

### **Example 1**

The following example relates the Nyquist and Shannon formulations. Suppose that the channel spectrum is between 3 MHz and 4 MHz, and the Signal-to-Noise ratio is 24 dB.

- (a). What is the maximum bit rate that this channel will support?
- (b). Assuming we can reach the limit determined in (a), how many signaling levels are required?

### **Example 2**

Given a channel with an intended capacity of 20 Mbps, the bandwidth of the channel is 3 MHz. What Signal-to-Noise ratio is required to achieve this capacity?

### **Example 3**

Assume an audio signal ranging from 300 to 3000 Hz and a sampling rate of 7 KHz to generate a PCM signal.

- (a). For a quantizing SNR of 37 dB, how many quantization levels are required?  
What data rate is required?
- (b). Consider “hi-fi” audio signals ranging from 20 to 20,000 Hz. What is the minimum required sampling rate?
- (c). Given a  $SNR = 80$  dB, how many quantization levels are required?
- (d). What data rate would be required to transmit the digital signals in real time?
- (e). What capacity (in bits) is required to store the music on CD disks?  
(Assume a 50 minute CD).

### **Example 4**

A modem constellation diagram has data points at the following coordinates: (1, 1), (1, -1), (-1,1), and (-1,-1). How many bps can a modem with these parameters achieve at 1200 baud?

### **Example 5**

A modem constellation has data points at the following coordinates: (0,1) and (0,2). Does the modem use phase modulation or amplitude modulation?

