# Rules for Reporting Significant Figures

1. Nonzero digits always count as significant figures

2. Zeros are what mix people up. There are three situations in which they can occur.

*leading zeros* precede all nonzero digits and are **never** significant (i.e., 0.000182 has three sign. figs.)

*captive zeros* are between nonzero digits and are **always** significant (i.e., 1008.02 has six sign. figs.)

*trailing zeros* are significant **only if** a number contains a decimal point (i.e., 1200 has two sign. figs.; 1200.00 has six sign. figs., $1.200 \times 10^3$ has four sign. figs.)

*** Note here the advantage of using exponential notation to clear up these ambiguities!**

**3.** Exact numbers have no bearing on the number of significant figures in a calculated result. Examples of these are the following;

conversion factors such as 1 L = 1000 mL
numbers reflecting an exact count such as 8 stones or 16 people
stoichiometry in chemical reactions involves exact numbers

## Operations

**Rules for multiplication/division**

The answer to contain the same **number of sign. figs.** as the least precise measurement used in the calculation.

| | | |
|---|---|---|
| 72.5674 | *six sign. figs* | |
| x 3.34 | *three sign. figs (limiting term)* | |
| 242.3751160 | | *initial answer (must be rounded off to three sign. figs.)* |
| | | Final Answer = $2.42 \times 10^2$ |

**Rules for addition/subtraction**

The answer to contain the same **number of decimal places** as the least precise measurement used in the calculation.

| | |
|---|---|
| 456.367963 | |
| - 452.1 | *least number of decimal places (limiting term)* |
| 4.267963 | *initial answer (must be rounded off to one decimal place)* |
| | Final Answer = 4.3 ! |

**Rules for logarithms**

In logarithmic values, only those numbers to the right of the decimal place count as significant. For example,

pH = 10.26 has only two significant figures and corresponds to a $[H^+] = 5.5 \times 10^{-11}$ **M**
$pK_a = 4.730$ has three significant figures and corresponds to $K_a = 1.86 \times 10^{-5}$

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*Sample Exercises:*

1. What is the pH if the concentration of $H^+$ is measured to be $1.25 \times 10^{-6}$ **M** ?

2. What is the $pK_{sp}$ if the solubility product has been determined to be $2 \times 10^{-30}$ ?

***Solutions***

**1.** $[H^+] = 1.25 \times 10^{-6}$ M has <u>three</u> significant figures, therefore the pH is reported to three places after the decimal point. So pH = 5.903 is reported. (The whole number to the left of the decimal point reports the order of magnitude in powers of ten).

**2.** $pK_{sp} = -\log K_{sp} = -\log (2 \times 10^{-30}) = 29.7$
(note: there is only one significant figure in this result)