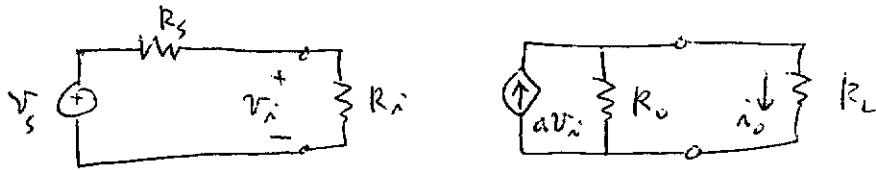


1.2

(a) Transconductance Amp

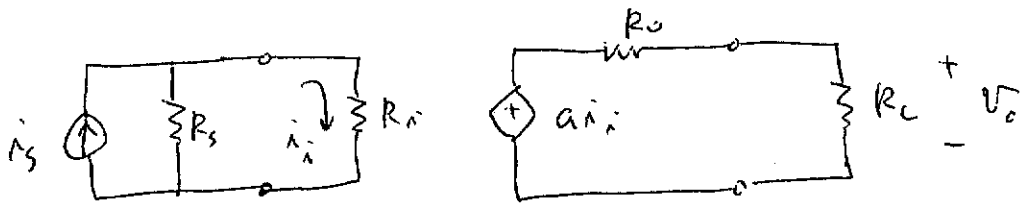


$$i_o = \frac{R_o}{R_o + R_L} a v_i$$

$$= \frac{R_o}{R_o + R_L} \times a \times \frac{R_i}{R_s + R_i} v_s$$

$$\therefore A = \frac{i_o}{v_s} = \frac{R_o}{R_o + R_L} a \frac{R_i}{R_s + R_i}$$

(b) Transresistance Amp.

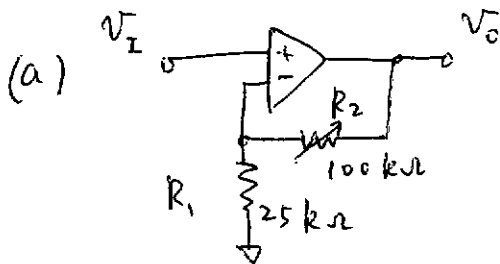


$$v_o = \frac{R_L}{R_o + R_L} a i_i$$

$$= \frac{R_L}{R_o + R_L} a \frac{R_s}{R_s + R_i} i_s$$

$$\therefore A = \frac{v_o}{i_s} = \frac{R_L}{R_o + R_L} a \frac{R_s}{R_s + R_i}$$

1.8

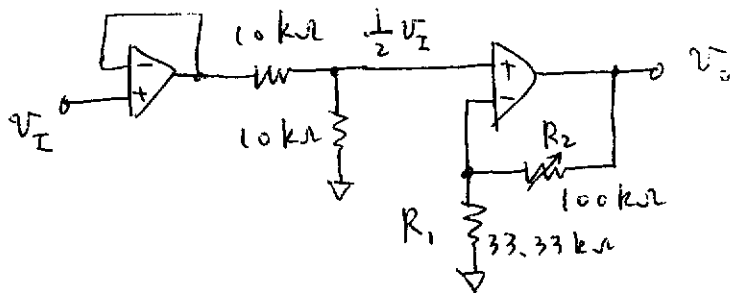


$$R_2 = 0 \Rightarrow A = 1 + \frac{R_2}{R_1} = 1$$

$$R_2 = 100 \text{ k}\Omega \Rightarrow A = 1 + \frac{100}{R_1} = 5$$

$$\therefore R_1 = 25 \text{ k}\Omega$$

(b)



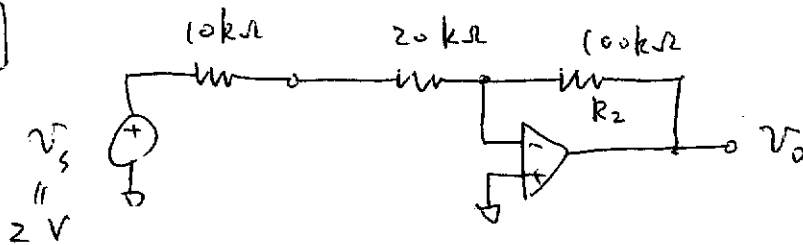
$$R_2 = 0 \Rightarrow A = \frac{1}{2} \left(1 + \frac{R_2}{R_1} \right) = 0.5$$

$$R_2 = 100k\Omega \Rightarrow A = \frac{1}{2} \left(1 + \frac{100}{R_1} \right) = 2$$

$$\therefore R_1 = 33.33k\Omega$$

1.12

(a)



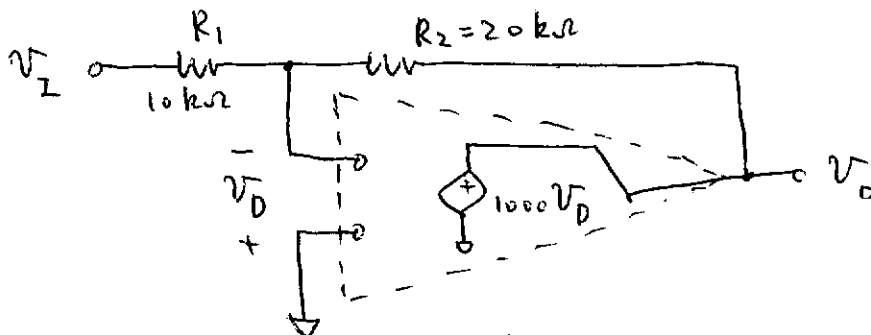
$$v_O = -\frac{100}{30} \times 2 = -6.66V$$

$$\therefore |v_O| < 10V$$

(b) $\frac{v_O}{v_I} = -5$ output $\frac{v_O}{v_I} = -5$

$$\frac{R_2}{30} = 5 \quad \therefore R_2 = 150k\Omega$$

1.14



$$A = \frac{v_O}{v_I} = \frac{-a R_2}{(1+a) R_1 + R_2} = -1.994 \quad (a = 1000)$$

$$v_I = 5 \sin(2\pi \times 1000 t) \quad V$$

$$v_o = -9.97 \sin(2\pi \times 1000 t) \quad V$$

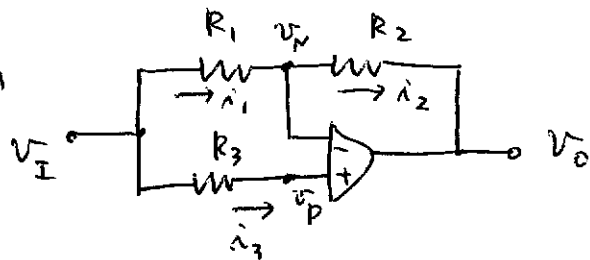
$$v_D = \frac{v_o}{1000} = -9.97 \sin(2\pi \times 1000 t) \quad mV$$

$$v_D = v_P - v_N = 0 - v_N$$

$$\therefore v_N = -v_D = 9.97 \sin(2\pi \times 1000 t) \quad mV$$

1.21

(a) ① S/w open κ_1

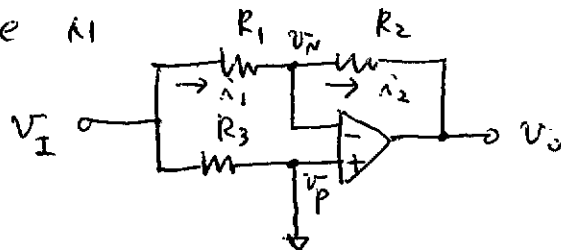


$$i_3 = 0 \Rightarrow v_P = v_I = v_N$$

$$i_1 = \frac{v_I - v_N}{R_1} = 0 \Rightarrow i_2 = i_1 = 0$$

$$\therefore v_o = v_N = v_I \Rightarrow A = 1$$

② S/w close κ_1



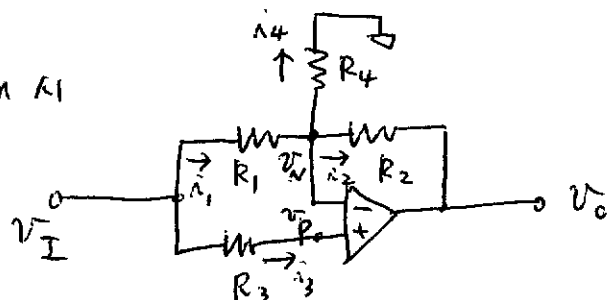
$$v_P = 0 = v_N \Rightarrow i_1 = \frac{v_I}{R_1} = i_2$$

$$v_o = -R_2 i_2 = -\frac{R_2}{R_1} v_I$$

$$\therefore A = -\frac{R_2}{R_1}$$

(b)

① S/w open κ_1



$$\dot{\lambda}_3 = 0 \Rightarrow v_p = v_I = v_N$$

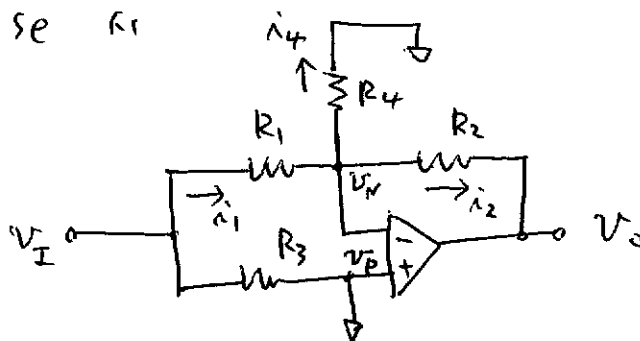
$$\dot{\lambda}_1 = \frac{v_I - v_N}{R_1} = 0, \quad \dot{\lambda}_4 = \frac{v_N}{R_4} = \frac{v_I}{R_4}$$

$$\dot{\lambda}_1 = \dot{\lambda}_2 + \dot{\lambda}_4 \Rightarrow \dot{\lambda}_2 = -\dot{\lambda}_4 = -\frac{v_I}{R_4} = \frac{v_N - v_o}{R_2}$$

$$\therefore v_o = v_I + \frac{R_2}{R_4} v_I = \left(1 + \frac{R_2}{R_4}\right) v_I = \frac{v_I - v_o}{R_2}$$

$$\therefore A = 1 + \frac{R_2}{R_4}$$

(ii) s/w close R_1



$$v_p = 0 = v_N$$

$$\dot{\lambda}_1 = \frac{v_I}{R_1}, \quad \dot{\lambda}_2 = -\frac{v_o}{R_2}, \quad \dot{\lambda}_4 = \frac{0}{R_4} = 0$$

$$\dot{\lambda}_1 = \dot{\lambda}_2 + \dot{\lambda}_4 = \dot{\lambda}_2 \quad \text{or } \underline{0 \neq 2}$$

$$\frac{v_I}{R_1} = -\frac{v_o}{R_2} \Rightarrow v_o = -\frac{R_2}{R_1} v_I$$

$$\therefore A = -\frac{R_2}{R_1}$$

(c) $R_2 = R_4 = 20 \text{ k}\Omega$, $R_1 = 10 \text{ k}\Omega$

1-31

$$(i) v_1 = v_3 = v_5 = 0 \quad \text{or } \underline{0 \neq 2}$$

$$\frac{v_2 - v_p}{R} + \frac{v_4 - v_p}{R} + \frac{v_6 - v_p}{R} = \frac{v_p}{R} \Rightarrow v_p = \frac{1}{4} (v_2 + v_4 + v_6)$$

$$v_{o1} = v_p \times \left(1 + \frac{R}{\frac{R}{3}}\right) = v_2 + v_4 + v_6$$

(11)

$$v_2 = v_4 = v_6 = 0 \text{ of CCH}$$

$$v_p = v_n = 0$$

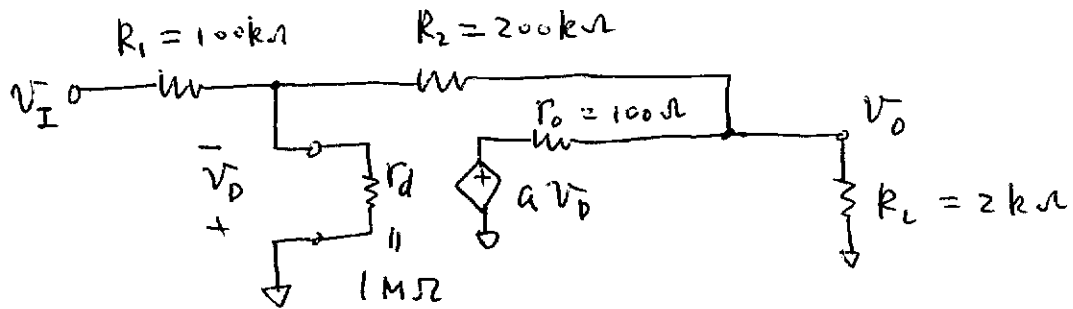
$$\frac{v_1}{R} + \frac{v_3}{R} + \frac{v_5}{R} = - \frac{v_{o2}}{R}$$

$$v_{o2} = -v_1 - v_3 - v_5$$

$$\therefore v_o = v_{o1} + v_{o2} = v_2 + v_4 + v_6 - v_1 - v_3 - v_5$$

($\frac{v_o}{v_i} = \frac{v_o}{v_i}$)

1-52



$$A = - \frac{a R_2 - r_o}{(1+a) R_1 + (R_2 + r_o) (1 + R_1/r_d)}$$

$$= - \frac{200a - 0.1}{(1+a) \times 100 + (200 + 0.1) (1 + 100/1000)}$$

$$= - \frac{200a - 0.1}{100a + 320.11}$$

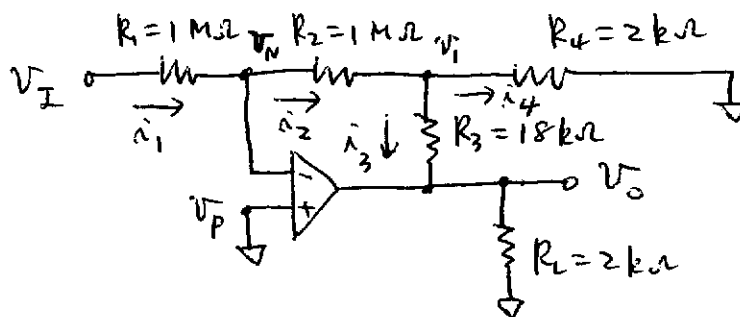
(a)

$$2 - \frac{200a - 0.1}{100a + 320.11} = 0.02 \Rightarrow a \doteq 633.92$$

(b)

$$2 - \frac{200a - 0.1}{100a + 320.11} = 0.00002 \Rightarrow a \doteq 320156.8$$

1-66



$$v_p = v_n = 0$$

$$\hat{i}_1 = \frac{v_I}{R_1} = \hat{i}_2 = \frac{-v_I}{R_2} \Rightarrow v_I = -\frac{R_2}{R_1} v_I$$

$$\hat{i}_3 = \frac{v_I - v_0}{R_3}, \quad \hat{i}_4 = \frac{v_I}{R_4}$$

$$\hat{i}_2 = \hat{i}_3 + \hat{i}_4 \quad \text{이름}$$

$$\frac{-v_I}{R_2} = \frac{v_I - v_0}{R_3} + \frac{v_I}{R_4} \Rightarrow \frac{v_0}{R_3} = \left(\frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} \right) v_I$$

$$\therefore v_0 = \left(\frac{R_3}{R_2} + \frac{R_3}{R_3} + \frac{R_3}{R_4} \right) v_I = \left(1 + \frac{R_3}{R_2} + \frac{R_3}{R_4} \right) v_I$$

$$= -\frac{R_2}{R_1} \left(1 + \frac{R_3}{R_2} + \frac{R_3}{R_4} \right) v_I$$

$$= -10.018 v_I$$

$$(a) \quad V_{im} = 0.5 \text{ V} \Rightarrow V_{om} = 5.009 \text{ V}$$

($\frac{1}{2} \hat{v}_1 + \frac{1}{2} \hat{v}_2 \rightarrow \frac{1}{2} \hat{v}_n$)

$$(b) \quad V_{im} = 2 \text{ V} \Rightarrow V_{om} = 20.036 \text{ V}$$

($\frac{1}{2} \hat{v}_1 + \frac{1}{2} \hat{v}_2 \rightarrow \text{clipping}$)

$$\left(\begin{array}{l} v_I = -\frac{R_2}{R_1} v_I = -v_I \quad \text{이름} \\ V_{im} = V_{im} \Rightarrow (a) \text{ or } (b) \quad \frac{1}{2} \hat{v}_1 + \frac{1}{2} \hat{v}_2 \end{array} \right)$$