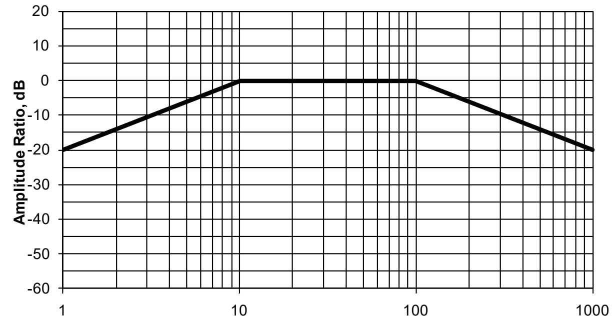
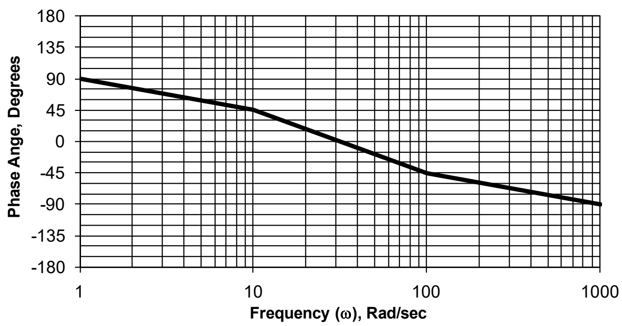
Example problem: Determine the transfer function for the Bode plot below.





1. Looking at the magnitude plot, start at low frequency (the left part of the plot)
2. What gives us this +20 dB/dec slope? A derivative
3. Since a derivative crosses 0 dB at 1 rad/s, we know our plot has been shifted down because we have a value of -20 dB at 1 rad/s.
4. We have a gain that has shifted the plot -20 dB. The equation for the gain shift is:
   a. $dB = 20\log_{10} K$
      $-20dB = 20\log_{10} K \rightarrow K = 0.1$
5. So far we know that our transfer function is:
   a. $TF = 0.1 \cdot s \cdot other\ components$
6. To find the other components, continue moving to the right as frequency increases. The next change in our magnitude plot happens at 10 rad/s
   a. The slope changes from +20 dB/dec to 0 dB/dec
   b. The only thing that contributes a slope of -20 dB/dec after a certain frequency is a 1st lag
7. The magnitude slope changes at 10 rad/s
   a. Breakpoint frequency $\omega_b = 10\frac{rad}{s} = \frac{1}{\tau} \rightarrow \tau = 0.1$
   b. Our 1st lag has the form of: $\frac{1}{(0.1s+1)}$
8. So far we know that our transfer function is:
   a. $TF = 0.1 \cdot s \cdot \frac{1}{(0.1s+1)} \cdot other\ components$
9. To find the other components, continue moving to the right as frequency increases. The next change in our magnitude plot happens at 100 rad/s
   a. The slope changes from 0 dB/dec to -20 dB/dec
   b. The only thing that contributes a slope of -20 dB/dec after a certain frequency is a 1st lag
10. The magnitude slope changes at 100 rad/s
    a. Breakpoint frequency $\omega_b = 100\frac{rad}{s} = \frac{1}{\tau} \rightarrow \tau = 0.01$
    b. Our 1st lag has the form of: $\frac{1}{(0.01s+1)}$
11. Our final transfer function is:
    a. $TF = 0.1 \cdot s \cdot \frac{1}{(0.1s+1)} \cdot \frac{1}{(0.01s+1)} = \frac{s}{10(0.1s+1)(0.01s+1)}$