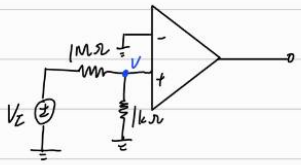
HW1_solution

1.



$$V = \frac{1k}{1000k+1k} V_I = \frac{1}{1001} V_I$$

A→放大倍率

$$V_o = AV = \frac{AV_I}{1001}$$

$$4 = \frac{A}{1001} \Rightarrow A = 4004 \#$$

2. (a), (b), (c), (d) 都一樣

$$V_o = -100k \times I_{in} \qquad R_{in} = \frac{V_i}{I_{in}} = 20k$$

$$= -100k \times \frac{V_i}{20k}$$

$$= -5\, V_i$$

3. $\frac{V_o}{V_i} = -\frac{R_2}{R_1}$, $R_1 + R_2 = 110\ k\Omega$

(a) $\frac{V_o}{V_i} = -10 = -\frac{R_2}{R_1}$

$R_1 = 10k\Omega \quad R_2 = 100k\Omega$

(b) $\left|\frac{V_o}{V_i}\right| = \frac{R_2}{R_1} = \frac{1}{10}$

$R_1 = 100k\Omega \quad R_2 = 10k\Omega$

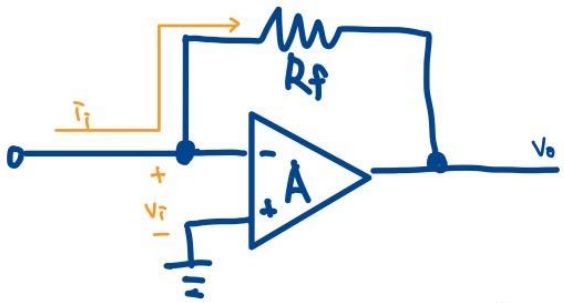
(c) $\left|\frac{V_o}{V_i}\right| = \frac{R_2}{R_1} = 100$

$101\, R_1 = 110k$

$R_1 = \frac{110}{101} k\Omega$

$R_2 = \frac{11000}{101} k\Omega$

4.



(a) for $A=\infty \Rightarrow V_i = 0$

$$i_i = \frac{0 - V_o}{R_f}$$

$$\Rightarrow \frac{V_o}{i_i} = -R_f = R_m \quad (1) *$$

$V_i = 0 \Rightarrow R_{in} = \frac{V_i}{i_i} = 0$ *

虛底設的 (virtual ground)

(b) finite opamp gain $\Rightarrow V_i = -\frac{V_o}{A}$

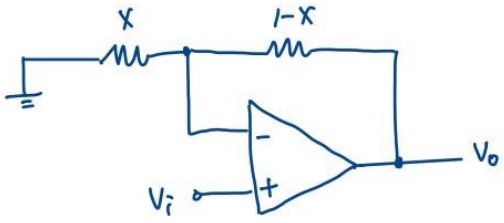
$$V_o = \frac{-V_o}{A} - i_i R_f$$

$$R_m = \frac{V_o}{i_i} = \frac{-R_f}{1 + 1/A} *$$

$$R_i = \frac{V_i}{i_i} = \frac{R_f}{1+A} *$$

不会

5.

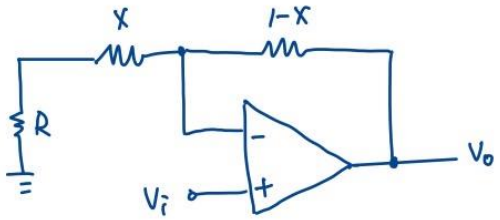


$$\frac{V_o}{V_i} = 1 + \frac{R_2}{R_1}$$

$$= 1 - \frac{1-x}{x}$$

$$= \frac{1}{x}$$

$0 \le x \le 1 \Rightarrow \infty \ge \frac{V_o}{V_i} \ge 1$ #



$$\frac{V_o}{V_i} = 1 + \frac{10k(1-x)}{10k \cdot x + R}$$

$$11 \ge \frac{V_o}{V_i} \ge 1$$

at $\frac{V_o}{V_i} = 11$, $x = 0$?

$\Rightarrow \frac{V_o}{V_i} = 11 = 1 + \frac{10k}{R} \Rightarrow R = 1k$ #

$$10 = \frac{10k(1-x)}{x + R}$$

↑ ↓ ↓

0

怪怪

6.

(a) $I_1 = \frac{1}{10k} = 0.1mA$ ✓

$I_2 = I_1 = 0.1mA$ ✓

$V_X = -I_2 \times 10k\Omega = -1V$ ✓

$I_3 = (0 - V_X)\, 0.1k\Omega = 10mA$ ✓

$I_L = I_2 + I_3 = 10.1mA$ ✓

(b) $V_o = V_X - R_L \times I_L > -13$

$-1 - R_L \times 10.1mA > -13$

$\Rightarrow R_L < \frac{12V}{10.1mA} \approx 1.18k\Omega$

(c) $I_L = I_2 + I_3$, I_L won't change

$-1 - 10.1 \times 1 < V_o < -1 - 10.1 \times 0.1$

$-11.1V < V_o < -2.01V$

7. (a) $R_1 = R$ $R_2 = \frac{R}{2} + R // R = R$ $R_3 = \frac{R}{2} + R // R_2 = R$ $R_4 = R$

(b) $V_1 = -IR \Rightarrow I_1 = \frac{IR}{R} = I$

$V_2 = -IR - 2I \cdot \frac{R}{2} = -2IR \Rightarrow I_2 = 2I$

$V_3 = -2IR - 4I \times \frac{R}{2} = -4IR \Rightarrow I_3 = 4I$

$V_4 = -4IR - 8I \times \frac{R}{1} = -8IR$ $I_4 = -I_3 - 4I = -8I$

$V_1 - IR = 0$?

順電流方向

$V_1 = IR$

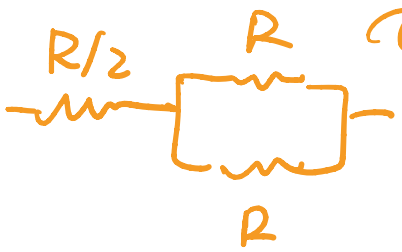
$V_1 - 0 = IR$

$0 - IR = V_1$

$I = -1$

node 1 $R_1 = R$

node 2



並:跑找

相加

再跑找

$\frac{R}{2} + \frac{R}{2} = R = R_2$

node 3 $R_3 = R$

node 4 $R_4 = R$

(b) node 1 $V_1 - \tilde{v}R = 0$

$\tilde{v} = \frac{V_1}{R}$