



EEEN 462 – ANALOGUE COMMUNICATION

MEASUREMENTS IN DECIBELS – TEST YOUR KNOWLEDGE

1. **Decibels (dB) represent**

- a) Absolute power values
- b) Logarithmic ratios
- c) Linear voltage scales

Answer: b) Logarithmic ratios

Explanation: dB quantifies ratios (e.g., gain/loss) on a logarithmic scale.

2. **The dB formula for power gain GG is: -----**

- a) $G_{dB} = 20 \log_{10} \left(\frac{P_2}{P_1} \right)$
- b) $G_{dB} = 10 \log_{10} \left(\frac{P_2}{P_1} \right)$
- c) $G_{dB} = \log_e \left(\frac{P_2}{P_1} \right)$

Answer: b) $G_{dB} = 10 \log_{10} \left(\frac{P_2}{P_1} \right)$

Explanation: Power ratios use 10 due to $P \propto V^2$

3. **A power ratio of 1 corresponds to:**

- a) 0 dB
- b) 3 dB
- c) 10 dB

Answer: a) 0 dB

Explanation: $10 \log_{10}(1) = 0$ dB (no gain/loss).

4. **A 3 dB power gain implies a linear power ratio of**

- a) 1.5
- b) 2
- c) 3

Answer: b) 2

Explanation: $10 \log_{10}(x) = 3 \Rightarrow \log_{10}(x) = 0.3 \Rightarrow x = 10^{0.3} \approx 2$

5. **For voltage gain, the dB formula assumes:**

- a) Identical resistance
- b) Identical current
- c) Any impedance

Answer: a) Identical resistance

Explanation: $V_{dB} = 20 \log_{10} \left(\frac{V_2}{V_1} \right)$ holds only if $R_1 = R_2$

PART 2: CONVERSIONS

6. **Convert 20 dB to a linear power ratio.**

Answer: 100

Explanation: $10 \log_{10}(x) = 20 \Rightarrow \log_{10}(x) = 2 \Rightarrow x = 10^2 = 100.$

7. **Convert a voltage ratio of 100 to dB.**

Answer: 40 dB

Explanation: $20 \log_{10}(100) = 20 \times 2 = 40 \text{ dB}.$

8. **A loss of -6 dB corresponds to a power ratio of:**

- a) 0.25
- b) 0.5
- c) 0.75

Answer: a) 0.25.

Explanation: $10 \log_{10}(x) = -6 \Rightarrow x = 10^{-0.6} \approx 0.25.$

9. **A system has a gain of 20 dB. If input power is 2 mW, output power is:**

- a) 20 mW
- b) 200 mW
- c) 2 W

Answer: b) 200 mW

Explanation: $P_{\text{out}} = P_{\text{in}} \times 10^{20/10} = 2 \times 100 = 200 \text{ mW}.$

10. **A voltage gain of 40 dB corresponds to a linear ratio of:**

Answer: 100

Explanation: $20 \log_{10}(x) = 40 \Rightarrow \log_{10}(x) = 2 \Rightarrow x = 100.$

11. Convert 0.001 W to dBm.

Answer: 0 dBm

Explanation: $P_{\text{dBm}} = 10 \log_{10} \left(\frac{0.001}{0.001} \right) = 10 \log_{10}(1) = 0 \text{ dBm}.$

12. -30 dB implies a power reduction by a factor of:

- a) 100
- b) 1000
- c) 10,000

Answer: b) 1000

Explanation: $10 \log_{10}(x) = -30 \Rightarrow x = 10^{-3} = 0.001$ (factor = $\frac{1}{0.001} = 1000$).

13. A 10:1 voltage divider has a gain of:

- a) -20 dB
- b) -10 dB
- c) -6 dB

Answer: a) -20 dB

Explanation: $20 \log_{10}(0.1) = -20 \text{ dB}.$

14. A 3 dB bandwidth is the frequency range where power is:

- a) Half of maximum
- b) 70.7% of maximum
- c) Unchanged

Answer: a) Half of maximum

Explanation: -3 dB power $\approx$ 50% of max power

15. An amplifier has 30 dB voltage gain. If $V_{\text{in}}=0.1 \text{ V}$, $V_{\text{out}}=?$

Answer: 10 V

Explanation: $V_{\text{out}} = V_{\text{in}} \times 10^{30/20} = 0.1 \times 10^{1.5} \approx 10 \text{ V}.$

PART 3: REFERENCE UNITS (DBM, DBW)

16. 0 dBm equals:

- a) 0 W
- b) 1 mW
- c) 1 W

Answer: b) 1 mW

Explanation: dBm references 1 mW (0 dBm = 1 mW).

17. **Convert 20 dBm to mW.**

Answer: 100 mW

Explanation: $P = 1 \times 10^{20/10} = 100 \text{ mW}$.

18. **30 dBW is equivalent to:**

- a) 0 dBm
- b) 30 dBm
- c) 60 dBm

Answer: c) 60 dBm

Explanation: 30 dBW = 1000 W; dBm = $10 \log_{10}(1000/0.001) = 60 \text{ dBm}$.

19. **A signal is -10 dBm. Its power is:**

- a) 0.1 mW
- b) 0.01 mW
- c) 0.001 mW

Answer: a) 0.1 mW.

Explanation: $P = 1 \times 10^{-10/10} = 10^{-1} = 0.1 \text{ mW}$.

20. **10 W expressed in dBm is:**

Answer: 40 dBm

Explanation: $P_{\text{dBm}} = 10 \log_{10} \left(\frac{10}{0.001} \right) = 10 \log_{10}(10,000) = 40 \text{ dBm}$.

21.

PART 4: CASCADED SYSTEMS

21. **Three amplifiers have gains of 10 dB, 15 dB, and -5 dB. Total gain is:**

- a) 20 dB
- b) 25 dB
- c) 30 dB

Answer: a) 20 dB

Explanation: Total dB = $10 + 15 - 5 = 20 \text{ dB}$.

22. **A filter (-3 dB) is followed by an amplifier (+20 dB). Net gain is**

- a) 17 dB

b) 23 dB

c) 60 dB

Answer: a) 17 dB

Explanation: $-3 + 20 = 17 \text{ dB}$.

23. **Stage 1: -6 dB, Stage 2: +12 dB. If input is 4 W, output is**

Answer: 16 W

Explanation: $\text{Net gain} = -6 + 12 = 6 \text{ dB}$. $P_{\text{out}} = 4 \times 10^{6/10} = 4 \times 4 = 16 \text{ W}$.

24. **A 20 dB attenuator followed by a 30 dB amplifier has net gain**

a) 10 dB

b) 50 dB

c) -10 dB

Explanation: $-20 + 30 = 10 \text{ dB}$.

25. **Two amplifiers (10 dB each) and a cable (-2 dB). Overall gain**

Answer: 18 dB

Explanation: $10 + 10 - 2 = 18 \text{ dB}$.

PART 5: SNR AND NOISE

26. **SNR is 20 dB. If signal power is 100 mW, noise power is**

a) 1 mW

b) 10 mW

c) 100 mW

Answer: a) 1 mW

Explanation: $\text{SNR}_{\text{dB}} = 10 \log_{10} \left(\frac{P_s}{P_n} \right) = 20 \Rightarrow \frac{P_s}{P_n} = 100 \Rightarrow P_n = \frac{100 \text{ mW}}{100} = 1 \text{ mW}$.

27. **If the noise floor is -90 dBm, the minimum detectable signal (0 dB SNR) must be**

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a) -90 dBm

b) -60 dBm

c) 0 dBm

Answer: a) -90 dBm

Explanation: $\text{SNR} = 0 \text{ dB} \Rightarrow P_{\text{signal}} = P_{\text{noise}} = -90 \text{ dBm}$.

28. After a 3 dB noise figure amplifier, SNR:

- a) Halves
- b) Doubles
- c) Unchanged

Answer: a) Halves

Explanation: Noise figure (NF) = 3 dB $\Rightarrow$ SNR drops by 3 dB (factor of 2)

29. Input SNR = 30 dB. Amplifier NF = 6 dB. Output SNR is:

- a) 24 dB
- b) 30 dB
- c) 36 dB

Answer: a) 24 dB

Explanation: Output SNR = Input SNR - NF = 30 - 6 = 24 dB.

30. A system has noise power 10^{-12} W. Express noise floor in dBm.

Answer: -90 dBm

Explanation: $P_{\text{dBm}} = 10 \log_{10} \left(\frac{10^{-12}}{0.001} \right) = 10 \log_{10}(10^{-9}) = -90 \text{ dBm}.$