1.68 Figure P1.68 shows a signal source connected to the input of an amplifier. Here R_s is the source resistance, and R_i and C_i are the input resistance and input capacitance, respectively, of the amplifier. Derive an expression for $V_i(s)/V_s(s)$, and show that it is of the low-pass STC type. Find the 3-dB frequency for the case $R_s = 10 \, k\Omega$, $R_i = 40 \, k\Omega$, and $C_i = 5 \, pF$.
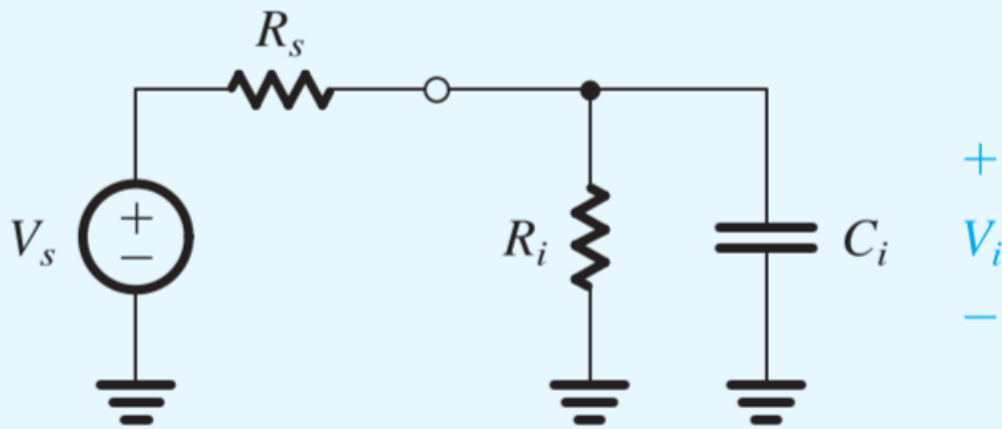

Figure P1.68

1.72 Measurement of the frequency response of an amplifier yields the data in the following table:

f (Hz)	10	10^2	10^3	10^4	10^5	10^6	10^7
$|T|$ (dB)	0	20	37	40		37	20	0

Provide approximate plausible values for the missing table entries. Also, sketch and clearly label the magnitude frequency response (Bode plot) of this amplifier.

1.43 Consider the voltage-amplifier circuit model shown in Fig. 1.16(b), in which $A_{vo} = 100$ V/V under the following conditions:

(a) $R_i = 10R_s, \quad R_L = 10R_o$
(b) $R_i = R_s, \quad R_L = R_o$
(c) $R_i = R_s/10, \quad R_L = R_o/10$

Calculate the overall voltage gain v_o/v_s in each case, expressed both directly and in decibels.
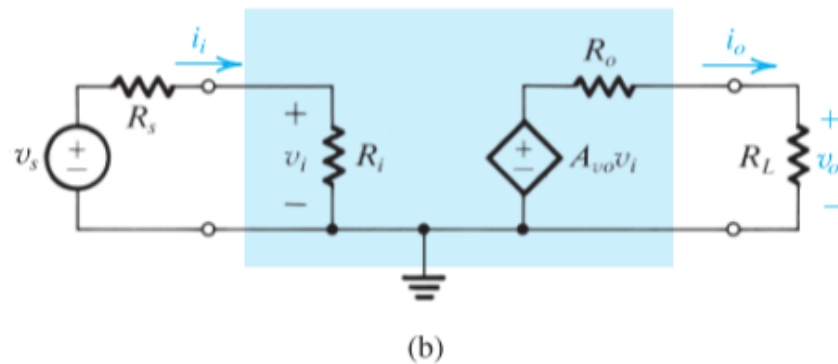

(b)

Figure 1.16 (a) Circuit model for the voltage amplifier. (b) The voltage amplifier with input signal source and load.

1.44 An amplifier with 40 dB of small-signal, open-circuit voltage gain, an input resistance of 1 MΩ, and an output resistance of 100 Ω, drives a load of 500 Ω. What voltage and power gains (expressed in dB) would you expect with the load connected? If the amplifier has a peak output-current limitation of 20 mA, what is the rms value of the largest sine-wave input for which an undistorted output is possible? What is the corresponding output power available?

*1.78 For the circuit shown in Fig. P1.78, first evaluate $T_i(s) = V_i(s)/V_s(s)$ and the corresponding cutoff (corner) frequency. Second, evaluate $T_o(s) = V_o(s)/V_i(s)$ and the corresponding cutoff frequency. Put each of the transfer functions in the standard form (see Table 1.2), and combine them to form the overall transfer function, $T(s) = T_i(s) \times T_o(s)$. Provide a Bode magnitude plot for $|T(j\omega)|$. What is the bandwidth between 3-dB cutoff points?
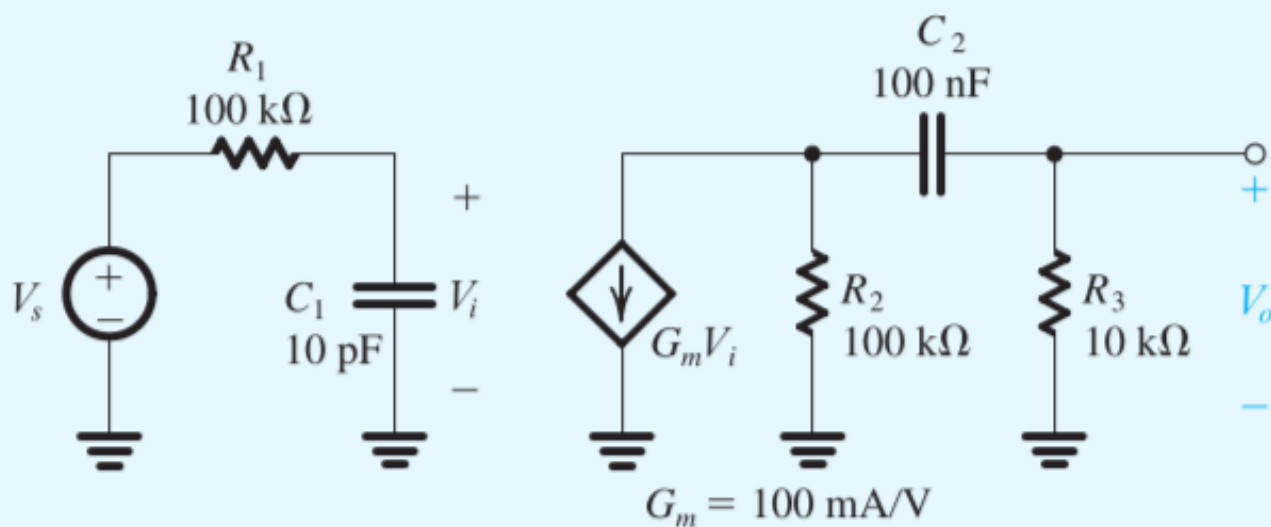

R_1
100 kΩ

C_2
100 nF

V_s

C_1
10 pF

V_i

$G_m V_i$

R_2
100 kΩ

R_3
10 kΩ

V_o

$G_m = 100$ mA/V

Figure P1.78