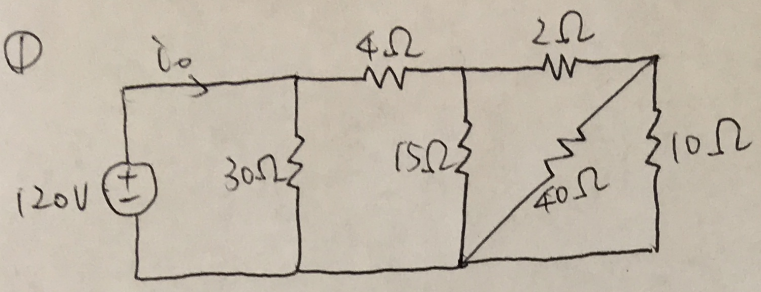
①




Find $i_o$

$40 \parallel 10 = 8$

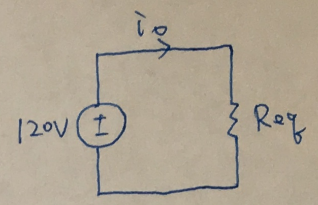
$8 + 2 = 10$

$15 \parallel 10 = 6$

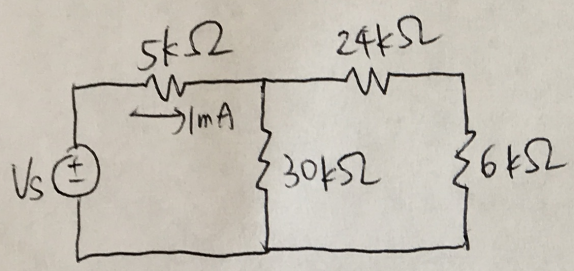
$6 + 4 = 10$

$30 \parallel 10 = 7.5 = R_{eq}$

$i_o = \frac{120}{R_{eq}} = 16\,A$ #




②



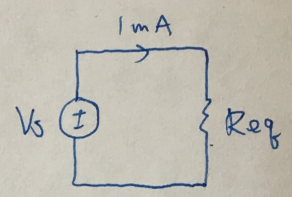

Find Vs

$24 + 6 = 30$

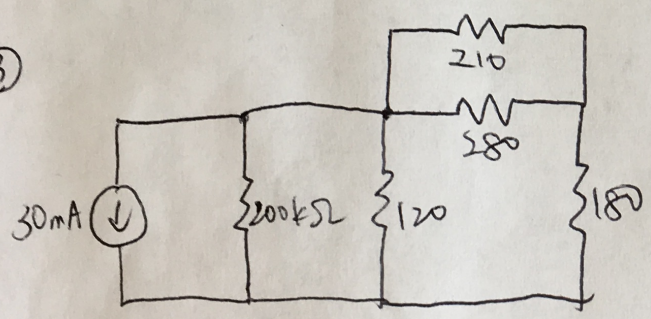
$30 \parallel 30 = 15$

$5 + 15 = 20 = R_{eq}$

$V_s = 1 \cdot 20 = 20\,V$ #




③



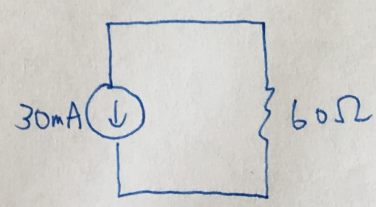

Find the equivalent resistance seen by the source.

$210 \parallel 280 = 120$

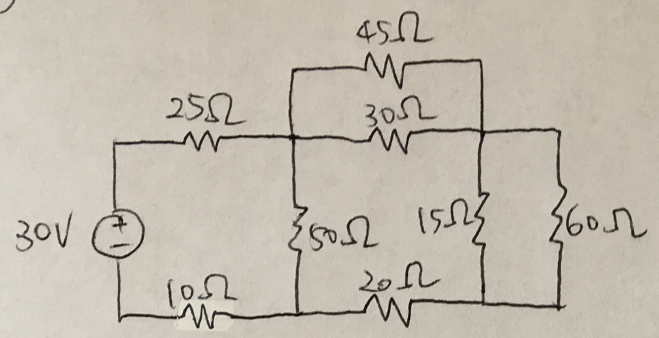
$120 + 180 = 300$

$300 \parallel 120 = 85.7$

$85.7 \parallel 200 = 60\,\Omega$ #



④




Find the equivalent resistance seen by the source.

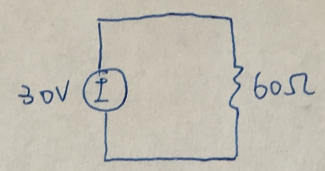
$15 // 60 = 12$

$45 // 30 = 18$

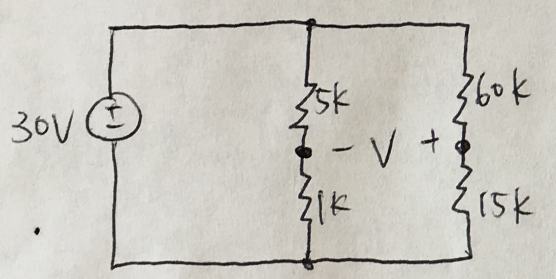
$18 + 12 + 20 = 50$

$50 // 50 = 25$

$25 + 25 + 10 = 60\Omega$ #




⑤ Voltage Divider



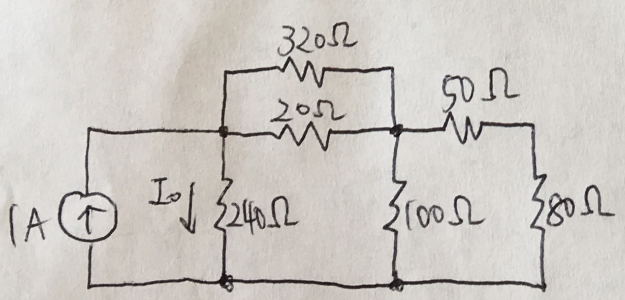

Find V

$V_{1k} = 30 \cdot \frac{1}{5+1} = 5\,V$

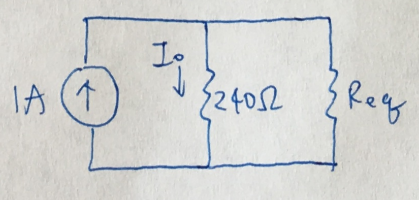
$V_{15k} = 30 \cdot \frac{15}{60+15} = 6\,V$

$V = V_{15k} - V_{1k} = 1\,V$ #

⑥ Current Divider




Find Io.




$50 + 80 = 130$

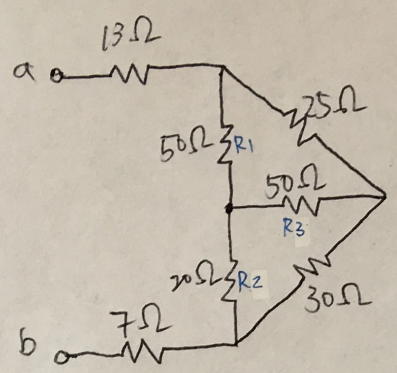
$130 // 100 = 56.5$

$320 // 20 = 18.8$

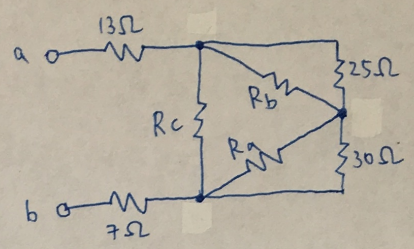
$18.8 + 56.5 = 75.3 = R_{eq}$

$I_o = \frac{R_{eq}}{240 + R_{eq}} = 0.24\,A$ #

⑦




Find the equivalent resistance Rab




$R_1R_2 + R_2R_3 + R_3R_1 = 4500$

$R_a = \frac{4500}{R_1} = 90\,\Omega$

$R_b = \frac{4500}{R_2} = 225\,\Omega$

$R_c = \frac{4500}{R_3} = 90\,\Omega$

$25 \parallel R_b = 22.5$

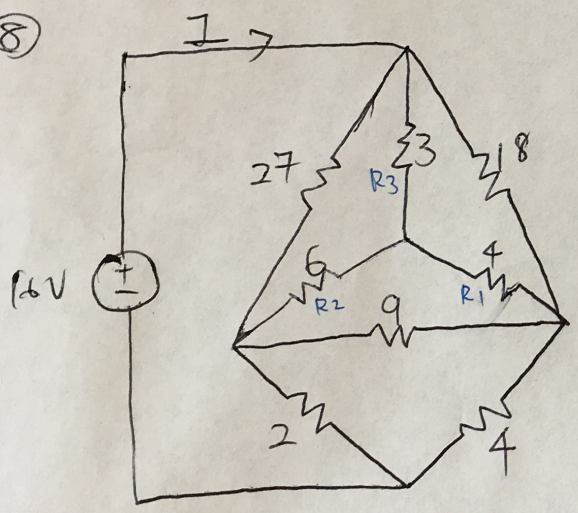
$30 \parallel R_a = 22.5$

$22.5 + 22.5 = 45$

$45 \parallel R_c = 30$

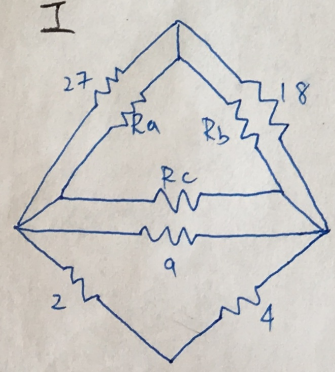
$13 + 30 + 7 = 50\,\Omega$ #

⑧




Find I

$Y \to \Delta$




$R_1R_2 + R_2R_3 + R_3R_1 = 54$

$R_a = \frac{54}{4} = 13.5$

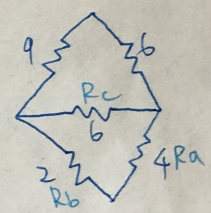
$R_b = \frac{54}{6} = 9$

$R_c = \frac{54}{3} = 18$

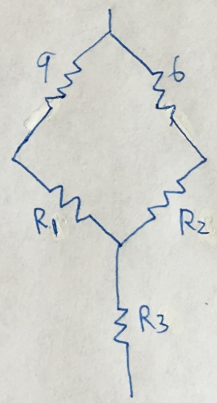
$R_a \parallel 27 = 9$

$R_b \parallel 18 = 6$

$R_c \parallel 9 = 6$




$\Delta \to Y$




$R_a + R_b + R_c = 12$

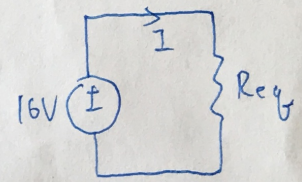
$R_1 = \frac{2 \cdot 6}{12} = 1$, $R_2 = \frac{6 \cdot 4}{12} = 2$, $R_3 = \frac{4 \cdot 2}{12} = \frac{2}{3}$

$9 + R_1 = 10$

$6 + R_2 = 8$

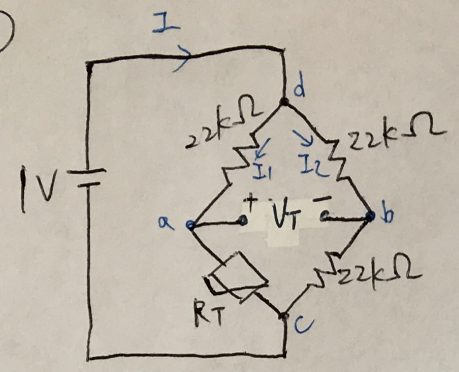
$10 \parallel 8 = \frac{40}{9}$

$\frac{40}{9} + \frac{2}{3} = \frac{46}{9} = R_{eq}$




$I = \frac{16}{R_{eq}} = 3.13\,A$ #

⑨




$R_o = 22k\Omega$

$B = 4000\,K$

$T_o = 298.15\,K$

If $V_T$ is measured to be 0.356V, T?

$R_T$ is called a Thermister. Its resistance is related to the surrounding temperature.

For our particular thermister:

$$R_T = R_o e^{-B\left(\frac{1}{T_o} - \frac{1}{T}\right)}$$ called an NTC thermister

$R_T$: Resistance value, in $\Omega$

$R_o$: Resistance value at $T_o$, in $\Omega$

$T_o$: Some fixed temp, usually 298.15K (25°C)

B: A constant defined by the particular thermister you are using, in K

T: the ambient temp., in K

In a digital thermister, voltage is measured across $V_T$ and the above relationship is used to determine the temp.

$V_T = V_{ac} - V_{bc}$

$V_{bc} = 1 \cdot \frac{22}{22+22} = 0.5\ V$

$0.356 = V_{ac} - 0.5$

$\Rightarrow V_{ac} = 0.856$

Find $R_T$

$V_{da} = 1 - 0.856 = 0.144$

$\frac{V_{da}}{V_{ac}} = \frac{22k}{R_T} \rightarrow R_T = 131\,k\Omega$

Solving the thermistor equation for T

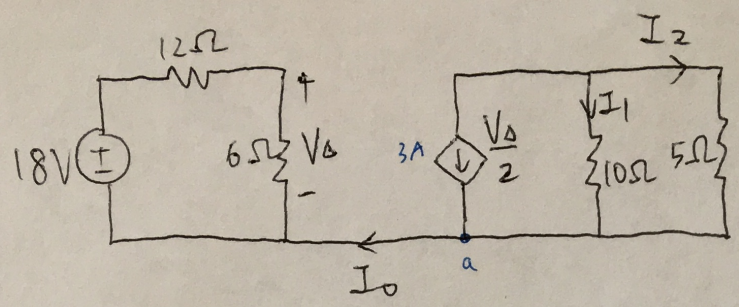
$$T = \frac{B}{\ln R_T - \ln R_o + \frac{B}{T_o}}$$

$= 263.15\ K$

$= -10°C$

$= 14°F$

(10)




Find $I_o$, $I_1$, $I_2$

$$V_\Delta = 18 \cdot \frac{6}{12+6} = 6\ V$$

$$\frac{V_\Delta}{2} = 3\ A$$

$$I_1 = -3 \cdot \frac{5}{10+5} = -1\ A$$

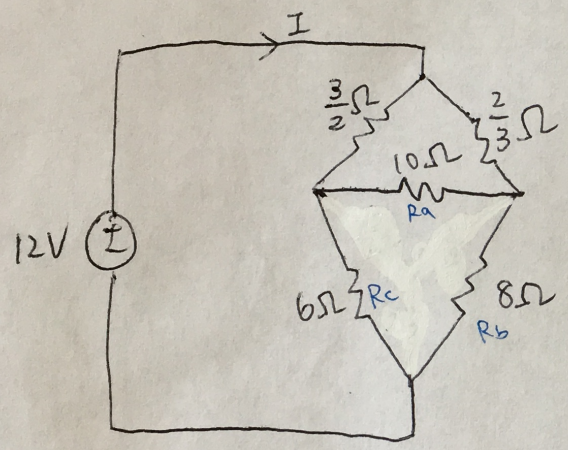
$$I_2 = -3 \cdot \frac{10}{10+5} = -2\ A$$

KCL at a:

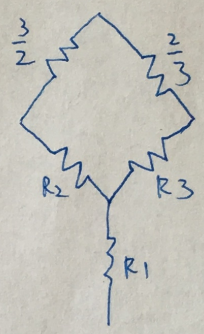
$$3 + (-1) + (-2) - I_o = 0$$

$$\Rightarrow I_o = 0\ A \ \#$$

(11)




Find I




$$R_a + R_b + R_c = 24$$

$$R_1 = \frac{8 \cdot 6}{24} = 2$$

$$R_2 = \frac{6 \cdot 10}{24} = 2.5$$

$$R_3 = \frac{10 \cdot 8}{24} = \frac{10}{3}$$

$$\frac{3}{2} + R_2 = 4$$

$$\frac{2}{3} + R_3 = 4$$

$$4 \parallel 4 = 2$$

$$2 + R_1 = 4$$

$$I = \frac{12}{4} = 3\ A \ \#$$