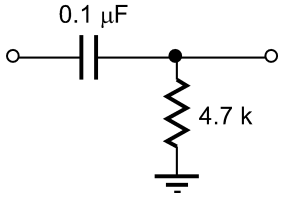
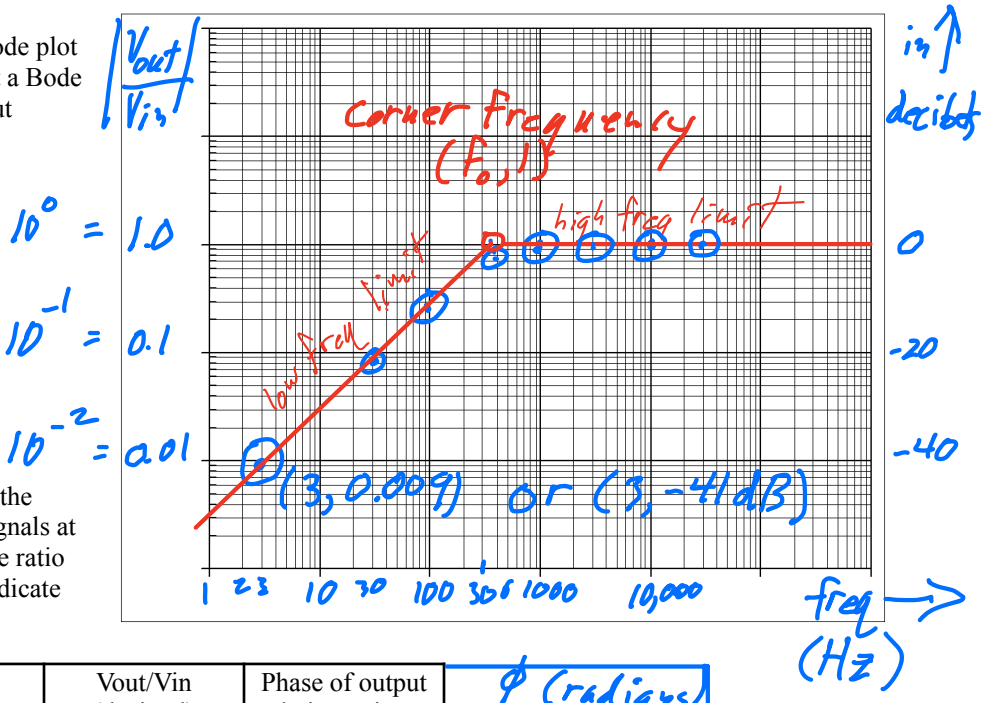
Electronics Worksheet **RC Circuits**

1. For the circuit shown, draw the Bode plot on the grid provided. Remember that a Bode plot is a log-log plot and be sure to put numbers and labels on the scales.



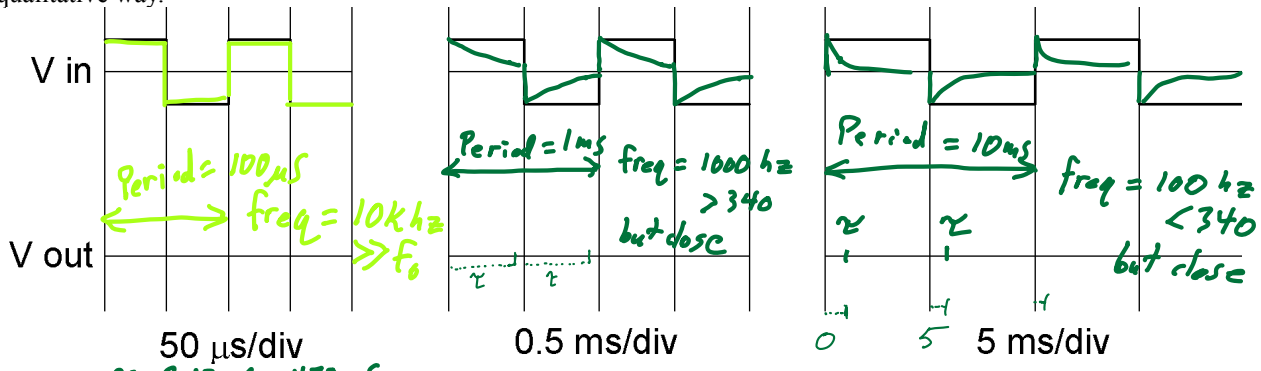


2. Consider sinewave signals driving the circuit above. For sinewave input signals at the following frequencies, indicate the ratio in two ways. If you're ready, also indicate the phase of those signals.

Frequency	Vout/Vin (dB)	Vout/Vin (decimal)	Phase of output relative to input	ϕ (radians)
3 Hz	-41	0.0089	$+89.5^0$	1.56
30 Hz	-21	0.088	84.9	1.48
100 Hz	-11	0.28	73.5	1.28
300 Hz	-3.6	0.66	48.5	0.846
1000 Hz	-0.47	0.95	18.7	0.327
3000 Hz	-0.055	0.994	6.4	0.112
10 kHz	-0.005	0.999	1.9	0.034
30 kHz	-0.0005	1	0.65	0.01

3. Now consider square-wave signals. Draw the output waveform for the given square-wave inputs. Note the scale changes so the three square wave inputs have different frequencies

4. Determine the frequencies of these square-waves and try to relate the behavior to the Bode plot in a qualitative way.



so $\tau = 0.47\text{mS} = 470\,\mu\text{S}$ ≅ 10 divisions!

$\tau = RC = 0.47$ msec for signal to drop by 1/e

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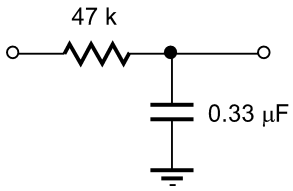
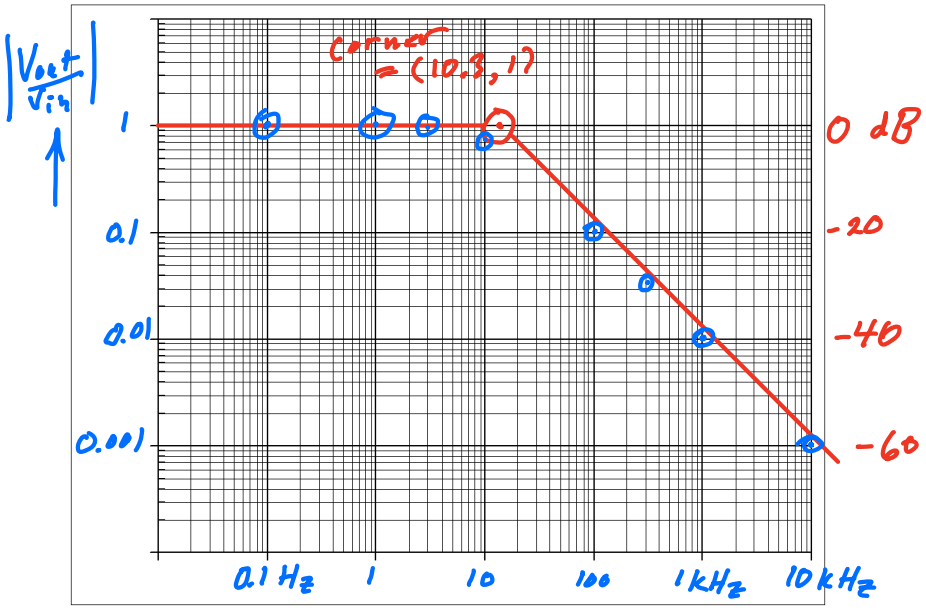
5. Here's another one but of the other type. Complete the Bode plot on the right for this one too. Then label both this one and the previous one as either Hi-pass or Lo-pass.

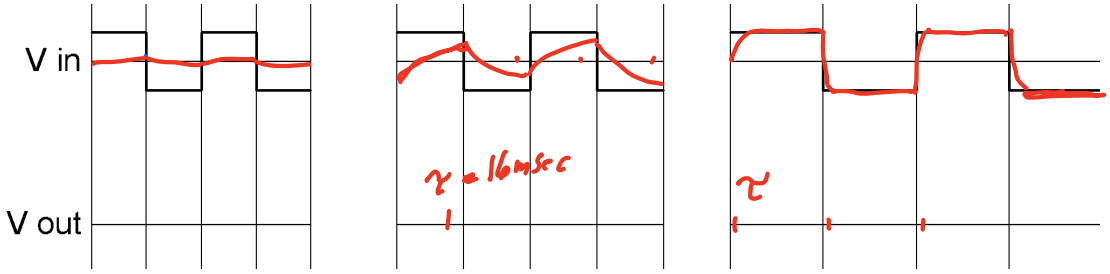


$\tau = RC = 16\ msec$

$f_o = \frac{1}{2\pi RC} = 10.3\ Hz$



Frequency	Vout/Vin (dB)	Vout/Vin (decimal)	Phase of output relative to input	ϕ radians
0.1 Hz	~ 0	~1	-0.6°	-0.01
1 Hz	-0.04	0.996	-5.6	-0.097
3 Hz	-0.36	0.96	-16.3	-0.284
10 Hz	-2.90	0.72	-44.3	-0.77
100 Hz	-19.8	0.10	-84.1	-1.47
300 Hz	-29.3	0.034	-88.0	-1.54
1 kHz	-40	0.010	-89.4	-1.56
10 kHz	-60	0.0010	-89.9	-1.57



Pick your own time scales to show the behavior at short, intermediate, and long times.

1 div = 2ms 1 div = 20 msec 1 div = 200 ms