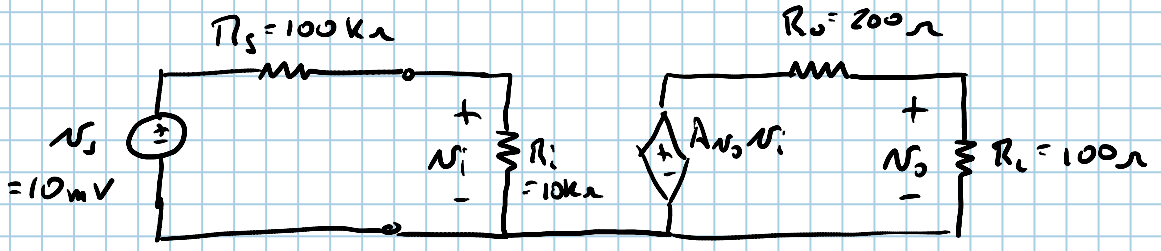
1.52

$A_{V_0} = 1000\ V/V$



(a) $$v_o = \left(\frac{R_L}{R_L + R_o}\right) A_{V_0} v_i, \quad v_i = \left(\frac{R_i}{R_i + R_s}\right) v_s$$

$$v_o = \left(\frac{R_L}{R_L + R_o}\right) A_{V_0} \left(\frac{R_i}{R_i + R_s}\right) v_s = \left(\frac{100}{100 + 200}\right)\left(1000\ V/V\right)\left(\frac{10\ k\Omega}{10\ k\Omega + 100\ k\Omega}\right)(0.01\ V)$$

$$\boxed{v_o = 0.303\ V}$$

(b) $\frac{v_o}{v_s} \equiv$ VOLTAGE GAIN FROM SOURCE TO LOAD

$$\boxed{\frac{v_o}{v_s} = \frac{0.303\ V}{0.01\ V} = 30.3\ V/V = \left(\frac{R_L}{R_L + R_o}\right)\left(\frac{R_i}{R_i + R_s}\right) A_{V_0}}$$

1.52 (cont.)

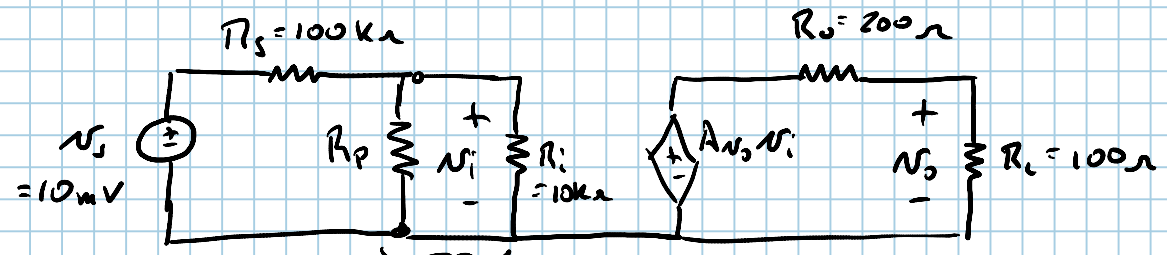
(c) $\frac{v_o}{v_i}$ = GAIN FROM AMPLIFIER INPUT TO LOAD

$$v_i = \left(\frac{R_i}{R_i + R_s}\right) v_s = \left(\frac{10k}{10k + 100k}\right) 10\,mV = 0.909\,mV$$

$$\frac{v_o}{v_i} = \frac{303.03\,mV}{0.909\,mV} = \boxed{333.33\ V/V}$$

(d) IF $v_o = 0.606\ V$

FIND R_p TO BRING CIRCUIT INTO SPEC.



ORIGINAL CIRCUIT:

$$v_i = \left(\frac{R_i}{R_s + R_i}\right) v_s$$

↑ TOO LARGE ×2

NEW CIRCUIT:

$$v_i = \left(\frac{R_p // R_i}{R_p // R_i + R_s}\right) v_s$$

$$\frac{1}{2}\left(\frac{R_i}{R_s + R_i}\right) = \frac{R_p // R_i}{R_p // R_i + R_s}$$

$$\frac{1}{2}\left(\frac{10}{110}\right) = \frac{R_p // 10}{R_p // 10 + 100}$$

$$\frac{5}{110} = \frac{R_p // 10}{R_p // 10 + 100}$$

$$\frac{1}{1 + \frac{100}{R_p // 10}} = \frac{5}{110}$$

$$1 + \frac{100}{R_p // 10} = 22$$

$$\frac{100}{R_p // 10} = 21 \Rightarrow R_p // 10 = \frac{100}{21}$$

$$\frac{1}{\frac{1}{R_p} + \frac{1}{10}} = \frac{100}{21} \Rightarrow \frac{1}{R_p} + \frac{1}{10} = \frac{21}{100}$$

$$\boxed{R_p = 9.09\,k\Omega}$$

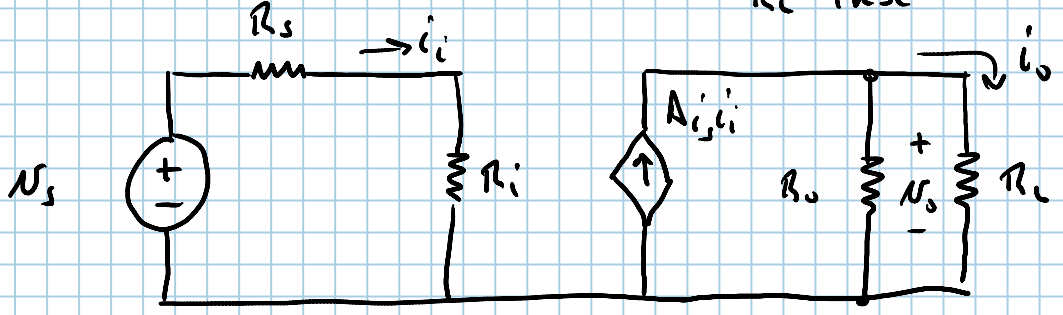
1.53

$R_i = 1k\Omega$ $\quad R_o = 10k\Omega$ $\quad R_s = 100k\Omega$ $\quad R_L = 1k\Omega$

$v_s = 100mV$ $\quad A_{i_s} = 100\ A/A$

FIND i_o/i_i, v_o/v_s

POWER GAIN



$$i_i = \frac{v_s}{R_s + R_i} = \frac{0.1V}{101k\Omega} = 990.1\times10^{-6}\ mA$$

$$i_o = \left(\frac{R_o}{R_o + R_L}\right) A_{i_s} i_i = \left(\frac{10k\Omega}{11k\Omega}\right)\left(100\ \frac{A}{A}\right)(990.1\times10^{-6}\ mA) = 90\times10^{-3}\ mA = 90\ \mu A$$

$$A_i = \frac{i_o}{i_i} = \frac{90\times10^{-6}\ A}{990\times10^{-9}\ A} = 90.9\ A/A$$

IN dB: $A_i = 20\log(90.9) = 39.17\ dB$

$v_o = i_o R_L = (90\times10^{-3}\ mA)(1k\Omega) = 90\times10^{-3}\ V = 90\ mV$

$v_s = 100mV$

$$\frac{v_o}{v_s} = \frac{90mV}{100mV} = \boxed{0.9\ V/V}$$

IN dB: $A_v = 20\log(0.9) = \boxed{-0.915\ dB}$

$A_p = A_i A_v = (90.9\ A/A)(0.9\ V/V) = \boxed{81.81\ W/W}$

IN dB: $A_p = 10\log(81.81) = \boxed{19.13\ dB}$