1) A resistor has the following color bands: Yellow-Purple-Red-Gold. What is its resistance and tolerance?

a) 4.7kΩ, 10%
b) 4.7kΩ, 5%
c) 47kΩ, 5%
d) 2.7kΩ, 5%

4 7 Two zeros 5% tolerance

2) For the resistor in question #1, what is the range of possible values?

a) 4.23kΩ - 5.17kΩ
b) 4.465kΩ - 4.935kΩ
c) 44.65kΩ - 49.35kΩ
d) 2.565kΩ - 2.835kΩ

$4.7K \cdot .05 = 235$

$4.7k \pm 235$

3) A 1kΩ resistor has 3.3V across it. What is the current through the resistor?

a) 3300 A
b) 3.3 A
c) 303 A
d) 3.3 mA

$I = \frac{E}{R} = \frac{3.3V}{1k\Omega}$

4) A resistor has 1.5V across it, and 220mA through it. What is its resistance?

a) 0.33 Ω
b) 330 Ω
c) 0.147 Ω
d) 6.82 Ω

$R = \frac{E}{I} = \frac{1.5V}{220mA}$

5) A 2A current source has 5V across it. How much power is it supplying?

a) 0.4 W
b) 2.5 W
c) 20 W
d) 10 W

$P = VI = 2A \cdot 10V$

6) A 2.7kΩ resistor dissipates 3W. What is the voltage across it?

a) 1.11 mV
b) 900 V
c) 30 V
d) 90 V

$P = \frac{V^2}{R}$

$V = \sqrt{PR}$

$= \sqrt{3W \cdot 2.7k\Omega}$

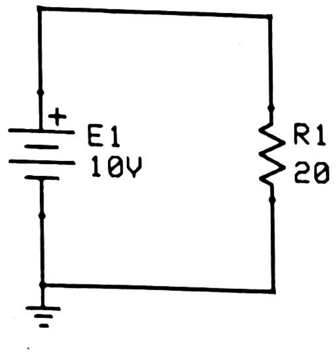


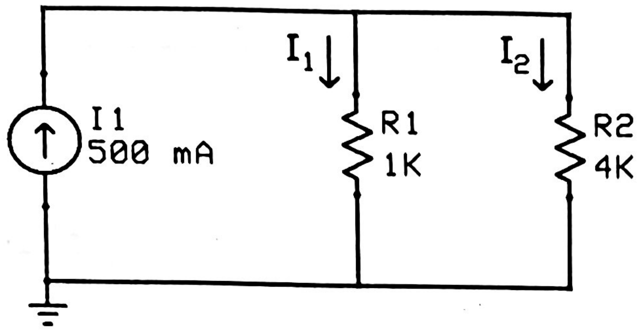
Figure 1

7) See figure 1. How much power is R_1 dissipating?
   a) 0.5 W
   b) 2 W
   c) 25 mW
   d) 5 W

$$P = \frac{V^2}{R} = \frac{10^2}{20}$$

8) See figure 1. How much power would R_1 dissipate if the polarity of E_1 was flipped?
   a) 0 W
   b) -2 W
   c) 5 W
   d) -5 W

$$P = \frac{V^2}{R} = \frac{(-10)^2}{20}$$



$R_T = 1k // 4k$
$= 800$

Figure 2

9) See figure 2. What is I_1?
   a) 500 mA
   b) 400 mA
   c) 250 mA
   d) 100 mA

$$I_1 = I_s \cdot \frac{R_T}{R_1}$$
$$= 500mA \cdot \frac{800\Omega}{1k\Omega}$$

10) See figure 2. What is I_2?
   a) 500 mA
   b) 400 mA
   c) 250 mA
   d) 100 mA

KCL: $I_s = I_1 + I_2$

$$I_2 = I_s - I_1$$
$$= 500mA - 400mA$$

or

$$I_2 = I_s \cdot \frac{R_T}{R_2}$$
$$= 500mA \cdot \frac{800\Omega}{4k\Omega}$$

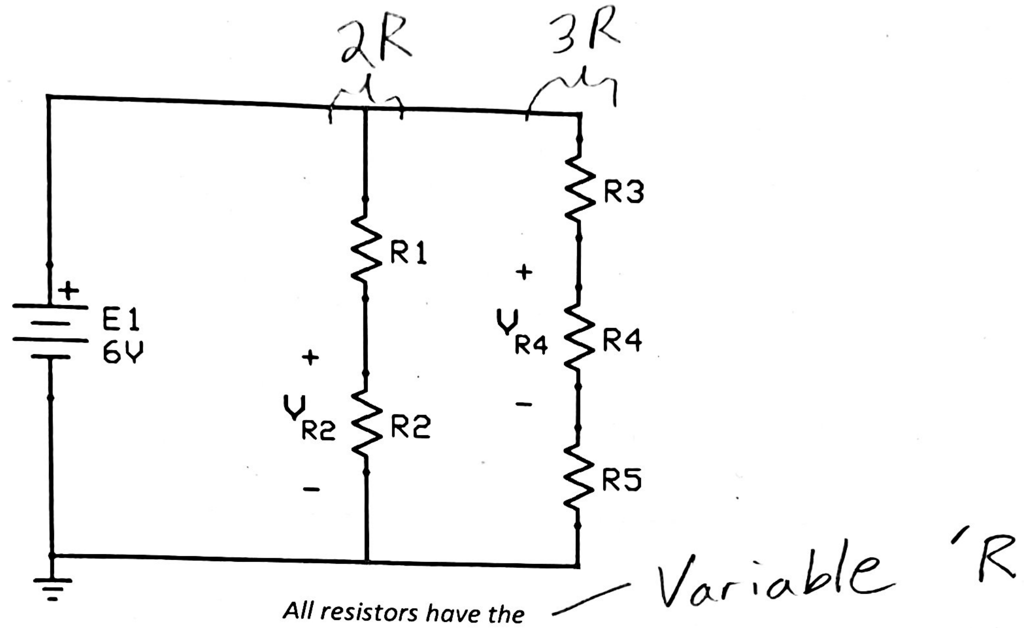


Figure 3 *All resistors have the same value.*

11) See figure 3. What is the voltage across R_2 (polarity as shown)?
   a) 1 V
   b) 2 V
   c) 3 V
   d) 6 V

$$V_{R2} = E \cdot \frac{R_2}{R_T} = 6V \cdot \frac{R}{2R} = 6V \cdot \frac{1}{2}$$

$-R_T$ refers to that specific branch of series resistors

12) See figure 3. What is the voltage across R_4 (polarity as shown)?
   a) 1 V
   b) 2 V
   c) 3 V
   d) 6 V

$$V_{R4} = E \cdot \frac{R_4}{R_T} = 6V \cdot \frac{R}{3R} = 6V \cdot \frac{1}{3}$$

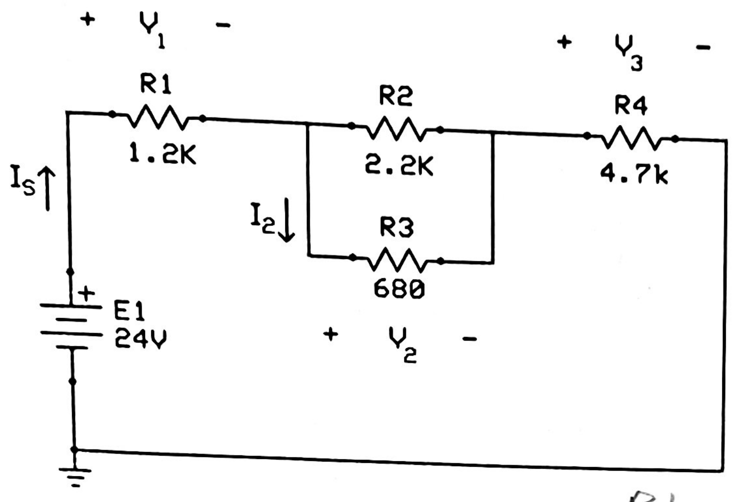
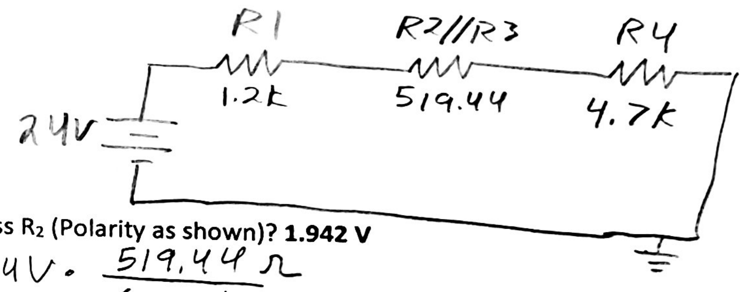


Figure 4



$R_{parallel} = 519.444$ $R_T = 6419.444$

13) See figure 4. What is the voltage across R_2 (Polarity as shown)? **1.942 V**

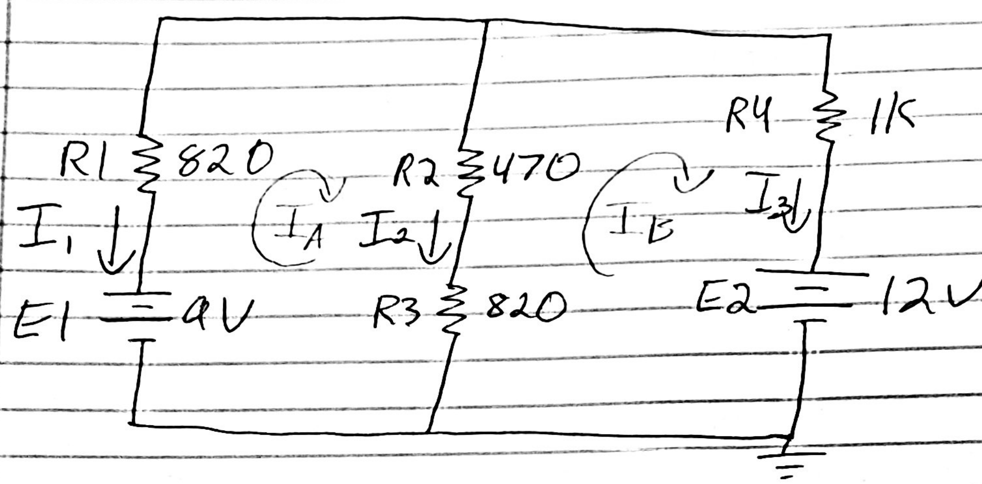
$$V_{R2} = \frac{R2//R3}{R_T} \cdot E = 24V \cdot \frac{519.44\,\Omega}{6.419k\Omega}$$

14) See figure 4. What is the value of I_2 (Direction as shown)? **2.856 mA**

$$I_2 = \frac{V_{R2}}{R_2} = \frac{1.942V}{680}$$

15) See figure 5. What is the value of I_S (Direction as shown)? **3.739 mA**

$$I_S = \frac{E}{R_T} = \frac{24V}{6.419k\Omega}$$



Loop A:

$9V - 820I_A - 470I_A + 470I_B - 820I_A + 820I_B = 0$
$I_A(-820-470-820) + I_B(470+820) = -9$

Loop B:
$-820I_B + 820I_A - 470I_B + 470I_A - 1kI_B - 12V = 0$
$I_A(820+470) + I_B(-820-470-1k) = 12$

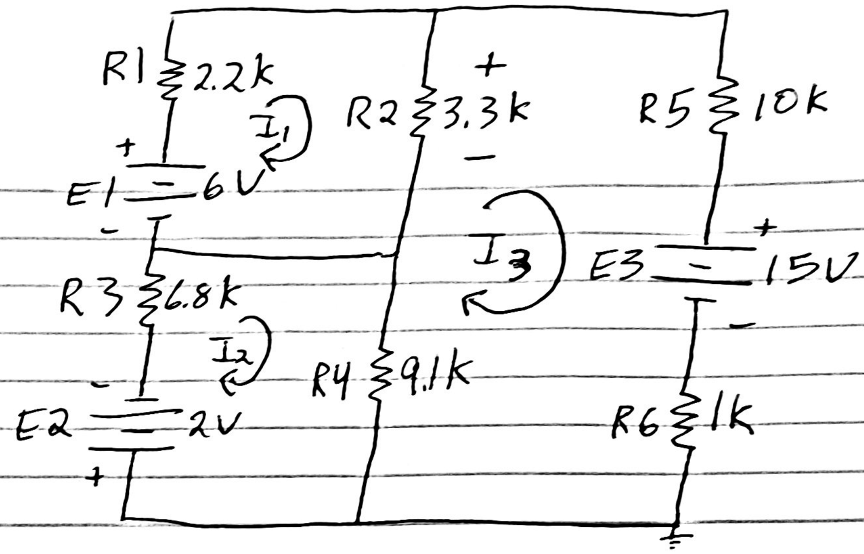
Equation Solver $\rightarrow$ $I_A = 1.619mA$
$I_B = -4.328mA$

16. $I_1 = -I_A = -1.619mA$
$I_2 = I_A - I_B = 1.619mA - (-4.328mA) = 5.947mA$
$I_3 = I_B = -4.328mA$

17. $P_{E1} = E_1 \cdot I_A = 9V \cdot 1.619mA = 14.571mW$ Supplied
V+I same
direction

$P_{E2} = E_2 \cdot -I_B = 12V \cdot 4.328mA = 51.936mW$ Supplied

$P_T = P_{E1} + P_{E2} = 66.507mW$



Loop 1:

$6V - 2.2k\,I_1 - 3.3k\,I_1 + 3.3k\,I_3 = 0$

$I_1(-2.2k - 3.3k) + I_2(0) + I_3(3.3k) = -6$

Loop 2:

$-2V - 6.8k\,I_2 - 9.1k\,I_2 + 9.1k\,I_3 = 0$

$I_1(0) + I_2(-6.8k - 9.1k) + I_3(9.1k) = 2$

Loop 3:

$-9.1k\,I_3 + 9.1k\,I_2 - 3.3k\,I_3 + 3.3k\,I_1 - 10k\,I_3 - 15V - 1k\,I_3 = 0$

$I_1(3.3k) + I_2(9.1k) + I_3(-9.1k - 3.3k - 10k - 1k) = 15$

18. Equation Solver → $I_1 = 626.631\,\mu A$

$I_2 = -568.651\,\mu A$

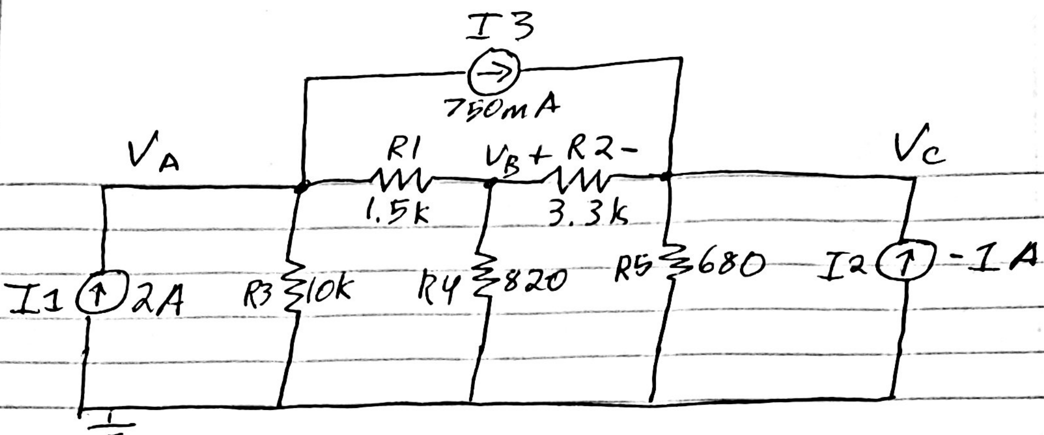
$I_3 = -773.797\,\mu A$

19. $I_{R2} = I_1 - I_3 = 1.400\,mA$

$V_{R2} = R_2 \cdot I_{R2} = 3.3k \cdot 1.4mA = 4.62\,V$

20. $I_{R4} = I_3 - I_2 = -205.146\,\mu A$

$P_{R4} = I_{R4}^2 \cdot R4 = (-20.146\,\mu A)^2 \cdot 9.1k = 382.972\,\mu W$



Node A:

$$2A = \frac{V_A}{10k} + \frac{V_A - V_B}{1.5k} + 750mA$$

$$V_A\left(\frac{1}{10k} + \frac{1}{1.5k}\right) + V_B\left(\frac{-1}{1.5k}\right) + V_C(0) = 1.25A$$

Node B:

$$0 = \frac{V_B - V_A}{1.5k} + \frac{V_B}{820} + \frac{V_B - V_C}{3.3k}$$

$$V_A\left(\frac{-1}{1.5k}\right) + V_B\left(\frac{1}{1.5k} + \frac{1}{820} + \frac{1}{3.3k}\right) + V_C\left(\frac{-1}{3.3k}\right) = 0$$

Node C:

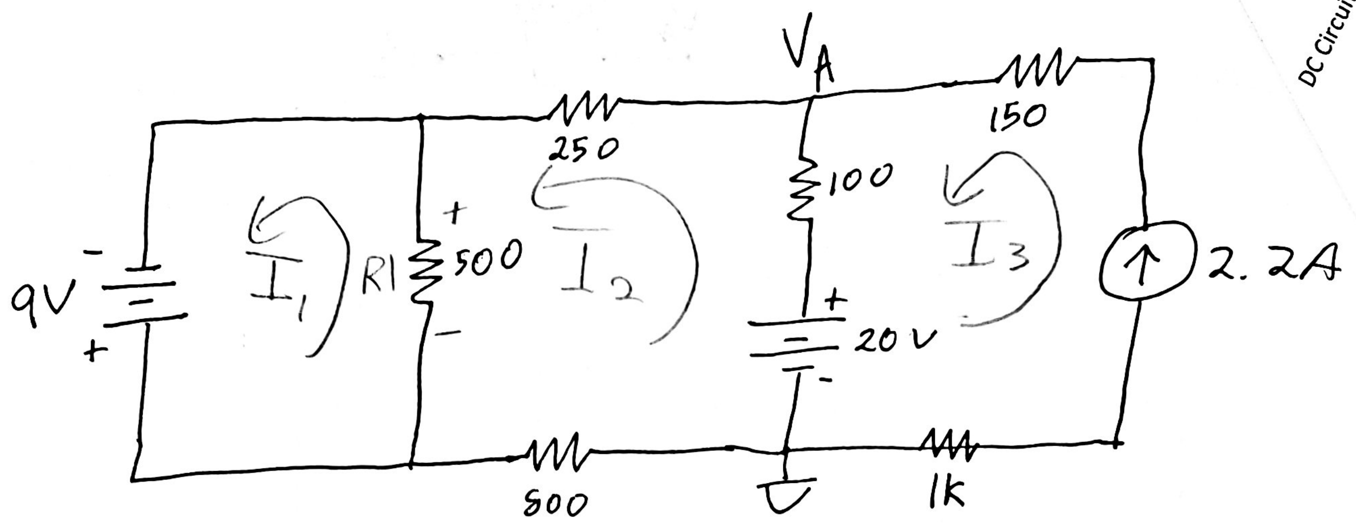
$$750mA - 1A = \frac{V_C - V_B}{3.3k} + \frac{V_C}{680}$$

$$V_A(0) + V_B\left(\frac{-1}{3.3k}\right) + V_C\left(\frac{1}{3.3k} + \frac{1}{680}\right) = -.25A$$

21 Equation Solver → $V_A = 2.213\ kV$
$V_B = 670.364\ V$
$V_C = -26.420\ V$

22 $V_{R2} = V_B - V_C = 696.784\ V$

23 $V_{I3} = V_A - V_C = 2.239kV$
$P_{I3} = VI = 2.239\ kV \cdot 750\ mA = 1.680\ kW$



$$-500I_1 + 500I_2 + 9V = 0$$

$$\left[I_1(-500) + I_2(500) = -9 \right.$$

$$20V - 100I_2 + 100I_3 - 250I_2 - 500I_2 + 500I_1 - 800I_2 = 0$$

$$\left[I_1(500) + I_2(-100-250-500-800) + I_3(100) = -20 \right.$$

$$I_1(500) + I_2(-100-250-500-800) = -240$$

$$-150I_3 - 100I_3 + 100I_2 - 20V = 0$$

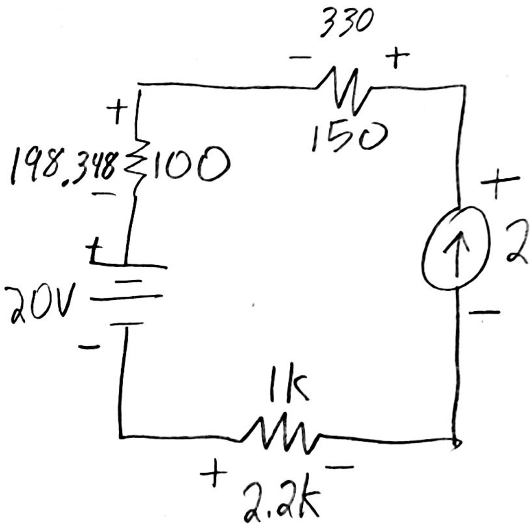
$$\left[I_2(100) + I_3(-150-100-1k) = 20 \right.$$

$$I_2(100) = 2.77k$$

$$I_1 = 234.522\,mA$$

$$I_2 = 216.522\,mA$$

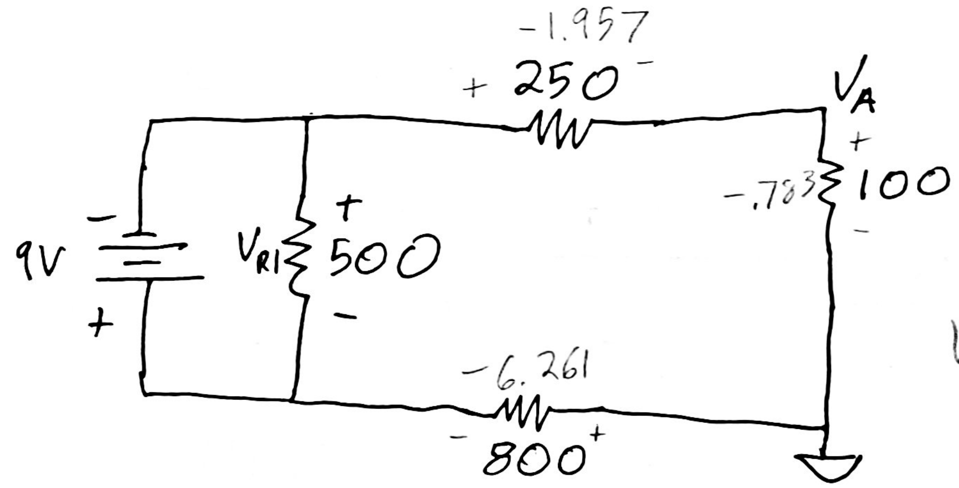
25. $V_{R1} = -9V$



24. $V_A = 20V + 198.348V$
$= 218.348 V$

26. $V_{I1} = 2.748 kV$

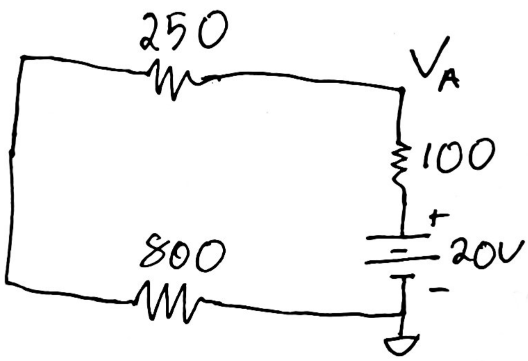
$P_{I1} = 6.046 kW$



$R_T = 348.48$

$V_A' = -782.61 mV$

$V_{R1}' = -9$



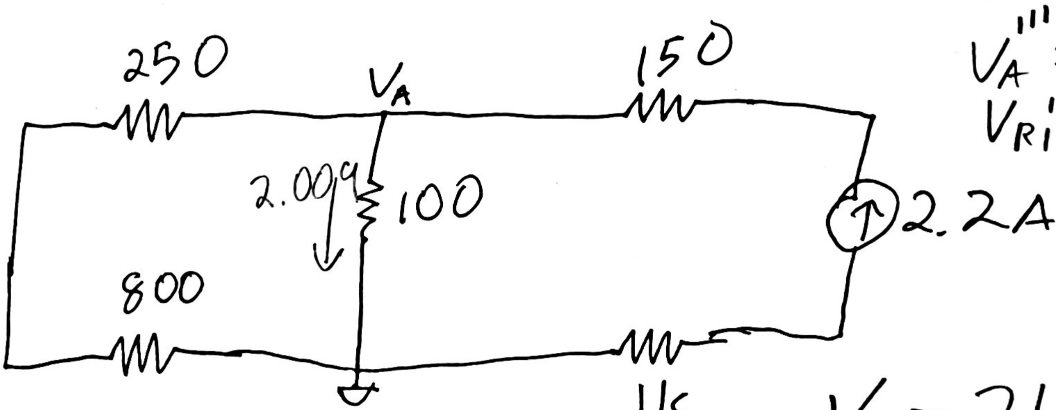
$V_A'' = 18.261$

$V_{R1}'' = 0$

$R_P = 91.304$

$V_A''' = 200.87$

$V_{R1}''' = 0$

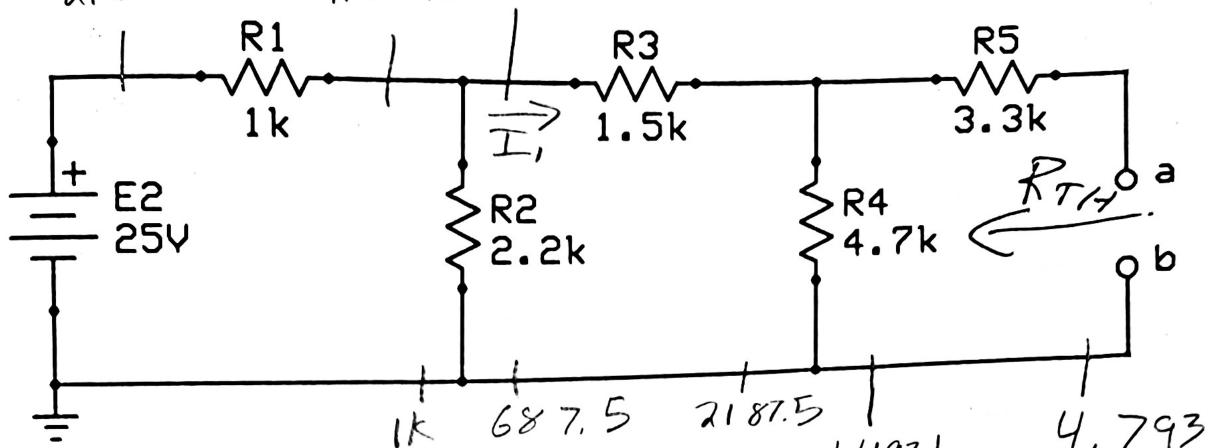


$V_A = 218.35 V$

$V_{R1} = -9 V$

Finding R_T, NOT R_{TH}

2.624k 1.624k 6.2kΩ



1k 687.5 2187.5 1.493k 4.793k

Figure 9

Finding R_{TH}

27) See Figure 9. For the Thevenin circuit external to points a and b, what is the Thevenin voltage?

11.7 V

28) What is the Thevenin resistance?

4.793 kΩ

29) If this Thevenin circuit were converted to a current source, what would be the value of that current source? Aka Norton

2.441 mA

30) What resistance would dissipate the maximum amount of power when connected to this network? What is the maximum power dissipated?

4.793 kΩ

7.14 mW

27. $I_S = \frac{25V}{R_T} = \frac{25V}{2.624k} = 9.527mA$ $I_1 = I_S \cdot \frac{1.624k}{6.2k} = 2.495mA$

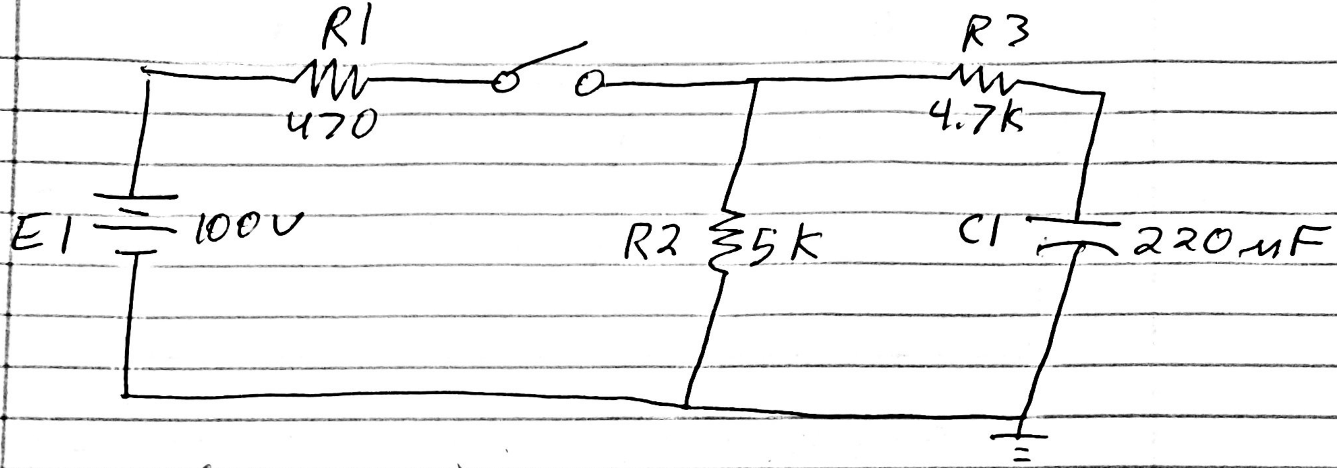
$V_{TH} = R4 \cdot I_1 = 11.727V$

28. $(((R1 // R2) + R3) // R4) + R5 = 4.793k\Omega$

29. $I_N = \frac{V_{TH}}{R_{TH}} = 2.447mA$

30. $R_L = R_{TH} = 4.793k\Omega$

$P_{Max} = \frac{E_{TH}^2}{4R_{TH}} = 7.173mW$



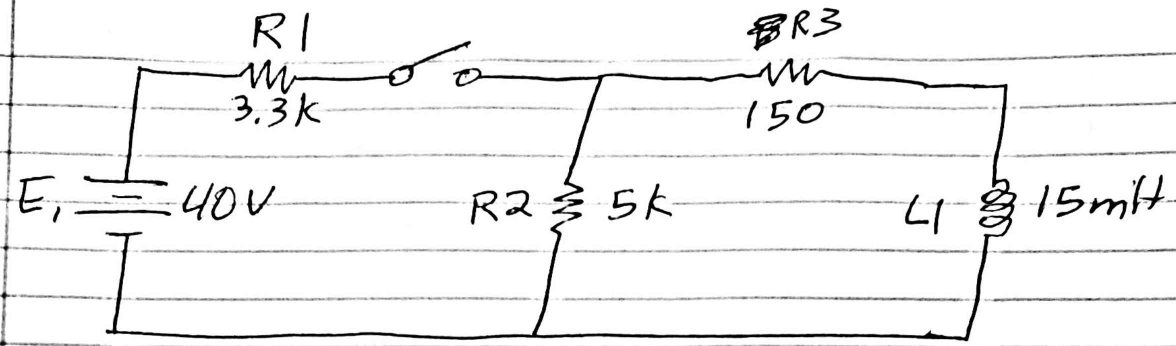
31. $R_{TH} = (470 // 5k) + 4.7k = 5.13k\Omega$
$\tau = R_{TH} \cdot C = 1.129 sec$

32. $R_{TH} = 5k + 4.7k = 9.7k$
$\tau = R_{TH} \cdot C = 2.134 sec$

33. $E_{TH} = 100V \cdot \frac{5k}{5k+470} = 91.408V$

Charging:
$e(t) = 91.408\left(1 - e^{-t/1.129s}\right) V$

$75 = 91.408\left(1 - e^{-t/1.129s}\right)$
$.820497 = 1 - e^{-t/1.129s}$
$-.179503 = -e^{-t/1.129s}$
$.179503 = e^{-t/1.129s}$
$\ln .179503 = -t/1.129s$
$-1.718 = -t/1.129s$
$t = 1.939$



34. $R_{TH} = (3.3k \parallel 5k) + 150 = 2.138k\Omega$

$V_{TH} = \frac{40V \cdot 5k}{8.3k} = 24.096V$

$\tau = L/R_{TH} = 7.016\mu S$

$i_L(t) = \frac{24.096V}{2.138k\Omega}\left(1 - e^{-t/7.016\mu S}\right) A$

35. 0V - Short Circuit b/c $t \gg 5\tau$