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Engr 065 - Circuit theory
Homework No. 2
9.4.22

1. a) Given a light bulb' rated 90 w and 120 v, what is the resistance?

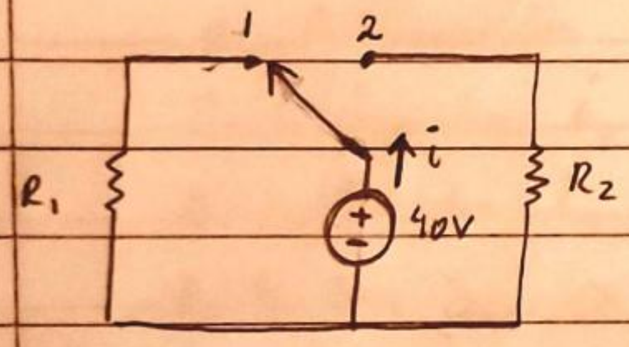
↳ Consider that Power; $P = V^2/R$

rewrite to find $R \rightarrow R = V^2/P$

↳ Thus, Considering $V = (120)^2$ $P = 90w$

↳ $1440/40 = 360\ \Omega$

B. Given the circuit below, and $R_1 = 150\ \Omega$ and $R_2 = 330\ \Omega$



-Calculate current i as switch is in position 1

↳ Apply ohm's law, $v = R_1 i_1$

↳ $i_1 = v/R_1$; $R_1 = 150\ \Omega$ $v = 40v$

↳ $i_1 = 40v/150\ \Omega = .266\ A \Rightarrow 266\ mA$

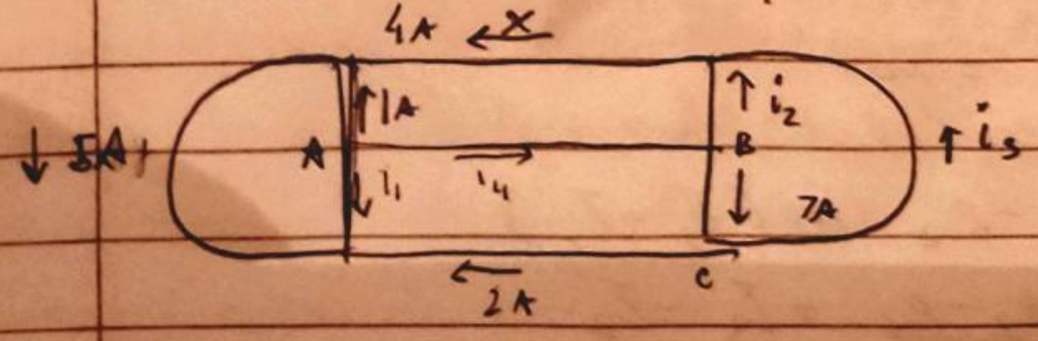
C. Repeat B, compute switch in position 2

↳ recall rewrite of ohm's law

↳ $i_2 = v/R_2$; $v = 40$ $R_2 = 330\ \Omega$

↳ Thus, $40v/330\ \Omega = .122\ A = 122\ mA$

2. Determine i_1, i_2, i_3, i_4, and Consider $x = 4A$ and $y = 5A$



i_1 ↳ Consider $\downarrow 5A$ $\downarrow i_1$ $\leftarrow 2A \Rightarrow -i_1 - 5A - 2A = 0$

↳ $-i_1 - 7A = 0$; $i_1 = -7A$ ✓

i_4 ↳ Consider $\uparrow 1A \rightarrow i_4$ $\downarrow i_1 = -7A$

↳ $1 + i_4 - 7 = 0 \Rightarrow i_4 = 6A$ ✓

i_3 ↳ $-7A + 2A + i_3 = 0 \Rightarrow i_3 = 5$ ✓

i_2 ↳ $-i_2 - i_3 + 5 = 0$

↳ $i_2 = 5 + 5 = 0$

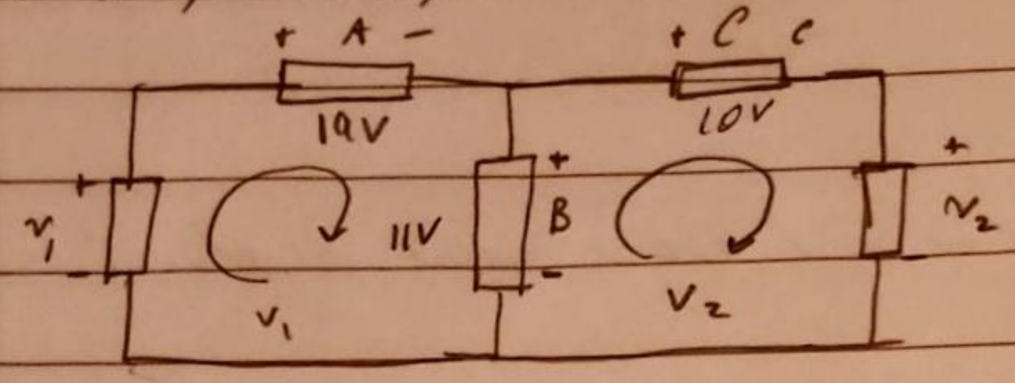
↳ $i_2 = 0$

Thus, $i_1 = -7A$, $i_2 = 0A$, $i_3 = 5A$, $i_4 = 6A$ ✓

Problem 2

B. Calc the V_1 and V_2 of the Circuit below, given that

$A = 19V$, $B = 11V$, $C = 10V$



V_1 ↳ Consider kvl $= -V_1 + 19 + 11$

↳ $V_1 - 19 - 11 = 0$

↳ $V_1 = 30V$ ✓

V_2 ↳ Consider one more kvl $= V_2 - 11V + 10V$

↳ $V_2 - 11 + 10 = 0$

$V_2 = 1V$ ✓

Problem 3

- Consider the fact that there is a linear relationship between the resistance and temperature of a semiconductor. Given that at 25°C the ohm resistance is 5Ω, and at 100°C there is 340Ω. Calculate the temperature at 1kΩ ($C \cdot 10^{-3}$)

A ↳ Consider $R_1 = 5000\Omega$, $T = 25°C$

$R_2 = 340\Omega$, $T = 100C$

B. ↳ Since there is a linear relationship, we can find slope

↳ $\frac{R_2 - R_1}{T_2 - T_1} = \frac{340 - 5000}{100 - 25} = -62.1\Omega$

C. Consider that, $R_3 = 1k\Omega \Rightarrow 1000\Omega$

↳ Thereby, slope between R_2 & R_3

↳ $\frac{R_3 - R_2}{T_3 - T_2} = m$

↳ $R_3 - R_2 = m(T_3 - T_2)$

↳ $\frac{R_3 - R_2}{m} = T_3 - T_2$

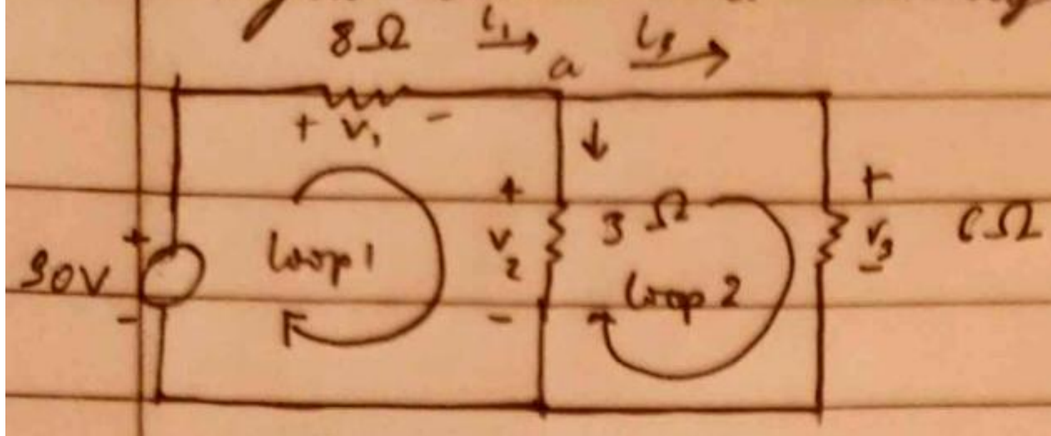
↳ $\frac{R_3 - R_2}{m} - T_2 = T_3$; $T_2 = 100$ $T_3 = ?$ $R_3 = 1000$

$R_2 = 340\Omega$

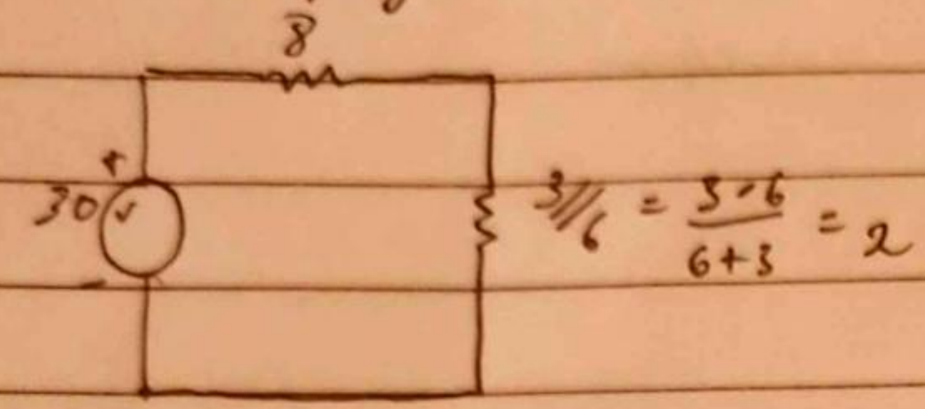
↳ $100 + \frac{1000 - 340}{-62.1} = 89.4°C$ ✓

Problem 4.

a. Find Current and voltage in the following Circuit



↳ simplify the Circuit



A. ↳ Consider $R_{eq} = 8 + 2$ // series Circuit

↳ Thus, $R_{eq} = 10\ \Omega$ ✓

B. ↳ Consider $i_1 = V/R_{eq} = 30/10 = 3A$ ✓

C. ↳ Consider $i_2 = 3 \cdot 2/6 = 2A$ ✓

D. ↳ Consider $i_3 = 3 \cdot 3/9 = 1A$ ✓

E ↳ Consider $V_1 = R \cdot I \Rightarrow 8 \cdot 3 \Rightarrow V_1 = 24V$ ✓

F. ↳ Consider $V_2 = R \cdot I \Rightarrow 3 \cdot 2 \Rightarrow 6V$ ✓

G ↳ Consider $V_3 \Rightarrow 6 \cdot 1 = 6V$ ✓

b. Compute power absorbed by each element

↳ Consider $P = i^2 R$

↳ Thusly, $P_{8\Omega} = 3^2 \cdot 8 = 72W$ ✓

$P_{3\Omega} = 2^2 \cdot 3 = 12W$ ✓

$P_{6\Omega} = 1^2 \cdot 6 = 6W$ ✓

c. Power supplied by each element

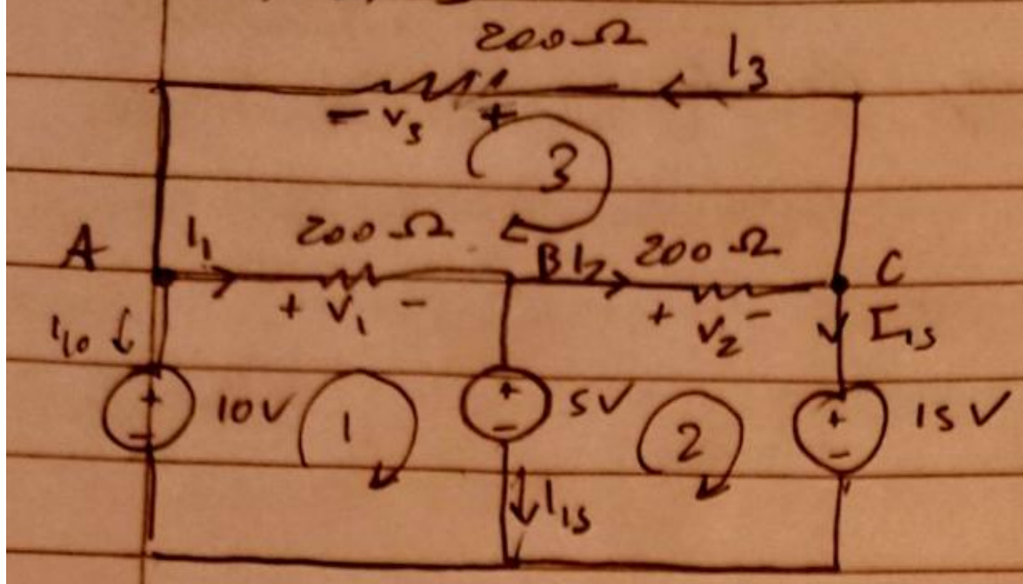
↳ Consider $P = VI$

↳ $P_{30V} = 30 \cdot i_1 = 90W$; $i_1 = 3$ ✓

↳ $P_{30V} = 30 \cdot i_2 = 60W$; $i_2 = 2$ ✓

↳ $P_{9V} = 30 \cdot 1 = 30W$; $i_1 = 1$ ✓

Problem 5



a. use kvl Find voltage across each resistor

↳ kvl $Loop_1 = -10V + V_1 - 5 = 0$

↳ $V_1 = 15V$ ✓

↳ kvl $Loop_2 = 5V + 15V + V_2 = 0$

↳ $V_2 = -20V$ ✓

↳ kvl $Loop_3 = -15 - V_3 - (-20) =$

↳ $-V_3 = -5$; $V_3 = 5V$ ✓

b. find Current running through each resistor

↳ Consider ohm's law; $V = IR \Rightarrow I = V/R$

↳ $I_1 = 15V/200\Omega = .750\,A = 75mA$ ✓

↳ $I_2 = -20/200 = -1/10 = -1mA$ ✓

↳ $I_3 = 5/200 = 1/40 = 25mA$ ✓

c. Find Current through each voltage source

↳ refer to diagram above.

↳ At A $\Rightarrow I_3 = I_{10} + I_1$

↳ $I_{10} = 25 - 75$

↳ $I_{10} = 50 \cdot 10^{-3}\,mA$ ✓

↳ At B $\Rightarrow I_1 = I_2 + I_5$

↳ $I_5 = 75mA - (-1mA)$

↳ $I_5 = 175 \cdot 10^{-3}\,mA$ ✓

↳ At C $\Rightarrow I_2 = I_3 + I_{15}$

↳ $I_{15} = 1mA - 25mA$

↳ $I_{15} = -125 \cdot 10^{-3}\,mA$ ✓