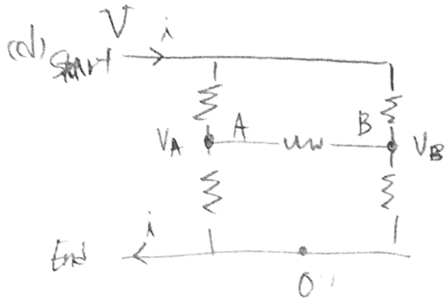
Electrical and Electronic Circuits (001) Prof. Ha, Soonhoi 2016-11164 길종범 컴퓨터공학부

Homework #1

Exercise 2.3 (c), (d)

(c) $R_{eq} = \dfrac{1}{\frac{1}{4+2} + \frac{1}{2+1}} = 2\ (\Omega)$ series + parallel

(d)



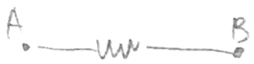
V_A : voltage at A | V_B voltage at B

V voltage at startpoint | 0: voltage at Endpoint

$$A: \frac{V - V_A}{4} = \frac{V_A - V_B}{3} + \frac{V_A}{2} \cdots ① \text{ (KCL)}$$

$$B: \frac{V - V_B}{2} = \frac{V_B - V_A}{3} + \frac{V_B}{1} \cdots ② \text{ (KCL)}$$

$2① - ② \Rightarrow V_A = V_B$

so,  part doesn't have current.

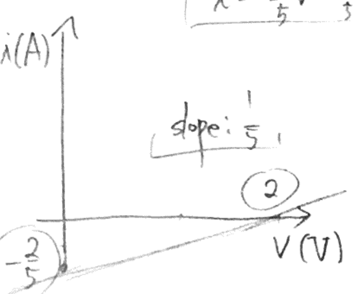
Then, R_{eq} will be same with (c)'s R_{eq}

$$R_{eq} = \frac{1}{\frac{1}{4+2} + \frac{1}{2+1}} = 2\ (\Omega)$$

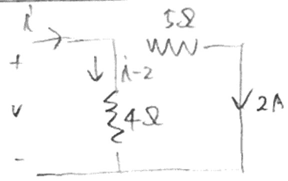
Exercise 2.8 (c), (e)

(c) $V - 5i - 2 = 0$

$\Rightarrow \boxed{i = \frac{1}{5}V - \frac{2}{5}}$

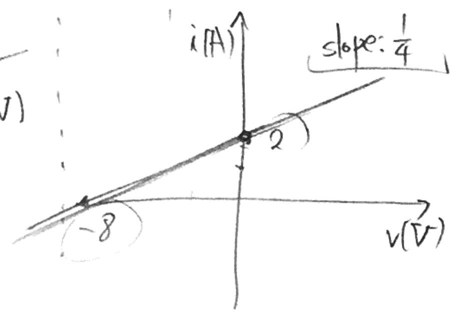


(e)

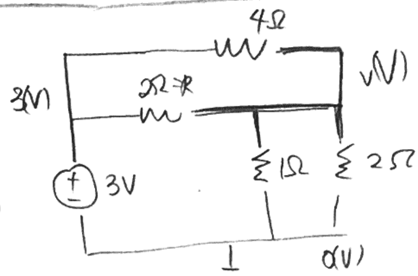


$V - 4(i-2) = 0$

$\boxed{i = \frac{1}{4}V + 2}$



Problem 2.9



at bold node. (KCL)

$$\frac{V-3}{4} + \frac{V-3}{2} + \frac{V}{1} + \frac{V}{2} = 0$$

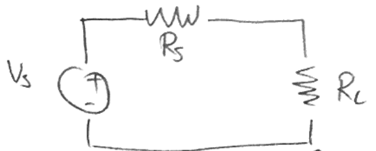
$$9V - 3 - 6 = 0 \iff V = 1\ (V)$$

※ — R → i — let i is current on R to right direction

$$i = \frac{3-V}{2} = 1\ (A)$$

$$P_R = i^2 R = \boxed{2\ (W)}$$

Problem 2.11 (b)



$$P_{R_L} = \frac{V_S R_L}{R_S + R_L} \cdot \frac{V_S}{R_S + R_L} = V_S^2 \cdot \frac{R_L}{R_S^2 + 2R_S R_L + R_L^2}$$

$$= V_S^2 \frac{1}{R_S} \cdot \frac{R_L/R_S}{1 + 2(R_L/R_S) + (R_L/R_S)^2} \Rightarrow \text{equal } A(k)$$

let $k = R_L/R_S$

$$A(k) = \frac{k}{1 + 2k + k^2} = \frac{1}{(k+1)} - \frac{1}{(k+1)^2}$$

$$= -\left(\frac{1}{(k+1)} - \frac{1}{2}\right)^2 + \frac{1}{4}$$

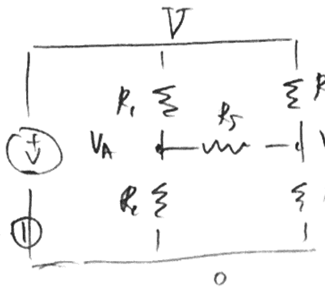
when $k+1 = 2$ $A(k)$ will be maximum

so. $\frac{R_L}{R_S} = k = 1$

$\therefore$ when $\boxed{R_L = R_S}$

the Power dissipated in R_L is maximum

Exercise 3.1



KCL at A

$$\frac{V_A-V}{R_1}+\frac{V_A-V_B}{R_5}+\frac{V_A-0}{R_2}=0 \quad \cdots ①$$

2 1 4

KCL at B

$$\frac{V_B-V}{R_3}+\frac{V_B-V_A}{R_5}+\frac{V_B-0}{R_4}=0 \quad \cdots ②$$

3 1 1

$$\left(\frac{1}{2}+\frac{1}{1}+\frac{1}{4}\right)V_A-\frac{1}{1}V_B-1=0 \quad ③ \quad (\text{by } ①)$$

$$-\frac{1}{1}V_A+\left(\frac{1}{3}+\frac{1}{1}+\frac{1}{2}\right)V_B-\frac{2}{3}=0 \quad ④ \quad (\text{by } ②)$$

$$7V_A-4V_B-4=0 \quad \cdots ⑤ \qquad ⑤-⑥$$

$$-6V_B+11V_B-4=0 \quad ⑥ \qquad 13V_A=15V_B$$

⑤에 ⑦ 대입 $\frac{105}{15}V_A-\frac{52}{15}V_A-4=0$

$V_A=\frac{60}{53}(V)$, $V_B=\frac{52}{53}(V)$

$$i=\frac{V_A-V_B}{R_5}=\boxed{\frac{8}{53}(A)}$$

Exercise 3.18 (b)

$V_{\{A,B,C,D,E\}}$: voltage at $\{A,B,C,D,E\}$

$V_E=0$, $V_C=V_D+V_1$

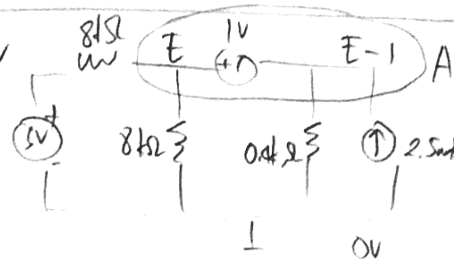
KCL at A $\quad \frac{V_A-V_D}{R_1}+\frac{V_A-V_B}{R_2}+\frac{V_A-0}{R_4}=0$

KCL at B $\quad \frac{V_B-V_A}{R_2}+\frac{V_B-0}{R_5}+\frac{V_B-(V_D+V_1)}{R_3}=0$

KCL at D $\quad \frac{V_D-A}{R_1}+\frac{(V_D+V_1)-V_B}{R_3}+\frac{V_D-0}{R_6}=0$

we can find V_A, V_B, V_D with 3 above equations

Exercise 3.25



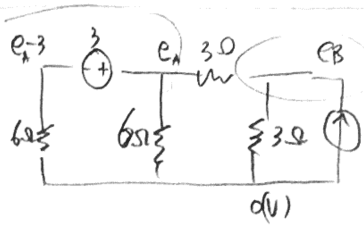
KCL at SuperNode A

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

$$22E-5-20-20=0 \qquad \boxed{E=\frac{45}{22}(V)}$$

Problem 3.10

1) Node Method



KCL at A

$$\frac{e_A-3-0}{6}+\frac{e_A-0}{6}+\frac{e_A-e_B}{3}=0$$

$$\Rightarrow 4e_A-2e_B-3=0 \quad \cdots ①$$

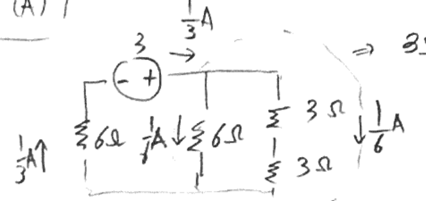
KCL at B

$$\frac{e_B-e_A}{3}+\frac{e_B-0}{3}-2=0 \qquad \Rightarrow e_A=3\ (V)$$

$$-e_A+2e_B-6=0 \quad \cdots ② \qquad e_B=4.5\,(V)$$

$$i=\frac{e_A-0}{3}=\boxed{\frac{1}{2}(A)}$$

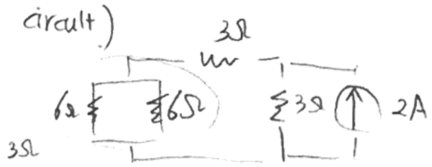
2) ⓐ only voltage



$i_V=\frac{1}{6}(A)$

(by parallel and series circuit)

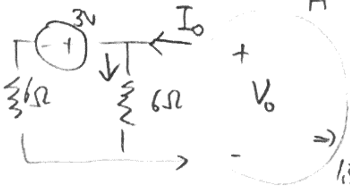
ⓑ only current



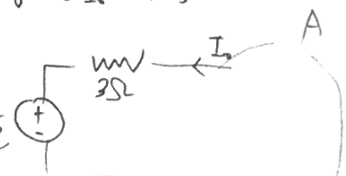
$$i_I=\frac{2}{3}\times\frac{1}{2}=\frac{1}{3}(A)$$

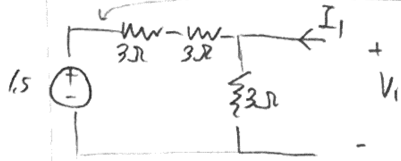
$$i=i_V+i_I=\boxed{\frac{1}{2}(A)}$$

3)



$V_0=3I_0+1.5$





$V_1=2I_1+0.5$

$I_1=2A$이므로 $V_1=4.5$

$I_0=I_1-\frac{4.5}{3}=0.5A$ 이므로 $V_0=3V$

$$i=\frac{3}{6}=0.5=\boxed{\frac{1}{2}(A)}$$