# DeciBel or dB[1]

There is one theory that deciBels were invented to make the element 2, 3, and 4 exams harder for students of amateur radio. This is not true. They were created to reduce multiplication and division to addition and subtract in per-calculator and per-computer days. The deciBels are based on logarithms. You use logarithms every day in that your hearing is logarithmic and so is your sensitivity to light. In fact the power gain in decibels is given by $dB = 10 \times \log(Power_{gain}) = 10 \times \log(\frac{Power_{out}}{Power_{input}})$ and the anti-logarithm is given by $Power_{gain} = \frac{Power_{output}}{Power_{input}} = 10^{\frac{dB}{10}}$ .

Note an increase in power is a positive and a decrease in power is negative. A power amplifier has an input of 5 watts and an output of 50 watts. Therefore the $10 \times \log(\frac{50}{5}) = 10\,dB$ . Get out your scientific calculator and try it. A transmission line reduces the power out of the transmitter from 50 watts to 40 watts, what is the lose in dB? Therefore $dB = 10 \times \log(\frac{40}{50}) = -0.97$ . If the system consist of a 5 watt transmitter feeding the amplifier discussed above followed by the transmission line discussed above the power to the antenna is $10 - 0.97 = 9.03\,dB$ which is $\frac{Power_{output}}{5} = 10^{\frac{9.03}{10}} = 8$ and solving for $Power_{output} = 8 \times 5 = 40$ watts to the antenna the $10^{0.903} = 8$ would have been found in a math table of anti-logarithms.

In general if you are given powers you will need to use $dB = 10 \times \log(\frac{Power_{out}}{Power_{input}})$ and if you are given dB you will need to use $Power_{gain} = \frac{Power_{output}}{Power_{input}} = 10^{\frac{dB}{10}}$ . Now lets look at the questions in the 2014 to 2019 General Class License Pool that are related to deciBels.

## *Questions*

G4D05 (D)
How does a signal that reads **20 dB** over S9 compare to one that reads S9 on a receiver, assuming a properly calibrated S meter?

A. It is 10 times less powerful
B. It is 20 times less powerful
C. It is 20 times more powerful
D. It is 100 times more powerful

Since you are given dB (see bold above), this requires the use of the anti-logarithmic or exponentiation $10^{\frac{20}{10}} = 10^2 = 10 \times 10 = 100$ . Therefore D is the correct answer.

1 2015-2019 Element 3 Question Pool, revised 11 February 2015

G5B01 (B)
What dB change represents a **two-times increase or decrease in power**?
A. Approximately 2 dB
B. Approximately 3 dB
C. Approximately 6 dB
D. Approximately 12 dB

Since you are given power (see bold above) this requires using the relationship

$dB = 10 \times \log(\frac{P_{output}}{P_{input}})$ . Therefore $dB = 10 \times \log(\frac{2}{1}) = 10 \times 0.301 \approx 3$ for two-times increase power

or $dB = 10 \times \log(\frac{1}{2}) = 10 \times (-0.301) \approx -3$ for two-time decrease of power and B is the correct answer.

G5B10 (C)
What percentage of power loss would result from a transmission line loss of **1 dB**?
A. 10.9 percent
B. 12.2 percent
C. 20.5 percent
D. 25.9 percent

Since you are given dB (see bold above), this requires the use of the anti-logarithmic or exponentiation

$10^{\frac{-1}{10}} = 10^{-0.1} = 0.794$ or 79.5 % which is a 20.5% power loss and C is the correct answer.

## *Some Other deciBel Questions and Answers*

Question G6B13 in answer D uses connect type DB-25 which has nothing to do with deciBels. This is a Sub-D connector of size B with 25 contact points and both the pin and socket versions are shown to the right.

There are several questions in General Class sub-element 9 that use dB, dBi and dBd. We need to know what dBi and dBd means to answer these questions and that discussion will be delayed until we study antennas.

Question G3B01 uses 3 dB in one of the answers. For that to be the correct answer, the radio wave would need to traveler exactly the same distance for both the short-path and the long-path and to be in phase when they arrived. Then and only then would the signal strength increase by 3dB would be the correct answer. But the exact same distance and in-phase was not part of the problem statement and therefore is not a the correct answer.