Midterm Exam: 1 hour, 10:30 AM – 12:00PM including preparation/submission.

Name: 김다영

Student ID: 12201856

Honor Code: Please write this honor code below with your signature either in Korean or in English.

"나는 정직하게 시험에 응할 것을 서약합니다.""

"By signing this pledge, I promise to adhere to exam requirements and maintain the highest level of ethical principles during the exam period."

나는 정직하게 시험에 응할 것을 서약합니다.

Name/Student ID: 김다영/12201856 Date: 21.04.21 Signature: 김다영

Before the exam

- Camera should be on during the exam.
- Official student ID card is required for your identification.
- Official answer sheets (from I-Class) should be printed before the exam.

During the exam

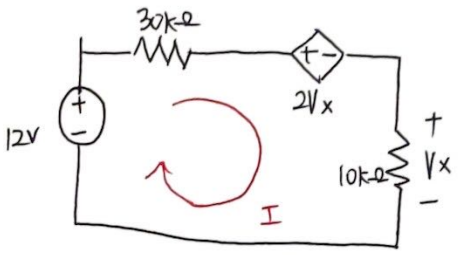
- It is closed book test.
- You can use personal calculator.
- Chatting or discussion is NOT allowed.
- You need to turn on your microphone during the exam.

After the exam

- Take photos (or scan) of your answer sheets and please check image quality.
- **E-mail these photos to you and to instructor: mgk@inha.ac.kr within 5 mins.**
- **Upload a combined pdf file to I-Class (midterm section) within 10 mins.**
- **Submit original papers to Hitech 314 within a week (deadline: 04.30 Fri).**

9 **Question Number:** 4.

a)



$-12 + 30kI + 2Vx + 10kI = 0.$

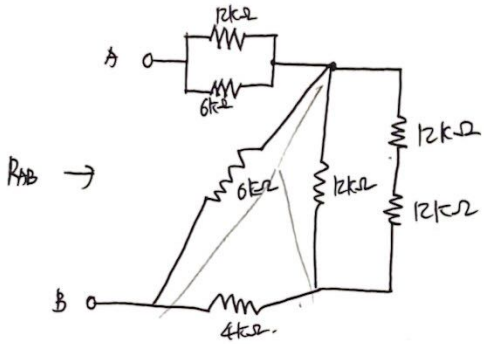
$Vx = 10kI$

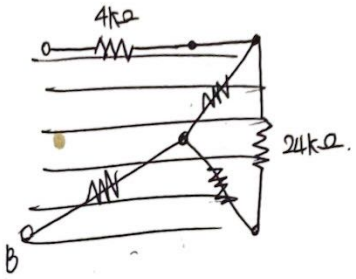
$40kI + 20kI = 12.$ $60kI = 12.$ ~~$I = 200$~~ $I = 2 \times 10^{-4} A = 2 \cdot 10^{-6} \cdot 10^{2} =$ 200 μA.

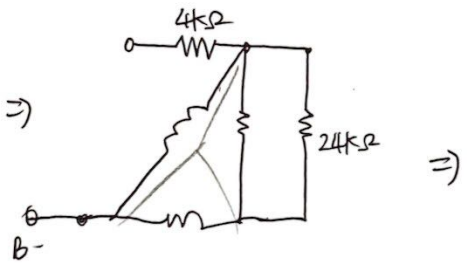
b) $P_{30k\Omega} = (200\mu A)^2 \cdot 30k = 400 \cdot 10^{-12} \cdot 30 \cdot k = 1.2 \times 10^{-5} W. = 12\mu W.$

$P_{30k\Omega} > 0$ 이므로 소비되는 전력, 즉 전달받는 전력이다.

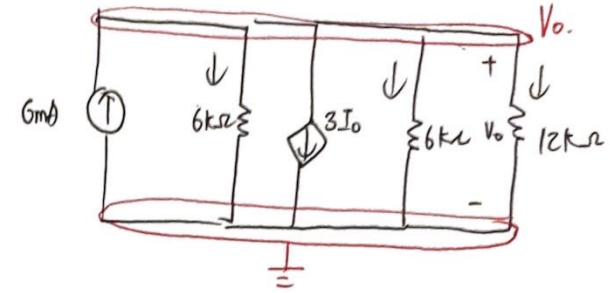
Question Number: 2.





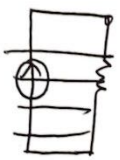


Question Number: 3.



a). Vo찾기 b) 12kΩ의 P찾기.

∄ $(6k\Omega \parallel 3k\Omega) = 2k\Omega$.



$2k\Omega + 4k\Omega = 6k\Omega$.

by. node voltage method.

$$-6mA + \frac{V_o}{6k} + 3I_o + \frac{V_o}{6k} + \frac{V_o}{12k} = 0.$$

$$I_o = \frac{V_o}{6k} \times \frac{6k}{6k+3k} = \frac{V_o}{9k}$$

$$\frac{V_o}{6k} + \frac{V_o}{3k} + \frac{V_o}{6k} + \frac{V_o}{12k} = 6 \cdot 10^{-3}.$$

$$2V_o + 4V_o + 2V_o + V_o = 12 \cdot 6 = 72$$

$$9V_o = 72, \quad V_o = 8V.$$

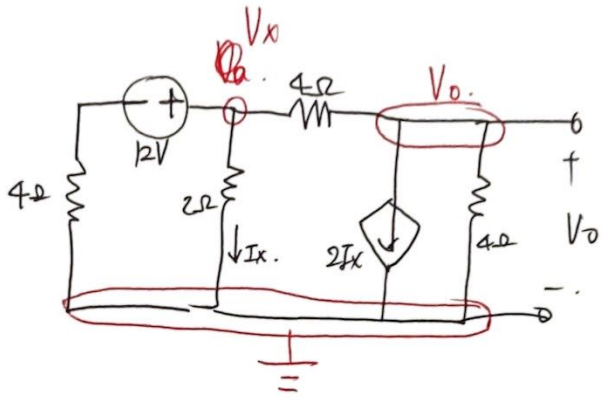
b). $V_o = 8[V]$일 때 $R = 12k\Omega$

$$P_{12k\Omega} = \frac{V^2}{R} = \frac{64}{12k} = 0.0053\ W = 5.3mW.$$

Question Number: 4.

Q

(a).



(a)

↓ Ix

(b)

$$\frac{V_x-12}{4}+\frac{V_x}{2}+\frac{V_x-V_o}{4}=0. \qquad V_x-12+2V_x+V_x-V_o=4V_x-V_o-12=0.$$

$$4V_x-V_o=12.$$

$$\frac{V_o-V_x}{4}+2I_x+\frac{V_o}{4}=0.$$

$$V_o-V_x+8I_x+V_o=0 \qquad I_x=\frac{V_x}{2}$$

~~$2V_o-V_x=8$~~

$$V_o-V_x+4V_x+V_o=0.$$

$$2V_o+3V_x=0.$$

$$V_x=2.182\ V$$

$$V_o=-3.273V.$$

(b)

essential node의 수 3개.

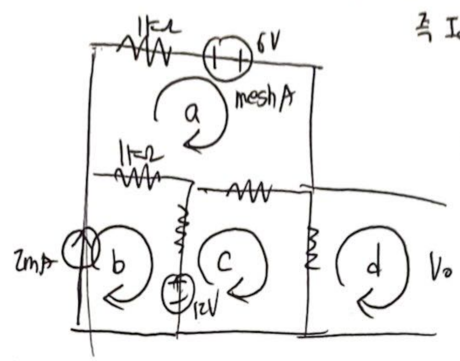
equation 수 3개

9

Question Number: 5.

(b)

(a) open circuit이므로 V_o부분의 $i=0$이다.
즉 $I_d=0$이다. V_o란 1kΩ 부분에서 mesh current 식에의해.
$V_o = 1k I_c$이다.



$I_a=a,\ I_b=b,\ I_c=c,\ I_d=d.$

mesh의 수 : 4

mesh. a)

$1k\,a - 6 + 2k(a-c) + 1k(a-b) = 0.$

$= 1ka - 6 + 2ka - 2kc + 1ka - 1kb$

$\Rightarrow 4ka - 1kb - 2kc = 6.$ $\quad 4ka - 2kc = 6 + 1kb = 8.$ $\quad 2a - c = 4\cdot10^{-3}.$

b)

$I_b = 2mA = b.$

c)

$2k(c-a) + 1k(c-d) - 12 + 1k(c-b) = 0.$

$= 2kc - 2ka + 1kc - 1kd - 12 + 1kc - 1kb = 0$

$-2ka + 4kc - kd - 1kb - 12 = 0$

$2ka + 1kb - 4kc + kd = -12.$ (b = 2mA) $\Rightarrow 2ka + 2 - 4kc = -12.$ $\quad 2ka - 4kc = -14$

$ka - 2kc = -7.$

$a - 2c = -7\cdot10^{-3}.$

d) V_o가 open이므로. $I_d = 0.$

~~$V_o = 1k\,I_d$~~ $V_o + 1k(d-c) = 0.$

$V_o = 1kc.$

$a = 5mA. \quad b = 2mA.$

$c = 6mA.$

∴ ~~$V_o = 1k\cdot 6mA =$~~

$V_o = 1k\cdot 6m = 6V$이다.

Question Number: 6.

a).

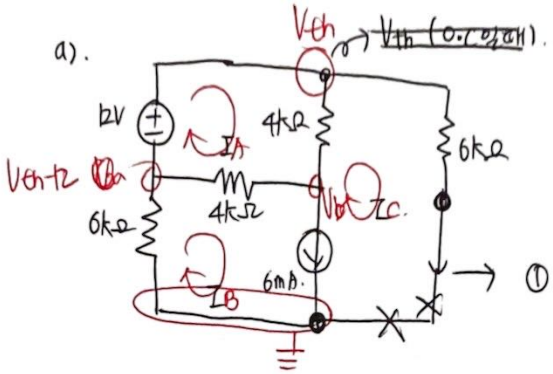
$60 \parallel 40 = 24\,\Omega$

$(60 \parallel 40) + 30 = 24 + 30 = 54\,\Omega$

(b).

Question Number: 7.

a).



$I_A=a$, $I_B=b$, $I_C=c$.

→ ① open. Vth 구하기! $i_{oc}=0$.

~~mesh B-C에서 Supermesh.~~ ~~$I_C=0$~~

~~$4k(C-a)=6k$.~~

① open일때 $I_C=0$.

mesh A. $-12+4k\,a+4k(a-b)=0$.

$b=6mA$.

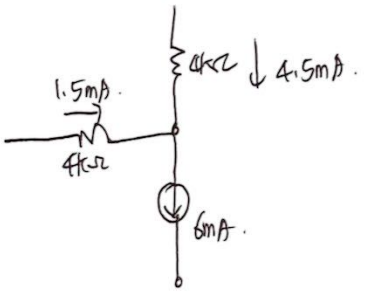
$-12+8ka-4kb=0$.

$8ka=4kb+12=24+12=36$.

$a=4.5mA$

~~Vth=Va~~

~~4kΩ~~ ~~Vth=Vc~~



② Short.

$I_C=I_{sc}=c$. by. Supermesh.

~~6kC~~

$a=2.5mA$. $b=4mA$. $C=-2mA$.

$\therefore i_{sc}=-2mA$

$-8a+10b+10c=0$

$4c-4a+6c+6b+4b-4a=0$

$4k(c-a)+6kc+6kb+4k(b-a)=0$.

$b-c=6mA$.

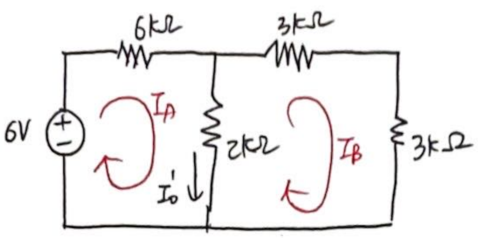
$-12+4k(a-c)+4k(a-b)=0$.

~~12+4ka~~

~~4k~~ : $4a-4c+4a-4b=12\cdot10^{-3}$.

$8a-4b-4c=12\cdot10^{-3}$.

Question Number: 8.



① 전류원을 deactivate.

$I_o' = I_A - I_B$.

$-6 + 6k I_A + 2k(I_A - I_B) = 0.$ $\quad 6k I_A + 2k I_A - 2k I_B = 6.$

$2k(I_B - I_A) + 3k(I_B) + 3k I_B = 0.$ $\quad 8k I_A - 2k I_B = 6$

$2(I_B - I_A) + 6 I_B = 0.$ $\quad 4 I_A - I_B = 3 \cdot 10^{-3}.$

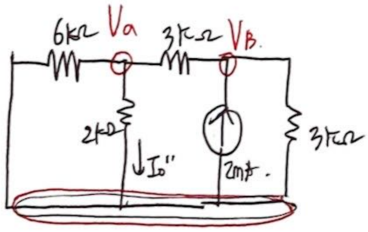
$2I_B + 6I_B = 2I_A.$

$I_A = 4I_B$. $\quad I_A - 4I_B = 0.$

$I_A = 800\mu A.$

$I_B = 200\mu A.$

$I_o' = (800 - 200)\mu A = \underline{600\mu A}.$



② 전압원을 deactivate.

node voltage 이용.

$\frac{V_a}{6k} + \frac{V_a}{2k} + \frac{V_a - V_B}{3k} = 0.$ $\quad V_a + 3V_a + 2V_a - 2V_B = 0.$

$6V_a = 2V_B.$ $\quad 3V_a = V_B.$

$\frac{V_B - V_a}{3k} - 2mA + \frac{V_B}{3k} = 0.$

$V_B - V_a - 6 + V_B = 0.$

$-V_a + 2V_B = 6.$

$-V_a + 6V_a = 6.$ $\quad 5V_a = 6.$ $\quad V_a = 1.2\,V,\ V_b = 3.6\,V.$

$I_o'' = \frac{1.2V}{2k\Omega} = 600\mu A.$

중첩의 원리에 의해 $I_o = I_o' + I_o'' = 600\mu A + 600\mu A = 1200\mu A = 1.2mA$