Problem #4 Solutions – Electronics

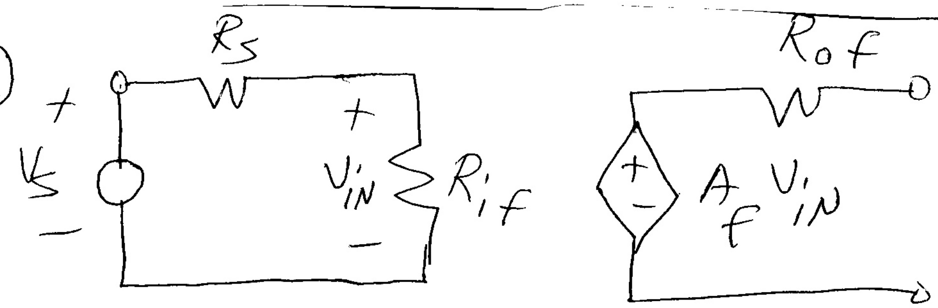
Fall 2012 WPE

(1) Assume loop gain $A\beta \gg 1$. Check assumption in later problems.

$$A_f = \frac{V_o}{V_s} \simeq \frac{1}{\beta}\,; \quad \beta = \frac{1K}{100K} = 10^{-2}$$

$$\boxed{A_f \cong 100}$$

(2)



$$V_o = \frac{A_f R_{if}}{(R_s + R_{if})} V_s$$

$$\frac{V_o}{V_s} \geq 0.9 A_f$$

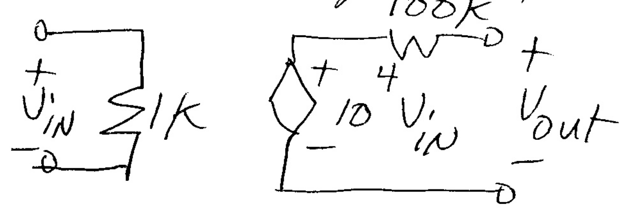
$$\therefore \frac{R_{if}}{R_{if} + R_s} \geq 0.9$$

$$R_s \leq \frac{R_{if}}{9}$$

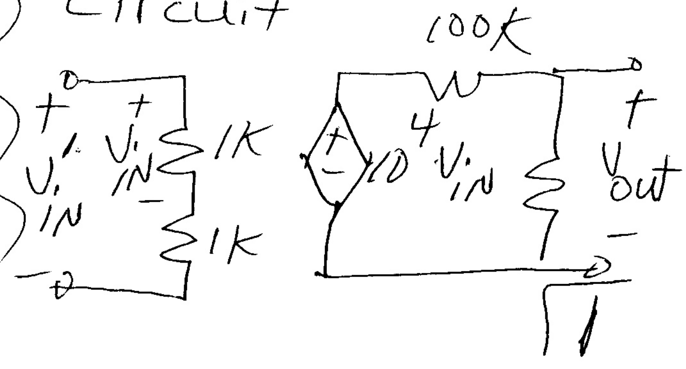
Need R_{if} value

Find R_{if} value

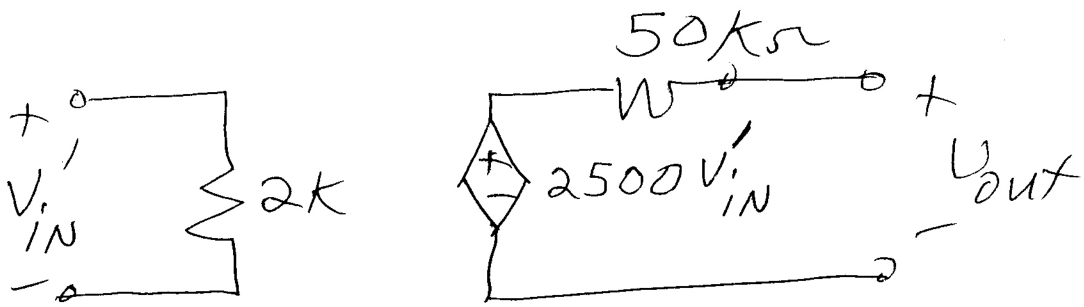
Model open loop amplifier as a voltage amplifier



Loading of feedback circuit



Prob. #4 Solutions Fall 2012 WPE



$$R_{if} = R_i'(1+A_v'\beta) = (2k)\{1+[2500][10^{-2}]\}$$

$$= (2\times10^3)(26) = 52k\Omega$$

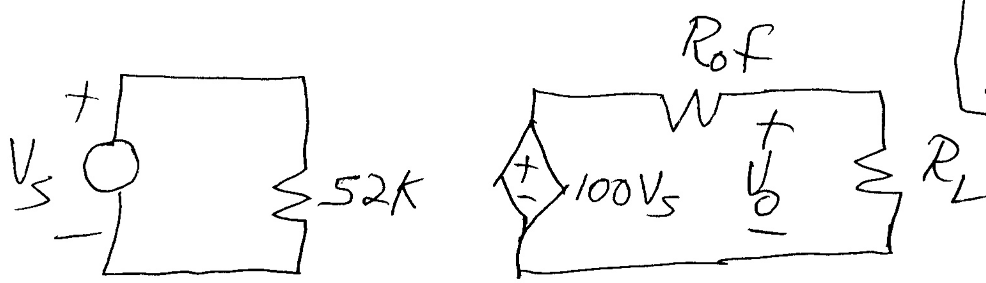
loop gain = 25

25 >> 1

prob. #1 assumption justified

$$R_S \le \frac{52k}{9} = 5.8k\Omega$$

③



$$\frac{V_o}{V_s} = \frac{R_L}{[R_L+R_{of}]}100 \ge 90$$

$$R_L \ge .9R_L + .9R_{of}$$

$$R_L \ge 9R_{of}$$

$$R_{of} = \frac{R_o}{[1+A_v'\beta]}$$

$A_v'\beta = 25$ from prob. #2

$$R_{of} = \frac{50k}{26} = 1.92k\Omega$$

$$R_L > (9)(1.92k\Omega)$$

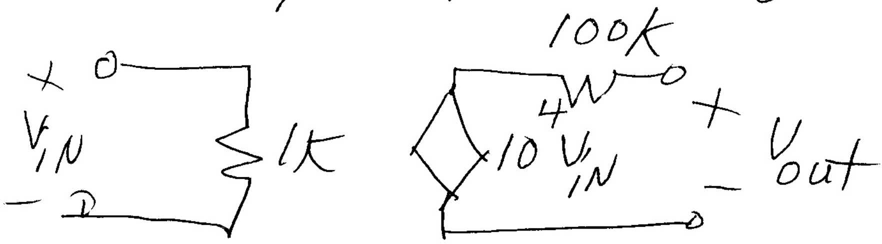
$$R_L \ge 17.3k\Omega$$

Problem #4 Solutions

Electronics – Fall 2012 WPE

If feedback circuit loading effects are ignored then the results for problems # 2 & #3 would be as follows.

Open loop amplifier equiv. ckt



$$R_{if} = (10^3)(1 + 10^4 \times 10^{-2}) = 100k\Omega$$

$$R_S < \frac{100k}{9} = 11.1k\Omega$$

$$R_{of} = \frac{100K}{100} = 1K$$

$$R_L \geq 9K$$

Ignoring loading of feedback circuit causes about a factor of two error in #2 & #3