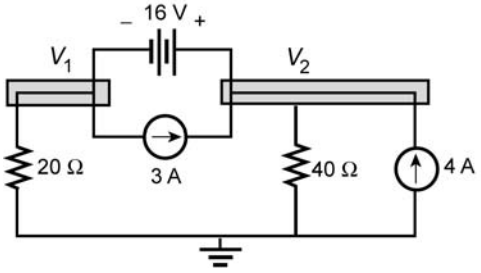
$$0.267V_1 - 0.1V_2 = 2$$

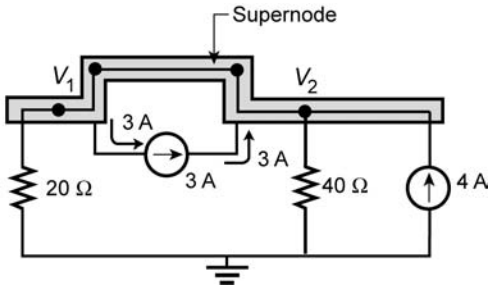
$$+0.1V_1 - 0.433V_2 = -2$$

$V_1 = \mathbf{10.08\ V}$, $V_2 = \mathbf{6.94\ V}$

$V_3 = V_2 - 24\text{ V} = \mathbf{-17.06\ V}$

51.





$\Sigma I_i = \Sigma I_o$

Supernode:

$$3\text{ A} + 4\text{ A} = 3\text{ A} + \frac{V_1}{20\,\Omega} + \frac{V_2}{40\,\Omega}$$

2 eq. 2 unk.
$$\begin{cases} 4\text{ A} = \dfrac{V_1}{20\,\Omega} + \dfrac{V_2}{40\,\Omega} \\ V_2 - V_1 = 16\text{ V} \end{cases}$$

Subt. $V_2 = 16\text{ V} + V_1$

$$4\text{ A} = \frac{V_1}{20\,\Omega} + \frac{(16\text{ V} + V_1)}{40\,\Omega}$$

and $V_1 =$ **48 V**

$V_2 = 16\text{ V} + V_1 =$ **64 V**

———————————

52. a. V_1 V_2

$$V_1\left[\frac{1}{2} + \frac{1}{8}\right] - V_2\left[\frac{1}{8}\right] = -5$$

$$-V_1\left[\frac{1}{8}\right] + V_2\left[\frac{1}{8} + \frac{1}{4}\right] = -3$$

———————————

$V_1 =$ **−10.27 V**, $V_2 =$ **−11.36 V**

b. $V_{I_1} = V_1 =$ **−10.27 V**, $V_{I_2} = V_2 =$ **−11.36 V**

53. a. V_1 V_2

$$V_1\left[\frac{1}{8} + \frac{1}{6}\right] - V_2\left[\frac{1}{6}\right] = -12\text{ A} + 9\text{ A} = -3\text{ A}$$

$$V_2\left[\frac{1}{20} + \frac{1}{5} + \frac{1}{6}\right] - V_1\left[\frac{1}{6}\right] = -9\text{ A}$$

———————————

$V_1 =$ **−29.29 V**, $V_2 =$ **−33.34 V**

b. $V_1 - V_{6\Omega} - 54\text{ V} - V_2 = 0$

$V_{6\Omega} = V_1 - V_2 - 54\text{ V} = -29.29\text{ V} - (-33.34\text{ V}) - 54\text{ V} = \mathbf{-49.95\ V}$

$\overset{+}{\ } \overset{-}{\ }$

54. a. $V_1\left[\frac{1}{9\ \Omega} + \frac{1}{10\ \Omega}\right] - V_2\left[\frac{1}{10\ \Omega}\right] = -2\text{ A}$

$V_2\left[\frac{1}{10\ \Omega} + \frac{1}{18\ \Omega} + \frac{1}{4\ \Omega}\right] - V_1\left[\frac{1}{10\ \Omega}\right] = 4\text{ A}$

b. $V_1\left[\frac{1}{9\ \Omega} + \frac{1}{10\ \Omega}\right] - V_2\left[\frac{1}{10\ \Omega}\right] = -2\text{ A}$

$-V_1\left[\frac{1}{10\ \Omega}\right] + V_2\left[\frac{1}{10\ \Omega} + \frac{1}{18\ \Omega} + \frac{1}{4\ \Omega}\right] = 4\text{ A}$

———————————————

$0.211\ V_1 - \ \ 0.1\ V_2 = -2$

$-0.1\ V_1 + .405\ V_2 = 4$

———————————————

c. $V_1 = \mathbf{-5.43\ V}$, $V_2 = \mathbf{8.53\ V}$

d. $I_{4\Omega} = \frac{V_2}{4\ \Omega} = \frac{8.53\text{ V}}{4\ \Omega} = \mathbf{2.13\ A}\downarrow$

55. a. $V_1\left[\frac{1}{2\ \Omega} + \frac{1}{2\ \Omega}\right] - V_2\left[\frac{1}{2\ \Omega}\right] = -5\text{ A}$

$V_2\left[\frac{1}{2\ \Omega} + \frac{1}{9\ \Omega} + \frac{1}{7\ \Omega} + \frac{1}{2\ \Omega}\right] - V_1\left[\frac{1}{2\ \Omega}\right] - V_3\left[\frac{1}{2\ \Omega}\right] = 0$

$V_3\left[\frac{1}{2\ \Omega} + \frac{1}{2\ \Omega} + \frac{1}{4\ \Omega}\right] - V_2\left[\frac{1}{2\ \Omega}\right] = 0$

———————————————

$V_1 = \mathbf{-6.556\ V}$, $V_2 = \mathbf{-3.113\ V}$

$V_3 = \mathbf{-1.245\ V}$

b. $I_{9\Omega} = \frac{V_2}{9\ \Omega} = \frac{-3.113\text{ V}}{9\ \Omega} = \mathbf{0.346\ A}\uparrow$

56. a. $V_1\left[\frac{1}{2\ \Omega} + \frac{1}{6\ \Omega}\right] - \frac{1}{6\ \Omega}V_3 = -5\text{ A}$

$V_2\left[\frac{1}{4\ \Omega}\right] = 5\text{ A} - 2\text{ A}$

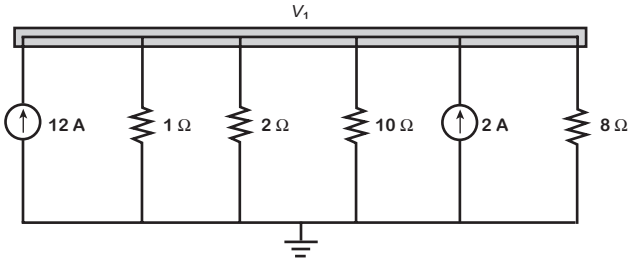
$V_3\left[\frac{1}{6\ \Omega} + \frac{1}{5\ \Omega}\right] - \frac{1}{6\ \Omega}V_1 = 2\text{A}$

———————————————

b. $V_1 = -\mathbf{6.92\ V}$, $V_2 = \mathbf{12\ V}$, $V_3 = \mathbf{2.3\ V}$

c. $I_{2\Omega} = \dfrac{V_2}{2\ \Omega} = \dfrac{6.92\ \text{V}}{2\ \Omega} = \mathbf{3.46\ A}$

57. a.



$$V_1\left[\frac{1}{1\ \Omega}+\frac{1}{2\ \Omega}+\frac{1}{10\ \Omega}+\frac{1}{8\ \Omega}\right] = 14\ \text{A}$$

$V_1[1.725\ \text{S}] = 14\ \text{A}$

$$V_1 = \frac{14}{1.725}\text{V}$$

$= \mathbf{8.1\ V}$

b. $V_a = 0\ \text{V}$, $V_b = \mathbf{8.12\ V}$

$V_{ab} = V_a - V_b = 0\ \text{V} - 8.12\ \text{V} = \mathbf{-8.12\ V}$

58. a. Same figure used for problem 46.

$V_1 = \mathbf{0\ V}$

$$V_2\left[\frac{1}{6\ \Omega}+\frac{1}{4\ \Omega}+\frac{1}{5\ \Omega}\right]-\frac{1}{6\ \Omega}V_1 = -3\ \text{A}$$

b. $V_1 = 0\ \text{V}$

$\therefore\ V_2[0.617\ \text{S}] = -3\ \text{A}$

$$V_2 = \frac{-3}{0.617}\text{V}$$

$= \mathbf{-4.86\ V}$

c. $I_{5\Omega} = \dfrac{V_2}{5\ \Omega} = \dfrac{4.86\ \text{V}}{5\ \Omega} = \mathbf{.972\ A}$

59. a.

$I_1(6\ \Omega + 2\ \Omega + 10\ \Omega) - 2\ \Omega I_2 - 10\ \Omega I_3 = 12\ \text{V}$

$I_2(2\ \Omega + 2\ \Omega + 5\ \Omega) - 5\ \Omega I_3 - 2\ \Omega I_1 = 0$

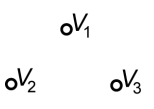
$I_3(5\ \Omega + 20\ \Omega + 10\ \Omega) - 5\ \Omega I_2 - 10\ \Omega I_1 = 0$

$$18I_1 - 2I_2 - 10I_3 = 12$$
$$-2I_1 + 9I_2 - 5I_3 = 0$$
$$-10I_1 - 5I_2 + 35I_3 = 0$$

b. $I_{5\Omega} = I_2 - I_3 = 0.362\text{ A} - 0.302\text{ A} = \mathbf{60\text{ mA}}$

c. **no**

d. **no**

60. a. 

$$V_1\left[\frac{1}{6\ \Omega}+\frac{1}{2\ \Omega}+\frac{1}{5\ \Omega}\right]-\frac{1}{2\ \Omega}V_2-\frac{1}{5\ \Omega}V_3 = 2\text{ A}$$
$$V_2\left[\frac{1}{2\ \Omega}+\frac{1}{5\ \Omega}+\frac{1}{10\ \Omega}\right]-\frac{1}{2\ \Omega}V_1-\frac{1}{5\ \Omega}V_3 = 0$$
$$V_3\left[\frac{1}{5\ \Omega}+\frac{1}{5\ \Omega}+\frac{1}{20\ \Omega}\right]-\frac{1}{5\ \Omega}V_2-\frac{1}{5\ \Omega}V_1 = 0$$

or
$$0.867V_1 - 0.5V_2 - 0.2V_3 = 12$$
$$-0.5V_1 + 0.8V_2 - 0.2V_3 = 0$$
$$-0.2V_1 - 0.2V_2 + 0.45V_3 = 0$$

$V_2 = \mathbf{5.7\text{ V}}$, $V_3 = \mathbf{5.6\text{ V}}$

b. $V_{5\Omega} = V_2 - V_3 = 5.7\text{ V} - 5.6\text{ V} = \mathbf{0.1\text{ V}}$

c. **no**

d. **no** $2\ \Omega/10\ \Omega = \dfrac{1}{5} \neq 5\ \Omega/20\ \Omega = \dfrac{1}{4}$

61. a. 

Source conversion: $E = IR = (12\text{ m})(2\text{ k}\Omega) = 24\text{ V}$
$R_s = 2\text{ k}\Omega$

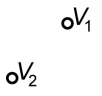
$$I_1(2\text{ k}\Omega + 33\text{ k}\Omega + 3.3\text{ k}\Omega) - 33\text{ k}\Omega I_2 - 3.3\text{ k}\Omega I_3 = 24\text{ V}$$
$$I_2(33\text{ k}\Omega + 56\text{ k}\Omega + 36\text{ k}\Omega) - 33\text{ k}\Omega I_1 - 36\text{ k}\Omega I_3 = 0$$
$$I_3(36\text{ k}\Omega + 3.3\text{ k}\Omega + 5.6\text{ k}\Omega) - 3.3\text{ k}\Omega I_1 - 36\text{ k}\Omega I_2 = 0$$

$I_1 = \mathbf{0.97\text{ mA}}$, $I_2 = I_3 = \mathbf{0.36\text{ mA}}$

b. $I_5 = I_2 - I_3 = 0.36\text{ mA} - 0.36\text{ mA} = \mathbf{0\text{ mA}}$

c, d. **yes**

62. a.



$$V_1\left[\frac{1}{2\text{ k}\Omega}+\frac{1}{33\text{ k}\Omega}+\frac{1}{56\text{ k}\Omega}\right]-\frac{1}{33\text{ k}\Omega}V_2-\frac{1}{56\text{ k}\Omega}V_3 = 12\text{ mA}$$

$$V_2\left[\frac{1}{33\text{ k}\Omega}+\frac{1}{3.3\text{ k}\Omega}+\frac{1}{36\text{ k}\Omega}\right]-\frac{1}{33\text{ k}\Omega}V_1-\frac{1}{36\text{ k}\Omega}V_3 = 0$$

$$V_3\left[\frac{1}{56\text{ k}\Omega}+\frac{1}{36\text{ k}\Omega}+\frac{1}{5.6\text{ k}\Omega}\right]-\frac{1}{36\text{ k}\Omega}V_2-\frac{1}{56\text{ k}\Omega}V_1 = 0$$

Rewritten:
$$548.16V_1 - 30.3V_2 - 17.86V_3 = 12\times 10^3$$
$$-30.3V_1 + 361.11V_1 - 27.78V_3 = 0$$
$$-17.86V_1 - 27.78V_2 + 224.21V_3 = 0$$

V_2 = **2.01 V,** V_3 = **2.01 V**

b. $V_{R_5} = V_2 - V_3 = 2.01\text{ V} - 2.01\text{ V} =$ **0 V**

c, d. **yes**

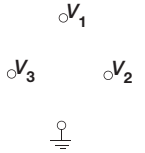
63. Mesh Analysis

$$(1\text{ k}\Omega + 2\text{ k}\Omega + 2\text{ k}\Omega)I_1 - 2\text{ k}\Omega\, I_2 - 2\text{ k}\Omega\, I_3 = 10$$
$$(2\text{ k}\Omega + 2\text{ k}\Omega + 2\text{ k}\Omega)I_2 - 2\text{ k}\Omega\, I_1 - 2\text{ k}\Omega\, I_3 = 0$$
$$(2\text{ k}\Omega + 2\text{ k}\Omega + 2\text{ k}\Omega)I_3 - 2\text{ k}\Omega\, I_1 - 2\text{ k}\Omega\, I_2 = 0$$

$I_1 = I_{10\text{V}} =$ **3.33 mA**

Nodal Analysis:

Source conversion: $I = 10\text{ V}/1\text{ k}\Omega = 10\text{ mA}$, $R = 1\text{ k}\Omega$



$$V_1\left[\frac{1}{1\text{ k}\Omega}+\frac{1}{2\text{ k}\Omega}+\frac{1}{2\text{ k}\Omega}\right]-\frac{1}{2\text{ k}\Omega}V_2-\frac{1}{2\text{ k}\Omega}V_3 = 10\text{ mA}$$

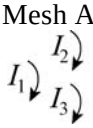
$$V_2\left[\frac{1}{2\text{ k}\Omega}+\frac{1}{2\text{ k}\Omega}+\frac{1}{2\text{ k}\Omega}\right]-\frac{1}{2\text{ k}\Omega}V_1-\frac{1}{2\text{ k}\Omega}V_3 = 0$$

$$V_3\left[\frac{1}{2\text{ k}\Omega}+\frac{1}{2\text{ k}\Omega}+\frac{1}{2\text{ k}\Omega}\right]-\frac{1}{2\text{ k}\Omega}V_2-\frac{1}{2\text{ k}\Omega}V_1 = 0$$

$V_1 = 6.67\text{ V} = E - IR_s = 10\text{ V} - I(1\text{ k}\Omega)$

$$I = \frac{10 - 6.67\text{ V}}{1\text{ k}\Omega} =$$ **3.33 mA**

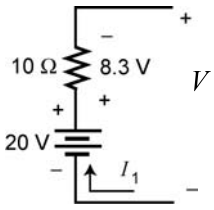
64. Mesh Analysis



Source conversion: $E = 20$ V, $R = 10\ \Omega$

$$(10 + 10 + 20)I_1 - 10I_2 - 20I_3 = 20$$
$$(10 + 20 + 20)I_2 - 10I_1 - 20I_3 = 0$$
$$(20 + 20 + 10)I_3 - 20I_1 - 20I_2 = 0$$

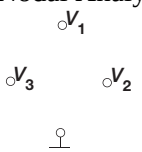
$I_1 = I_{20V} = 0.83$ A



$$V = 20\text{ V} - 8.3\text{ V} = 11.7\text{ V}$$

$$I_s = \frac{V}{R_s} = \frac{11.70\text{ V}}{10\,\Omega} = \mathbf{1.17A}$$

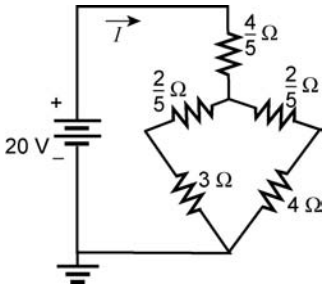
Nodal Analysis:



$$V_1\left[\frac{1}{10}+\frac{1}{10}+\frac{1}{20}\right] - \left[\frac{1}{20}\right]V_2 - \left[\frac{1}{10}\right]V_3 = 2$$
$$V_2\left[\frac{1}{20}+\frac{1}{20}+\frac{1}{10}\right] - \left[\frac{1}{20}\right]V_1 - \left[\frac{1}{20}\right]V_3 = 0$$
$$V_3\left[\frac{1}{10}+\frac{1}{20}+\frac{1}{20}\right] - \left[\frac{1}{10}\right]V_1 - \left[\frac{1}{20}\right]V_2 = 0$$

$$I_{R_s} = \frac{V_1}{R_s} = \mathbf{1.17\ A}$$

65.

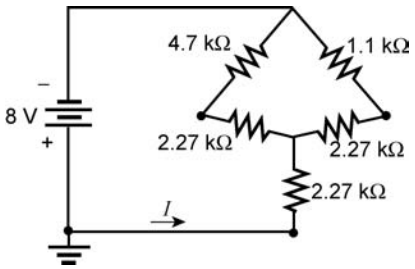


$$I = \frac{20\text{ V}}{\frac{4}{5}\Omega + \left[\frac{2}{5}\Omega + 3\,\Omega\right] \| \left[\frac{2}{5}\Omega + 4\,\Omega\right]}$$

$$= \frac{20\text{ V}}{\frac{4}{5}\Omega + (3.14\,\Omega) \| (4.4\,\Omega)}$$

$= \mathbf{7.36\ A}$

66.



$R_T = 2.27\ \text{k}\Omega + [4.7\ \text{k}\Omega + 2.27\ \text{k}\Omega] \,||\, [1.1\ \text{k}\Omega + 2.27\ \text{k}\Omega]$

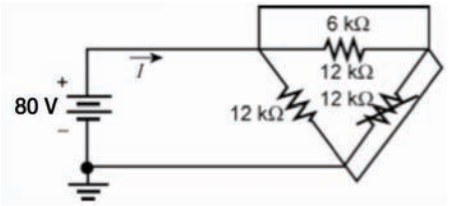
$= 2.27\ \text{k}\Omega + [6.97\ \text{k}\Omega] \,||\, [3.37\ \text{k}\Omega]$

$= 2.27\ \text{k}\Omega + 2.27\ \text{k}\Omega$

$= 4.54\ \text{k}\Omega$

$$I = \frac{8\ \text{V}}{4.54\ \text{k}\Omega} = \mathbf{1.76\ mA}$$

67.



(Y-Δ conversion)

$$I = \frac{80\ \text{V}}{12\ \text{k}\Omega \,||\, 12\ \text{k}\Omega \,||\, 6\ \text{k}\Omega} = \frac{80\ \text{V}}{3\ \text{k}\Omega}$$

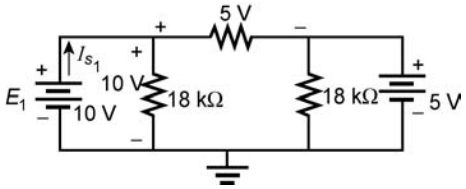
$= \mathbf{26.67\ mA}$

68. a. $$I = \frac{42\ \text{V}}{(18\ \Omega \,||\, 18\ \Omega) \,||\, [(18\ \Omega \,||\, 18\ \Omega) + (18\ \Omega \,||\, 18\ \Omega)]} = \frac{42\ \text{V}}{9\ \Omega \,||\, [9\ \Omega + 9\ \Omega]}$$

$= \mathbf{7\ A}$ (Y−Δ conversion)

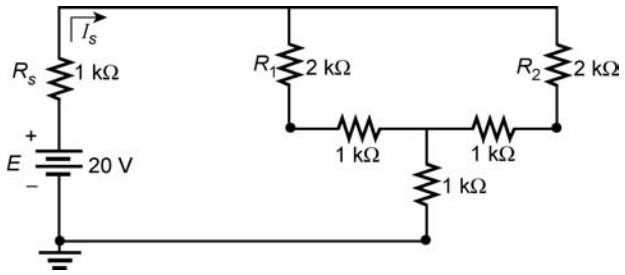
b. Δ − Y conversion

69.



$$I_{s_1} = \frac{10\ \text{V}}{18\ \text{k}\Omega} + \frac{5\ \text{V}}{18\ \text{k}\Omega} = \frac{15\ \text{V}}{18\ \text{k}\Omega} = \mathbf{0.83\ mA}$$

70. a.



b. $R' = R_1 + 1\ \text{k}\Omega = 3\ \text{k}\Omega$

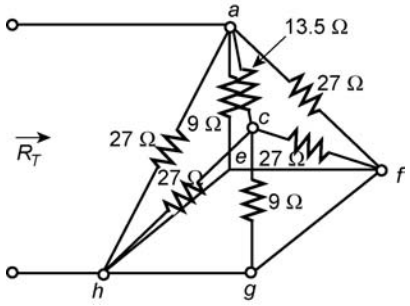
$R'' = R_2 + 1\ \text{k}\Omega = 3\ \text{k}\Omega$

$$R'_T = \frac{3\ \text{k}\Omega}{2} = 1.5\ \text{k}\Omega$$

$R_T = 1\ \text{k}\Omega + 1.5\ \text{k}\Omega + 1\ \text{k}\Omega = 3.5\ \text{k}\Omega$

$$I_s = \frac{E}{R_T} = \frac{20\ \text{V}}{3.5\ \text{k}\Omega} = \mathbf{5.71\ mA}$$

71. Using two $\Delta - Y$ conversions:



c – g: 27 Ω|| 9 Ω || 27 Ω = 5.4 Ω

a – h: 27 Ω || 9 Ω || 27 Ω = 5.4 Ω

R_T = 5.4 Ω || (13.5 Ω + 5.4 Ω)
= 5.4 Ω || 18.9Ω
= **4.2 Ω**