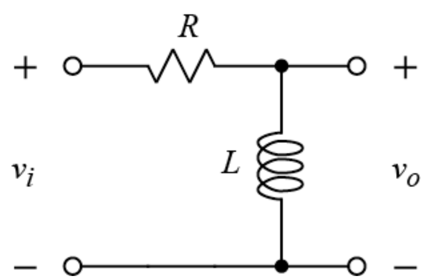
Ex:



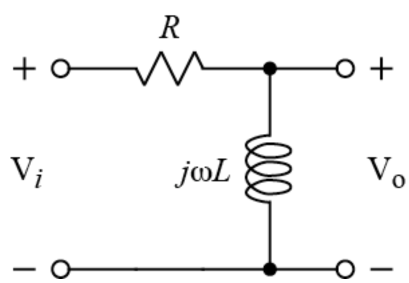
$R = 1\,\text{k}\Omega$ $\quad L = 40\ \mu\text{H}$

a) Determine the transfer function V_o/V_i.

b) Plot $|V_o/V_i|$ versus ω.

c) Find the cutoff frequency, ω_c.

SOL'N: a) We transform the circuit to the frequency domain.



The voltage-divider formula gives the transfer function, starting with the formula for V_o:

$$V_o = V_i \frac{j\omega L}{R + j\omega L}$$

Dividing by V_i gives the transfer function:

$$H(j\omega) = \frac{V_o}{V_i} = \frac{j\omega L}{R + j\omega L}$$

A better form is obtained by dividing top and bottom by $j\omega L$:

$$H(j\omega) = \frac{1}{1 + \dfrac{R}{j\omega L}} = \frac{1}{1 - j\dfrac{R}{\omega L}} = \frac{1}{1 - j\dfrac{1\text{k}}{\omega 40\mu}} = \frac{1}{1 - j\dfrac{25\text{M}}{\omega}}$$

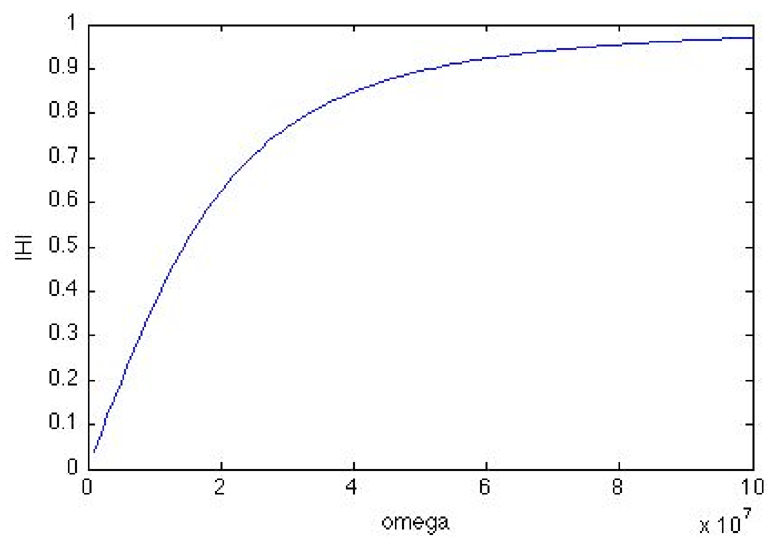
b) The plot is generated with the following Matlab® code.

```
% ECE2260F10_HW3p1soln.m
%
% Plot of transfer function of RL high-pass filter.

R = 1e3;
L = 40e-6;

omega = 1e6:1e6:100e6;
H = 1 ./ (1 - j*R./(omega*L));

plot(omega,abs(H))
xlabel('omega')
ylabel('|H|')
```



c) We find the cutoff frequency by setting the magnitude of the transfer function equal to $1/\sqrt{2}$ times the max value of $|H|$.

$$|H(j\omega_c)| = \frac{1}{\sqrt{2}} \max_{\omega} |H(j\omega)| = \frac{1}{\sqrt{2}}$$

We observe that $\sqrt{2} = |1 \pm j|$ meaning we can solve for ω_c by setting 25M/ω equal to one:

$$\frac{25\text{M}}{\omega_c} = 1$$

or

$$\omega_c = 25\text{M r/s}$$