1. **6.20.** The Fourier transform $X(\omega)$ of a signal $x(t)$ appears in Figure P6.20. The signal $x(t)$ is sampled with an impulse train $p(t)$ to form a new signal $\hat{x}(t) = x(t)p(t)$. The Fourier transform of $p(t)$ is $P(\omega) = 4 \sum_{k=-\infty}^{\infty} \delta(\omega - 4k)$. Sketch the Fourier transform of $\hat{x}(t)$.

![Figure P6.20](image)

2. **6.27.** For the system of Figure P6.27, sketch $A(\omega)$, $B(\omega)$, $C(\omega)$, and $Y(\omega)$. Show all amplitudes and frequencies.

![Figure P6.27](image)
6.30. In QAM [8], it is possible to send two signals on a single channel, which effectively doubles the bandwidth of the channel. QAM is used in the uplink (path from the house to the service provider) in today’s 56,000 bits/second modems, in DSL modems, and in Motorola’s Nextel cellular phones.

A block diagram of a QAM system is shown in Figure P6.30. Assume that $f_1(t)$ and $f_2(t)$ have bandwidth $\omega_0$, where $\omega_0 \ll \omega_c$ and $\omega_c$ is the carrier frequency.

![Figure P6.30](image)

You will find the trigonometric identities in Appendix A useful for solving this problem.

We form the following signals, as shown in Figure P6.30:

\[
\begin{align*}
\phi(t) &= f_1(t) \cos \omega_0 t + f_2(t) \sin \omega_0 t \\
g_1(t) &= \phi(t) \cos \omega_0 t \\
g_2(t) &= \phi(t) \sin \omega_0 t
\end{align*}
\]

(a) Determine the signal $g_1(t)$.

(b) Determine the signal $g_2(t)$.

(c) As shown in Figure P6.30, $g_1(t)$ and $g_2(t)$ are filtered by ideal low-pass filters, with cutoff frequency of $2\omega_0$ and unit amplitude, to form the output signals $e_1(t)$ and $e_2(t)$. Determine $e_1(t)$ and $e_2(t)$. 