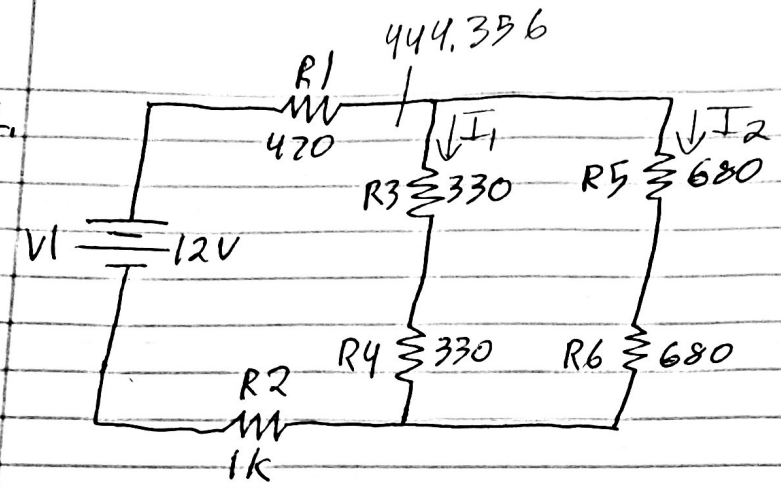
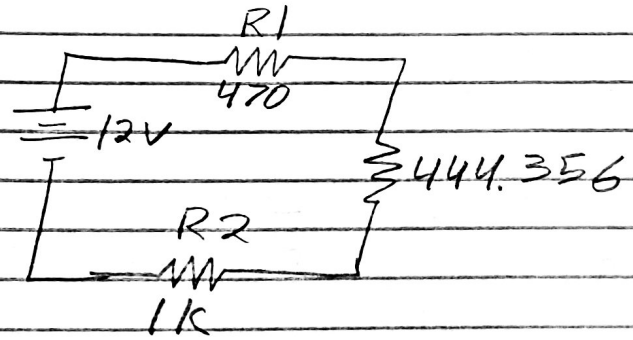
1.



$R_T = [(330+330)\,//\,(680+680)] + 470 + 1k = 1.914k\,\Omega$

$I_S = \frac{V_1}{R_1} = \frac{12V}{1.914k} = 6.270mA$



$V_{R1} = 12V\left(\frac{R1}{R_T}\right) = 2.947V$

$V_{R2} = 12V\left(\frac{R2}{R_T}\right) = 6.270V$

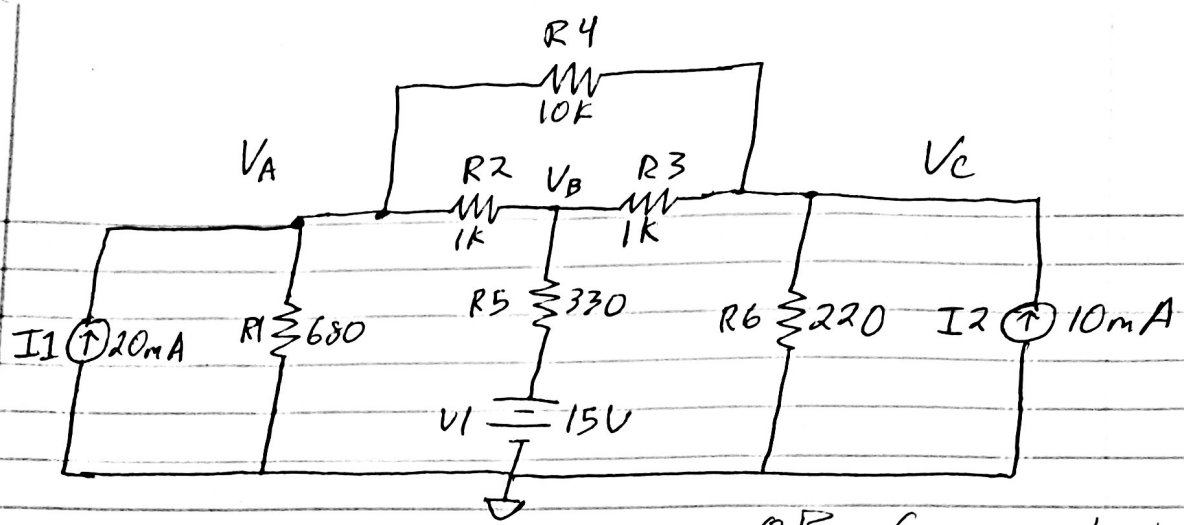
$I_1 = I_S\left(\frac{444.356}{660}\right) = 4.221mA \quad I_{R3} = 4.221mA$

$V_{R4} = R4 \cdot I_1 = 1.393V$

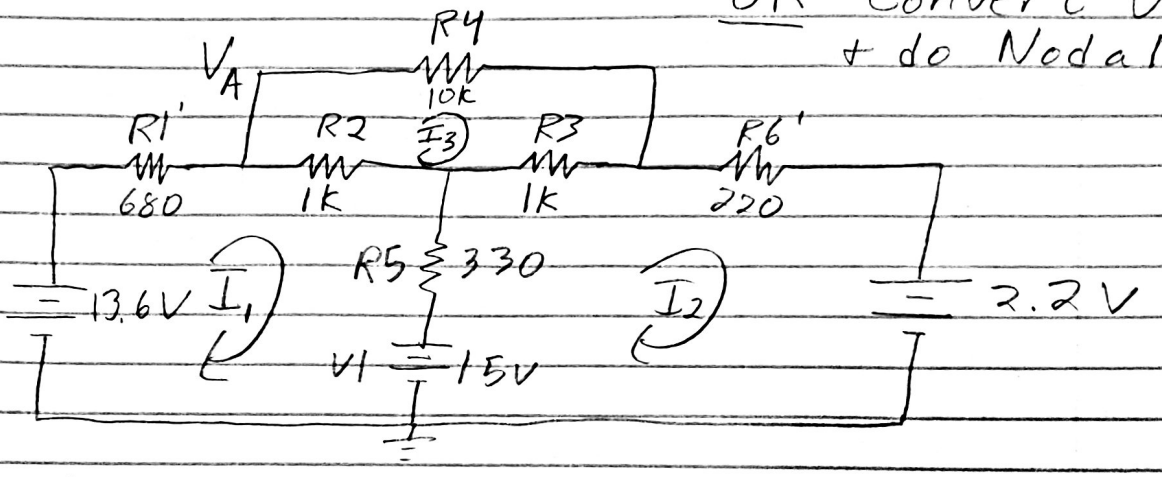
$I_2 = I_S - I_1 = 2.049mA$

$I_{R6} = 2.049mA$

2.



OR Convert V1 + do Nodal



Loop 1:

$13.6V - 680I - 1kI_1 + 1kI_3 - 330I_1 + 330I_2 - 15V = 0$

$I_1(-680-1k-330) + I_2(330) + I_3(1K) = 1.4$

Loop 2:

$15V - 330I_2 + 330I_1 - 1kI_2 + 1kI_3 - 220I_2 - 2.2V = 0$

$I_1(330) + I_2(-330-1k-220) + I_3(1k) = -12.8$

Loop 3:

$-1kI_3 + 1kI_1 - 10kI_3 - 1kI_3 + 1kI_2 = 0$

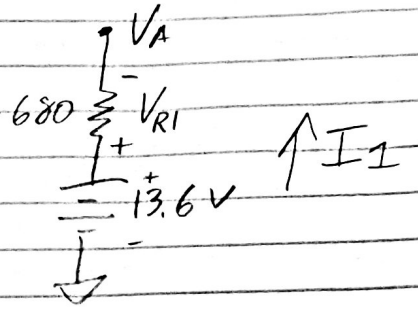
$I_1(1k) + I_2(1k) + I_3(-1k-10k-1k) = 0$

Equation Solver → $I_1 = 1.219mA$

$I_2 = 9.071mA$

$I_3 = 857.523\mu A$

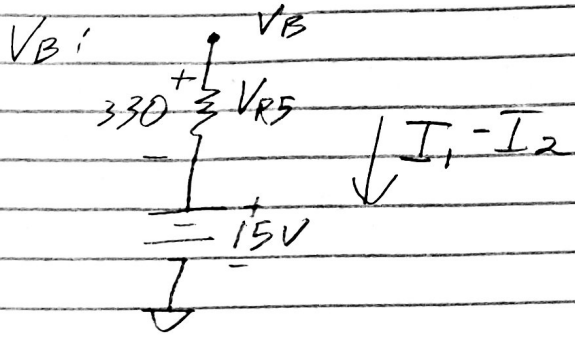
V_A:



$V_{R1} = 1.219\,mA \cdot 680$
$= 828.920\,mV$

$V_A = 13.6\,V - V_{R1}$
$= 12.771\,V$

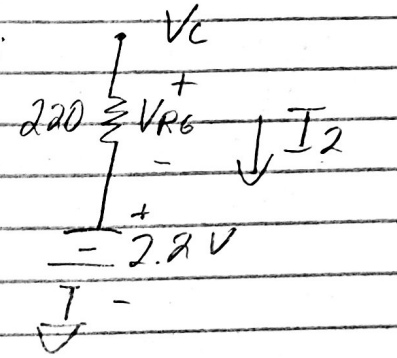
V_B:



$V_{R5} = -7.852\,mA \cdot 330$
$= -2.591\,V$

$V_B = 15\,V + V_{R5}$
$= 12.409\,V$

V_C:



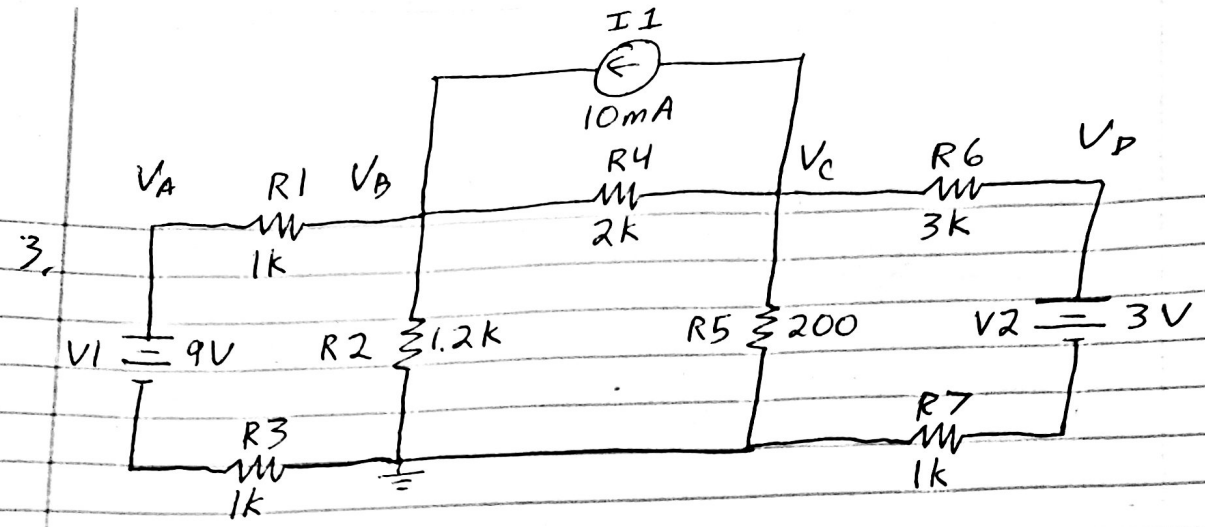
$V_{R6} = 9.071\,mA \cdot 220$
$= 1.996\,V$

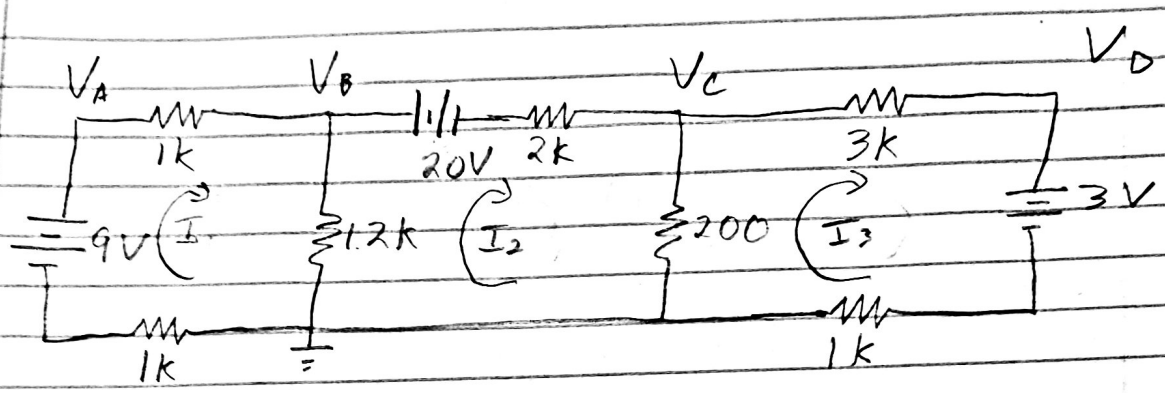
$V_C = 2.2\,V + V_{R6}$
$= 4.196\,V$

$I_{V1} = I_2 - I_1 = 7.852\,mA$

$P_{V1} = V_1 \cdot I_{V1} = 117.780\,mW$

$I_{R4} = 857.523\,\mu A$



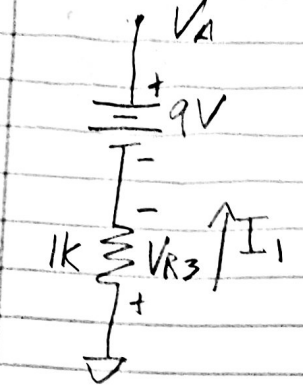


Loop 1:
$9V - 1kI_1 - 1.2kI_1 + 1.2kI_2 - 1kI_1$
$I_1(-1k - 1.2k - 1k) + I_2(1.2k) + I_3(0) = -9$

Loop 2:
$-1.2kI_2 + 1.2kI_1 - 20V - 2kI_2 - 200I_2 + 200I_3 = 0$
$I_1(1.2k) + I_2(-1.2k - 2k - 200) + I_3(200) = 20$

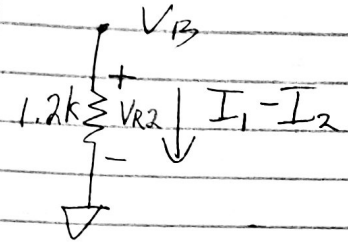
Loop 3:
$-200I_3 + 200I_2 - 3kI_3 - 3V - 1kI_3$
$I_1(0) + I_2(200) + I_3(-200 - 3k - 1k) = 3$

Equation Solver → $I_1 = 674.089\,\mu A$
$I_2 = -5.702\,mA$
$I_3 = -985.830\,\mu A$



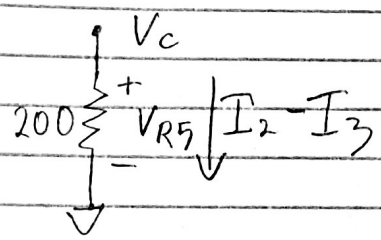
$$V_{R3} = I_1 \cdot R_3$$
$$= 674.089\,mV$$

$$V_A = 9V - V_{R3}$$
$$= 8.326V$$



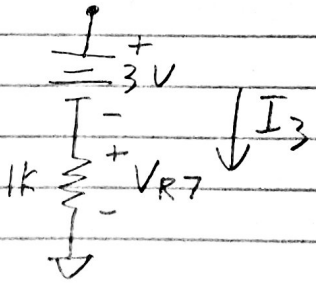
$$V_{R2} = (I_1 - I_2)\,R_2$$
$$= 7.651\,V$$

$$V_B = 7.651\,V$$



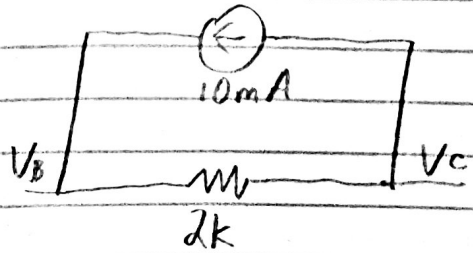
$$V_{R5} = (I_2 - I_3)\,R_5$$
$$= -943.234mV$$

$$V_C = -943.234mV$$



$$V_{R7} = I_3 \cdot R_7$$
$$= -985.83\,mV$$

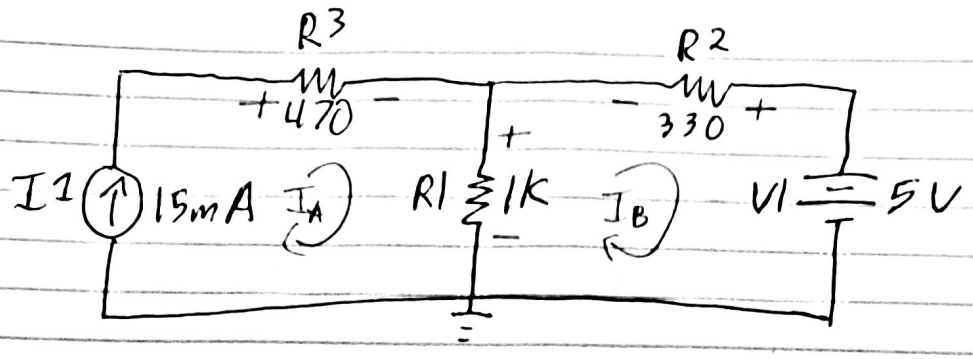
$$V_D = 3V + V_{R7}$$
$$= 2.014V$$

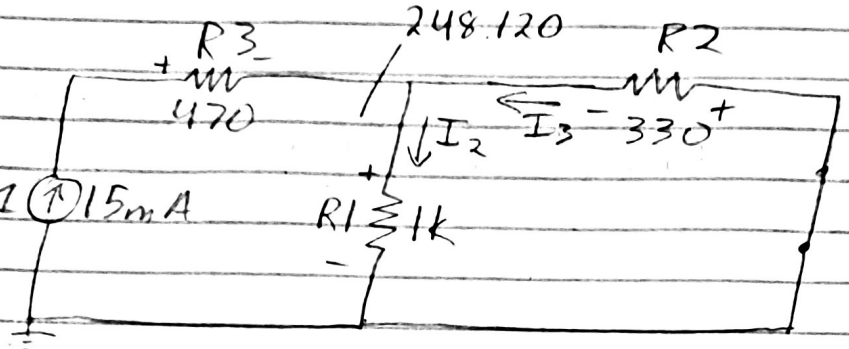


$$V_{I1} = V_C - V_B = -8.637V$$

$$P_{I1} = 8.637V \cdot 10mA$$
$$= 86.37\,mW$$

4.



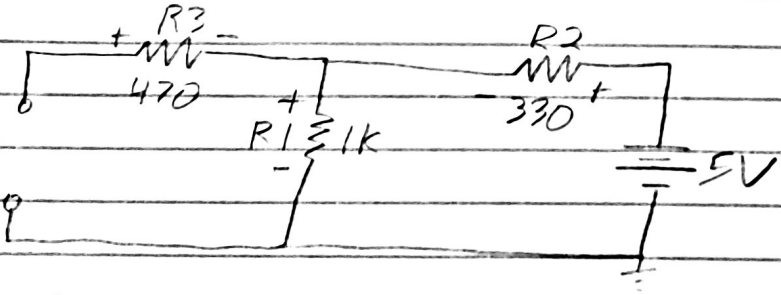


$V_{R3}' = R3 \cdot I1 = 7.05\,V$

$I_2 = I_1 \cdot \frac{248.12\,\Omega}{1k} = 3.722\,mA \qquad I_3 = -11.278\,mA$

$V_{R1}' = R1 \cdot I_2 = 3.722\,V$

$V_{R2}' = R2 \cdot I_3 = -3.722\,V$



$V_{R2}'' = 5V \cdot \frac{330\,\Omega}{1.330k\,\Omega} = 1.241\,V$

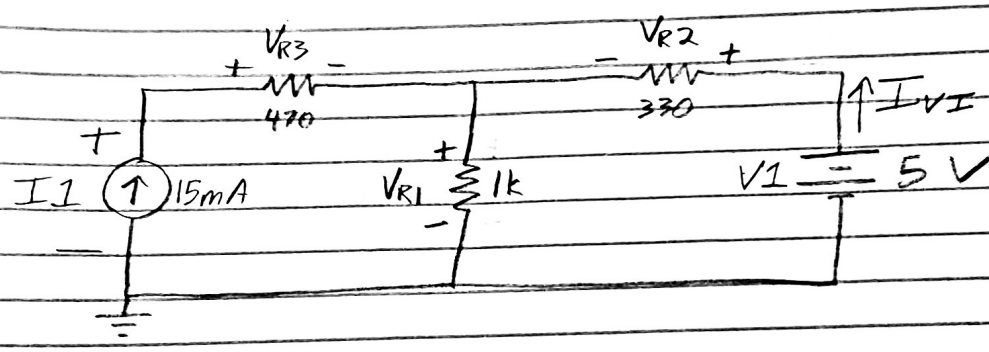
$V_{R1}'' = 5V \cdot \frac{1k\,\Omega}{1.33k\,\Omega} = 3.759\,V$

$V_{R3}'' = 0\,V$

$V_{R1} = V_{R1}' + V_{R1}'' = 3.722 + 3.759$
$= 7.481$

$V_{R2} = V_{R2}' + V_{R2}'' = -3.722 + 1.241$
$= -2.481V$

$V_{R3} = V_{R3}' + V_{R3}'' = 7.05V + 0V$
$= 7.05V$

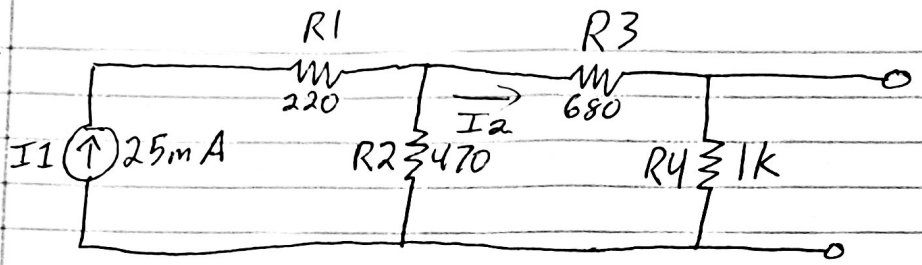


$I_{V1} = I_{R2} = \frac{V_{R2}}{R2} = -7.518mA$

$P_{V1} = 5V \cdot 7.518mA = 37.59\ mW$ Absorbed

$V_{I1} - V_{R3} - V_{R1} = 0$
$V_{I1} = 14.531V$
$P_{I1} = 14.531V \cdot 15mA = 217.965mW$
Supplied

5.

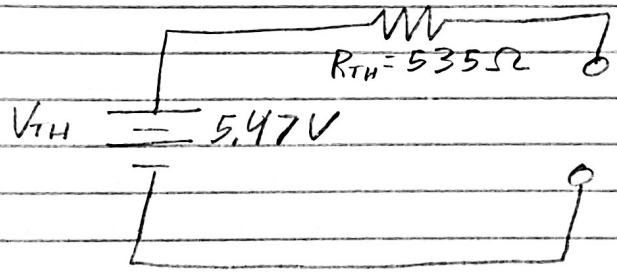


$R_{TH} = (470 + 680) // 1k = 534.8845\,\Omega$

$I_2 = I_1 \cdot \dfrac{(680 + 1k) // 470}{680 + 1k}$

$= 25mA \cdot \dfrac{367.256\,\Omega}{1.680k} = 5.465mA$

$V_{TH} = V_{R4} = 1k \cdot 5.465mA = 5.465$

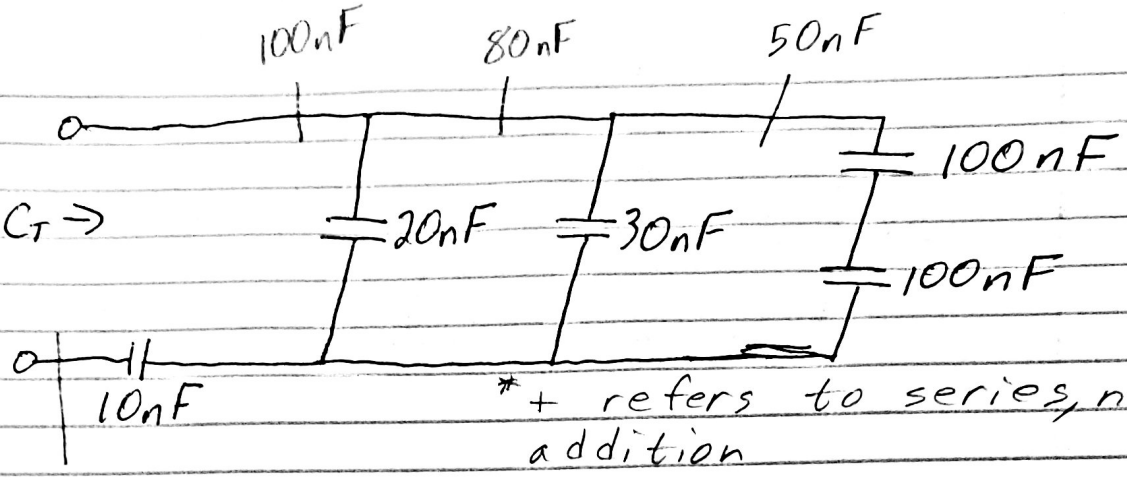


6. $\frac{\text{Output}}{\text{Input}} = \text{Efficiency}$

$\frac{100W}{P_{IN}} = .85 \qquad P_{IN} = 117.647W$

7. $.7 \times .6 \times .9 = 37.8\%$

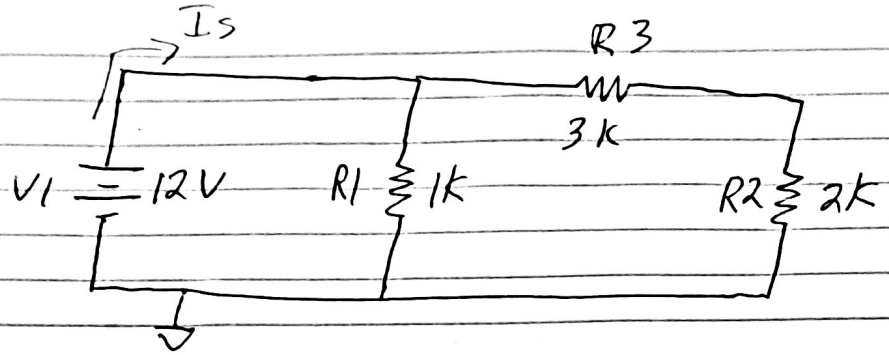
8.



$100nF + 100nF = 50nF$
$50nF // 30nF // 20nF = 100nF$
$100nF + 10nF = 9.09\ nF$

9. $V = \frac{Q}{C} = \frac{35nC}{9.09nF} = 3.85\ V$

10



$P_{R1} = \frac{12V^2}{1k} = 144mW$

$V_{R2} = 12V \cdot \frac{2k}{5k} = 4.8V$

$V_{R3} = 7.2V$

$P_{R2} = \frac{4.8V^2}{2k} = 11.52mW$

$P_{R3} = \frac{7.2V^2}{3k} = 17.28mW$

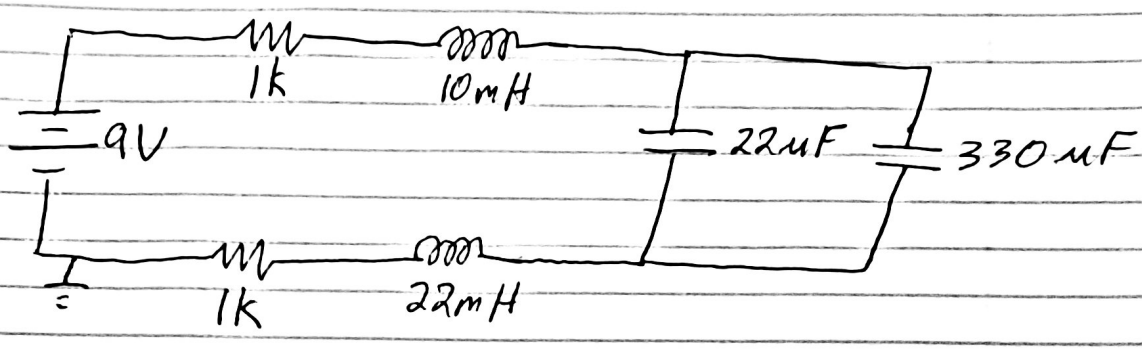
11. $I_S = \frac{12V}{5k // 1k} = 14.4mA$

$P = VI = 12 \cdot 14.4mA = 172.8mW$

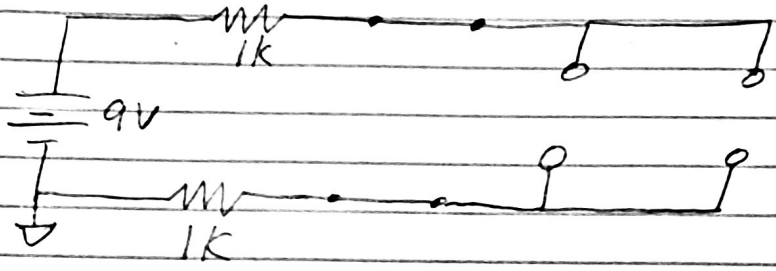
c) 173 mW Supplied

d) -173 mW Absorbed

12

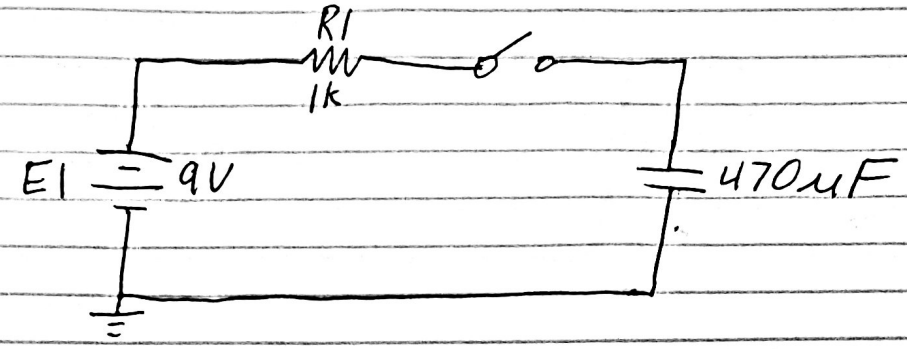


Steady State:



$V_{C1} = 9V$
$I_{L1} = 0A$
$V_{L2} = 0V$
$I_S = 0A$

13.



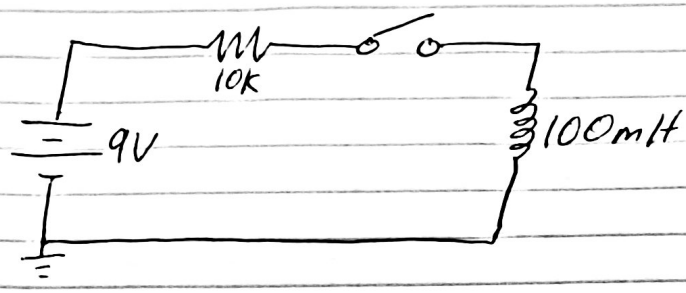
$\tau = RC = 1k \cdot 470uF = 470ms$

14 5τ: 99.3% of voltage

$9V \cdot .993 = 8.937V$

15. Infinity

16.

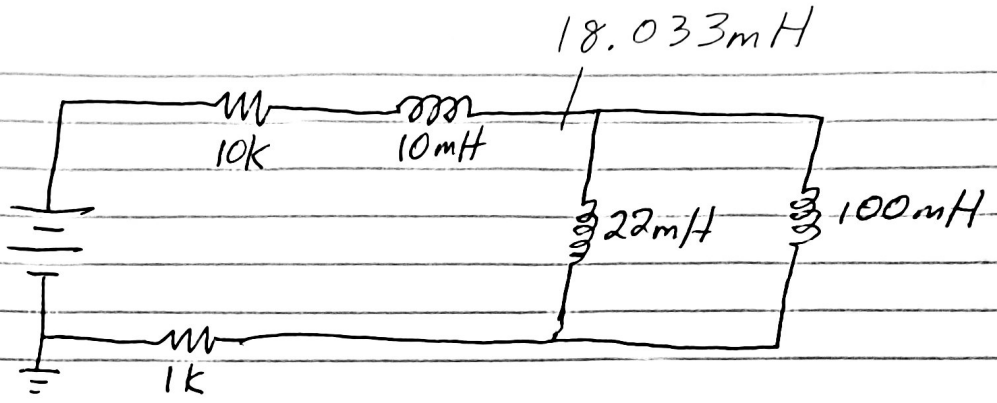


$$\tau = L/R = \frac{100mH}{10K} = 10\mu s$$

17. $i_L(t) = \frac{9V}{10k\Omega}\left(1 - e^{-t/10\mu s}\right) A$

18 Spark

19.



$L_T = (22mH // 100mH) + 10mH = 28.033\,mH$

20. $R_T = 10k + 1k = 11k\,\Omega$

21. b) 18 AWG