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Q.1. A signal travels from point A to point B. At point A, the signal power 100 W. At point B, the power is 90 W. What is attenuation in decibals?

Solution:

$$\text{Attenuation} = 10 \log_{10}\left(\frac{P_2}{P_1}\right)$$

$$= 10 \log_{10}\left(\frac{100}{90}\right)$$

$$\therefore \text{Attenuation} = 0.46 \text{ dB}$$

Q.2. The attenuation of a signal is -10 dB. What is the final signal power if it was originally 5 W?

Solution.

$$P_2 = P_1 \times 10^{\frac{\text{Attenuation}}{10}}$$

$$= 5 \times 10^{-10/10}$$

$$= 5 \times 10^{-1}$$

$$\therefore P_2 = 0.5 \text{ W}$$

Q.3. A signal has passed through three cascading amplifiers, each with 4dB gain. What is the total gain? How much is the signal amplified?

Solution:

$$\text{Total gain} = 4\text{dB} \times 3 = 12 \text{ dB}$$

Now,

$$dB = 10 \log_{10}\left(\frac{P_2}{P_1}\right)$$

Or,

$$P_2 = 10^{\frac{dB}{10}} \cdot P_1$$

$$= 10^{12/10} \cdot P_1$$

$$\therefore P_2 = 15.84 P_1$$

i.e, The signal has amplified 15 times the original signal.

Q.4. A line has signal to noise ratio of 1000 and a bandwidth of 4000 KHz. What is the maximum data rate supported by this line?

Solution.

$$C = \text{Bandwidth} \times \log_2 (SNR+1)$$
$$= 4000 \times \log_2 (1000+1) \text{ Kbps}$$
$$= 39868.9 \text{ Kbps}$$
$$\therefore C = 40 \text{ Mbps}$$

Therefore, maximum data rate supported is 40 Mbps.

Q.5. The performance of a telephone line is 4KHz of bandwidth. When the signal is 10 V, the noise is 5mV. What is the maximum data rate supported by this telephone line?

Solution:

$$C = \text{Bandwidth} \times \log_2 (SNR+1)$$
$$= 4000 \times \log_2 \left(\frac{S}{R}+1\right)$$
$$= 4000 \times \log_2 \left(\frac{10\text{V}}{5\text{mV}}+1\right)$$
$$= 4000 \times \log_2 \left(\frac{10\text{ V}}{0.005\text{ V}}+1\right)$$
$$= 4000 \times \log_2 (2000+1)$$
$$\therefore C = 43866.02 \text{ bps}$$
$$\therefore C = 43.86 \text{ Kbps}$$

Therefore, the maximum data rate supported is 44 Kbps