

Sig figs II

Fall 2010

Rules For Significant Digits

1. **Digits from 1-9 are always significant.**
2. **Zeros between two other significant digits are always significant**
3. **One or more additional zeros to the right of both the decimal place and another significant digit are significant.**
4. **Zeros used solely for spacing the decimal point (placeholders) are not significant.**

Recognizing significant digits will become much easier over time, as you continue to practice the rules. Below are some examples, which show the number of significant digits in a group of numbers, and an explanation why the digits are significant.

Table 1.1 Examples of Significant Digits

EXAMPLES	# OF SIG. DIG.	COMMENT
453 kg	3	All non-zero digits are always significant.
5057 L	4	Zeros between 2 sig. dig. are significant.
5.00	3	Additional zeros to the right of decimal and a sig. dig. are significant.
0.007	1	Placeholders are not sig.

When you look at the number in question, you must determine if it has a decimal point or not. If it has a decimal, you should think of "P" for "Present". If the number does not have a decimal place, you should think of "A" for "Absent".

Example, for the number 35.700, think "P", because the decimal is present.

For the number 6500, you would think "A", because the decimal is absent.

Now, the letters "A" and "P" also correspond to the "Atlantic" and "Pacific" Oceans, respectively. Now, assume the top of the page is North, and imagine an arrow being drawn toward the number from the appropriate coast. Once the arrow hits a nonzero digit, it and all of the digits after it are significant.

Example 1. How many significant digits are shown in the number 20 400 ? (remember that we use spaces, rather than commas, when writing numbers in Science.

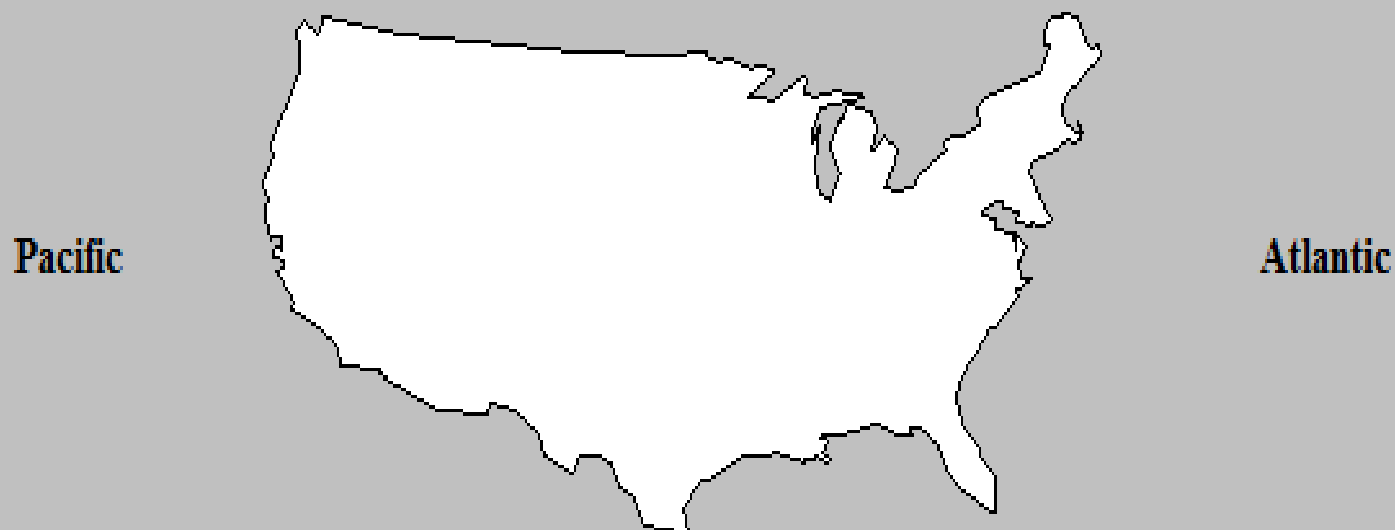
Well, there is no decimal, so we think of "A" for "Absent". This means that we imagine an arrow coming in from the Atlantic ocean, as shown below;

20 400 B

The first nonzero digit that the arrow hits would be the 4, making it, and all digits to the left of it significant.

ATLANTIC / PACIFIC RULE
For sig figs

Use this diagram to help determine the *number of significant figures* in a measured value...



If the decimal point is *present*, start counting digits from the *Pacific* (left) side, starting with the first non-zero digit.

0.003100 (4 sig. figs.)

If the decimal point is absent, start counting digits from the *Atlantic* (right) side, starting with the first non-zero digit.

31,400 (3 sig. figs.)

The Atlantic/Pacific Rule for Determining Significant Figures

- 1) look for the presence, or not, of a decimal point
 - this will tell you which side to start counting from
 - Pacific: left
 - Atlantic: right
- 2) if there is a decimal point you start counting from the left side of the number
 - starting from the very left side of the number, look for the first non-zero number
 - count the first non-zero number and every number (0-9) after that
 - example: 0.00010
 - because there is a decimal point, we start from the left side of the equation \rightarrow 0.00010, and look for the first non-zero number
 - 0.00010
 - count that number and every number after that regardless of what the number is (0-9)
 - in this case there are 2 significant figures
 - 0.00010

3) if there is **not** a decimal point you start counting from the right side of the number

- starting from the very right side of the number, look for the first non-zero number

- count the first non-zero number and every number (0-9) after that

- example: 721000

- because there is a decimal point, we start from the right side of the equation $721000.$, and look for the first non-zero number

721000

- count that number and every number after that regardless of what the number is (0-9)

- in this case there are 3 significant figures

- 721000

Example 1. How many significant digits are shown in the number 20 400 ? (remember that we use spaces, rather than commas, when writing numbers in Science.

Well, there is no decimal, so we think of "A" for "Absent". This means that we imagine an arrow coming in from the Atlantic ocean, as shown below;

20 400 B

The first nonzero digit that the arrow hits would be the 4, making it, and all digits to the left of it significant.

Answer - There are three significant digits in the number 20 400

Here are the significant digits, shown in boldface. **20 400**

Multiplying and Dividing

RULE: When multiplying or dividing, your answer may only show as many significant digits as the multiplied or divided measurement showing the least number of significant digits.

Example: When multiplying $22.37 \text{ cm} \times 3.10 \text{ cm} \times 85.75 \text{ cm} = 5946.50525 \text{ cm}^3$

We look to the original problem and check the number of significant digits in each of the original measurements:

22.37 shows 4 significant digits.

3.10 shows 3 significant digits.

85.75 shows 4 significant digits.

Our answer can only show 3 significant digits because that is the least number of significant digits in the original problem.

5946.50525 shows 9 significant digits, we must round to the tens place in order to show only 3 significant digits. Our final answer becomes 5950 cm^3 .

Adding and Subtracting

RULE: When adding or subtracting your answer can only show as many decimal places as the measurement having the fewest number of decimal places.

Example: When we add $3.76 \text{ g} + 14.83 \text{ g} + 2.1 \text{ g} = 20.69 \text{ g}$

We look to the original problem to see the number of decimal places shown in each of the original measurements. 2.1 shows the least number of decimal places.

We must round our answer, 20.69, to one decimal place (the tenth place). Our final answer is 20.7 g

1 Which of the following numbers shows 3 significant digits?

A

120.0

B

1.0

C

3.0×10^4

D

10 070

E

55.0

0.0203	3 significant figures
2.50	3 significant figures
2500	
3.7×10^9	
45009	
100.	
10200	
34000.00	
0.0600	
0.0058363	
0.508	
5007.00	
2.40×10^4	
0.005670	
54000	
0.025	

