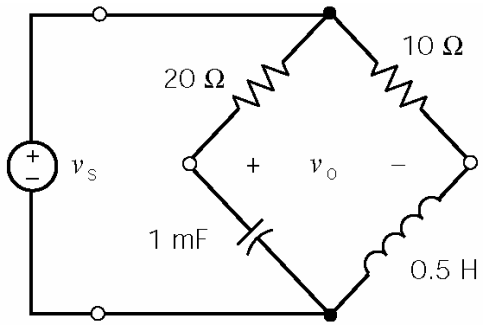
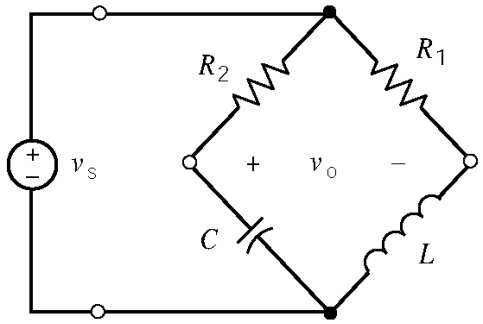
Example:

The input to this circuit is the voltage of the voltage source, v_s. The output of the circuit is the voltage, v_o. Use MATLAB to plot the gain and phase shift of this circuit as a function of frequency for frequencies in the range $1 < \omega < 1000$ rad/s.



Solution:



Using voltage division twice gives

$$\mathbf{V}_o(\omega) = \frac{\frac{1}{j\omega C}}{R_2 + \frac{1}{j\omega C}}\mathbf{V}_s(\omega) - \frac{j\omega L}{R_1 + j\omega L}\mathbf{V}_s(\omega)$$

so

$$\mathbf{H}(\omega) = \frac{\mathbf{V}_o(\omega)}{\mathbf{V}_s(\omega)} = \frac{1}{1 + j\omega C R_2} - \frac{j\omega L}{R_1 + j\omega L}$$

Modify the MATLAB script given in Section 13.7 of the text:

```
% P13_7_1.m - plot the gain and phase shift of a circuit

%-----------------------------------------------------------------
%     Create a list of logarithmically spaced frequencies.
%-----------------------------------------------------------------

wmin=1;       % starting frequency, rad/s
wmax=1000;    % ending frequency, rad/s

w = logspace(log10(wmin),log10(wmax));

%-----------------------------------------------------------------
%   Enter values of the parameters that describe the circuit.
%-----------------------------------------------------------------

R1 = 10;   % Ohms
R2 = 20;   % Ohms
C = 0.001; % Farads
L = 0.5;   % Henries

%-----------------------------------------------------------------
% Calculate the value of the network function at each frequency.
%   Calculate the magnitude and angle of the network function.
%-----------------------------------------------------------------
```

```
for k=1:length(w)
    H(k) = 1/(1+j*R2*C*w(k)) - j*L*w(k)/(R1+j*L*w(k));
    gain(k) = abs(H(k));
    phase(k) = angle(H(k))*180/pi;
end

%---------------------------------------------------------------
%                   Plot the frequency response.
%---------------------------------------------------------------

subplot(2,1,1), semilogx(w, gain)
xlabel('Frequency, rad/s'), ylabel('Gain, V/V')
title('Frequency Response Plots')
subplot(2,1,2), semilogx(w, phase)
xlabel('Frequency, rad/s'), ylabel('Phase, deg')
```

Here are the plots produced by MATLAB: