

Chapter 9 #1a, 3, 7, 11, 12, 13

- 1a) Determine the common logarithm of the following numbers: 10^3 , 50 and 0.707.

$$\log_{10} 10^3 = \underline{\underline{3}}$$

$$\log_{10} 50 = \underline{\underline{1.699}}$$

$$\log_{10} 0.707 = \underline{\underline{-0.151}}$$

- 3) Determine:

a) $20 \log_{10} \frac{84}{6}$ using log rules and compare to $20 \log_{10} 14$

$$20 \log_{10} \frac{84}{6} = 20 \log_{10} 84 - 20 \log_{10} 6 = 1.146 = 20 \log_{10} 14$$

Same.

b) $10 \log_{10} \frac{1}{250}$ using eq (9.7) and compare with $10 \log_{10} 4 \times 10^{-3}$

$$10 \log_{10} \frac{1}{250} = -10 \log_{10} 250 = -24 = 10 \log_{10} 4 \times 10^{-3}$$

same

c) $\log_{10} (40)(0.2)$ using eq (9.8) and compare to $\log_{10} 8$

$$\log_{10} (40)(0.2) = \log_{10} (40) + \log_{10} (0.2) = 0.903 = \underline{\underline{\log_{10} 8}}$$

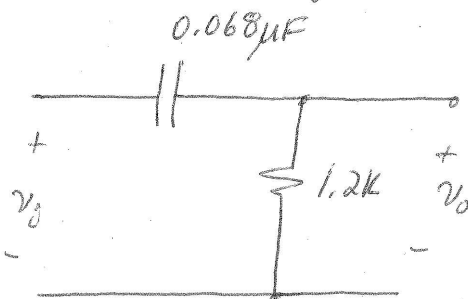
same

7) Input and output voltage measurements of $V_i = 10\text{mV}$ and $V_o = 25\text{V}$ are made. What is the voltage gain in decibels?

$$G_{dB} = 20 \log_{10} \left(\frac{V_o}{V_i} \right) = 20 \log_{10} \left(\frac{25}{10\text{mV}} \right) = \underline{\underline{67.96\text{dB}}}$$

Chapter 9 #11, 12, 13

11) For the network (of fig below)



a) Determine the mathematical expression for the magnitude of the ratio v_o/v_i .

$$|A_v| = \left| \frac{v_o}{v_i} \right| = \frac{1}{\sqrt{1 + (f_1/f)^2}}$$

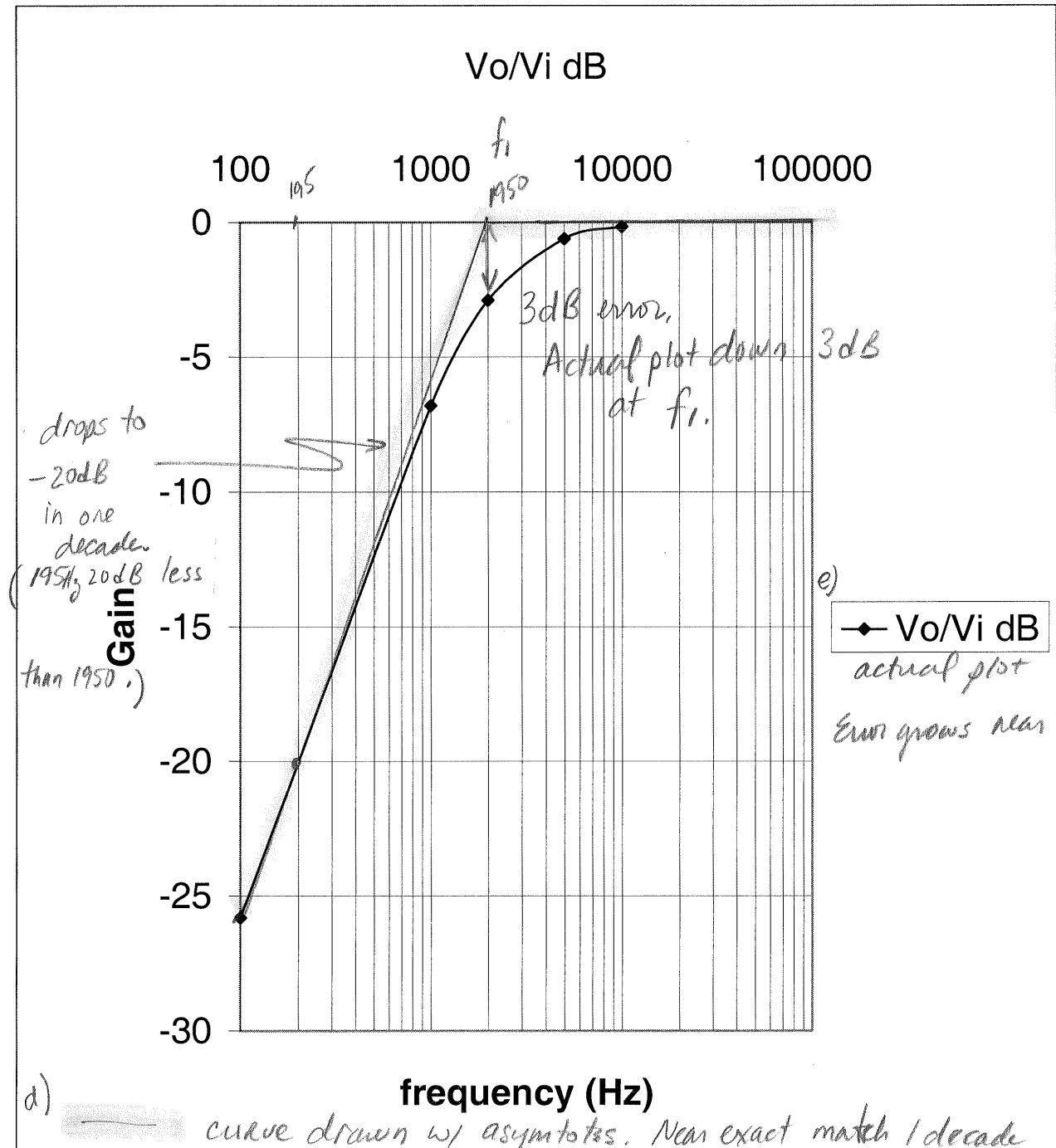
$$f_1 = \frac{1}{2\pi RC} = \frac{1}{2\pi(1.2k)(0.068\mu)} = 1950 \text{ Hz}$$

$$|A_v| = \frac{1}{\sqrt{1 + (1950/f)^2}}$$

b) Using the results from part (a), determine v_o/v_i at 100 Hz, 1 kHz, 2 kHz, 5 kHz and 10 kHz, and plot the resulting curve for a frequency range of 100 Hz to 10 kHz. Use a log scale. Plot $|A_v|$ in dB.

R 1200 ohms
C 6.80E-08 farads

f (Hz)	w (rad/sec)	Vo/Vi	Vo/Vi dB
100	628.3	0.05	-25.814
1000	6283.2	0.46	-6.81618
2000	12566.4	0.72	-2.90267
5000	31415.9	0.93	-0.61515
10000	62831.9	0.98	-0.16215



c) Determine the break frequency, f_1 (from before) = 1950 Hz.

d) Sketch the asymptotes and locate the 3dB point,
See plot.

e) Sketch the frequency response for v_o/v_i and compare to results in part (b). See plot.

12) a) For the network in problem 11, determine the mathematical expression for the angle by which v_o leads v_i .

$$a) \theta = \tan^{-1} \frac{f_1}{f} = \tan^{-1} \left(\frac{1.95 \text{ kHz}}{f} \right)$$

b) determine the phase angle at $f = 100, 1000, 2000, 5000, 10000$, and plot the resulting curve for the frequency range of 100 - 10,000 Hz. See plot.

c) determine the break frequency.

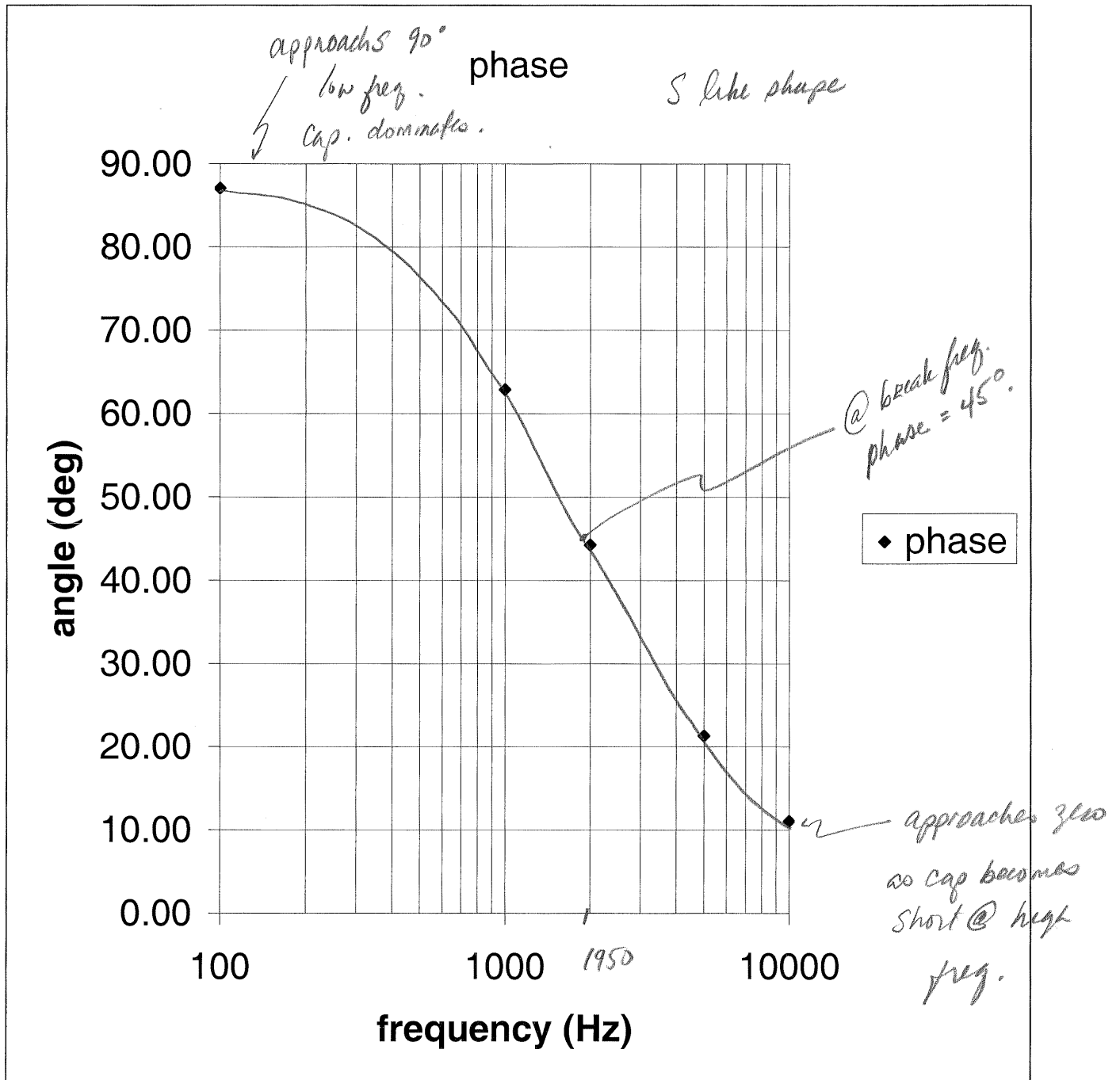
$$f_1 = \frac{1}{2\pi RC} = 1950 \text{ Hz}$$

- d) Sketch the frequency response of θ for the same frequency spectrum of part (B) and compare results. (use log axis for axes).

First find $\theta = 45^\circ$ at $f_1 = 1950 \text{ Hz}$. The angle of v_o goes to 45° @ 1950 Hz . At low frequency circuit is capacitive. Angle goes to 90° . At high freq. circuit is resistive. Angle goes to 0° . Sketch an approach to 90° at low freq and 0° at high freq. Use an expected shape for the curve noting that the largest (negative) slope (steepest point) occurs in θ near f_1 . The resulting curve should be quite close to the plot below.

R 1200 ohms f1 1.95E+03 Hz
C 6.80E-08 farads

f (Hz)	phase
100	87.06
1000	62.86
2000	44.28
5000	21.31
10000	11.04



ps

13 a) What frequency is 1 octave above 5KHz?
(double) 10KHz

b) What frequency is 1 decade below 10 KHz?
 $(1/10th) = \underline{1 \text{ KHz}}$

c) What frequency is 2 octaves below 20 KHz?
(quarter) 5 KHz (20 KHz \rightarrow 10 KHz \rightarrow 5 KHz)
octave octave

d) What frequency is 2 decades above 1 kHz?

(10×10)

$1 \text{ kHz} \Rightarrow 10 \text{ kHz} \Rightarrow 100 \text{ kHz}$

↑ decade

1 decade.