REPASO EXAMEN 2

INEL 4076 - Marzo 2013

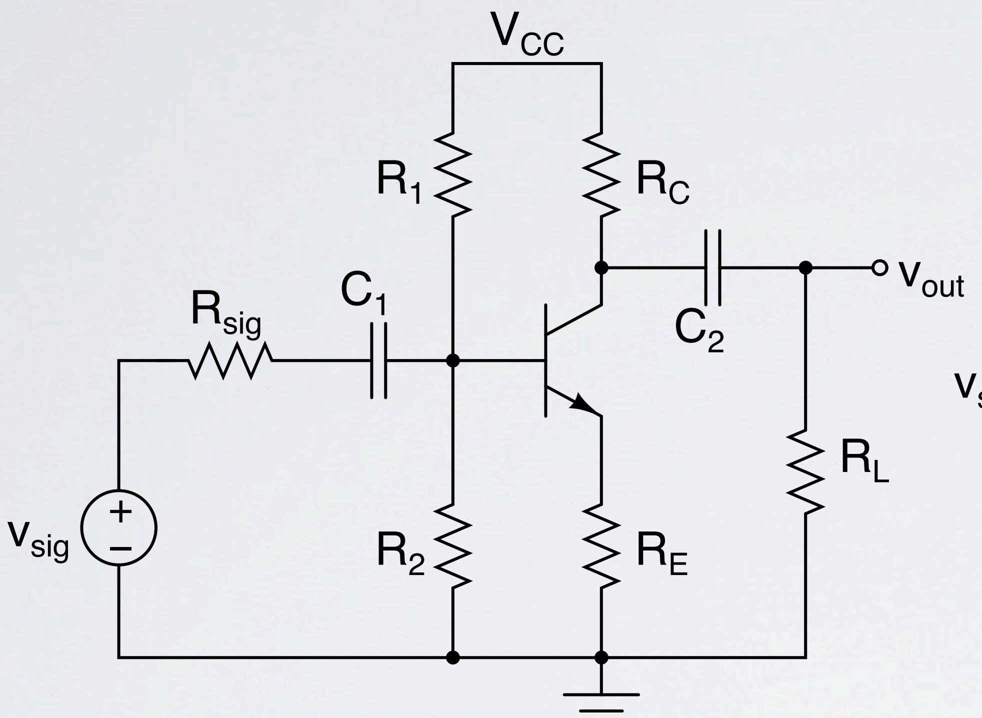
SECCIONES EN LIBRO

- 11-1,11-2,11-4
- 13-6 to 13-8 (sect. 13-1 to 13-5 for reference)
- 14-1 to 14-5

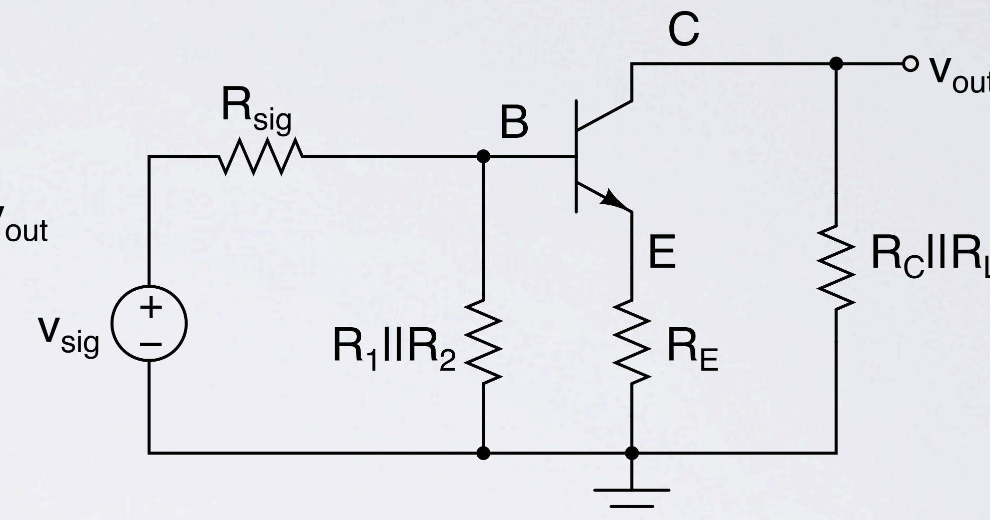
TEMAS

- Amplificadores CE con BJT (ganancia, Rin, Rout)
- Modelos de amplificadores
- OPAMPS (análisis ideal, ancho de bada, etc)

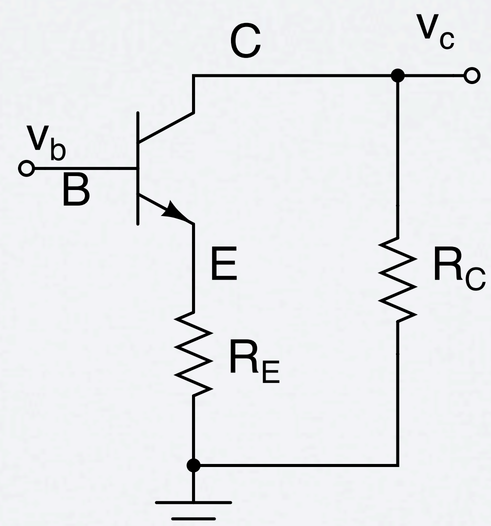
COMMON EMITTER AMP



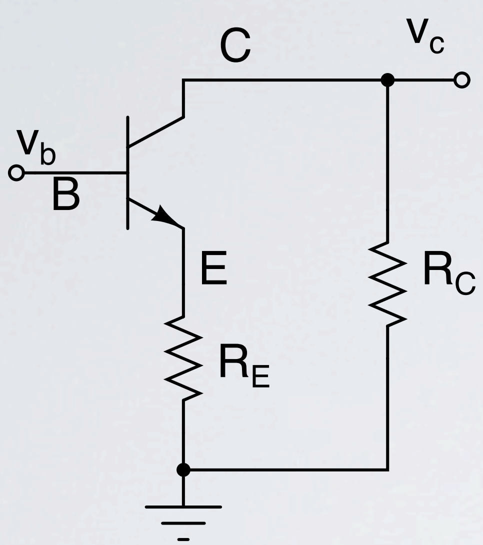
(a) Original circuit



(b) AC equivalent circuit



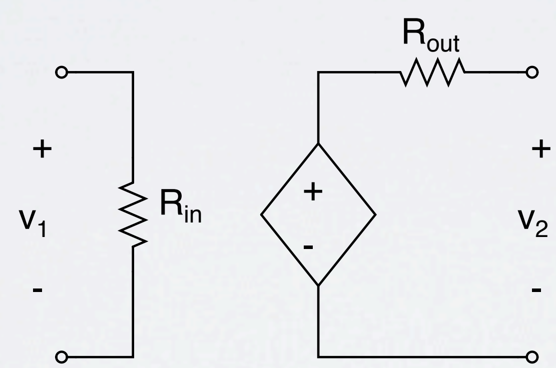
COMMON EMITTER AMP



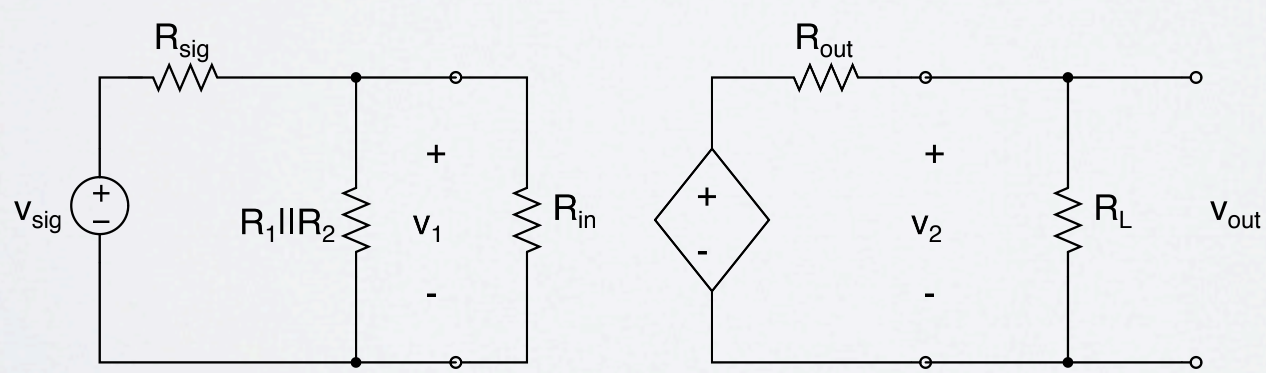
$$\frac{v_c}{v_b} = \frac{-\beta \times R_C}{r_\pi + R_E\,(1+\beta)}$$

$$R_{in} = r_\pi + R_E\,(1+\beta)$$

$$R_{out} = R_C$$

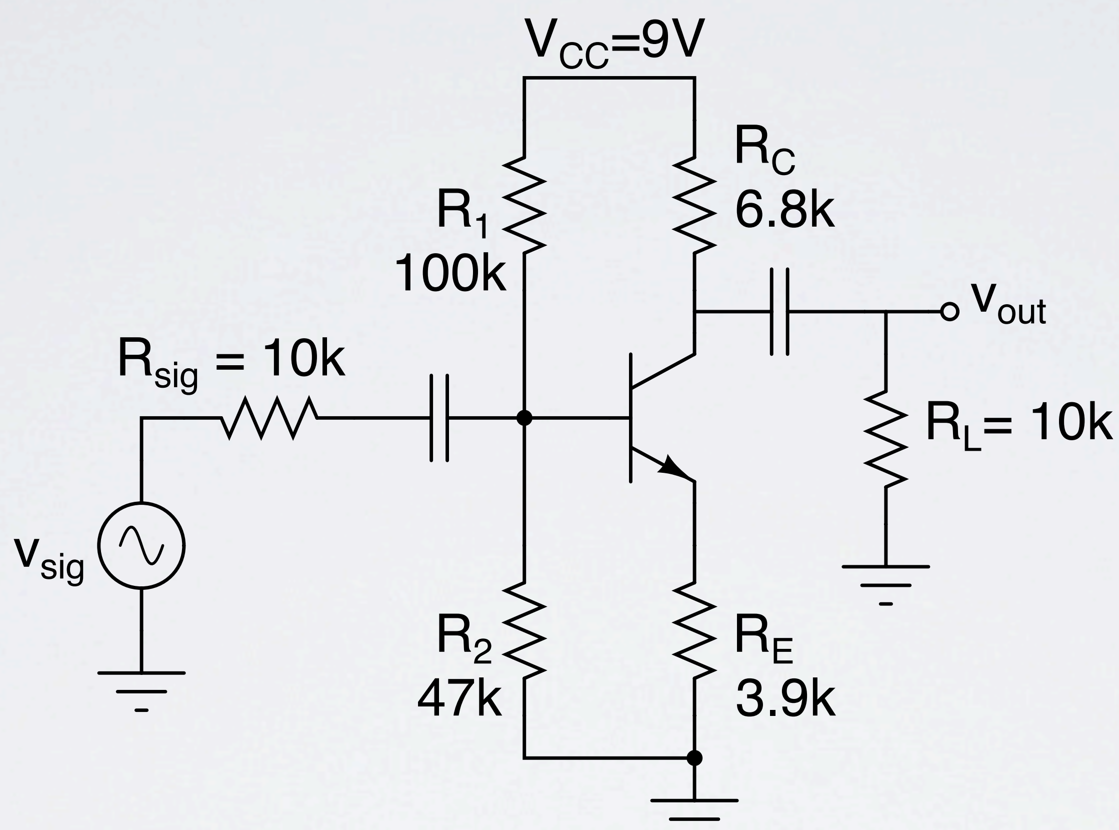


Two-port network model of the amplifier.



Original circuit, including R_{sig} and R_L, using the two-port network model.

Find the voltage gain $A_v = v_{out}/v_{sig}$ for the following amplifier. Assume $\beta = 100$. Assume the capacitors are short circuits at the frequency of operation.



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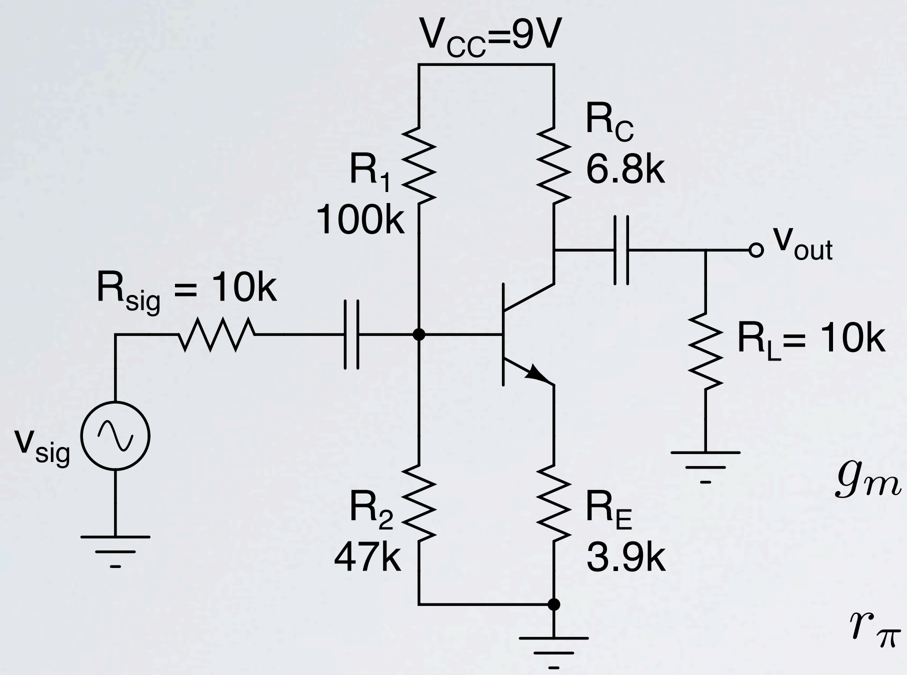


$$i_C = \frac{\beta}{\beta+1} i_E = \frac{\beta}{\beta+1} \frac{V_{CC}\frac{R_2}{R_1+R_2} - V_{BE}}{\frac{1}{\beta+1}\frac{R_1 R_2}{R_1+R_2} + R_E}$$

$$= \frac{100}{101} \frac{9V\frac{47}{147} - 0.7V}{\frac{1}{101}\frac{100k\Omega \times 47k\Omega}{100k\Omega + 47k\Omega} + 3.9k\Omega} = \boxed{0.51mA}$$

$$g_m = \frac{I_{CQ}}{V_T} = \frac{0.51mA}{0.025V} = 20.4mA$$

$$r_\pi = \frac{\beta}{g_m} = \frac{100}{20.4mA} = 4.9k\Omega$$

$$\mu = \frac{v_c}{v_b} = \frac{-\beta \times R_C}{r_\pi + R_E(1+\beta)}$$

$$= \frac{-100 \times 6.8k\Omega}{4.9k\Omega + 101 \times 3.9k\Omega} = 1.7$$

$$A_v = \frac{v_{out}}{v_{sig}} = \mu \frac{R_L}{R_{out} + R_L} \times \frac{R_1 \| R_2 \| R_{in}}{R_1 \| R_2 \| R_{in} + R_{sig}}$$

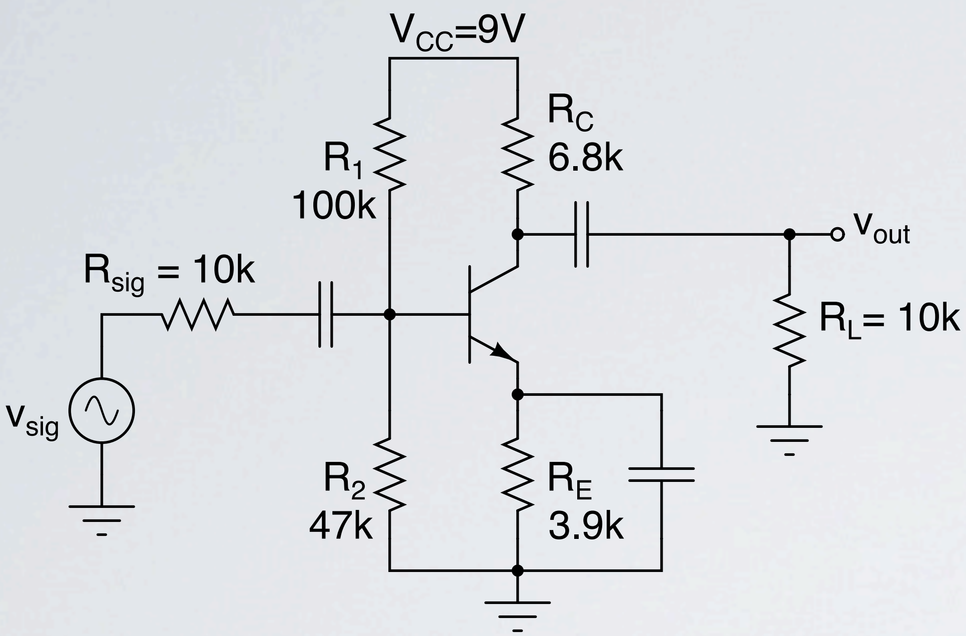
$$R_{in} = r_\pi + R_E(1+\beta) = 4.9k\Omega + 101 \times 3.9k\Omega = 399k\Omega$$

$$R_{out} = R_C = 6.8k\Omega$$

$$= -1.7V/V \frac{10k\Omega}{6.8k\Omega + 10k\Omega} \times \frac{32k\Omega \| 399k\Omega}{32k\Omega \| 399k\Omega + 10k\Omega}$$

$$= -1.7V/V \frac{10}{16.8} \frac{29.6}{39.6} = -0.76V/V$$

We can increase the gain by including a bypass capacitor across R_E. The circuit becomes:

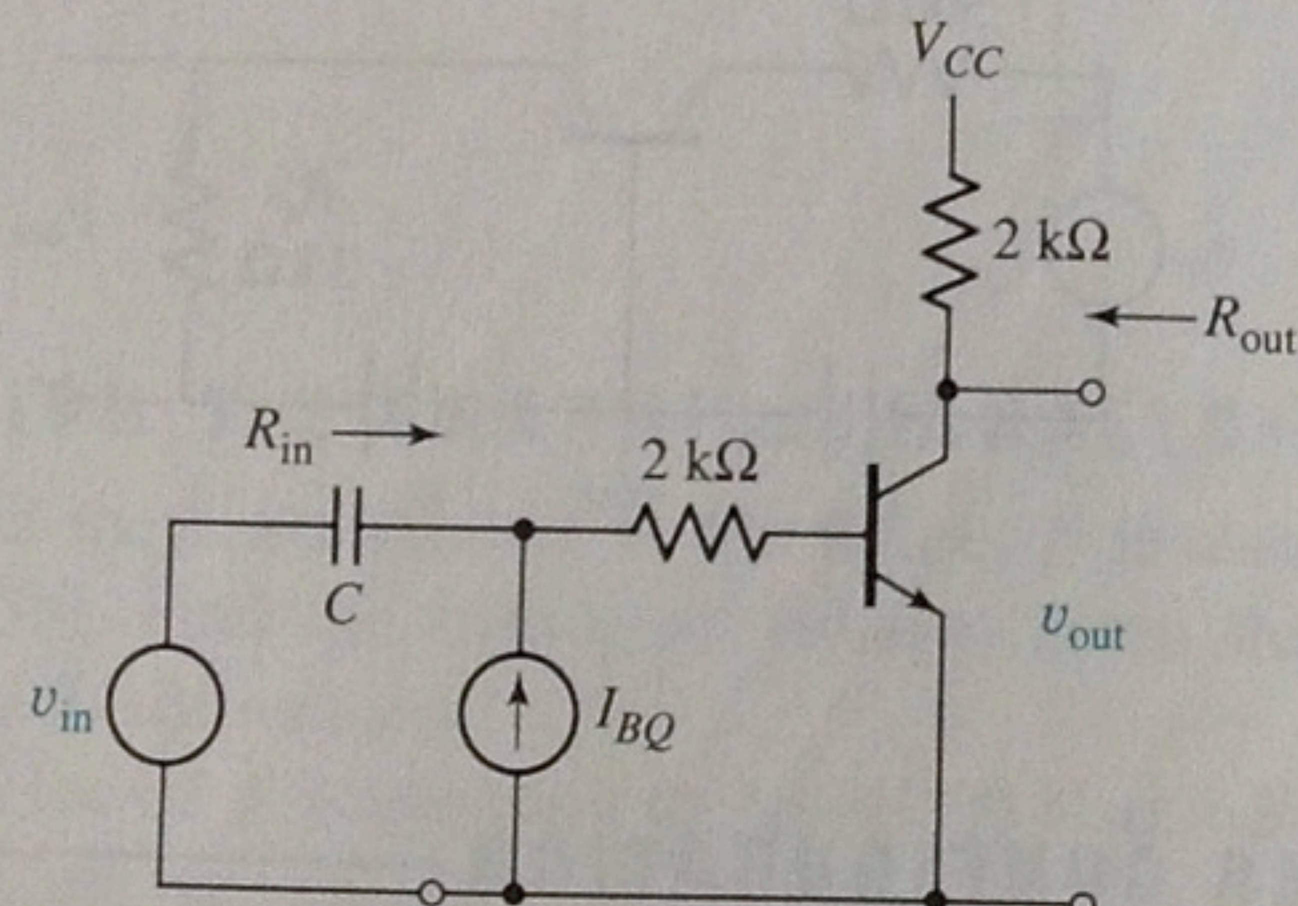


R_E becomes 0.

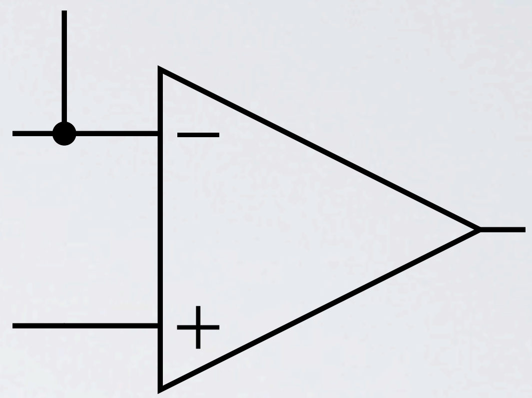
$$\begin{aligned}
\mu &= \frac{-\beta \times R_C}{r_\pi + R_E(1+\beta)} \\
&= \frac{-100 \times 6.8k\Omega}{4.9k\Omega + 101 \times 0} = \frac{-100 \times 6.8k\Omega}{4.9k\Omega} = -139V/V \\
A_v &= \frac{v_{out}}{v_{sig}} = \mu \frac{R_L}{R_{out} + R_L} \times \frac{R_1 \| R_2 \| R_{in}}{R_1 \| R_2 \| R_{in} + R_{sig}} \\
R_{in} &= r_\pi + R_E(1+\beta) = 4.9k\Omega + 101 \times 0 = 4.9k\Omega \\
R_{out} &= R_C = 6.8k\Omega \\
A_v &= -139V/V \frac{10k\Omega}{6.8k\Omega + 10k\Omega} \times \frac{32k\Omega \| 4.9k\Omega}{32k\Omega \| 4.9k\Omega + 10k\Omega} \\
&= -139V/V \frac{10}{16.8} \frac{4.25}{14.25} = -24.7V/V
\end{aligned}$$

7.30 Calculate the midband voltage gain of the circuit shown if $\beta = 100$ and $I_E = 2$ mA. Calculate the input and output impedances of the circuit.

Figure P7.30

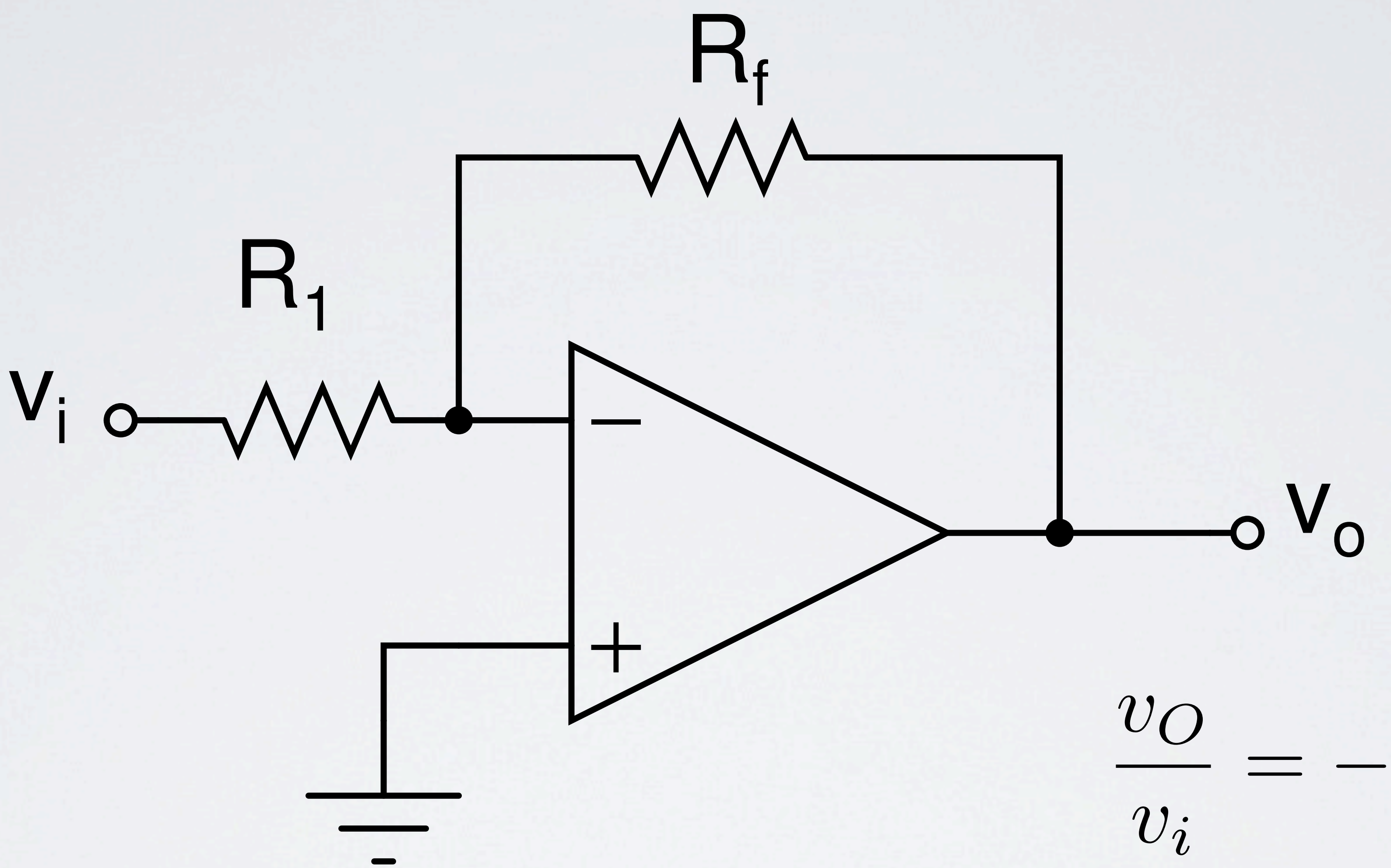


OPAMP IDEAL



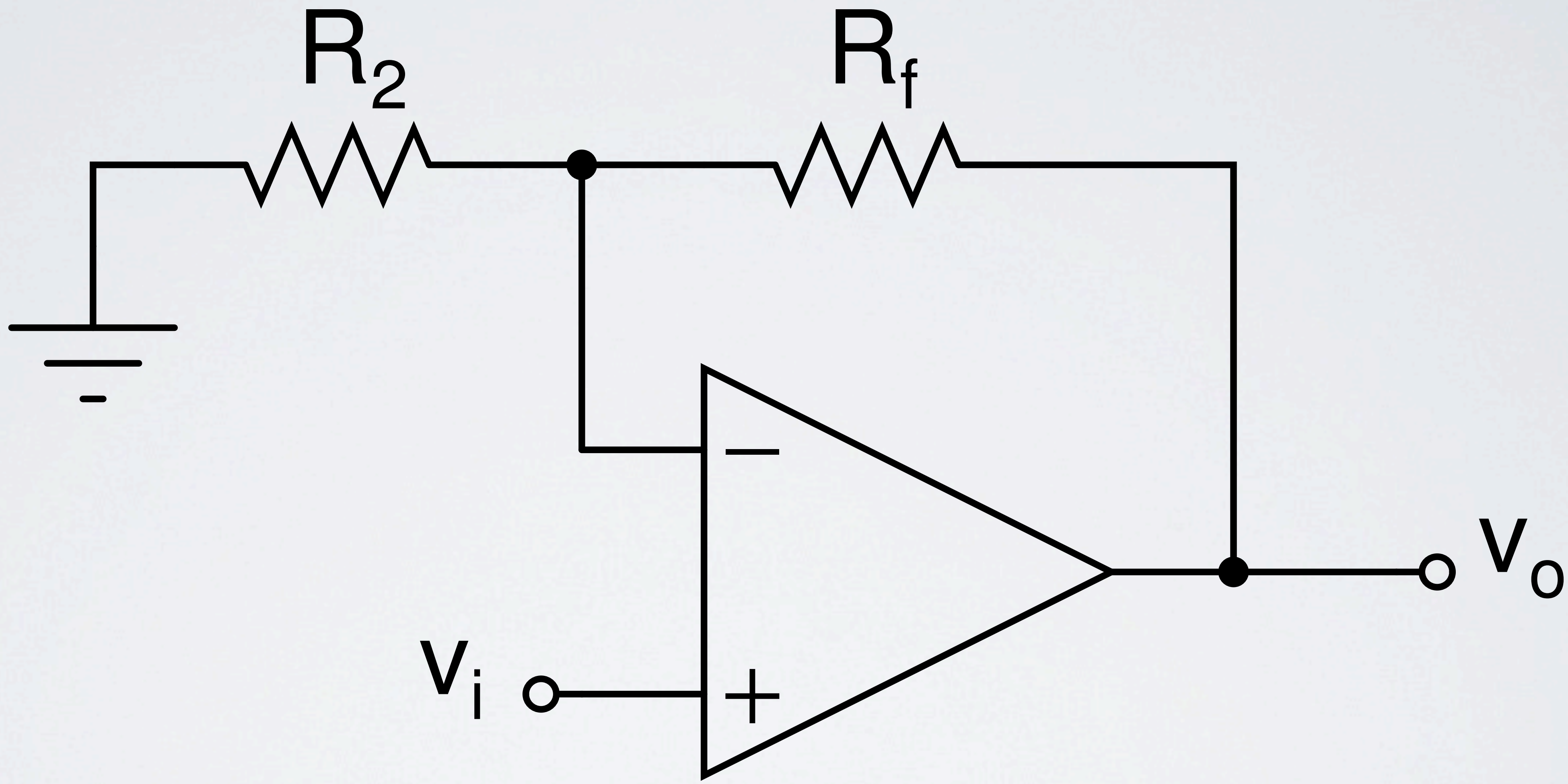
- A_{MBOA} = infinito
- no hay corriente entrando a los terminales - y +
- los voltajes en los terminales - y + son iguales

INVERTING AMPLIFIER



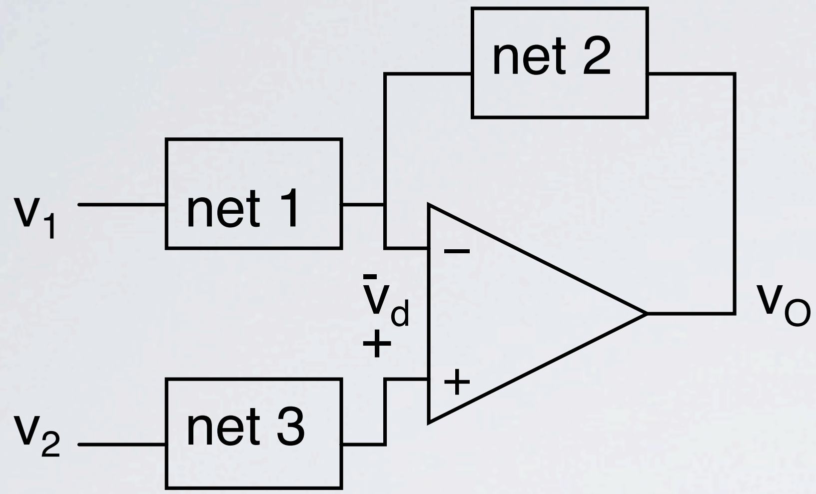
$$\frac{v_O}{v_i} = -\frac{R_f}{R_1}$$

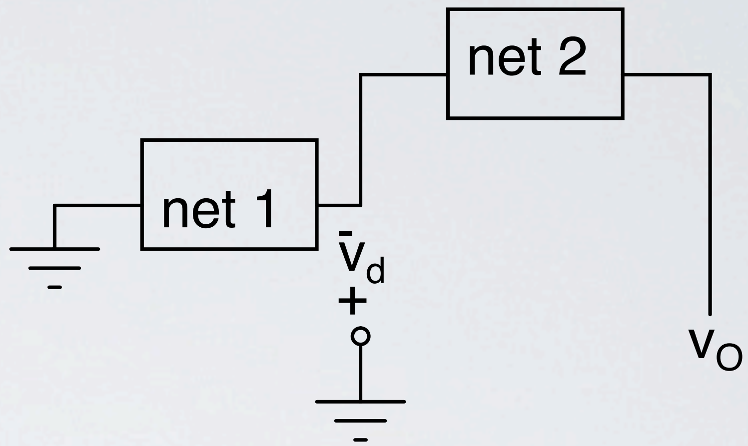
NON-INVERTING AMPLIFIER



$$\frac{v_O}{v_i} = 1 + \frac{R_f}{R_1}$$

OPAMP NO-IDEAL





Opamp no-ideal:

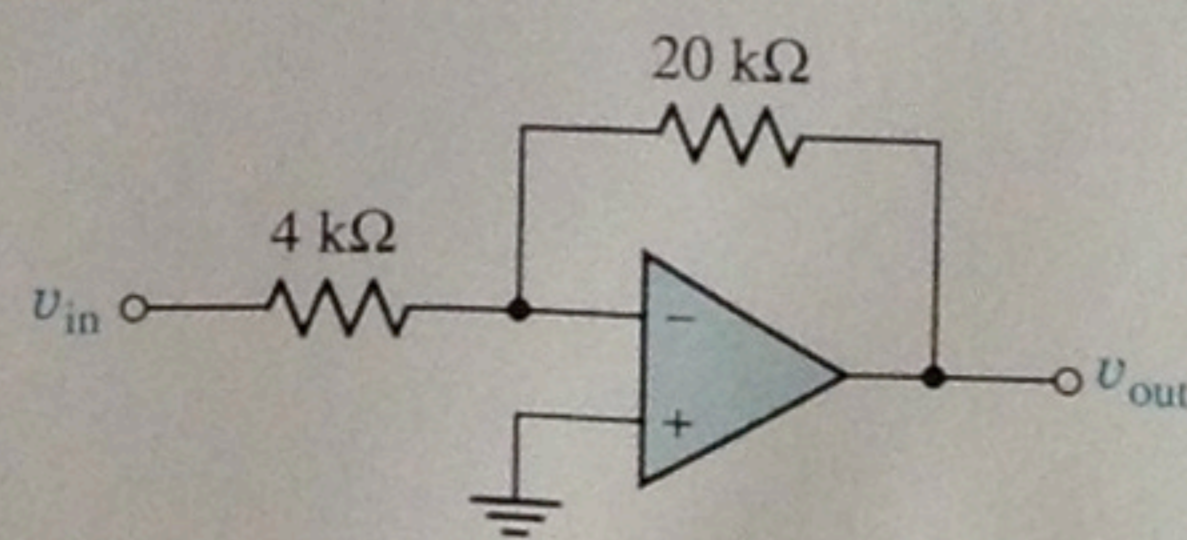
- Tiene una ganancia finita A_{MBOA}
- Tiene una frecuencia de ganancia unitaria f_t
- Factor de retro-alimentación: $\beta = -\frac{v_d}{v_O}$
- Ganancia del lazo (loop gain): $L = \beta \times A_{MBOA}$
- Ganancia del amplificador que usa el opamp no ideal:

$$A_f = A_{ideal} \frac{1}{1 + 1/L}$$

- Ancho de banda del amplificador que usa el opamp no ideal: $BW = \beta \times f_t$

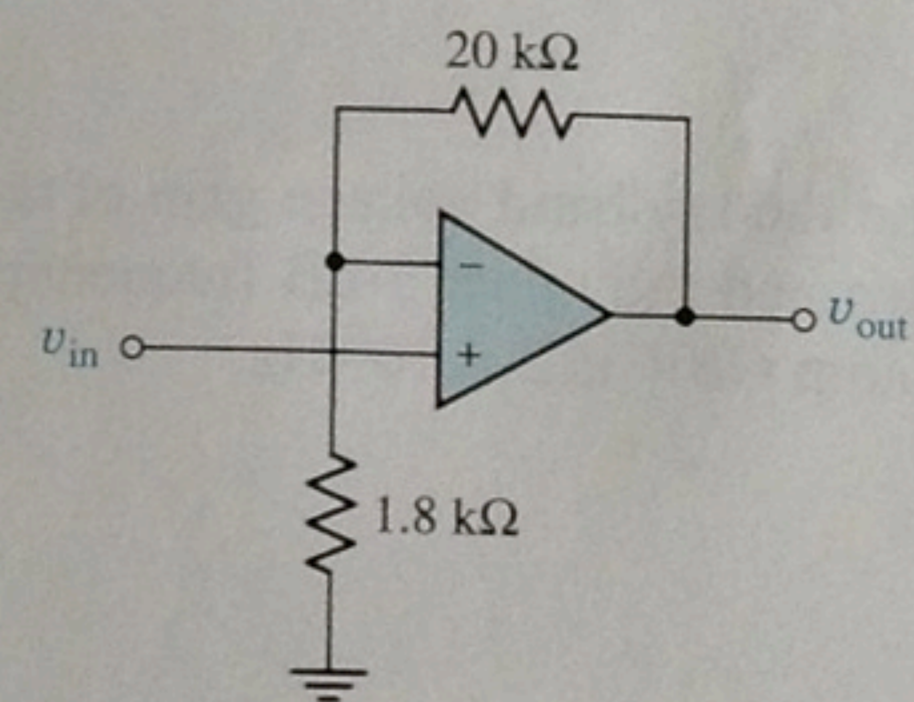
4.22 The upper corner frequency of the voltage gain for the circuit shown is found to be 150 kHz. What is the *GBW* of the op amp?

Figure P4.22



4.21 The upper corner frequency of the voltage gain for the circuit shown is found to be 150 kHz. What is the *GBW* of the op amp?

Figure P4.21



4.25 Calculate the midband voltage gain of the noninverting circuit shown and the upper 3-dB frequency, assuming that the op amp GBW is 2×10^6 Hz.

Figure P4.25