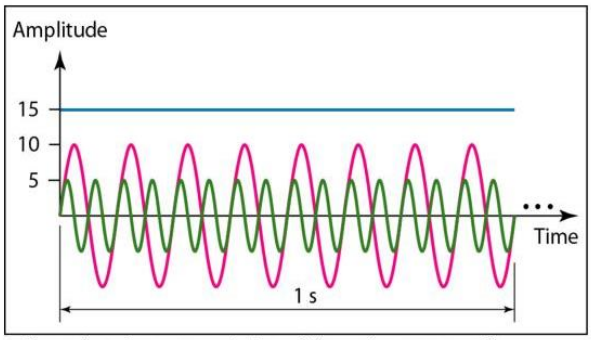
Sample problems for Chapter 0

1. The period of a signal is 100 ms. What is its frequency in kilohertz?
2. A sine wave is offset 1/6 cycle with respect to time 0. What is its phase in degrees and radians?
3. Find the frequency domain representation of the following sine waves.



a. Time-domain representation of three sine waves with frequencies 0, 8, and 16

4. Suppose a signal travels through a transmission medium and its power is reduced to one-half. What is the attenuation (loss of power) in dB?

5. The power of a signal is 10 mW and the power of the noise is 1μW. What are the values of SNR and SNR_{dB}?

6. A telephone line uses the frequency band from 300 to 3300 Hz for data communications. The signal-to-noise ratio is around 3162. Find the channel capacity using the Shannon's formula.

Answers:

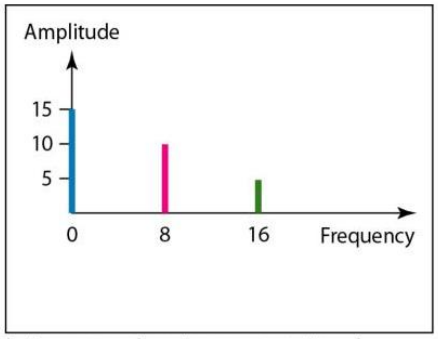
1. 100 ms = $100 \times 10^{-3} s = 10^{-1} s$

   $f = \frac{1}{T} = \frac{1}{10^{-1}} Hz = 10\ Hz = 10 \times 10^{-3}\ kHz = 10^{-2}\ kHz$

2. 1 complete cycle is 360 degrees. Therefore , 1/6 cycle is

   $\frac{1}{6} \times 360 = 60^{o} = 60 \times \frac{2\pi}{360}$ rad = $\frac{\pi}{3}$ rad =1.046 rad

3.



b. Frequency-domain representation of the same three signals

4.

Losing one-half means that $P_2 = \frac{1}{2} P_1$. So the loss in dB can be expressed as,

$$10 \log_{10} \frac{P_2}{P_1} = 10 \log_{10} \frac{0.5\ P_1}{P_1} = 10(-0.3) = -3 \text{ dB}$$

5. SNR=$\frac{10000\mu W}{1\mu W} = 10000$ SNR_dB=$10 \times \log_{10} 10000$ =40 dB.

6. Bandwidth is 3000 Hz. Therefore, C = 3000 $\log_2(1 + 3162)$ = 34860 bps.