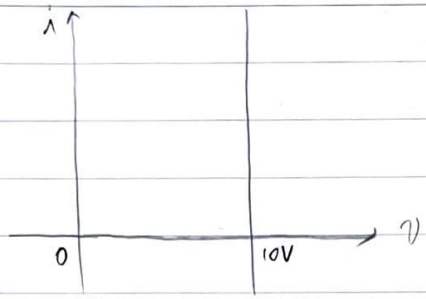
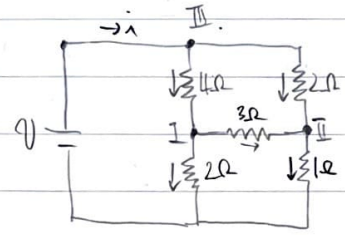
EEC HW1. 2021-16988 Jaewan Park.

Problem 1.2.



Exercise 2.3 (d)



Connect a test voltage and let the total voltage, current as v, i. Let the voltage at node I and II as v_1, v_2. Now apply KCL

$\therefore$ Node I: $\frac{v-v_1}{4} - \frac{v_1-v_2}{3} - \frac{v_1-0}{2} = 0$

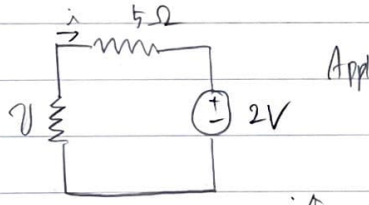
Node II: $\frac{v-v_2}{2} + \frac{v_1-v_2}{3} - \frac{v_2-0}{1} = 0$

$\therefore v_1 = \frac{v}{3}$, $v_2 = \frac{v}{3}$.

Node III: $i - \frac{v-v_1}{4} - \frac{v-v_2}{2} = 0$

$\therefore i = \frac{1}{2}v$, $R_{EQ} = \frac{v}{i} = 2\Omega$

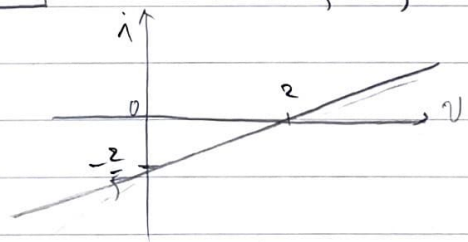
Exercise 2.8 (c)



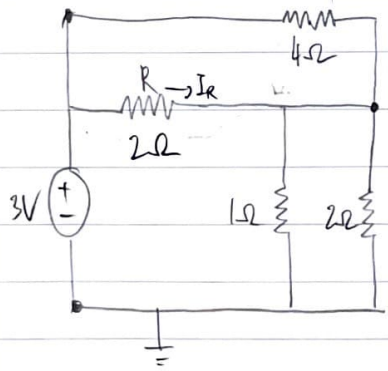
Apply loop analysis.

$2V - v + 5i = 0$

$\therefore i = \frac{1}{5}v - \frac{2}{5}$



Problem 2.9



$R_{EQ} = 2||4 + 1||2 = 2\Omega$

$\therefore I_R = \frac{3V}{2\Omega} \times \frac{4}{2+4} = 1A$

$\therefore P_R = I_R^2 \cdot R = 2W$

Problem 2.11 (b)

$V_L = V_S \times \frac{R_L}{R_S+R_L}$

$\therefore P_L = \frac{V_L^2}{R_L} = V_S^2 \times \frac{R_L}{(R_S+R_L)^2}$

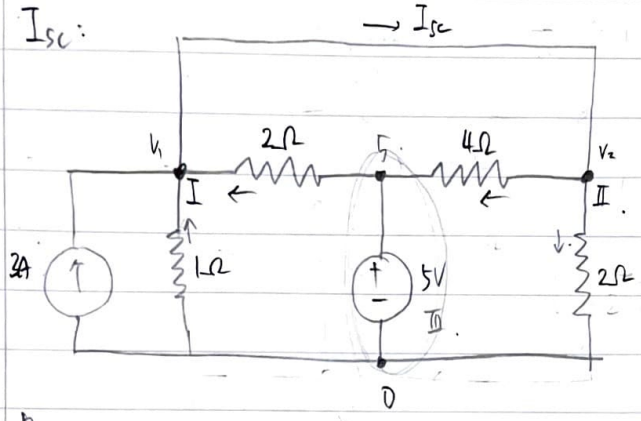
$\frac{dP_L}{dR_L} = V_S^2 \times \frac{1\cdot(R_S+R_L)^2 - R_L \cdot 2(R_S+R_L)}{(R_S+R_L)^4} > 0$

$\Leftrightarrow R_S = R_L$

$\therefore P_L$ maximum at $R_S = R_L$

Exercise 3.10.

I_{sc}:



Apply node analysis.

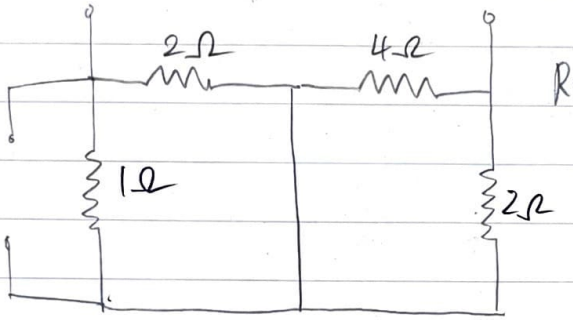
Node I: $3 + \frac{4-V_1}{1} + \frac{5-V_1}{2} = I_{sc}$

Node II: $I_{sc} = \frac{V_2-0}{2} + \frac{V_2-5}{4}$

$V_1 = V_2$

$\therefore I_{sc} = 1A, \quad V_1 = V_2 = 3V$

R_T:

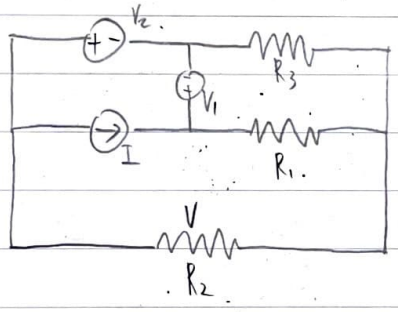


$R_T = 1 \| 2 + 4 \| 2$

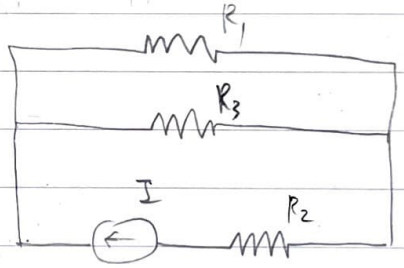
$= 2\Omega$

$\therefore I_N = 1A, \quad R_N = 2\Omega$

Exercise 3.16

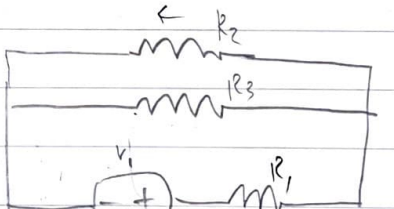


Use superposition find contributes of V (let each contributions to V: V_I, V_{V_1}, V_{V_2})

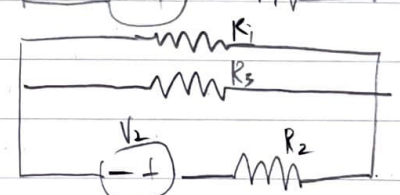


I: $V_I = I \times R_2$

V_1: $V_{V_1} = V_1 \times \frac{R_2 \| R_3}{R_1 + R_2 \| R_3}$

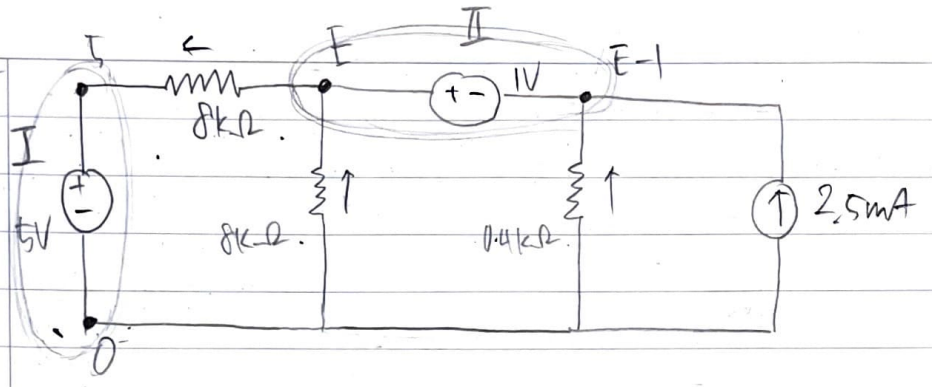


V_2: $V_{V_2} = -V_2 \times \frac{R_2}{R_1 \| R_3 + R_2}$



$\therefore V = I R_2 + V_1 \frac{R_2 R_3}{R_1 R_2 + R_2 R_3 + R_3 R_1} - V_2 \frac{R_1 R_2 + R_2 R_3}{R_1 R_3 + R_2 R_3 + R_3 R_1}$

Exercise 3.25

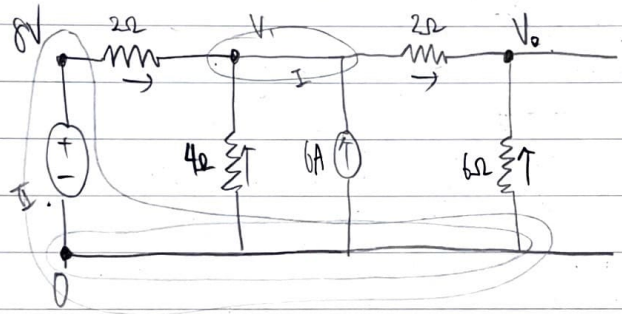


Apply node analysis to

Node I: $\frac{E-5}{8} = \frac{0-E}{8} + \frac{0-E+1}{0.4} + 2.5$

$\therefore E = \frac{41}{22} V$

Problem 3.3



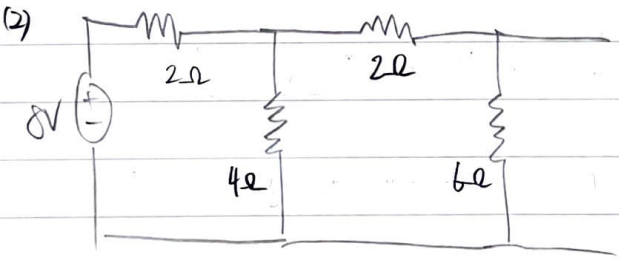
(1) Apply node analysis to node

Node II: $\frac{8-V_1}{2} + \frac{0-V_1}{4} + 6 + \frac{0-V_o}{6} = 0$

Node I: $\frac{8-V_1}{2} + \frac{0-V_1}{4} + 6 = \frac{V_1-V_o}{2}$

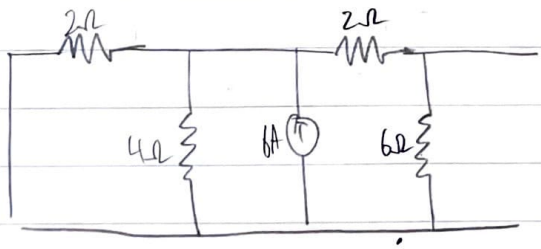
$\therefore V_o = \frac{60}{11} V, \quad V_1 = \frac{50}{11} V$

(2)



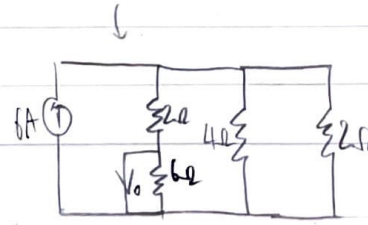
$R_{EQ} = 2 + 4 \| 8 = \frac{14}{3} \Omega$

$V_o = 8V \times \frac{4 \| 8}{2 + 4 \| 8} \times \frac{6}{2+6} = \frac{24}{11} V$

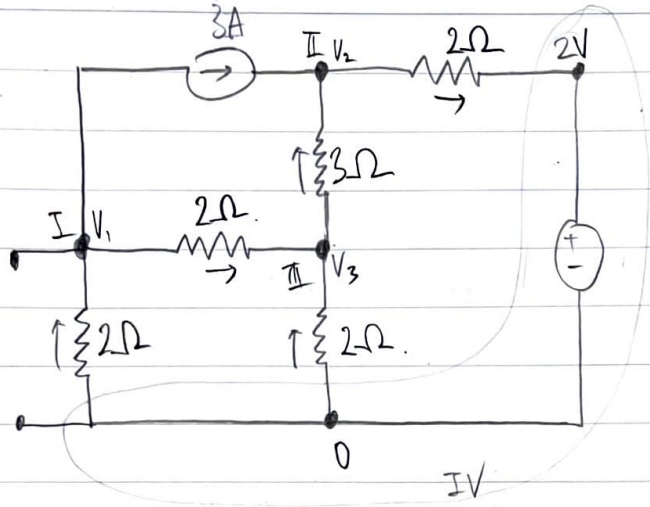


$V_o = 6\Omega \times \left(6A \times \frac{2 \| 4}{8 + 2 \| 4}\right) = \frac{36}{11} V$

$\therefore V_o = \frac{24}{11} V + \frac{36}{11} V = \frac{60}{11} V$



Problem 3.6



Apply node analysis on

Node I : $3 + \frac{V_1 - V_3}{2} = \frac{0 - V_1}{2}$

Node II : $3 + \frac{V_3 - V_2}{3} = \frac{V_2 - 2}{2}$

Node III : $\frac{V_1 - V_3}{2} + \frac{0 - V_3}{2} = \frac{V_3 - V_2}{3}$

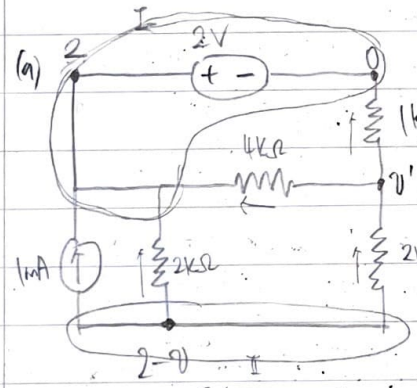
$\therefore V_1 = -\frac{56}{19} V, \quad V_2 = \frac{92}{19} V, \quad V_3 = \frac{2}{19} V$

$\therefore V_x = V_1 = -\frac{56}{19} V$

2019 1st Exam

2.

(a)



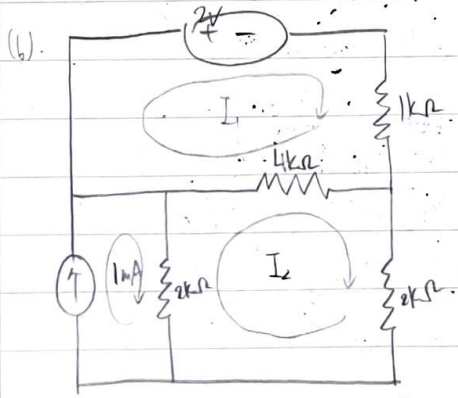
Apply node analysis on

Node I : $\frac{V'-0}{1} + \frac{2-V-2}{2} + 1 + \frac{V'-2}{4} = 0$

Node II : $1 + \frac{2-V-2}{2} + \frac{2-V-V'}{2} = 0$

$\therefore V' = \frac{1}{3} V, \quad V = \frac{11}{6} V$

(b)



Apply loop analysis on

Loop 1 : $2 + 1 \cdot I_1 + 4 \cdot (I_1 - I_2) = 0$

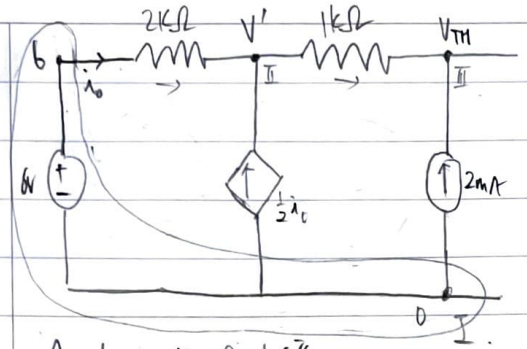
Loop 2 : $2 \cdot (I_2 - 1) + 4 \cdot (I_2 - I_1) + 2 \cdot I_2 = 0$

$\therefore I_1 = -\frac{1}{3} mA \quad I_2 = \frac{1}{6} mA$

$V = 2 \cdot (1 - I_2)$

$= \frac{11}{6} V$

#3.



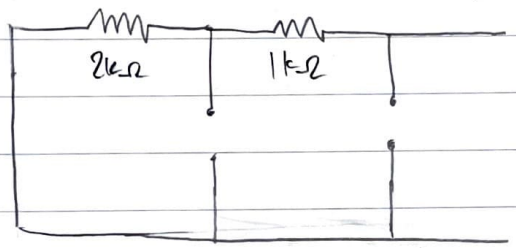
Apply node analysis on

Node I : $i_o + \frac{1}{2} i_o + 2 = 0$

Node II : $\frac{1}{2} i_o + i_o = \frac{V' - V_{TH}}{1}$

$i_o = \frac{6 - V'}{2}$

$\therefore i_o = -\frac{4}{3}\,mA,\quad V' = \frac{26}{3}\,V,\quad V_{TH} = \frac{32}{3}\,V$



$R_{TH} = 2 + 1 = 3k\Omega$.

$\therefore V_{TH} = \frac{32}{3}\,V,\quad R_{TH} = 3k\Omega$.