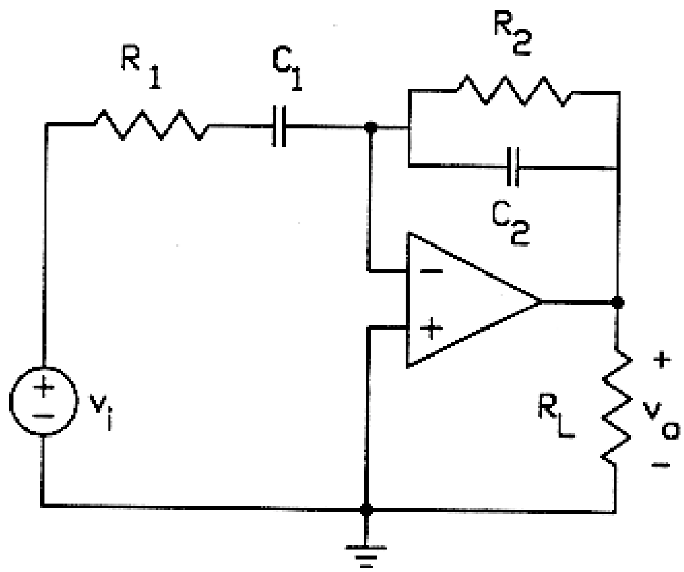
P13.4-16 Pick the appropriate circuit from Table 13.4-2.



$$H(\omega) = -\frac{k}{\left(1+j\frac{\omega}{p_1}\right)\left(1+j\frac{\omega}{p_2}\right)}$$

where

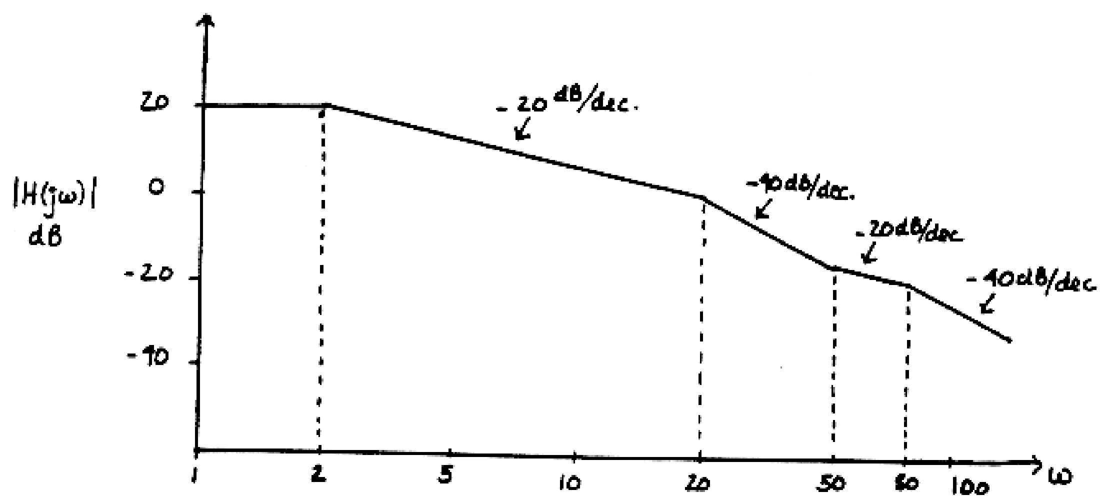
$$k = C_1R_2$$
$$p_1 = \frac{1}{C_1R_1}$$
$$p_2 = \frac{1}{C_2R_2}$$

We require

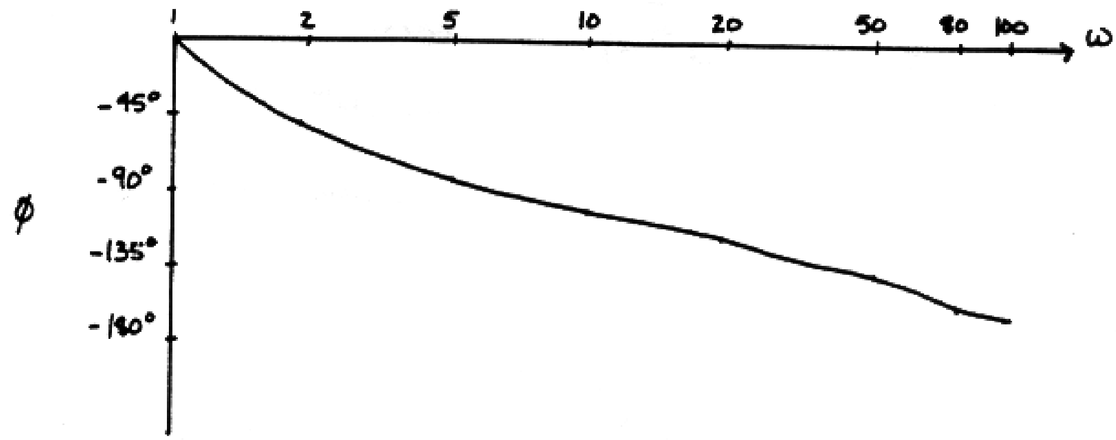
$$200 = p_1 = \frac{1}{C_1R_1}$$
$$500 = p_2 = \frac{1}{C_2R_2}$$
$$34\text{dB} = 50 = k = C_1R_2$$

Pick $C_1 = 1\mu\text{F}$. Then $R_1 = 5\text{k}\Omega$, $R_2 = 50\text{k}\Omega$ and $C_2 = 0.04\mu\text{F}$.

P13.4-17 $$H(j\omega) = \frac{10(j\omega/50+1)}{(j\omega/2+1)(j\omega/50+1)(j\omega/80+1)}$$



$$\varphi = \tan^{-1}\omega/50 - \tan^{-1}\omega/2 - \tan^{-1}\omega/20 - \tan^{-1}\omega/80$$



P13.4-18

$$H_{1,2} = -\frac{R_2/R_1}{1+j\omega R_2 C} \Rightarrow H_{Total} = H_{1,2}^2 = (R_2/R_1)^2\left(\frac{1}{1+j\omega R_2 C}\right)^2$$

(a) At low frequency,

$H_T = (R_2/R_1)^2 \quad \therefore$ for $H_T = 1$, need $R_1 = R_2$

Now also $\omega_1 = 1000 = 1/R_2 C$, so $\underline{\text{let } C = 1\mu F}$

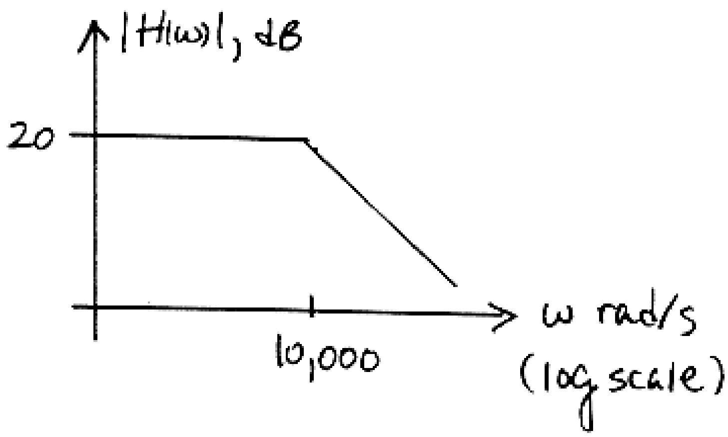
$$\therefore \underline{R_1 = R_2 = 1/(1000)\,(10^{-6}) = 1k\Omega}$$

(b) At $\omega = 10{,}000$

$$|H| = \frac{1}{1+(\omega R_2 C)^2} = \frac{1}{1+\left[(10^4)(10^3)(10^{-6})\right]^2} = 10^{-2}$$

$$\Rightarrow 20\log|H| = 20\log 10^{-2} = \underline{-40dB}$$

P13.4-19

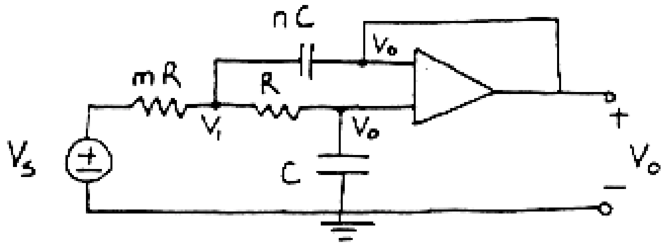


(a) $H(\omega) = \dfrac{V_o(\omega)}{V_s(\omega)} = -\dfrac{R_2/R_1}{1+j\omega R_2 C} = -\dfrac{10}{1+j\dfrac{\omega}{10{,}000}}$

(b) 10=20dB

(c) 10,000 rad/sec

P13.4-20



Assume $V_i \simeq 0$, then $V_+ = V_- = V_o$

Use $s = j\omega$

Voltage divider yields : $V_o = V_1 \dfrac{1/sC}{R+1/sC} \Rightarrow V_1 = (1+sRC)V_0$

KCL at V_1: $(V_1 - V_s)/mR + (V_1 - V_o)/R + (V_1 - V_o)snC = 0$

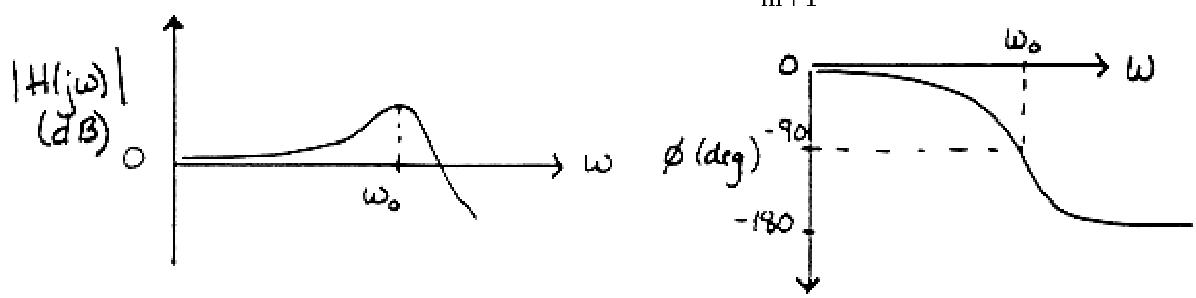
Plugging V_1 into above yields

$$V_o\left[\frac{1}{mR} + sC + \frac{sC}{m} + s^2 nRC^2\right] = \frac{V_s}{mR}$$

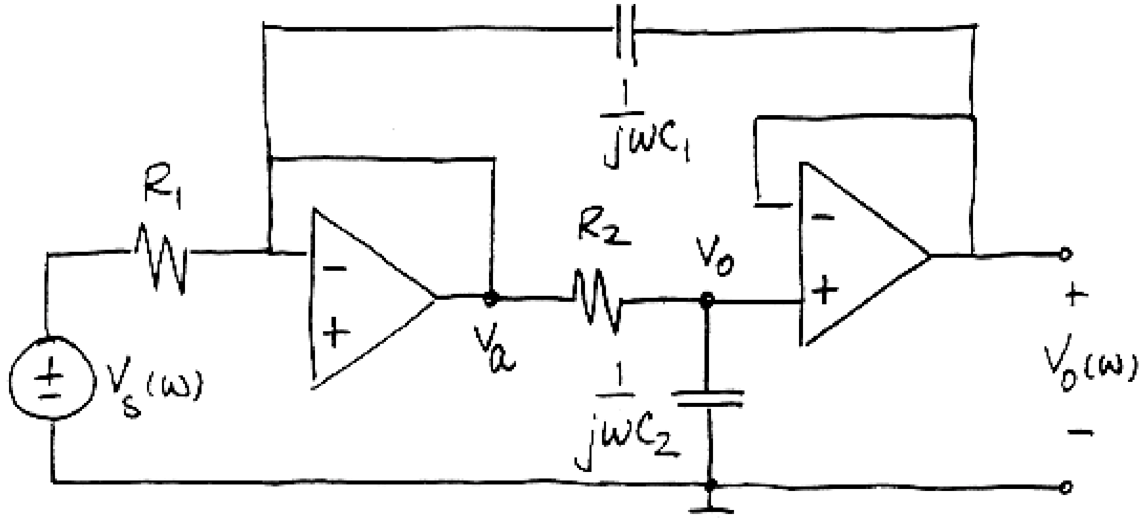
$$\therefore \frac{V_o}{V_s} = \frac{1}{1+s(m+1)RC + nmR^2C^2s^2}$$

$$\Rightarrow H(j\omega) = V_o/V_s = \frac{1}{1-(\omega/\omega_o)^2 + j(\omega/Q\omega_o)} \quad \text{where } \omega_0 = \frac{1}{\sqrt{mn}RC}$$

$$Q = \frac{\sqrt{mn}}{m+1}$$



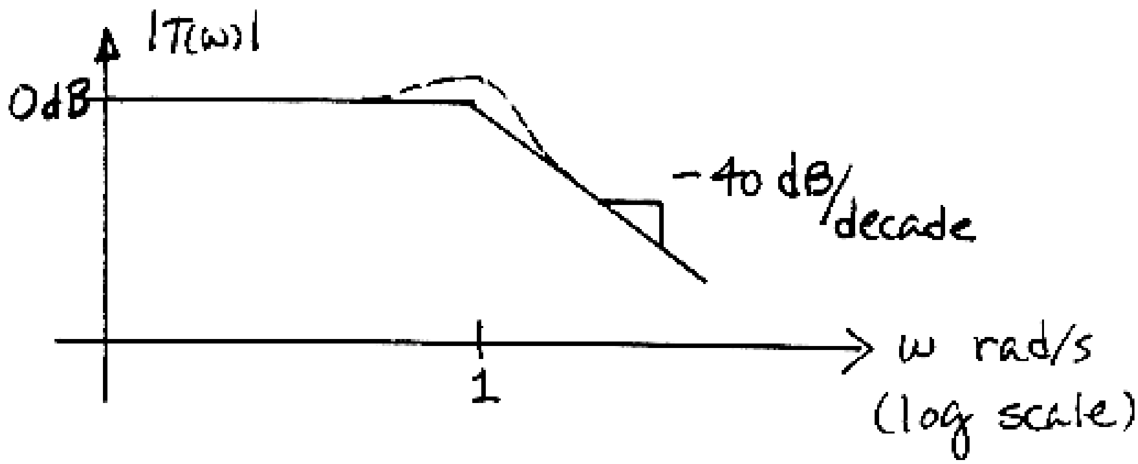
P13.4-21



$$\left.\begin{aligned} V_o(\omega) &= \frac{\frac{1}{j\omega C_2}}{R+\frac{1}{j\omega C_2}} V_a(\omega) \\ 0 &= \frac{V_a(\omega)-V_s(\omega)}{R_1} + j\omega C_1 (V_a(\omega)-V_o(\omega)) \end{aligned}\right\} \Rightarrow V_o(1+j\omega C_1 R_1)(1+j\omega C_2 R_2) = j\omega C_1 R_1 V_o + V_s$$

$$T(\omega) = \frac{V_o(\omega)}{V_s(\omega)} = \frac{1}{1+C_2 R_2 j\omega - \omega^2 C_1 C_2 R_1 R_2} = \frac{1}{-\omega^2 + .8 j\omega + 1}$$

Second order poles with $\omega_o = 0$ and $\delta = .4$



Section 13-5: Resonant Circuits

P13.5-1

$$\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{\left(\frac{1}{120}\right)\left(\frac{1}{30} \text{ x } 10^{-6}\right)}} = 60 \text{ k rad/sec}$$

$$Q = R\sqrt{\frac{C}{L}} = 10{,}000\sqrt{\frac{\frac{1}{30}\times 10^{-6}}{\frac{1}{120}}} = 20$$

$$\omega_1 = -\frac{\omega_0}{2Q} + \sqrt{\left(\frac{\omega_0}{2Q}\right)^2 + \omega_0{}^2} = 58.52 \text{ k rad/s}$$

$$\omega_2 = \frac{\omega_0}{2Q} + \sqrt{\left(\frac{\omega_0}{2Q}\right)^2 + \omega_0{}^2} = 61.52 \text{ k rad/s}$$

$$BW = \frac{1}{RC} = \frac{1}{(10000)\left(\frac{1}{30}\times 10^{-6}\right)} = 3 \text{ k rad/s}$$

Notice that $BW = \omega_2 - \omega_1 = \dfrac{\omega_0}{Q}$

P13.5-2

$$R = k = |H(\omega_0)| = \frac{8}{20\cdot10^{-3}} = 400\Omega$$

$$\omega_0 = 1000 \text{ rad/s}$$

$$|H(\omega)| = \frac{k}{\sqrt{1+Q^2\left(\frac{\omega}{\omega_0}-\frac{\omega_0}{\omega}\right)^2}}$$

At $\omega = 897.6$ rad/s, $|H(\omega)| = \frac{4}{20.10^{-3}} = 200$, so

$$200 = \frac{400}{\sqrt{1+Q^2\left(\frac{897.6}{1000}-\frac{1000}{897.6}\right)^2}} \Rightarrow Q = 8$$

Now

$$\left.\begin{aligned} \frac{1}{\sqrt{LC}} &= \omega_0 = 1000 \\ 400\sqrt{\frac{C}{L}} &= Q = 8 \end{aligned}\right\} \Rightarrow \begin{aligned} C &= 20\mu F \\ L &= 50 \text{ mH} \end{aligned}$$

P13.5-3

$$\omega_0 = \frac{1}{\sqrt{LC}} = 10^5 \text{ rad/s},\ Q = \frac{1}{R}\sqrt{\frac{L}{C}} = 10,\ BW = \frac{R}{L} = 10^4 \text{ rad/s}$$

P13.5-4

$$\omega_0 = \frac{1}{\sqrt{LC}} = 10^4 \text{ rad/s},\ Q = \frac{1}{R}\sqrt{\frac{L}{C}} = 10,\ BW = \frac{R}{L} = 10^3 \text{ rad/s}$$

P13.5-5

$$R = Z(\omega_0) = 100\Omega$$

$$\frac{1}{100C} = BW = 500 \Rightarrow C = 20\mu F$$

$$\frac{1}{\sqrt{(20\cdot10^{-6})L}} = \omega_0 = 2500 \Rightarrow L = 8mH$$

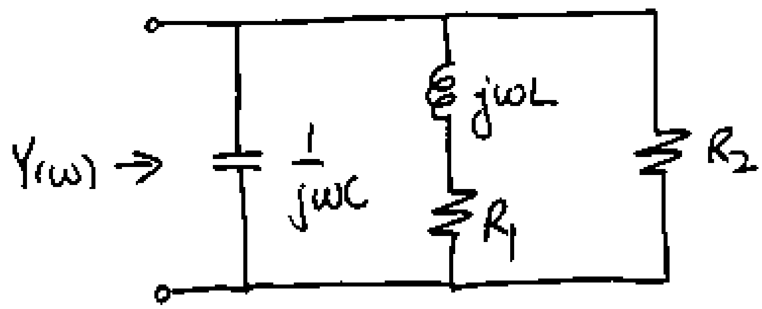
P13.5-6

$$R = \frac{1}{Y(\omega_0)} = 100\Omega$$

$$\frac{100\Omega}{L} = BW = 500 \Rightarrow L = 0.2H$$

$$\frac{1}{\sqrt{(0.2)C}} = \omega_0 = 2500 \Rightarrow C = 0.8\mu F$$

P13.5-7



$$Y(\omega) = j\omega C + \frac{1}{R_1 + j\omega L} + \frac{1}{R_2}$$

$$= \frac{\left(R_1 + R_2 - \omega^2 CLR_2\right) + j\omega\left(L + CR_1R_2\right)}{R_2\left(R_1 + j\omega L\right)} \times \frac{R_1 - j\omega L}{R_1 - j\omega L}$$

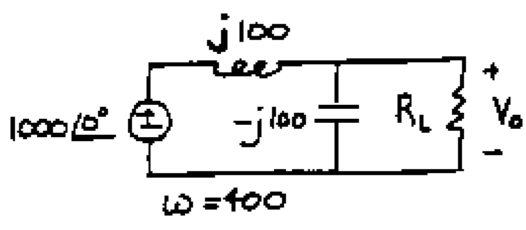
$$= \frac{R_1\left(R_1 + R_2 - \omega^2 CLR_2\right) - \omega^2 L\left(L + CR_1R_2\right) + j\omega R_1(LCR_1R_2) - j\omega L\left(R_1 + R_2 - \omega^2 CLR_2\right)}{R_2(R_1 - \omega^2 L^2)}$$

$\omega = \omega_0$ is the frequency at which the imaginary part of $Y(\omega)$ is zero:

$$R_1(LCR_1R_2) - L\left(R_1 + R_2 - \omega_0^2 CLR_2\right) = 0$$

$$\omega_0 = \sqrt{\frac{LR_2 - CR_1^2R_2}{CL^2R_2}} = 12.9 \text{ M rad/sec}$$

P13.5-8

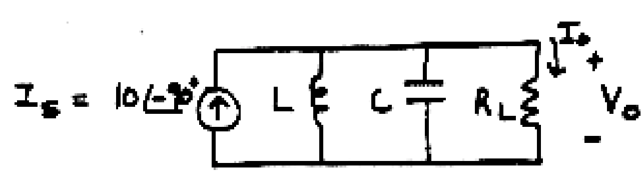


(a) Using voltage divider

$$V_o = \left(1000\angle 0^\circ\right) \frac{\dfrac{(100)(-j100)}{100-j100}}{\dfrac{(100)(-j100)}{100-j100} + j100} = \left(1000\angle 0^\circ\right) \frac{100/\sqrt{2}\angle -135^\circ}{100/\sqrt{2}\angle -135^\circ + j100} = \frac{10^5/\sqrt{2}\angle -135^\circ}{50\sqrt{2}\angle -135^\circ} = 1000\angle 90^\circ$$

$\therefore |V_o| = 1000V$

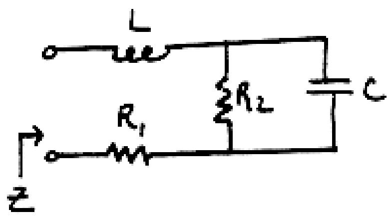
(b) Do a source transformation to obtain



So have an RLC resonant circuit with $\omega_0 = 1/\sqrt{LC} = 400$

Therefore the circuit is operated at resonance. This means that the L - C parallel combination has an overall Z = ∞ and hence $I_s = I_o$. When R_L is suddenly changed from 100Ω to 1 kΩ, due to the resonance condition, $V_o = R_L I_o$ suddenly increases by a factor of 10. This in turn causes very large (equal & opposite) currents in the L&C as the capacitor voltage is forced to abruptly change. Thus very large currents radiate electromagnetic radition and thus see sparks. Clearly we need a variable capacitor that varies as R_L varies such that when $R_L \neq 100\ \Omega$, $\Omega \neq \Omega_o$ and thus have $V_o = R_L I_o$ constant while both R_L and I_o change abruptly.

P13.5-9



$$\underset{\sim}{Z} = R_1 + j\omega L + \frac{1}{G_2 + j\omega C};\ G_2 = 1/R_2$$

$$= \frac{\left(R_1 G_2 + 1 - \omega^2 LC\right) + j\left(\omega L G_2 + \omega C R_1\right)}{G_2 + j\omega C}$$

at resonance $\underset{\sim}{Z} = Z\angle 0^\circ$

$$\text{or } \tan^{-1}\frac{\omega L G_2 + \omega C R_1}{\left(R_1 G_2 + 1 - \omega^2 LC\right)} = \tan^{-1}\frac{\omega C}{G_2}$$

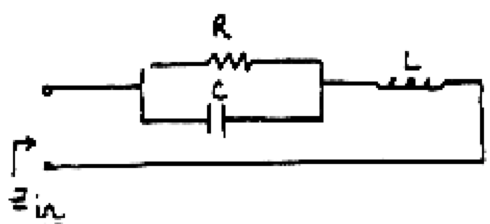
$$\text{thus } \frac{\omega L G_2 + \omega C R_1}{\left(R_1 G_2 + 1 - \omega^2 LC\right)} = \frac{\omega C}{G_2} \Rightarrow \omega^2 = \frac{C - L G_2^2}{LC^2} \ \ \&\ \ C > G_2^2 L$$

with $R_1 = R_2 = 1\Omega$ and $\omega_0 = 100$ rad/s

$$\omega_0^{\,2} = 10^4 = \frac{C - L}{LC^2},\ \text{if } \underline{C = 10\text{mF}} \Rightarrow \underline{L = 5\text{mH}}$$

and $C > G_2^2 L$ checks

P13.5-10



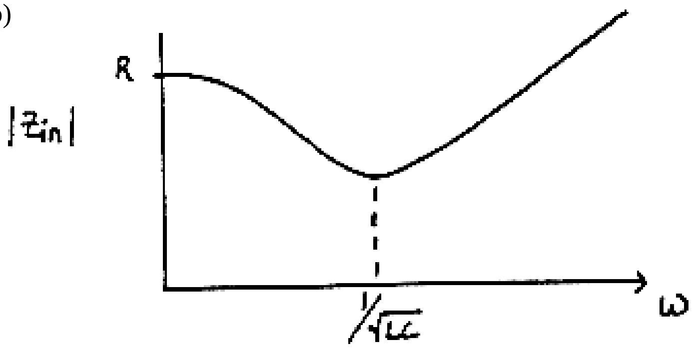
(a)

$$Z_{in} = j\omega L + \frac{R / j\omega C}{R + 1/j\omega C}$$

$$Z_{in} = \frac{\left(R - \omega^2 RLC\right) + j\omega L}{1 + j\omega RC}$$

$$\therefore |Z_{in}| = \underline{\sqrt{\frac{\left(R - \omega^2 RLC\right)^2 + \left(\omega L\right)^2}{1 + \left(\omega RC\right)^2}}}$$

(b)



(c) at $\omega = 1/\sqrt{LC}$, $|Z_{in}| = \dfrac{1}{\sqrt{(C/L)\left(1+R^2 C/L\right)}}$

P13.5-11

Let $V(\omega) = A\angle\theta^{\circ} = A$ and $V_2(\omega) = B\angle\theta$

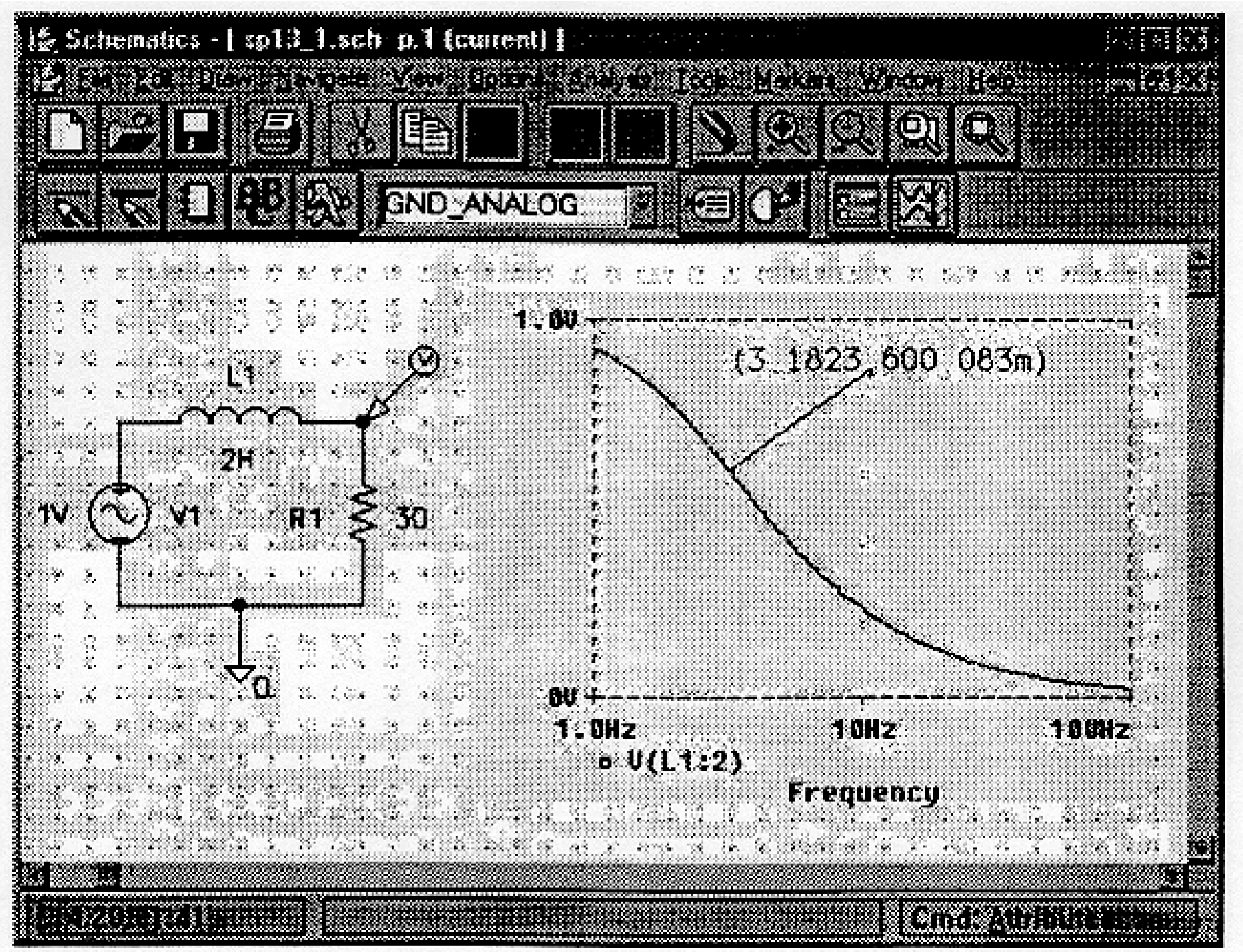
$$Y(\omega) = \frac{I(\omega)}{V(\omega)} = \frac{\dfrac{V(\omega)-V_2(\omega)}{R}}{V(\omega)} = \frac{A - B\angle\theta}{AR}$$

$$= \frac{A - B\cos\theta - j\,B\sin\theta}{AR}$$

$$|Y(\omega)| = \frac{\sqrt{(A - B\cos\theta)^2 + (B\sin\theta)^2}}{AR}$$

PSpice Problems

SP 13-1



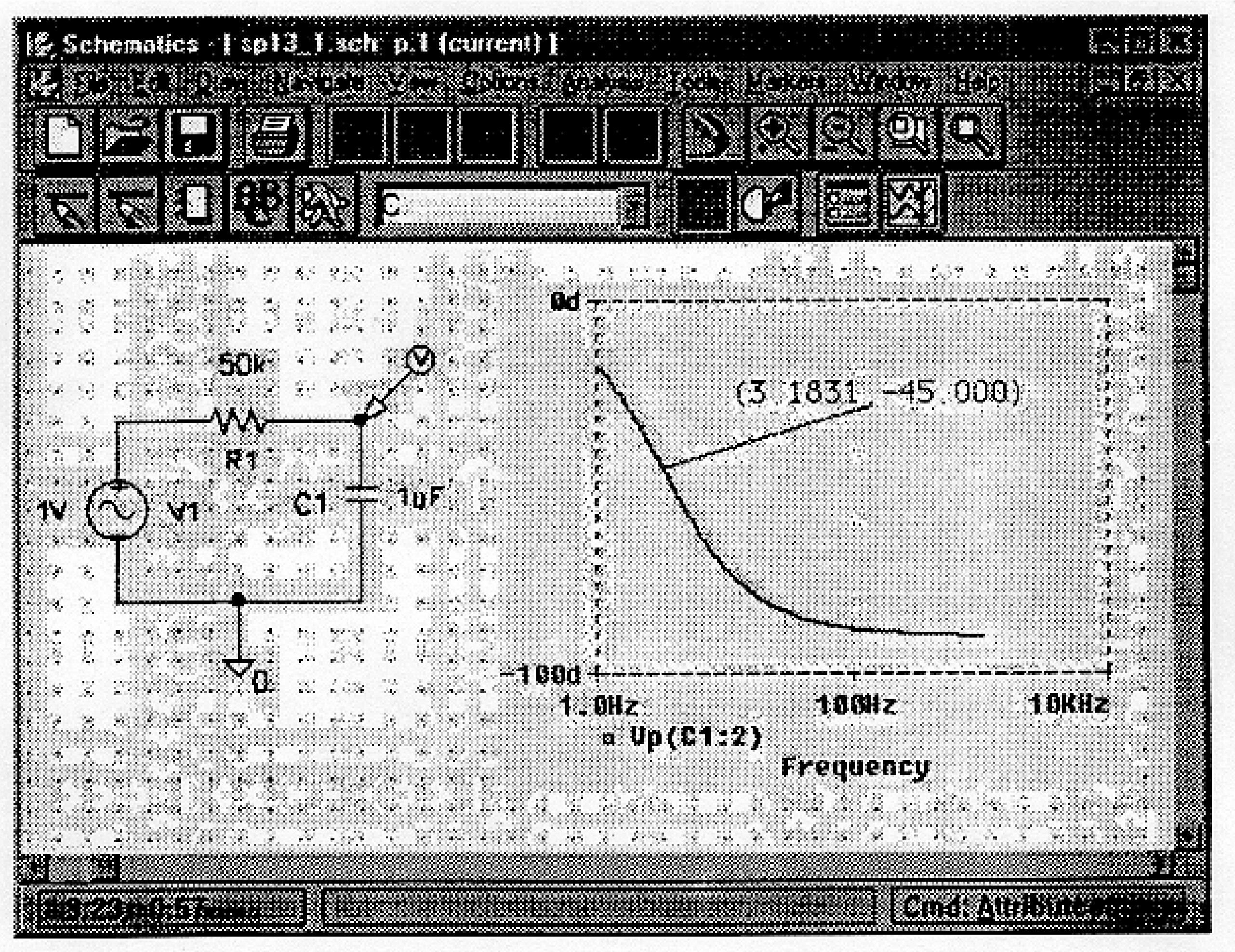
This simulation shows that the gain is

$$g = 600\times10^{-3} = 0.6$$

at the frequency

$$w = 2\pi\times3.1823 = 20\, rad/\text{sec}$$

SP 13-2 Here is a simulation of the circuit when R = 50kΩ

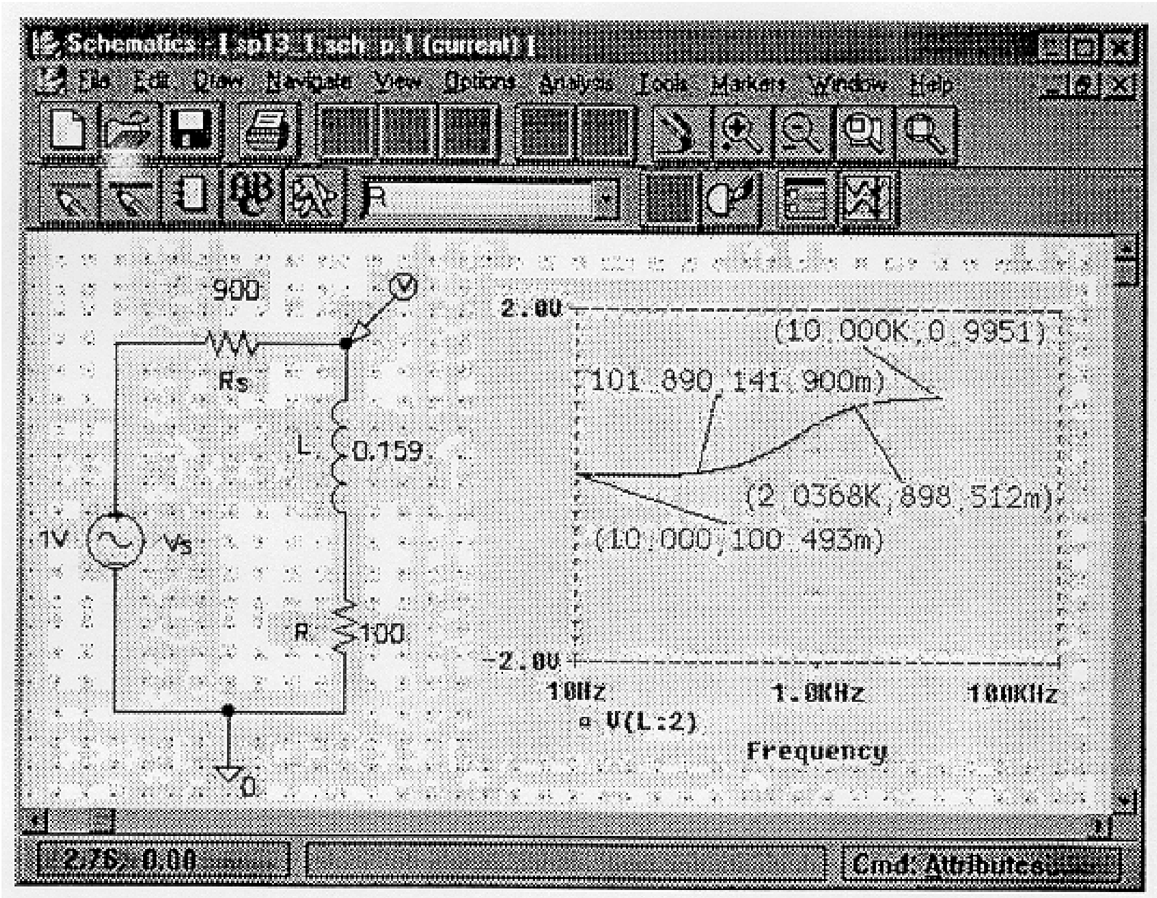


The phase shift is -45° *at the frequency*

$\omega = 2\pi \times 3.1831 = 20 rad/\sec$

as required.

SP 13-3

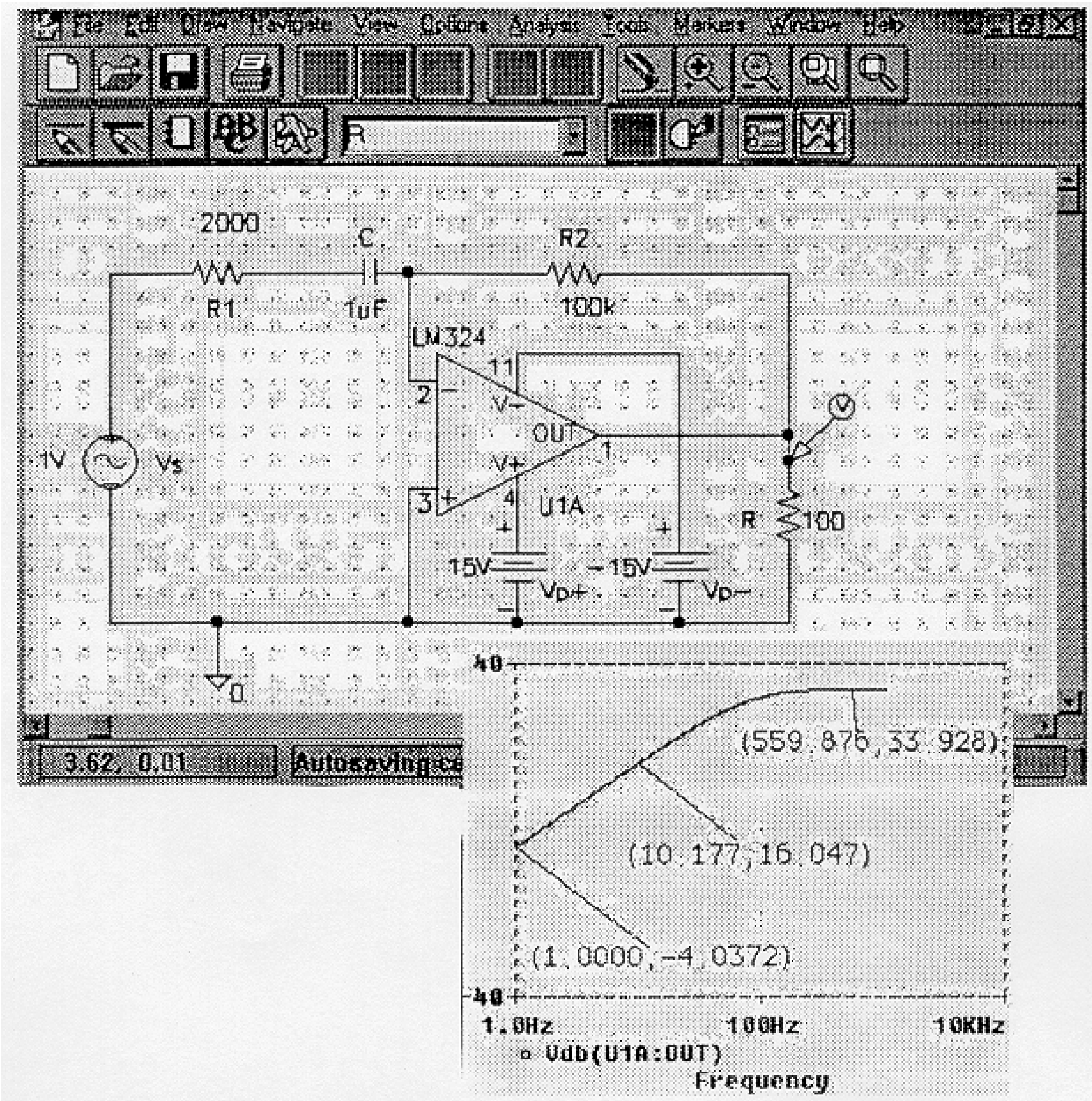


This simulation shows that the gain of the circuit is 0.1 at 10Hz and 0.995 at 10,000 Hz.

To satisfy the specifications on the corner frequencies, the gain must be ≤ 1.414 at 200 Hz and ≥ 7.07 at 2000 Hz. Both conditions are met.

The circuit satisfies the specifications.

SP 13-4

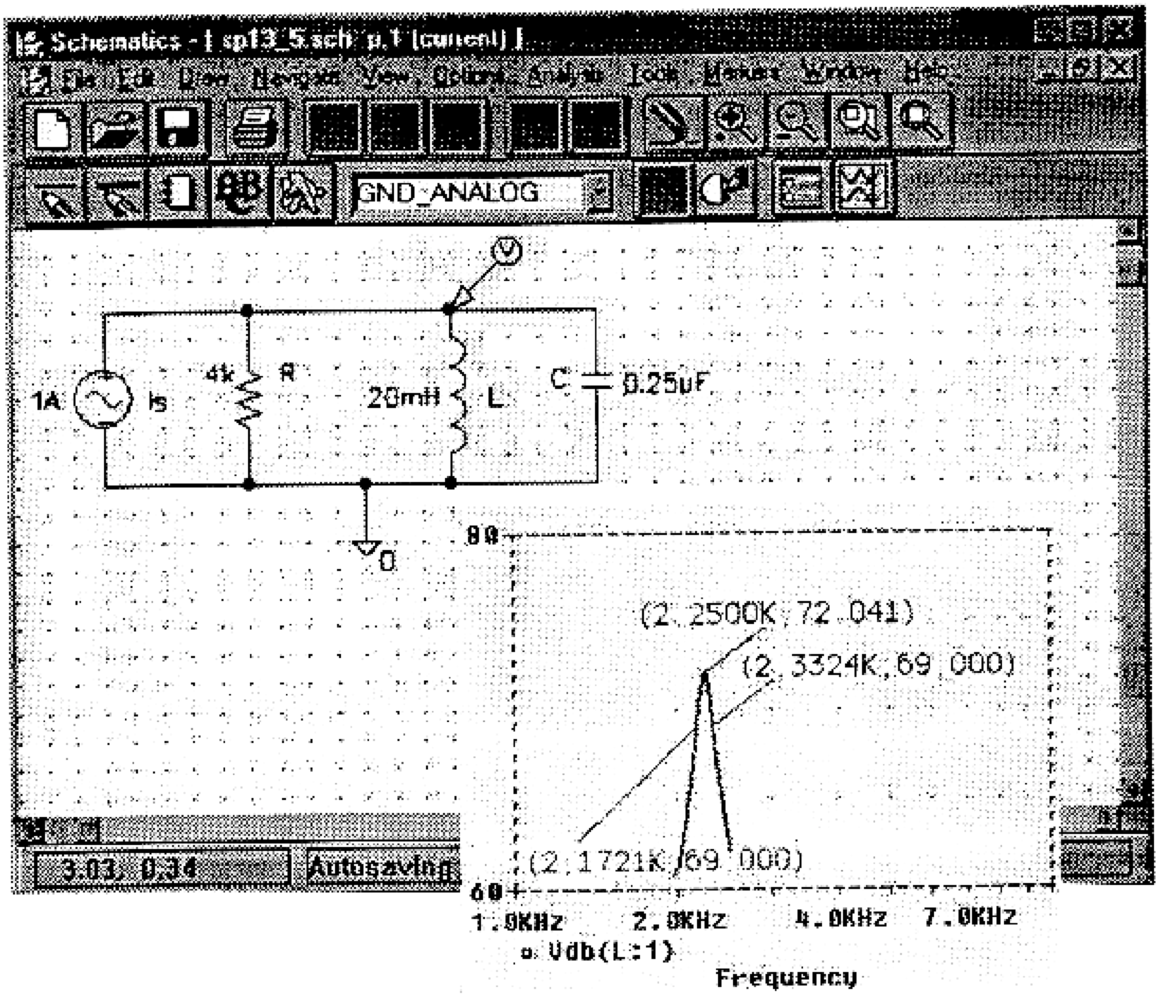


This simulation shows

- The high-frequency gain is 33.928 ≅ 34dB
- The slope of the low-frequency asymptote is

$$\frac{16\text{dB}-(-4\text{dB})}{\text{decade}} = 20\,\text{dB/decade}$$

SP 13-5

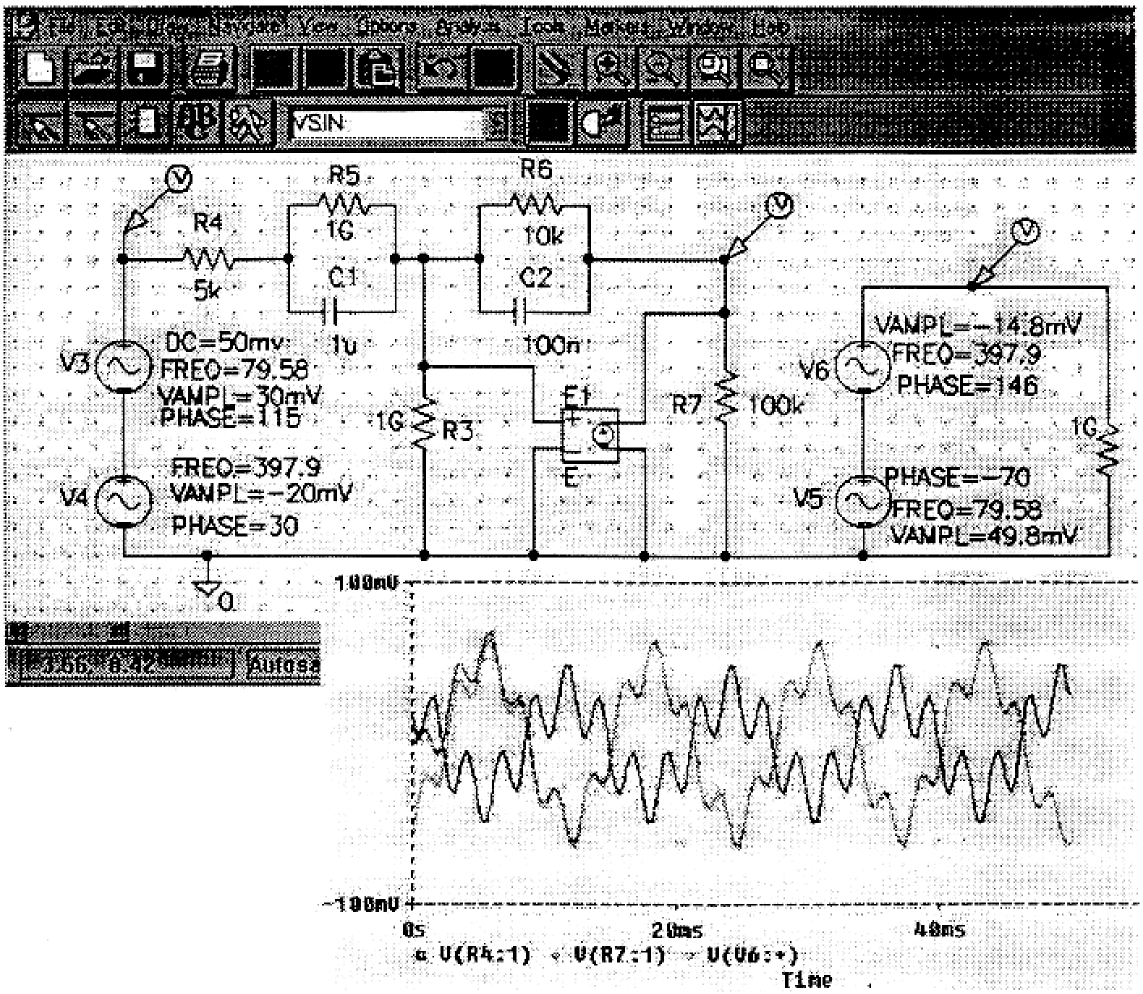


The peak of the frequency response is 72dB = 4000 at 2.25Hz = 14130rad / sec. So k = 4000 and $\omega_0 = 14130$

ω_1 and ω_2 are identified as the frequencies where the gain is $72-3 = 69$dB

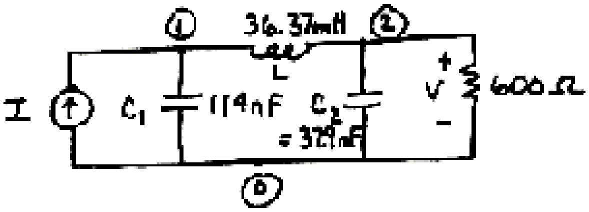
$$Q = \frac{\omega_0}{\omega_2-\omega_1} = \frac{f_0}{f_2-f_1} = \frac{2250}{2332.4-2172.1} = 14$$

SP 13-6



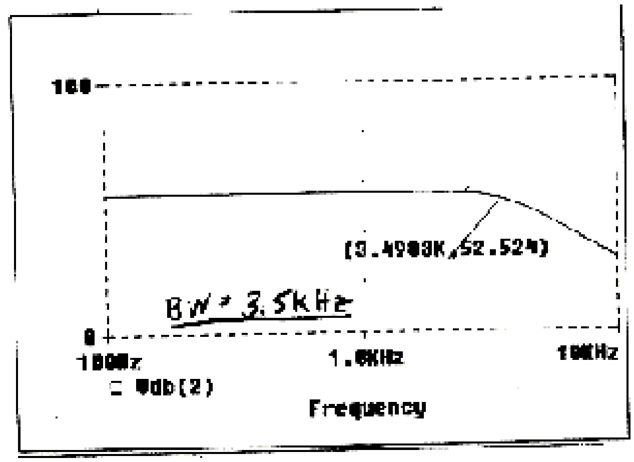
R3 and the dependent source E1 model an ideal op amp. V(R4:1) is $v_s(t)$. V(R7:1) is $v_0(t)$. V(V6:t) is the answer given in this solution manual. After the transient part dies out, V(R7:1) is identical to V(V6:t). The answer is correct.

SP 13-7

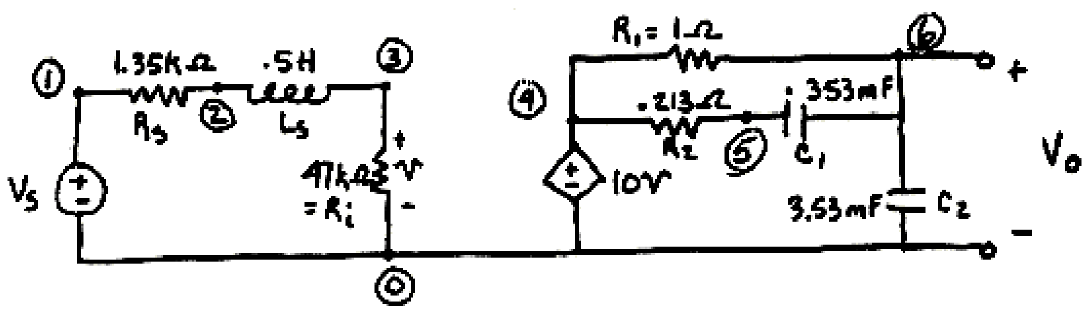



```
Is    1    0    ac    1
R1    2    0    600
C1    1    0    114n
C2    2    0    37.9n
L1    1    2    36.37m

.ac dec 50 100 10k
.probe
.end
```

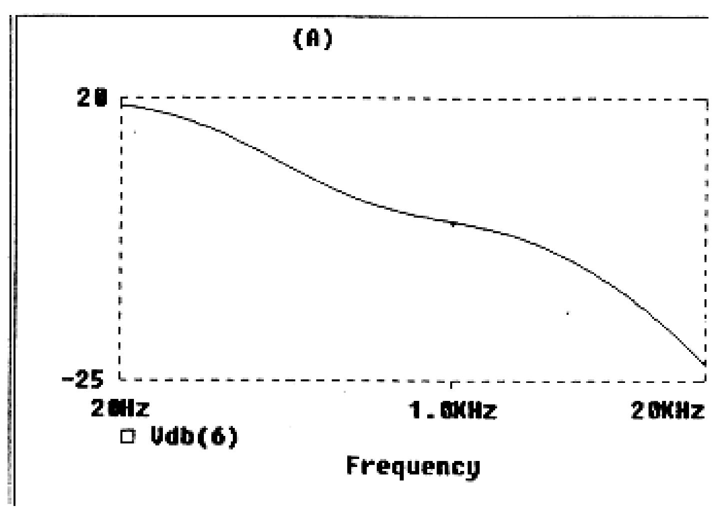


SP 13-8

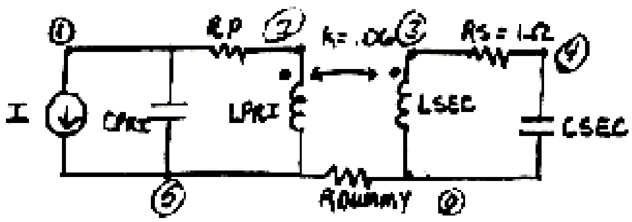



```
V1    1    0    ac        1
R2    1    2          1.35k
L3    2    3           500m
R4    3    0            47k
E5    4    0    3    0    10
R6    4    6              1
R7    4    5           213m
C8    5    6           353u
C9    6    0          3.53m

.ac dec 50 20 20k
.probe
.End
```

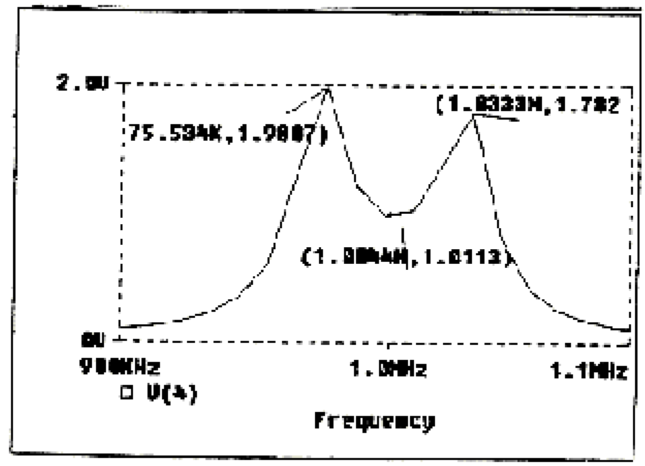


SP 13-9




```
Is     1     5     ac    1m
C1     1     5     2.53n
R1     1     2     1
L1     2     5     10u
L2     3     0     10u
R2     3     4     1
C2     4     0     2.53n
K1     L1    L2    0.06
Rdummy       5 0    1000k

.ac dec 200 900k 1100k
.probe
.end
```



Verification Problems

VP 13-1

When $\omega < 630$ rad / sec, $T(\omega) \simeq \frac{1}{10}$ which agrees with the tabulated values of $|T(\omega)|$ corresponding to $\omega = 200$ and 400 rad/sec.

When $\omega > 6300$ rad / sec, $T(\omega) \simeq 1$ which agrees with the tabulated values of $|T(\omega)|$ corresponding to $\omega = 12600, 25000, 50000$ and 100000 rad/sec.

At ω = 630 we expect |T(ω)| = -3dB = 0.707. This agrees with the tabulated value of |T(ω)| corresponding to ω = 6310.

At ω=630 we expect |T(ω)| = -20 + 3=-17dB = 0.14 which agrees with the tabulated values of |T(ω)| corresponding to ω =400 and 795 rad/s.

This data does seem reasonable.

VP 13-2 $BW = \frac{\omega_0}{Q} = \frac{10,000}{70} = 143 \neq 71.4$ rad/s This report is not correct.

VP 13-3

$$\omega_0 = \frac{1}{\sqrt{LC}} = 10\text{k rad/s} = 1.59 \text{ kHz}$$

$$Q = \frac{1}{R}\sqrt{\frac{L}{C}} = 20$$

$$BW = \frac{R}{L} = 500 \text{ rad/s} = 79.6 \text{ Hz}$$

The reported results are correct.

VP 13-4

The network function indicates a zero at 200 rad/s and a pole at 800 rad/s. In contrast, the Bode plot indicates a pole at 200 rad/s and a zero at 800 rad/s.

The Bode plot and network function don't correspond to each other.

p

where

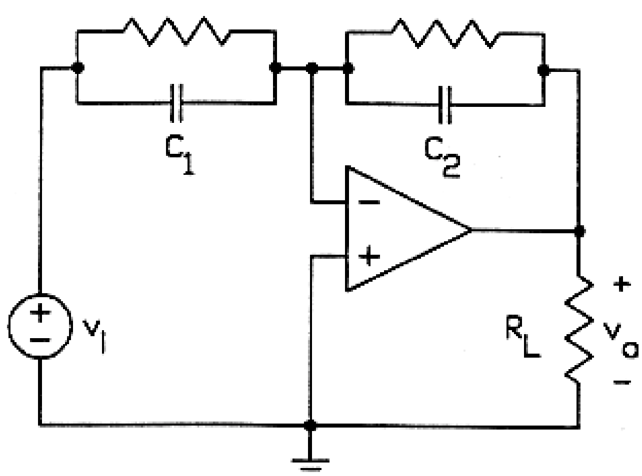
$$k = \frac{R_2}{R_1}$$

$$Z = \frac{1}{C_1R_1}$$

$$p = \frac{1}{C_2R_2}$$

Design Problems

DP 13-1 Pick an appropriate circuit from Table 13.4-2.



The specifications indicate that

$$2 = k = \frac{R_2}{R_1},\ 5 = k\frac{p}{z} = \frac{C_1}{C_2},$$

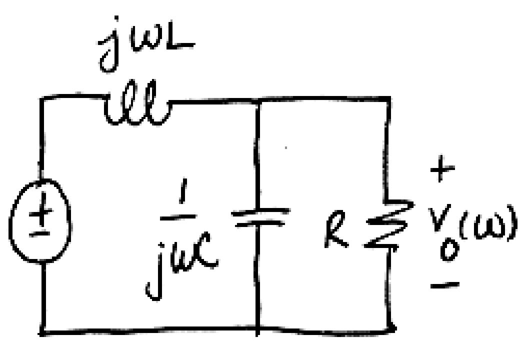
$$2\pi\cdot 1000 < z = \frac{1}{C_1 R_1} \textit{ and } 2\pi\cdot 10{,}000 > p = \frac{1}{C_2 R_2}$$

Try $z = 2\pi\cdot 2000$ rad/s. *Pick* $C_1 = 0.05\mu F$. *Then*

$$R_1 = \frac{1}{C_1 z} = 1.592\ \text{k}\Omega, \quad R_2 = 2R_1 = 3.183k\Omega, \quad C_2 = \frac{C_1}{k\frac{p}{k}} = 0.01\mu F$$

$$\textit{Check}:\ p = \frac{1}{C_2 R_2} = 31.42k\ \text{rad/s} < 2\pi\cdot 10{,}000$$

DP 13-2



$$H(\omega) = \frac{V_o(\omega)}{V_s(\omega)} = \frac{\frac{1}{j\omega C}\|R}{\ }$$

$$H(\omega) = \frac{V_o(\omega)}{V_s(\omega)} = \frac{\frac{1}{j\omega C}\|R}{j\omega L + \left(\frac{1}{j\omega C}\|R\right)} = \frac{\frac{R}{1+j\omega CR}}{j\omega L + \frac{R}{1+j\omega CR}} = \frac{\frac{1}{LC}}{-\omega^2 + j\omega\frac{1}{RC} + \frac{1}{LC}}$$

Pick $\frac{1}{\sqrt{LC}} = \omega_0 = 2\pi(100\cdot 10^3)$ rad/s. When $\omega = \omega_0$

$$H_0(\omega) = \frac{\frac{1}{LC}}{-\frac{1}{LC} + j\frac{1}{\sqrt{LC}}\frac{1}{RC} + \frac{1}{LC}}$$

So

$$\left|H(\omega_0)\right| = R\sqrt{\frac{C}{L}}$$

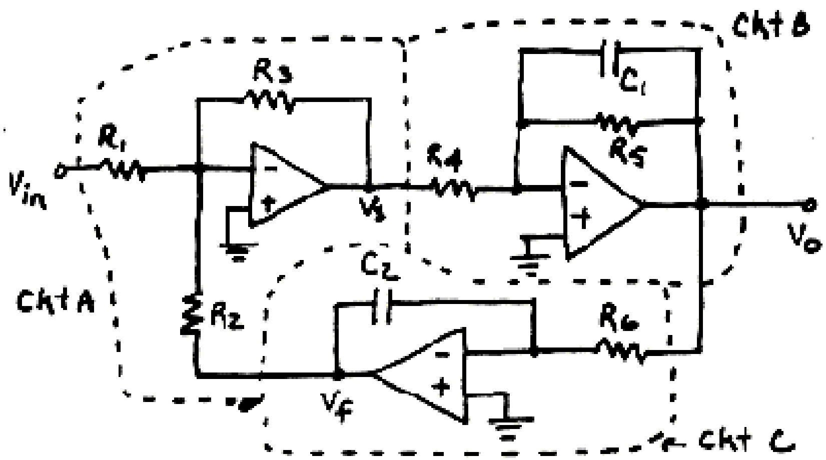
We require

$$-3\text{dB} = 0.707 = \left|H(\omega_0)\right| = R\sqrt{\frac{C}{L}} = 1000\sqrt{\frac{C}{L}}$$

Finally

$$\left.\begin{array}{l}\frac{1}{\sqrt{LC}} = 2\pi(100\cdot 10^3) \\ 0.707 = 1000\sqrt{\frac{C}{L}}\end{array}\right\} \Rightarrow \begin{array}{l}C = 1.13\text{nF} \\ L = 2.26\text{mH}\end{array}$$

DP 13-3



$R_1 = 10\text{k}\Omega$
$R_2 = 866\text{k}\Omega$
$R_3 = 8.06\text{k}\Omega$
$R_4 = 1\text{M}\Omega$
$R_5 = 2.37\text{M}\Omega$
$R_6 = 499\text{k}\Omega$
$C_1 = 0.47\mu\text{F}$
$C_2 = 0.1\mu\text{F}$

ckt A is inverting summer $\Rightarrow V_s = -R_3\left[\frac{V_{in}}{R_1}+\frac{V_f}{R_z}\right]$ (1)

ckt B is first order LPF $\Rightarrow V_o = -V_s\frac{Z_f}{Z_i} = -V_s\frac{R_5}{R_4}\left[\frac{1}{C_1R_5s+1}\right]$ (2)

ckt C is an integrator $\Rightarrow V_f = -\frac{1}{C_sR_6s}V_o$ (3)

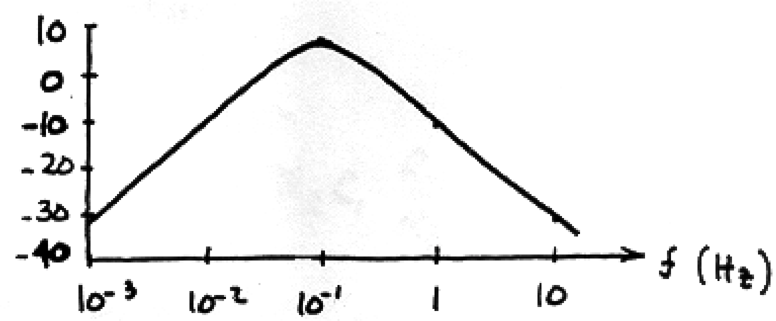
Continued

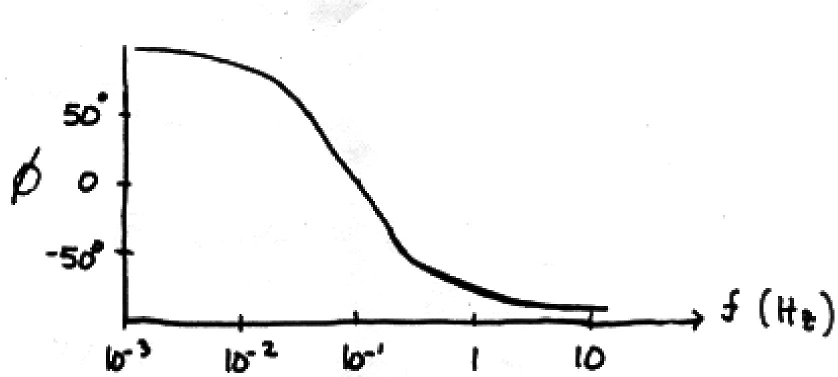
Solving (1) $\rightarrow$ (3) for V_o/V_{in} yields

$$V_o/V_{in} = \frac{\frac{R_3}{R_1R_4C_1}s}{s^2+\frac{1}{R_5C_1}s+\frac{R_3}{R_2R_4R_6C_1C_2}}$$

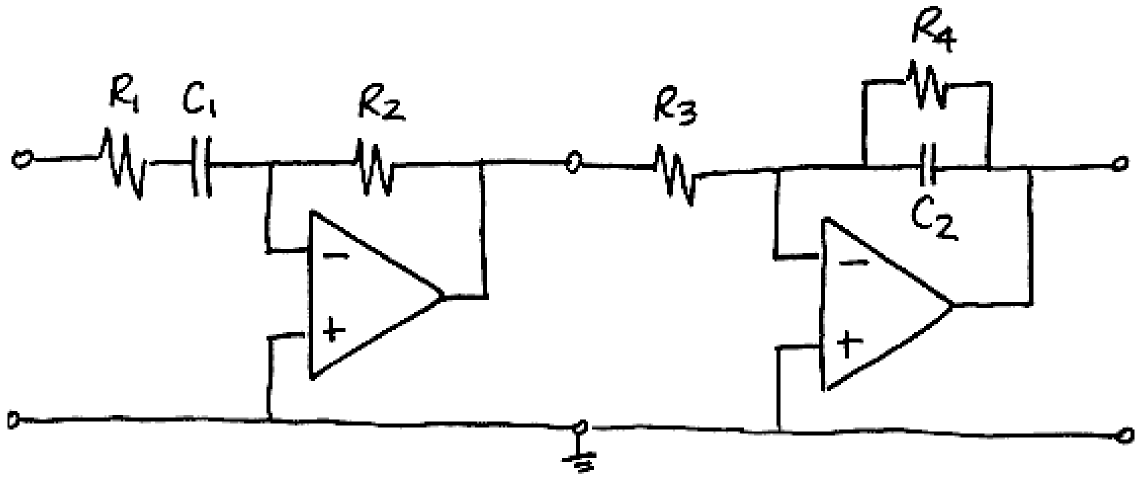
plugging in the values for the resistors & capacitors, can draw

$\left|\frac{V_0}{V_{in}}\right|$ (dB)





DP 13-4



$$H_1(\omega) = -K_1 \frac{j\omega}{1 + j\frac{\omega}{p_1}}$$

where

$$K_1 = R_2 C_1, \; p_1 = \frac{1}{C_1 R_1}$$

$$H_2(\omega) = \frac{K_2}{1 + j\frac{\omega}{P_2}}$$

where

$$K_2 = -\frac{R_4}{R_3}, \; p_2 = \frac{1}{C_2 R_4}$$

We require

$$10 = -K_1 K_2 = R_2 C_1 \frac{R_4}{R_3}$$

$$200 = p_1 = \frac{1}{R_1 C_1}$$

$$500 = p_2 = \frac{1}{C_2 R_4}$$

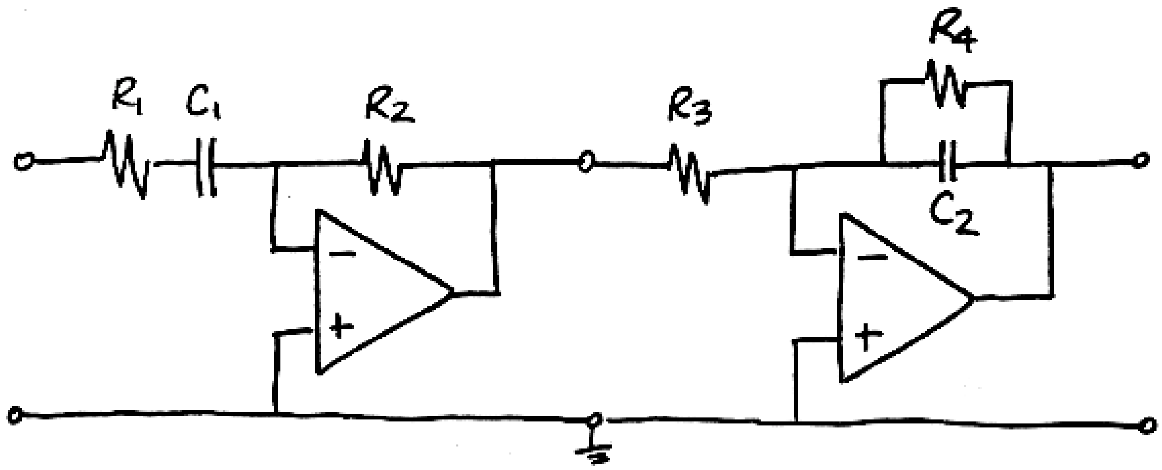
Pick $C_1 = 1\mu F$. Then $R_1 = \frac{1}{p_1 C_1} = 5k\Omega$

Pick $C_2 = 0.1\mu F$. Then $R_4 = \frac{1}{p_2 C_2} = 20k\Omega$

Next $10 = \frac{R_2}{R_3}(10^{-6})(20 \cdot 10^3) \Rightarrow \frac{R_2}{R_3} = 500$

Let $R_2 = 500k\Omega$ and $R_3 = 1k\Omega$

DP 13-5



$$H_1(\omega) = -K_1 \frac{j\omega}{1+j\frac{\omega}{p_1}}$$

where

$$K_1 = R_2C_1,\ p_1 = \frac{1}{C_1R_1}$$

$$H_2(\omega) = \frac{K_2}{1+j\frac{\omega}{p_2}}$$

where

$$K_2 = -\frac{R_4}{R_3},\ p_2 = \frac{1}{C_2R_2}$$

We require

$$20\text{dB} = 10 = -K_1K_2 = R_2C_1\frac{R_4}{R_3}$$

$$0.1 = p_1 = \frac{1}{R_1C_1}$$

$$100 = p_2 = \frac{1}{R_4C_2}$$

Pick $C_1 = 20\mu\text{F}$. Then $R_1 = \frac{1}{p_1C_1} = 500\text{k}\Omega$

Pick $C_2 = 1\mu\text{F}$. Then $R_4 = \frac{1}{p_2C_2} = 10\text{k}\Omega$

Next

$$10 = \frac{R_2}{R_3}(20\cdot10^{-6})(10\cdot10^{3}) \Rightarrow \frac{R_2}{R_3} = 50$$

Let $R_2 = 200\text{k}\Omega$ and $R_3 = 4\text{k}\Omega$

DP 13-6

The network function of this circuit is $$T(\omega)=\frac{1+\frac{R_2}{R_3}}{1+j\omega R_1 C}$$

The phase shift of this network function is $$\theta = -\tan^{-1}\omega R_1 C$$

The gain of this network function is $$G=\frac{1+\frac{R_3}{R_2}}{\sqrt{1+(\omega R_1 C)^2}}=\frac{1+\frac{R_3}{R_2}}{\sqrt{1+(\tan\theta)^2}}$$

Design of this circuit proceeds as follows. Since the frequency and capacitance are known, R_1 is calculated from

$$R_1=\frac{\tan(-\theta)}{\omega C}$$

Next pick R_2 = 10kΩ (a convenient value) and calculated R_3 using

$$R_3 = (G\cdot\sqrt{1+(\tan\theta)^2}-1)\cdot R_2$$

$$\theta=-45 \text{ deg},\ G=2,\ \omega=1000 \text{ rad/s} \Rightarrow R_1=10\text{k}\Omega,\ R_2=10\text{k}\Omega,\ R_3=18.284\ \text{k}\Omega,\ C=0.1\mu\text{F}$$

DP 13-7 From Table 13.4-2 and the Bode plot:

$$800 = z = \frac{1}{R_1(0.5 \text{ x } 10^{-6})} \Rightarrow R_1 = 2.5\text{ k}\Omega$$

$$32\text{dB} = 40 = \frac{R_2}{R_1} \Rightarrow R_2 = 100\text{ k}\Omega$$

$$200 = p = \frac{1}{R_2 C} \Rightarrow C = \frac{1}{(200)(100\text{k}\Omega)} = 0.05\mu\text{F}$$

$$20\text{dB} = 10 = k\frac{p}{z} = \frac{0.5\mu\text{F}}{C} = \frac{0.5\mu\text{F}}{0.05\mu\text{F}}$$

DP 13-8

$$H(\omega) = \frac{-R_2}{1+\frac{1}{j\omega C}} = -\frac{j\omega C R_2}{1+j\omega C R_1}$$

$$195^\circ = 180+90-\tan^{-1}\omega C R_1$$

$$\Rightarrow R_1 = \frac{\tan(270-195)}{(1000)(0.1 \text{ x } 10^{-6})} = 37.3\text{ k}\Omega$$

$$10 = \lim_{w\to\infty}|H(\omega)| = \frac{R_2}{R_1} \Rightarrow R_2 = 10R_1 = 373\text{ k}\Omega$$