1. \( y[n] = x[n] * h[n] \) 
   \[ y[0] = |x| = 1 \]
   \[ y[1] = |x|^2 + 2|x| = 6 \]
   \[ y[2] = |x|^2 + 2|x| + |x|^2 = 13 \]
   \[ y[3] = |x|^2 + 2|x| + 4x + 4|x|^2 + 1 = 18 \]
   \[ y[4] = |x|^2 + 2|x| + 4x + 4|x|^2 = 4 \]
   \[ y[5] = |x|^2 + 2|x| + 4x + 4|x|^2 = 0 \]
   \[ y[n] = 6^n + 6^n + 13 \cdot 6^n - 15 \cdot 6^n - 4 \cdot 6^n \]

2. a) The maximum frequency content is approximately 2000 Hz; therefore, the Nyquist rate is 2 x 2000 = 4000 Hz which is the minimum sampling rate for the ADC.

b) The ideal frequency of the lowpass anti-aliasing filter is 8000 Hz, in order to ensure that the signal is band-limited before sampling.

c) \( 2^8 = 256 \) discrete levels for the ADC.
3. \( g(t) \) \[
\begin{array}{c}
-2.5\mu s \\
2.5\mu s
\end{array}
\] \( \Rightarrow \)

\[
G(f) = 2 \times 5 \times 10^{-6} \left( \frac{\sin (\pi f \times 5 \times 10^{-6})}{\pi f \times 5 \times 10^{-6}} \right)
\]

Bandwidth (BW) from 0 Hz to first zero-crossing is 200 kHz

\[
BW = \frac{1}{T} \Rightarrow \frac{1}{5 \times 10^{-6}} = 200 \text{kHz} = BW
\]

4. 30 dB of gain is an increase in power by a factor of 1000!

\[
10^{30 \text{dB}} = 1000, \text{ therefore resulting power is } 2 \text{ Watts} \times 1000 = 2000 \text{ Watts output power}
\]

5. a.) \( 10^{-50 \text{dB}} = 10^{-5} \text{ mW} \Rightarrow 10^{-8} \text{ Watts} \)

b.) Dynamic Range = -50 dBm (1200 dBm) = 70 dB Dynamic Range

c.) \( 10^{-120 \text{dB}} = 10^{-12} \text{ mW} \)
1. \( M(f) \) is convolved with a cosine of frequency 770 kHz.

\[
\text{FT } A_c \cos(2\pi \cdot 770 \text{kHz} t)
\]

\[
\Rightarrow
\]

\[
\begin{align*}
\text{S}(f) &= \frac{A_c}{2} M(f - 770 \text{kHz}) + \frac{A_c}{2} M(f + 770 \text{kHz})
\end{align*}
\]

2. Signal from 1 is convolved with a cosine of frequency 770 kHz.

\[
\text{FT } A_m \cos(2\pi \cdot 770 \text{kHz} t) \quad \text{S}(t) = \text{S}(f)
\]

\[
\begin{align*}
\text{S}(f) &= \frac{A_c A_m}{2} M(f) + \frac{A_c A_m}{4} M(f - 1540 \text{kHz}) + \frac{A_c A_m}{4} M(f + 1540 \text{kHz})
\end{align*}
\]

3. Signal \( S(f) \) is lowpass filtered with 10 kHz LPF resulting in:

\[
\tilde{M}(f) = M(f) \cdot \frac{A_c A_m}{2}
\]