3.2 \[ G_{dB}=60\text{dB} \]
\[ V_i=3mV=3\times10^{-3} \text{volts} \]
\[ G_{dB}=20\log_{10}G \]
\[ 3\text{dB}=\log_{10}G \]
\[ \Rightarrow G=10^3 \]
\[ \Rightarrow G=V_o/V_i \]
\[ V_o = G \times V_i = 10^3(3\times10^{-3}) \]
\[ = 3 \text{ volts} \]

3.3 Eq. 3.2 applies. For G = 10, GdB = \log_{10}(10) = 20. Similarly, for G = 100 and 500, the decibel gains are 40 and 54.

3.6 a) From Eq. 3.14,
\[ G = 1 + \frac{R_2}{R_1} \]
\[ 100 = 1 + \frac{R_2}{R_1} \]
\[ 99 = \frac{R_2}{R_1} \]
Since \( R_1 \) and \( R_2 \) typically range from 1k\( \Omega \) to 1M\( \Omega \), we arbitrarily choose:
\[ R_2 = 99\text{k}\Omega \]
\[ \Rightarrow R_1 = 1\text{k}\Omega \]

b) \( f = 10 \text{ kHz} = 10^4 \text{ Hz} \)
\[ GPB = 10^6 \text{ Hz} \text{ for 741} \]
\[ G = 100 \]

From Eq. 3.15,
\[ f_o = \frac{GPB}{G} = \frac{10^6\text{Hz}}{100} = 10^4\text{Hz} \]
This is the corner frequency so signal is -3dB from dc gain.
dc gain = 100 = 40dB. Gain at 10^4 Hz is then 37 dB.
From Eq. 3.16,
\[ \phi = -\tan^{-1}\left(\frac{f}{f_o}\right) = -\tan^{-1}\left(\frac{10^4}{10^4}\right) = -\frac{\pi}{4} = -45^\circ \]
3.10  \( G = 10 \) (Actually -10 since output inverted)
Input impedance = 10 kΩ = 10000 Ω \( \approx R_1 \),
From Eq. 3.17,
\[
G = -\frac{R_2}{R_1}
\]
\[-10 = \frac{R_2}{10000}\]
\[\Rightarrow R_2 = 100kΩ\]
Since \( GPB_{\text{inv}} = 10^6 \text{Hz} \), from Eq. 3.18,
\[
GPB_{\text{inv}} = \frac{R_2}{R_1 + R_3} \cdot GPB_{\text{inv}}
\]
\[= \frac{100000}{10000 + 100000} \times (10^4)\]
\[= 508kHz\]
From Eq. 3.15,
\[
f_c = \frac{GPB}{G} = \frac{0.909 \times 10^4}{10} = 90.9kHz\]

3.15  If \( f_1 = 7600 \) Hz and \( f_2 = 2100 \) Hz then the following equation may be used,
\[f_2 \times 2^x = f_1\]  
where \( x \) = # octaves
Substituting,
\[2100 \times 2^x = 7600\]
\[2^x = 3.619\]
\[x \log 2 = \log 3.619\]
\[\Rightarrow x = 1.856 \text{ octaves}\]

3.16  \( f_c = 1kHz = 1000 \text{Hz} \), Butterworth
Rolloff = 24 dB/octave
\( A_{\text{roll}} = 0.10 \)
\( f_1 = 3kHz = 3000 \text{Hz} \)
\( f_2 = 20kHz = 20000 \text{Hz} \)
Since Rolloff = 24 dB/octave = 6n dB/octave,
\[\Rightarrow n = 4\]
From Eq. 3.20,
\[
G_1 = \frac{1}{\sqrt{1 + (f_1/f_c)^{2n}}}
\]
\[= \frac{1}{\sqrt{1 + (3000/1000)^2}}\]
\[= 0.01234\]
\[\Rightarrow A_{1s} = \frac{A_{\text{roll}}}{G_1} = \frac{0.10}{0.01234} = 8.1V = A_{1s}\]
From Eq. 3.20,
\[
G_2 = \frac{1}{\sqrt{1 + (20000/1000)^{2n}}}
\]
\[= 0.00000625\]
\[\Rightarrow A_{\text{roll}} = G_2 A_{1s} = 0.00000625(8.1) = 0.051mV\]