1a. $\omega \to 0$:L$\to$short so gain=1. $\omega \to \infty$:C$\to$short so gain=1. Passes low & high freqs.
$0 < \omega < \infty$: $L||C$ can only get larger, so gain< 1. Gain has a minimum somewhere.

1b. Let $Z = j\omega L||\frac{1}{j\omega C} = \frac{(j\omega L)/(j\omega C)}{j\omega L+1/(j\omega C)} = \frac{j\omega L}{1-\omega^2 LC}$.
$H(j\omega) = \frac{V_O}{V_I} = \frac{R}{R+Z} = \frac{R(1-\omega^2 LC)}{R(1-\omega^2 LC)+j\omega L} = \frac{(j\omega)^2+\frac{1}{LC}}{(j\omega)^2+j\omega\frac{1}{RC}+\frac{1}{LC}}$.

1c. $|H(j\omega)| = 0$ (can't get smaller than that) at $\omega_o = 1/\sqrt{LC}$ (same as series RLC).

1d. $|H(j0)| = |H(j\infty)| = 1$ so $|H(j\omega)| = 1/\sqrt{2}$ at cutoff frequencies ω_{c1}, ω_{c2}.
$|H(j\omega)| = 1/\sqrt{2}$ when $\pm\omega\frac{1}{RC} = \frac{1}{LC} - \omega^2 \to \omega_{c1}, \omega_{c2} = \pm\frac{1}{2RC} + \sqrt{\frac{1}{(2RC)^2} + \frac{1}{LC}}$.

1e. Bandwidth=$\omega_{c2} - \omega_{c1} = \frac{1}{RC}$. As before, $\omega_{c1} \approx \omega_o - \frac{1}{2RC}$; $\omega_{c2} \approx \omega_o + \frac{1}{2RC}$.

1f. $Q = \frac{\text{resonant freq}}{\text{bandwidth}} = \omega_o RC$ (same as parallel RLC circuit).

2a. $2\pi(50kHz) = \frac{1}{\sqrt{LC}} \to L = 1/[(100,000\pi)^2(0.1 \times 10^{-6})] = 101.3\mu H$.

2a. $8 = Q = \omega_o RC = 100,000\pi(0.1 \times 10^{-6})R \to R = \frac{800}{\pi} = 254.6\Omega$.

2c. $Q = \frac{\text{resonant freq}}{\text{bandwidth}} \to \text{Bandwidth} = \frac{50kHz}{8} = 6.25kHz$.

2b. $f_{c1} = 50 - \frac{6.25}{2} = 46.9kHz$. $f_{c2} = 50 + \frac{6.25}{2} = 53.1kHz$.
These differ from the exact answers using the square root by only 0.1kHz.

3a. $\frac{V_O}{V_I} = -\frac{Z_F}{Z_I}$ where $Z_I = R_1 + \frac{1}{j\omega C_1} = \frac{j\omega R_1 C_1+1}{j\omega C_1}$ and $Z_F = R_2||\frac{1}{j\omega C_2} = \frac{R_2}{j\omega R_2 C_2+1}$.

3a. $H(j\omega) = -\frac{j\omega/(R_1 C_2)}{(j\omega+\frac{1}{R_1 C_1})(j\omega+\frac{1}{R_2 C_2})}$. **Zero:** origin. **Poles:** $\frac{1}{R_2 C_2}$; $\frac{1}{R_1 C_1}$.

3b. $H(j0) = 0$. Makes sense: C_2 $\to$open vanishes; C_1 $\to$open $\to$gain=0.

3c. $H(j\infty) = 0$. Makes sense: C_1 $\to$short vanishes; C_2 $\to$short$\to$gain=0.

Bode: **Zero:** origin. **Poles:** $\frac{1}{R_2 C_2} = 10^3$; $\frac{1}{R_1 C_1} = 10^5$. $\omega \to 0 : |H(j\omega)| \simeq |\frac{-10^5 j\omega}{10^3 10^5}| = \frac{\omega}{10^3}$.

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4. $Q = \frac{\text{resonant freq}}{\text{bandwidth}} = \frac{100kr/s}{4r/s} = 25 = \frac{(100kr/s)L}{1000\Omega} \to L = 0.25H$
$100,000 = \frac{1}{\sqrt{LC}} \to C = 10^{-10}/0.25 = 400pF$. At resonance, impedance=R=1000Ω

5a. $V_I(t) = 12.54 - 25.08\sum_{n=1}^{\infty}\frac{\cos(754nt)}{4n^2-1}$ where $\frac{2(19.7)}{\pi} = 12.54$ (from inside back cover).

5b. **Pole:** $\frac{1}{RC} = \frac{1}{2(0.00663)} = 75.4\frac{rad}{sec} = 12Hz$. Gain== $\frac{1}{\sqrt{1+(\frac{f}{12})^2}}$. Phase=$-\tan^{-1}\frac{f}{12}$.

5c. $V_O(t) = 12.54 - 25.08\sum_{n=1}^{\infty}\frac{\cos[754nt-\tan^{-1}(10n)]}{(4n^2-1)\sqrt{1+100n^2}}$ using $f = 120n \to \omega RC = \frac{120n}{12} = 10n$.