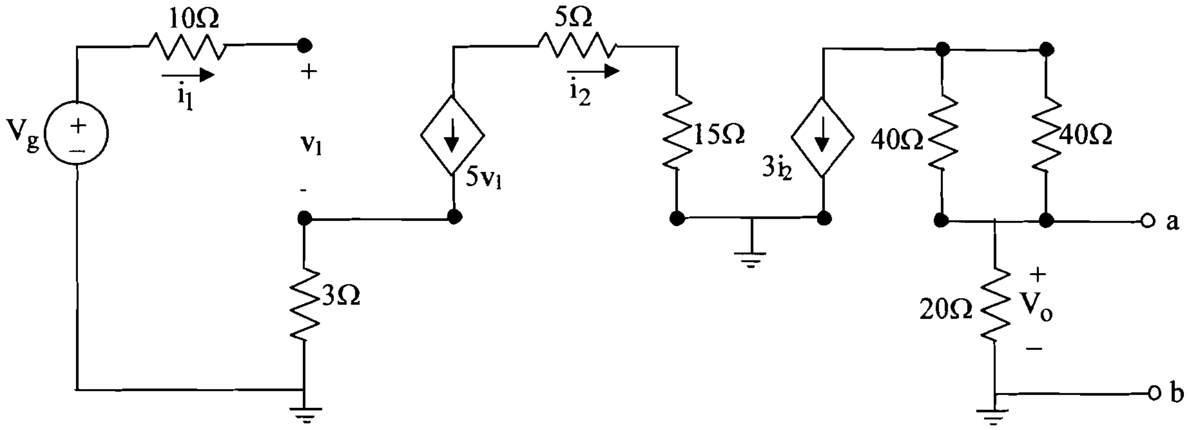
Homework #1:

1. Given V_g=10mV, find V_o. Find the Thevenin equivalent between terminals a-b. (Note: $v_1 \neq V_g$)



2. Sketch the following waveforms. Identify the dc component of the waveform and the ac component of the waveform.
   a. Vs=10cos(10t) V
   b. Vs=3V +7cos(10t) V
   c. Vs=3V $\pm$ 0.25V

3. Explain in your own words the procedural steps for plotting Bode Plots. (Note: I would prepare this question for use during an exam)

4. (a) Plug in values of ω from 0.1 to 10^5 rad/sec. Plot this graph of Volts vs ω.
   (b) Sketch the Bode plots using a straight-line approximation (procedures described in class)
   (c) Use Matlab to obtain the Bode Plot.
   (d) Compare the three. What differences do you see?

$$H(s) = \frac{10s}{(s+10{,}000)(s+100)}$$

5. Sketch the Bode plot using a straight-line approximation (procedures described in class) and then use Matlab to obtain the Bode Plot. Compare the two.

$$H(s) = \frac{100{,}000(s+10)^3}{s^2(s+10k)(s+1k)}$$

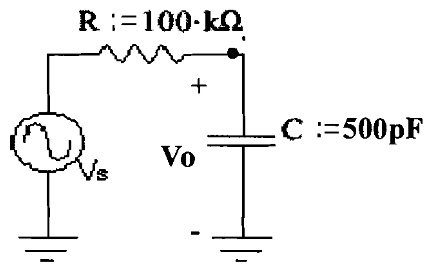
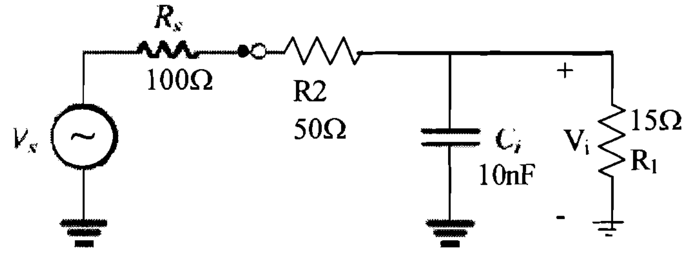


Fig. 1

6. Use PSPICE to simulate the circuit of Fig. 1 and determine the Bode Plots. Print out the schematic, along with the plots. ***(Double points – counts as two homework problems)***

7. Analyze the following circuit to find the transfer function Vi/Vs. Solve the circuit symbolically first (with R_S, R_i, R_l, C_i) and then plug in their values. Create a rough sketch of the transfer function using a straight-line approximation procedure.



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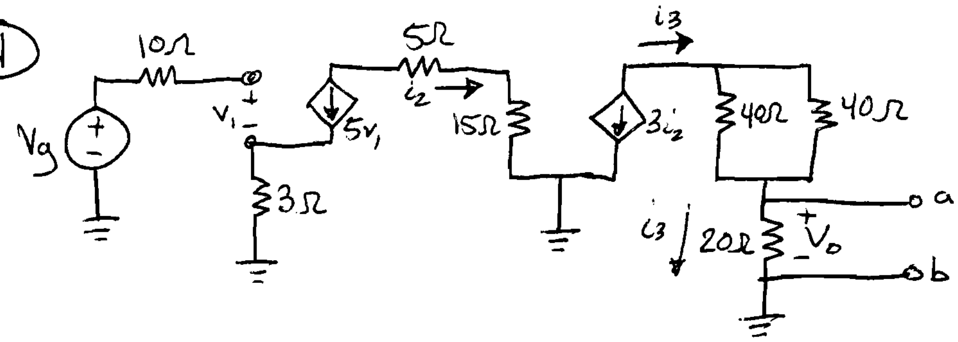


Find V_o:

$V_o = -3i_2(20\Omega)$

$i_2 = -5v_1$

$v_1 = V_g - (5v_1 \cdot 3\Omega)$

$V_1 = \frac{1}{16} V_g$

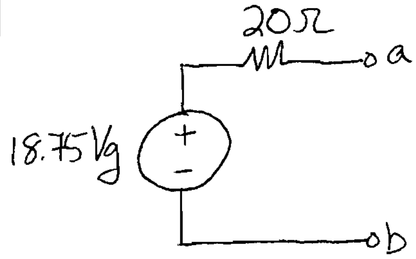
$i_2 = -\frac{5}{16} V_g$

$V_o = \frac{75}{4} V_g = 18.75 V_g$

Thevenin's Equivalent:

V_{th} = open circuit voltage = V_o = $18.75 V_g$

$R_{th} = 20\Omega$ because with V_g off $i_2 = i_3 = 0A$ leaving the only path between terminals a and be as the 20Ω resistor shown.



Thevenin Equivalent

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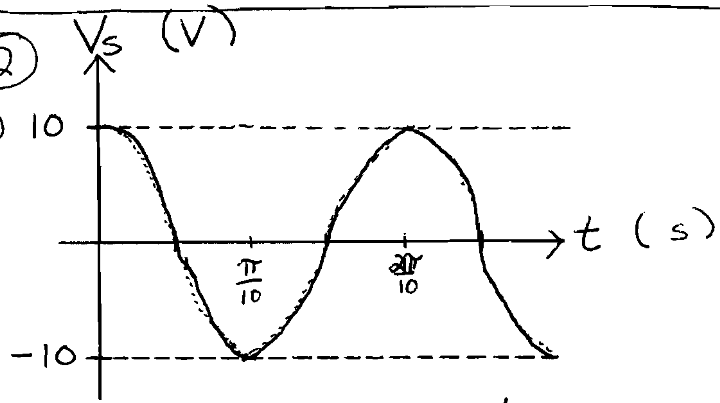
(2)

(a)

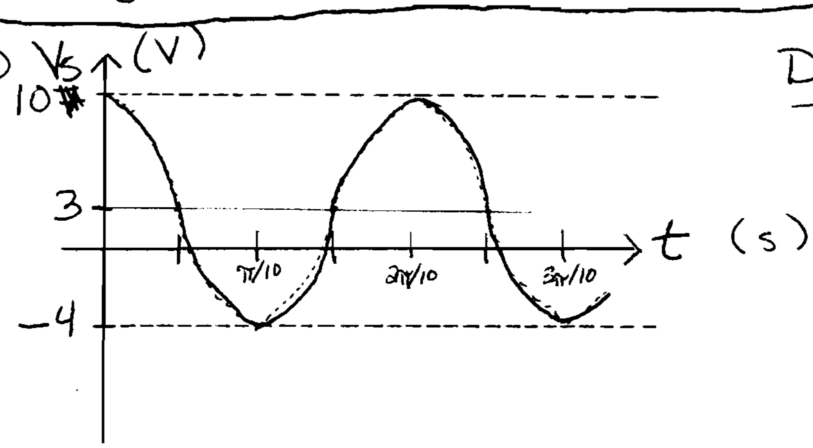


$V_s = 10\cos(10t)$ V

DC component = 0V

AC component = $10\cos(10t)$V

(b)

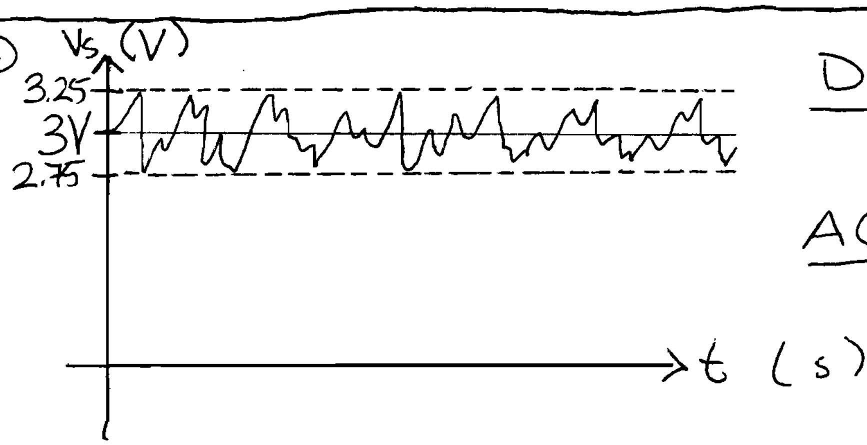


DC component: 3V

AC component: $7\cos(10t)$V

$V_s = 3V + 7\cos(10t)$ V

(c)



DC component: 3V

AC component (noise): ± 0.25V

(3) Procedural Steps for Bode Plots.

1. Determine the poles and the zeros.

2. Determine the starting point of the amplitude plot by plugging into the transfer function the first frequency on the plot.

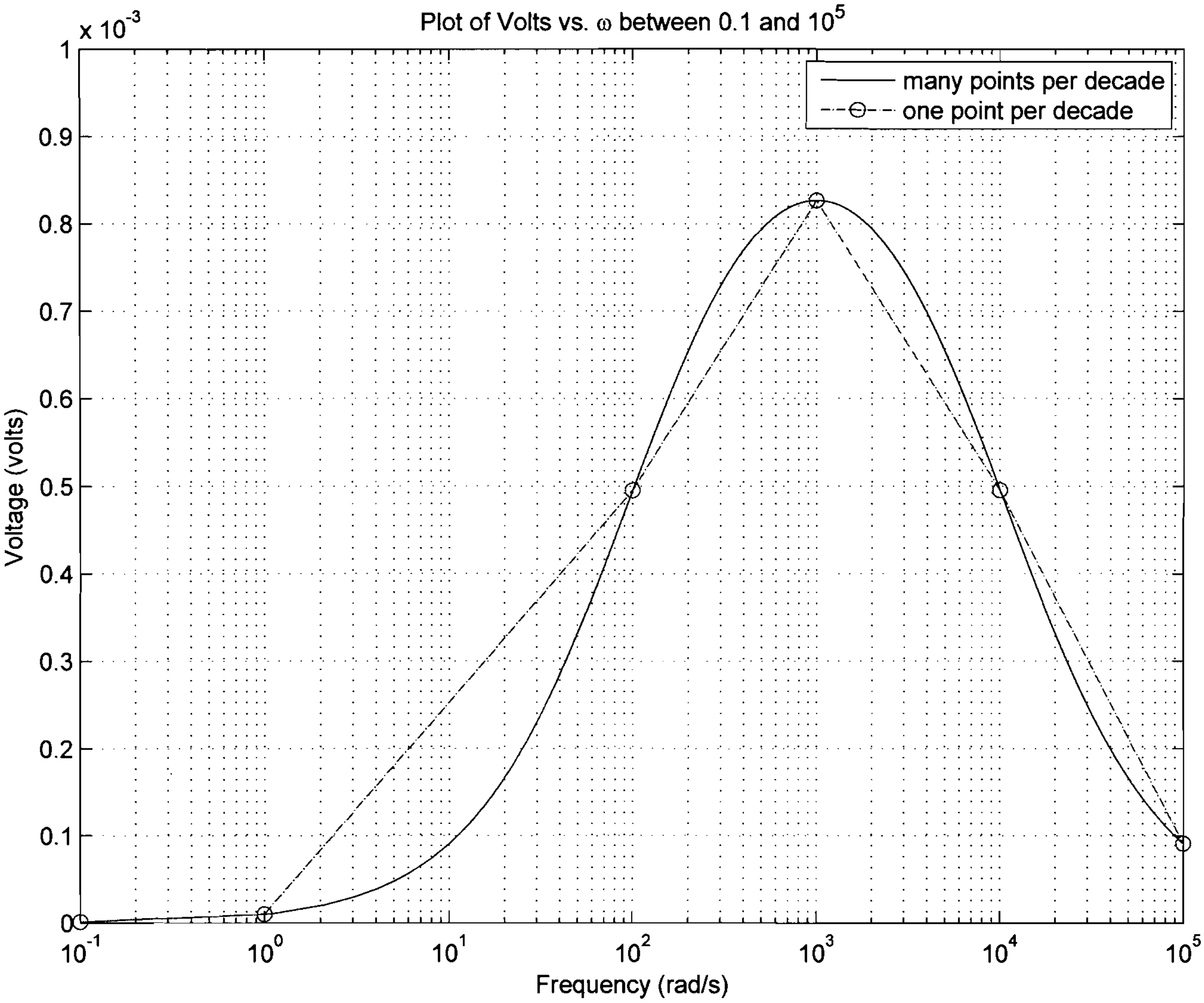
3. Draw the amplitude plot; begin at the starting point. Start with the slope given by poles or zeros at $\omega = 0$; at each zero add 20 dB/decade, and at each pole subtract 20dB/decade. The pole/zero order determines how many 20dB/decade are added or subtracted. Continue drawing, changing the slope until reaching the end of the graph.

4. Draw the phase plot.

Start Value = 0° if constants > 0
180° if constants < 0
$+90^\circ$ for each zero at the origin
-90° for each pole at the origin

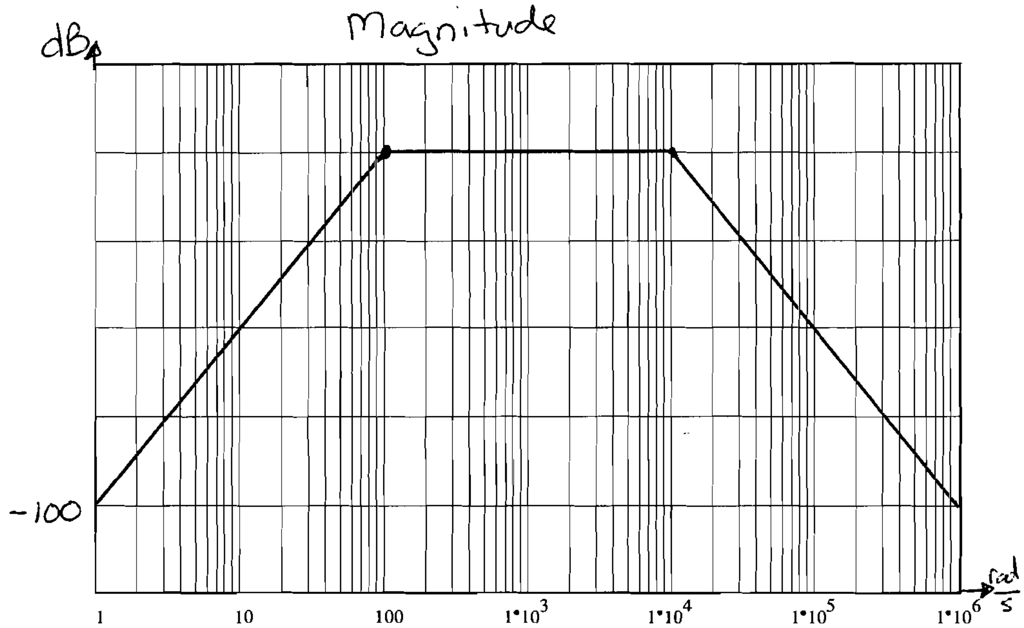
Each pole/zero contributes a 45° difference in the slope of the Bode Phase Diagram. Mark these on the plot; ~~and~~ the effect begins 1 decade before the pole/zero and ends 1 decade after the pole/zero.

4/a $H(s) = \frac{10s}{(s+10k)(s+100)}$



5/

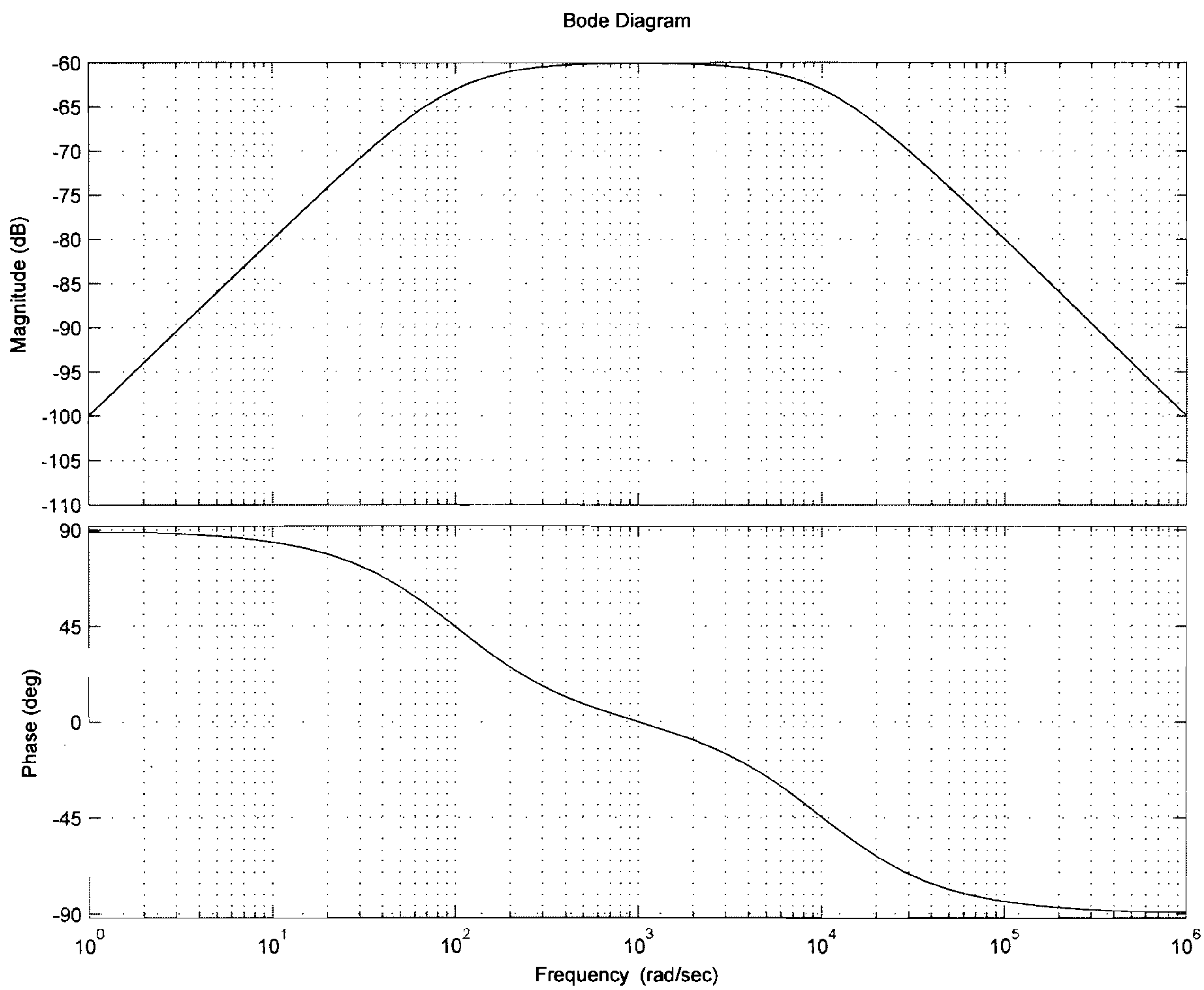
4b


Magnitude
dB
-100
1
10
100
1*10^3
1*10^4
1*10^5
1*10^6
rad/s


Phase
degrees
90°
45°
0°
-45°
-90°
1
10
100
1*10^3
1*10^4
1*10^5
1*10^6
rad/s

6/

4c

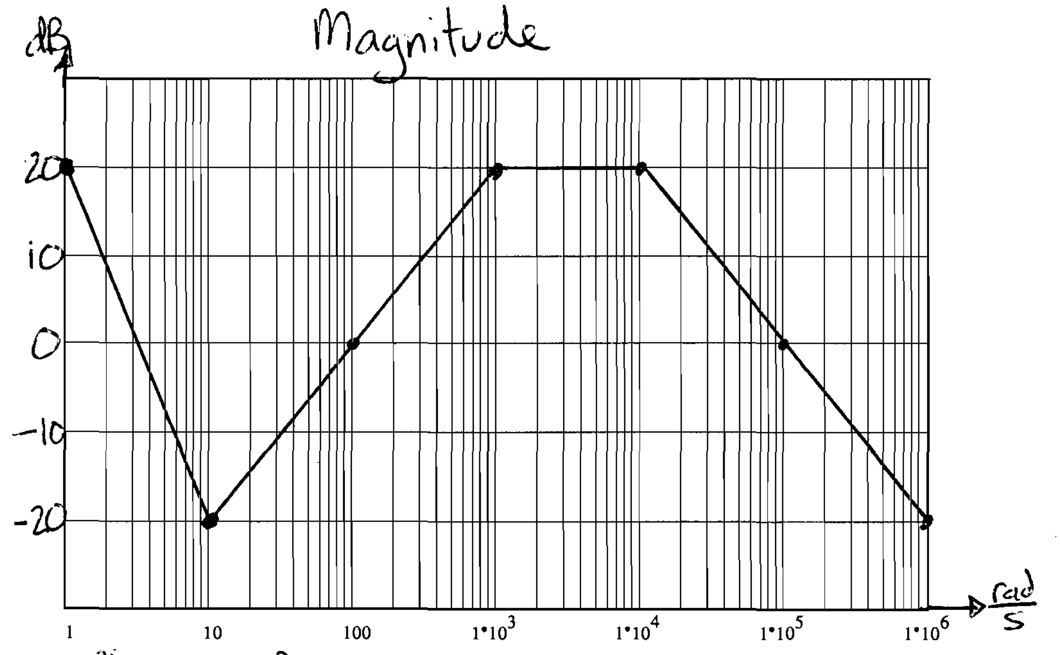


Bode Diagram
Magnitude (dB)
-60
-65
-70
-75
-80
-85
-90
-95
-100
-105
-110
Phase (deg)
90
45
0
-45
-90
10^0
10^1
10^2
10^3
10^4
10^5
10^6
Frequency (rad/sec)

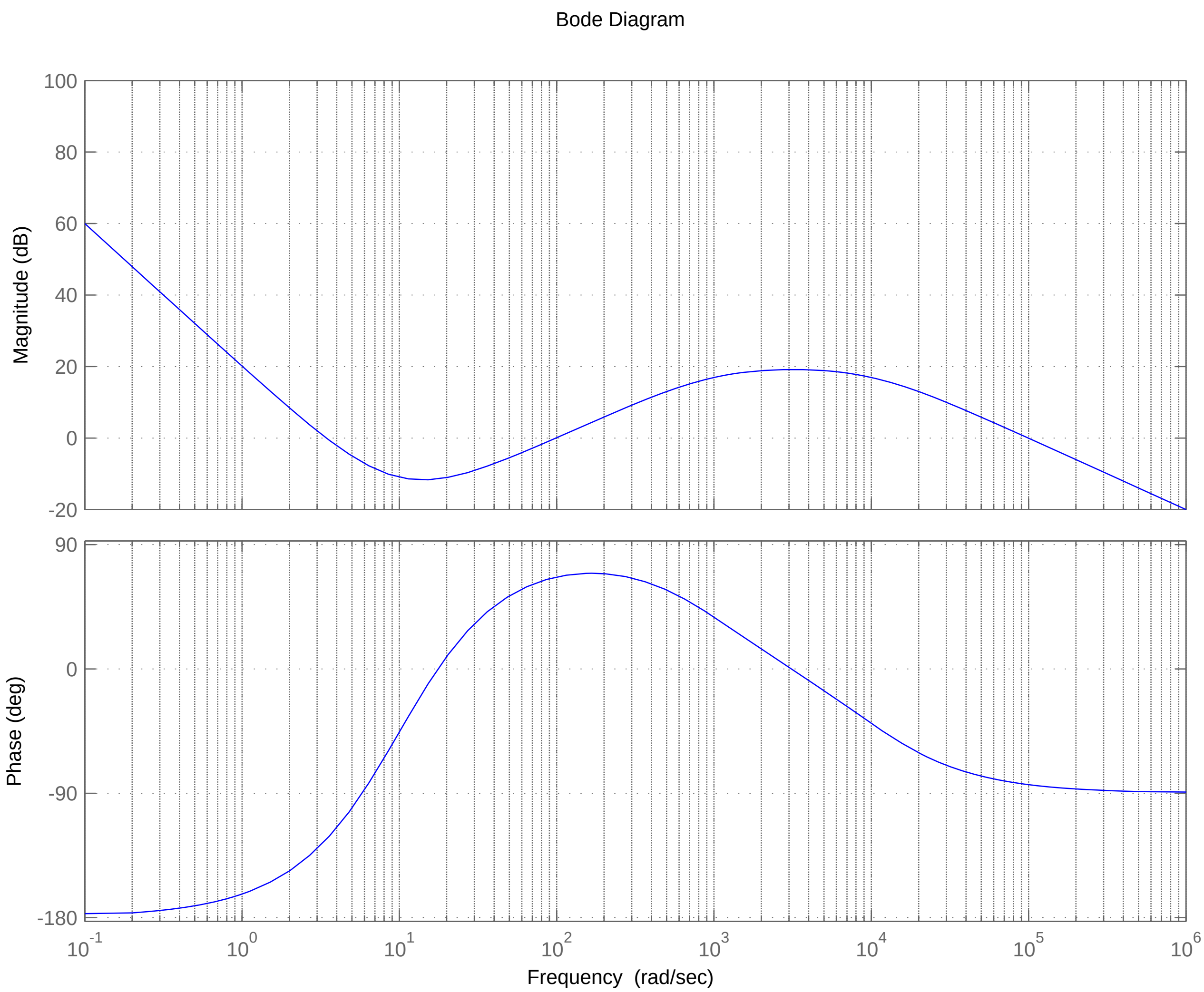
+/

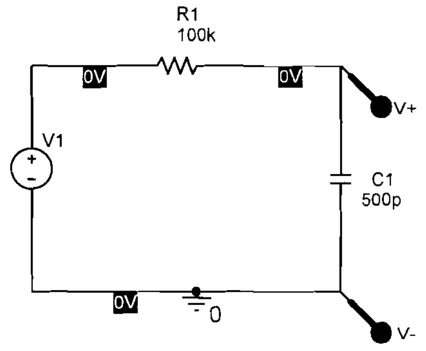
(5)

For the Magnitude Plot, there is a 3dB difference at each pole/zero (from the Matlab compared w/ the straight line approx.)



Similarly, the Phase Plot has errors, however the plot is correct during periods w/no change in slope and at the corner frequencies.


Bode Diagram
Magnitude (dB)
100
80
60
40
20
0
-20
Phase (deg)
90
0
-90
-180
10-1
100
101
102
103
104
105
106
Frequency (rad/sec)



Corner Frequency = 1/RC = 20 krad/s = 3.2 kHz

Title		
HW 1 Solution - Problem 5	ECE 2260	
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** Profile: "SCHEMATIC1-test" [E:\ECE2280\HW1 Stuff\hw1-schematic1-test.sim]
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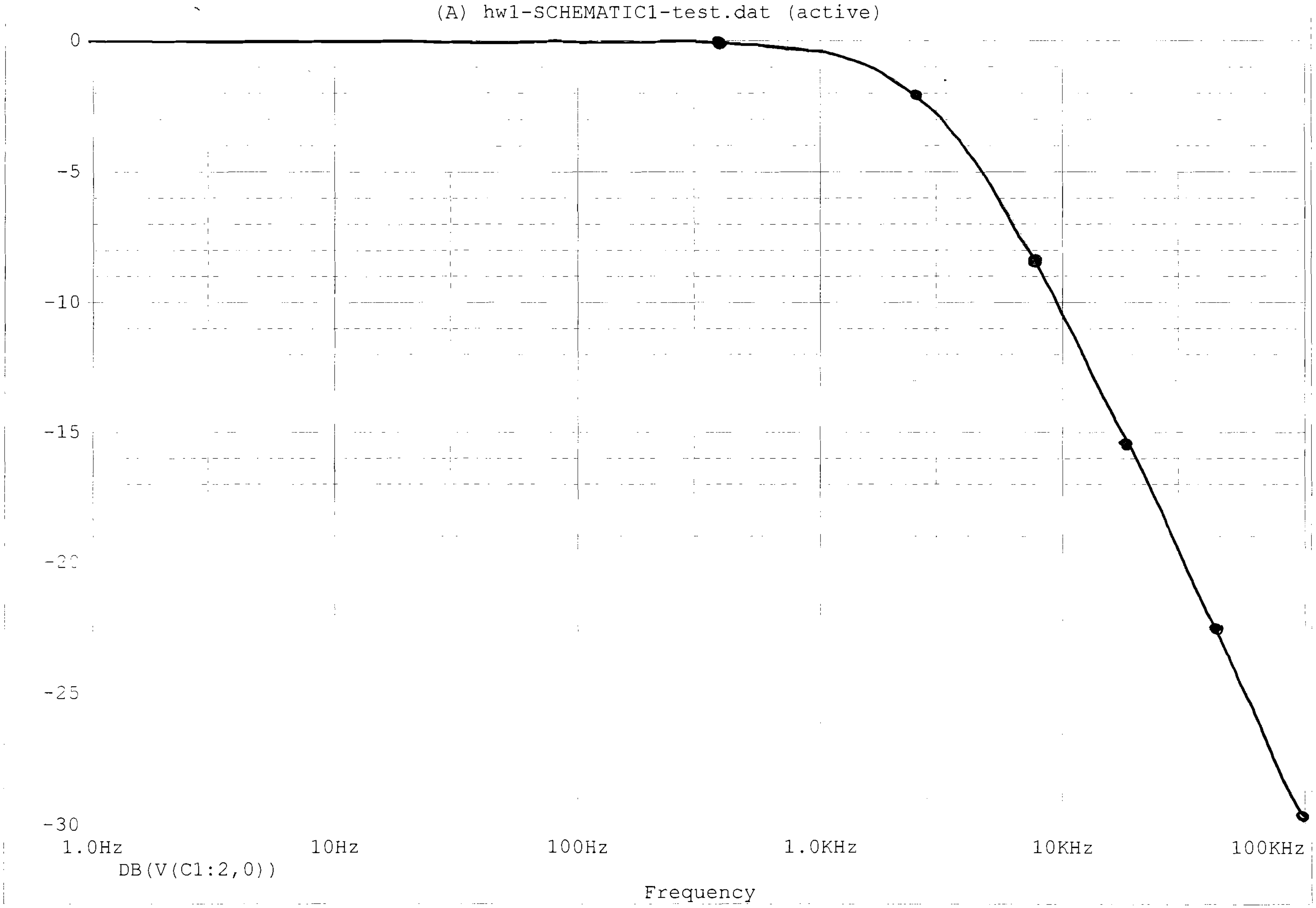

Date: January 09, 2008 Page 1 Time: 13:26:00

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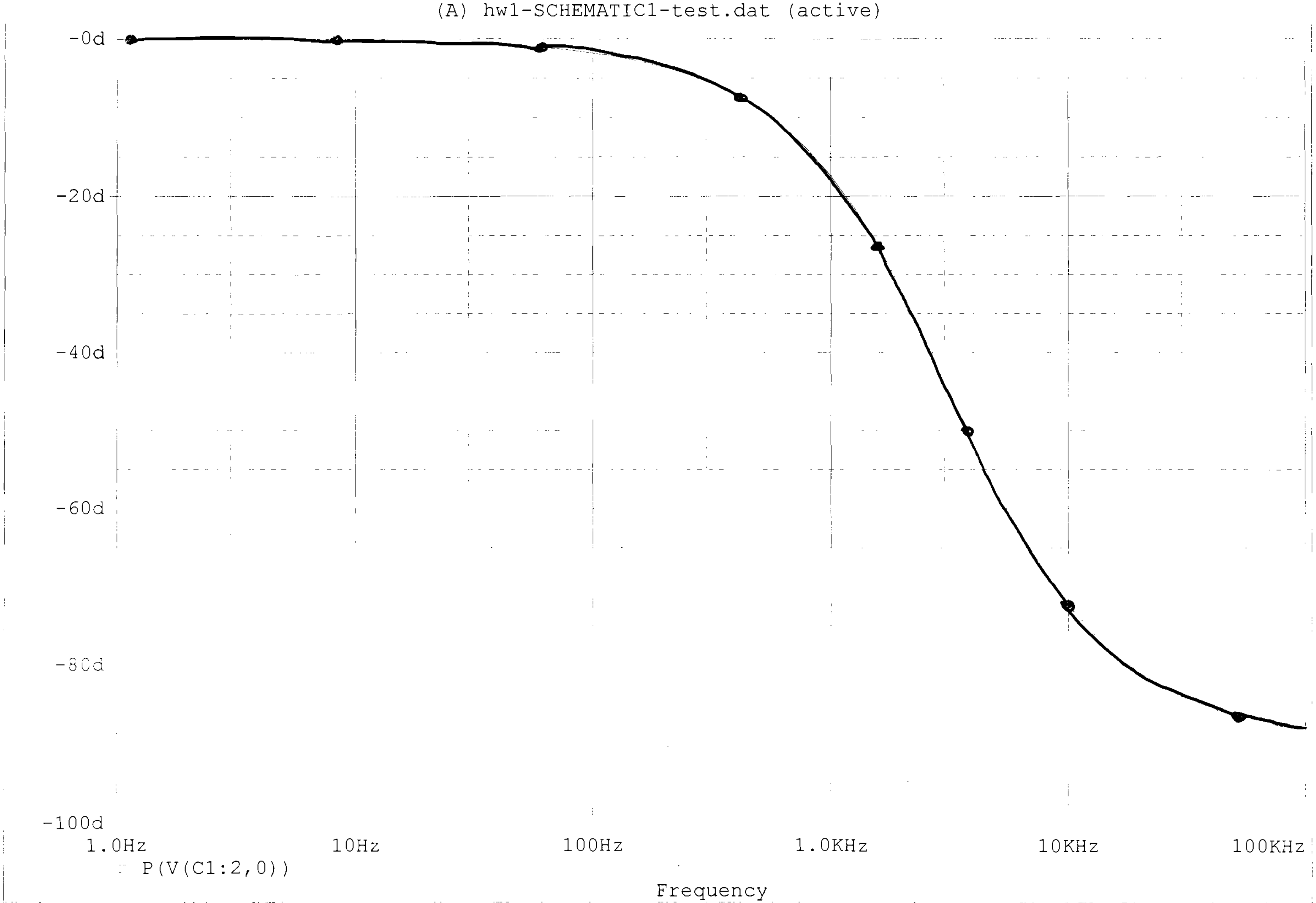

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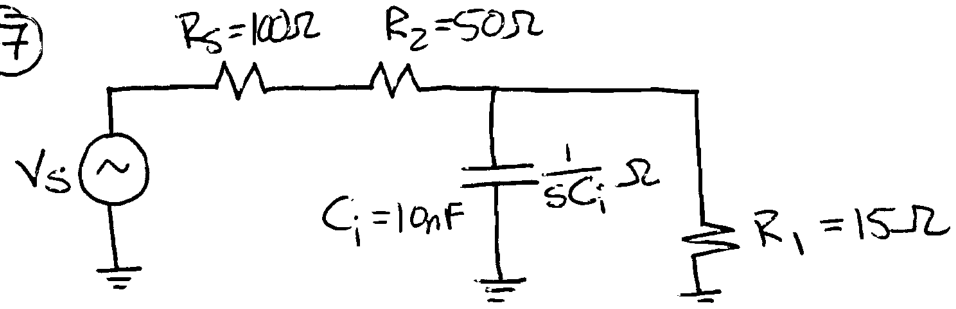
(7)



$$G_1 = \frac{1}{R_1} \qquad G_2 = \frac{1}{R_2 + R_S}$$

Using node voltage at the v_i node:

$$v_i G_1 + v_i s C_i + (v_i - v_s) G_2 = 0V$$

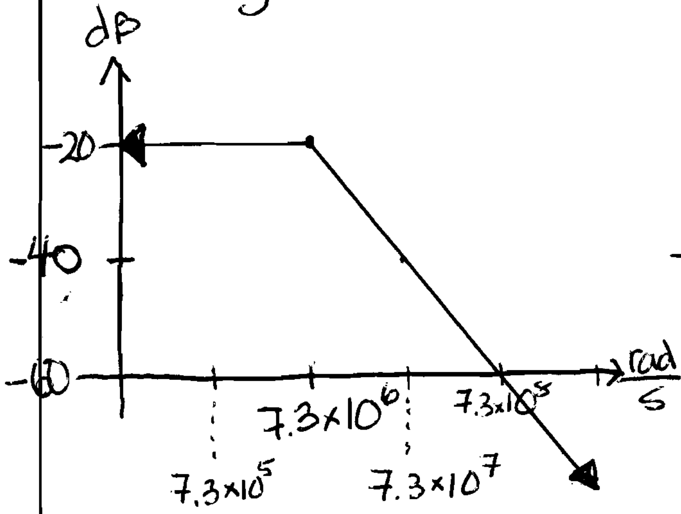
$$v_i (G_1 + G_2 + sC_i) = V_S G_2$$

$$\frac{V_i}{V_S} = \frac{G_2}{G_1 + G_2 + sC_i} = \frac{\frac{G_2}{G_1 + G_2}}{s\frac{C_i}{G_1 + G_2} + 1}$$

$$\therefore \frac{V_i}{V_S} = \frac{0.0909}{1.364\times10^{-7}s + 1} = \frac{0.0909}{\frac{s}{7.3\times10^6} + 1}$$

Here's a Rough sketch of the Bode Plots:

Magnitude



Phase