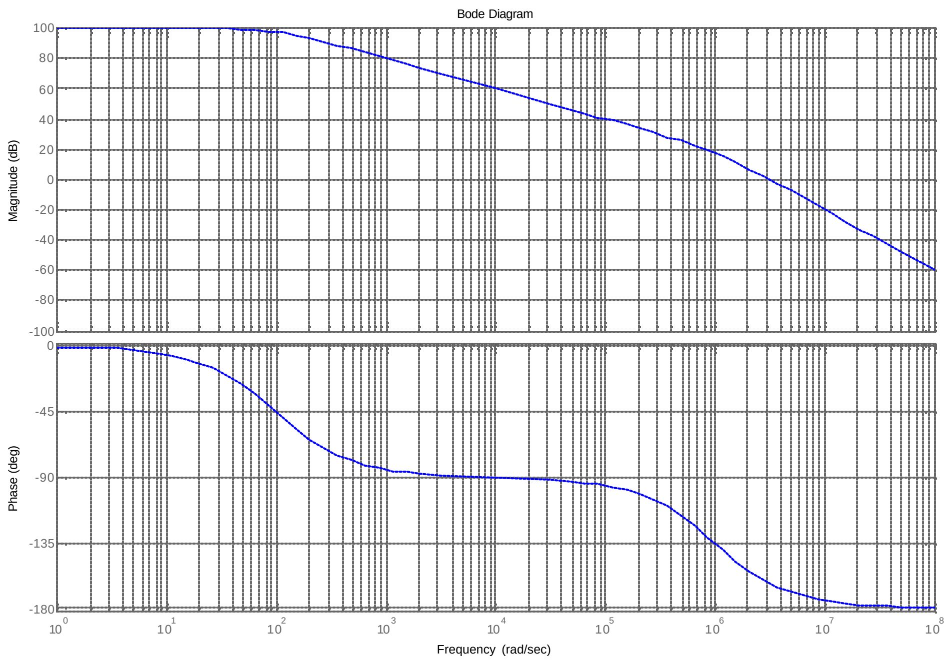
Midterm #1 solution:

$$A(s) = \frac{100k}{\left(\frac{s}{100}+1\right)\left(\frac{s}{1e6}+1\right)}$$



(b) Phase margin for β=.001=> $1=|A\beta| = \frac{100k*0.001}{\sqrt{\left(\left(\frac{f}{100}\right)^2+1^2\right)}\sqrt{\left(\left(\frac{f}{1e6}\right)^2+1^2\right)}}$

f = 100,000 Hz

When f=100k => the angle = $-\tan^{-1}(100k/100) - \tan^{-1}(100k/1e6) = -95.65^o$
So the phase margin = 180-96 = **84^o**

(c) $A_f = A/(1+A\beta)$ Therefore, to get the lowest gain value, we want β to be as large as possible. Check several phase margins to see the trend =>

PM = 45^o is when f = 1e6 Hz which will give β=141m $\left\{1=\frac{100{,}000*b}{\sqrt{(1e6/100)^2+1}*\sqrt{2}}\right\}$

PM = 135^o is when f = 100 Hz which will give β=14μ $\left\{1=\frac{100{,}000*b}{\sqrt{2}*\sqrt{(100/1e6)^2+1}}\right\}$

Therefore, the minimum phase for stability would be PM=45^o which will give
A_f= 100k/(1+(100k)*141m)=7.1V/V => 17dB