# LOGS: MATHEMATICAL RELATIONSHIPS AND SIGNIFICANT FIGURES

$$\log(ab) = \log(a) + \log(b)$$

$$\log(a/b) = \log(a) - \log(b)$$

$$\log(a^b) = b \log(a)$$

$$\log 1 = 0$$

$$\text{antilog of } x = 10^x$$

A log number has two parts: the characteristic and the mantissa.

- Characteristic is to the left of the decimal place and indicates the order of magnitude.
- Mantissa is to the right of the decimal place.

$$\log(2.216 \text{ x } 10^{10}) = \underbrace{10}_{\textbf{characteristic}}.\underbrace{3456}_{\textbf{mantissa}}$$

$$\log(2.216 \times 10^{10}) = \log(2.216) + \log(10^{10}) = 0.3456 + (10) = 10.3456$$

When taking a log of a number, the mantissa should have the same number of digits as the number of significant digits in the original number.

*Examples:*

$$\log(5.12 \times 10^{-5}) = \log(5.12) + \log(10^{-5}) = 0.709 + (-5) = -4.291$$

$$\log(5.12 \times 10^{-6}) = \log(5.12) + \log(10^{-6}) = 0.709 + (-6) = -5.291$$

$$\log(5 \times 10^{-5}) = -4.3$$

$$\log(5.1 \times 10^{-5}) = -4.29$$

When taking an antilog, count the digits in the matissa – that’s the number of significant figures your answer should have.

$$10^{-4.3} = 5 \times 10^{-5} \qquad 10^{-4.291} = 5.12 \times 10^{-5}$$

# SIGNIFICANT FIGURES & OPERATIONS

When making a measurement, always include all certain digits plus one uncertain digit. All of these digits are significant.

The least significant digit is the *only* one with uncertainty.

## Addition and Subtraction

When adding and subtracting, look at the uncertain digits in the numbers you are combining and consider that your answer can only have one uncertain digit.

*Example:*

**Uncertain digits in BOLD**

$$\begin{array}{r} 16.0\mathbf{0} \\ 39.\mathbf{1} \\ \underline{+\ \ 1.001\mathbf{8}} \\ 56.\mathbf{1018} \end{array} \quad \text{correctly reported as } 56.\mathbf{1}$$

Can only have one uncertain digit in answer so rounded to the tenths place.

## Multiplication and Division

When multiplying and dividing, your answer has the same number of significant figures as the number in the calculation with the fewest of significant figures.

*Example:*

$$m_{\text{KHP}} = \overset{\textbf{4 sig figs}}{\frac{0.09251\text{ mol Ba(OH)}_2}{\text{L solution}}} \times \underset{\textbf{3 sig figs}}{9.27\text{ mL solution}} \times \frac{1\text{ L}}{1000\text{ mL}} \times \frac{2\text{ mol KHP}}{1\text{ mol Ba(OH)}_2} \times \overset{\textbf{6 sig figs}}{\frac{204.224\text{ g KHP}}{\text{mol KHP}}}$$

$$m_{\text{KHP}} = 0.350\text{ g KHP}$$

Scalars (like 2 mol KHP) and conversion factors (like 1 L /1000 mL) are not considered when determining sig figs. They are considered to be *exact* and therefore have no uncertainty.

The answer should be reported with 3 sig figs (as shown).