

Study Guide: Significant Figures

This guide reviews the rules for determining and applying significant figures in scientific calculations, based on the provided source material. It includes a short-answer quiz, an answer key and a glossary of key terms.

Glossary of Key Terms	
Term	Definition
Significant Figures (SFs)	The digits in a number that are reliable and necessary to indicate the quantity of something. The source provides five rules for identifying them.
Non-Zero Numbers	All digits from 1 through 9. These are always considered significant.
Significant Zeros	Zeros that are considered part of a measurement. These include zeros between non-zero digits (e.g., 205) and zeros at the end of a decimal number (e.g., 2.50).
Non-Significant Zeros	Zeros that act only as placeholders and do not represent a measured value. These include zeros at the beginning of a decimal number and trailing zeros (e.g., 0.005).
Trailing Zeros	Zeros that appear at the end of a number. Their significance depends on the presence of a decimal point or overline; they are significant if a decimal or overline is present (16.00) but ambiguous if one is not (85000).
Ambiguous Zeros	Trailing zeros in a number that lacks a decimal point. It is unclear whether these zeros are significant or merely placeholders.
Decimal Places	The number of digits to the right of the decimal point. This value determines rounding in addition and subtraction.
pH	A measure related to the concentration of hydrogen ions, $[H^+]$. It has a unique rule for significant figures where the number of decimal places in the pH value equals the number of SFs in the $[H^+]$ value.
$[H_3O^+]$ or $[H^+]$	The concentration of hydronium or hydrogen ions. The number of significant figures in this value determines the precision of a calculated pH.
Overline	An alternative method to represent which trailing zeros are significant by the presence of a line drawn about those zeros.

Short-Answer Practice Quiz

Answer each question in 2-3 sentences, citing the relevant rules.

1. How many significant figures are in the number 5.082, and why?
2. Explain why the number 0.075 has only two significant figures.
3. How many significant figures are in the number 800. and what makes it different from the number 800?

4. What is the problem of "ambiguity" when determining the significant figures in a number like 12400000?
5. What is the governing rule for the number of significant figures in the final answer of a multiplication or division calculation?
6. If you multiply 24.65 (4 SFs) by 0.67 (2 SFs), the calculator displays 16.5155. What is the correctly rounded final answer?
7. How is the precision of a final answer determined in an addition or subtraction calculation?
8. When 2.045 is added to 34.1, the sum is 36.145. What is the correct final answer according to the rules of significant figures?
9. State the specific rule that links the significant figures of a concentration value ($[H^+]$) to the decimal places in a calculated pH value.
10. Given an $[H_3O^+]$ of 5.23×10^{-4} , the calculated pH is 3.281. Explain how the number of decimal places in the pH value was determined.

Short Answer Practice Quiz Key

1. The number 5.082 has four significant figures. This is because all non-zero digits (5, 8, 2) are significant, and zeros that fall between non-zero digits (the 0 between 5 and 8) are also considered significant.
2. The number 0.075 has two significant figures (7 and 5). Zeros that appear at the beginning of a decimal number serve only as placeholders and are not significant.
3. The number 800. has three significant figures. The decimal point at the end indicates that the trailing zeros are significant, showing precision to the ones place. The number 800 without a decimal point would be ambiguous.
4. The trailing zeros in a number like 12400000 are ambiguous because it is unclear if they are measured values or simply placeholders. This number could have as few as three significant figures (1, 2, 4) or as many as seven, depending on the precision of the measurement.
5. In a multiplication or division calculation, the final answer must be rounded to have the same number of significant figures as the input number with the fewest significant figures.
6. The correctly rounded final answer is 17. The input value 0.67 has only two significant figures, which is the fewest in the calculation. Therefore, the answer 16.5155 must be rounded to two significant figures.
7. In an addition or subtraction calculation, the final answer must have the same number of decimal (underline) places as the input number with the fewest decimal

(overline) places. The total number of significant figures is not the primary consideration.

8. The correct final answer is 36.1. The number 34.1 has only one decimal place, which is fewer than the three decimal places in 2.045. Therefore, the answer must be rounded to a single decimal place.

9. For pH calculations, the number of decimal places in the final pH value must be equal to the number of significant figures in the original hydronium ion ($[H_3O^+]$) or hydrogen ion ($[H^+]$) concentration value.

10. The number of decimal places in the pH value (3.281) was determined by the number of significant figures in the concentration. The concentration, 5.23×10^{-4} , has three significant figures (5, 2, 3), so the resulting pH value is correctly reported with three decimal places.