EECE 2150 - Circuits and Signals: Biomedical Applications Fall 2018, Quiz 7

Prof. Charles A. DiMarzio

1 November 2018

Student Name: _____

Consider the circuit in the figure.

1. Write the equation for the amplifier gain in simplest rectangular form.

$A_v =$ _____ +j _____

2. Now, use the values, $R = 1\,\text{k}\Omega$ and $C = 10\,\mu\text{F}$. The phase is -45° at a frequency of 10 kHz. That is, the real and imaginary parts of A_v are equal at that frequency. What is the value of the inductor?

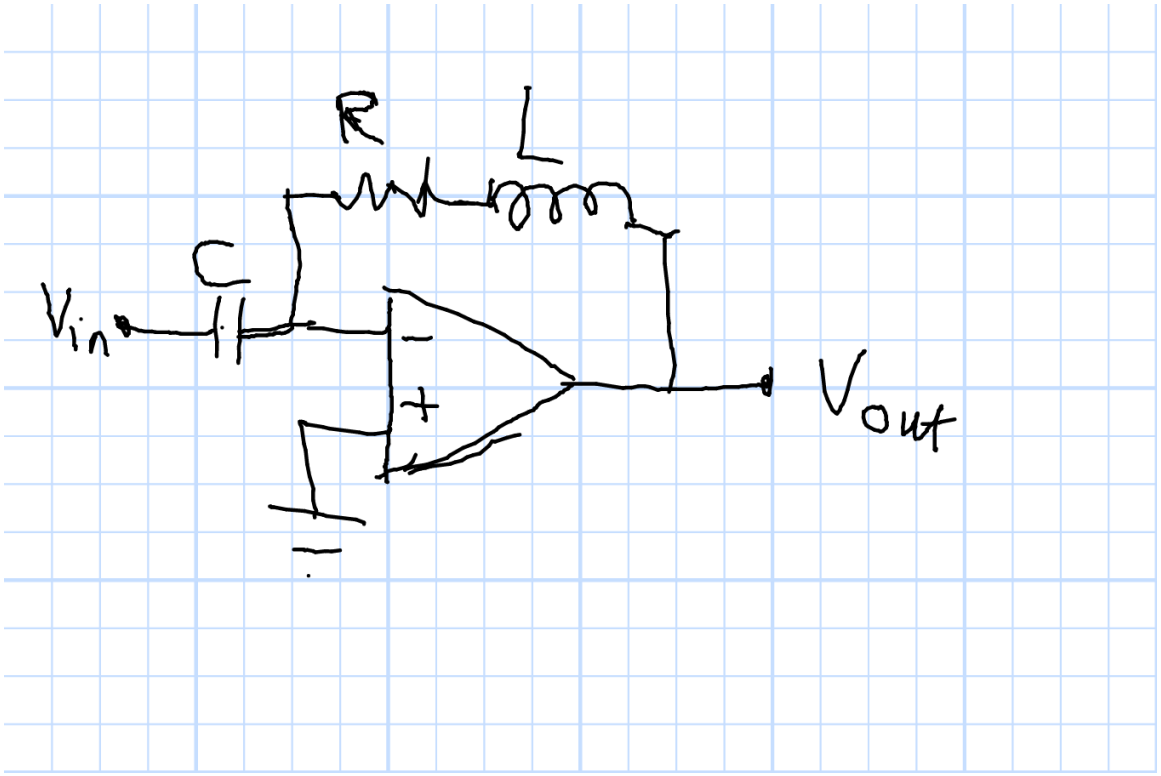
$L =$ _____ H.

3. What is the DC gain ($f = 0$)?

$A_v =$ _____ .

4. What is the gain at $f = 1\,\text{MHz}$? Express it in polar coordinates with the angle in degrees.

$A_v =$ _____ $\angle$ _____ $^\circ$.


R
L
C
V_{in}
−
+
V_{out}

1.

$$A_V = -\frac{R + j\omega L}{1/(j\omega C)}$$

$$A_V = -j\omega C \times R - j\omega C \times j\omega L$$

$$A_V = \omega^2 LC - j\omega RC$$

2.

$$\omega^2 LC = \omega RC$$

$$L = \frac{R}{\omega}$$

$$L = \frac{1000\,\Omega}{2\pi 10^4\,\mathrm{Hz}} = 15.9\,\mathrm{mH}.$$

3.

$$Z_1 \to \infty \qquad A_v = 0.$$

4.

$$A_V = \omega^2 LC - j\omega RC$$

$$A_V = \left(2\pi 10^{12}\,\mathrm{Hz}\right)^2 \times 0.0159\,\mathrm{H} \times 10^{-5}\,\mathrm{F} - j2\pi 10^6\,\mathrm{Hz} \times 1000\,\Omega \times 10^{-5}\,\mathrm{F}$$

$$A_v = 6.28 \times 10^6 - j6.28 \times 10^4.$$

$$|A_v| = 6.28 \times 10^6 \qquad \phi = -0.57^\circ$$

To a good approximation, the gain is real.