Objectives: I can express numbers in standard form and scientific notation.

Scientific Notation and Standard Form (Decimal Notation) Notes

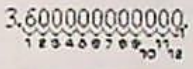
- By using exponents, we can reformat numbers. For very large or very small numbers, it is sometimes simpler to use "scientific notation" (so called, because scientists often deal with very large and very small numbers).
- The format for writing a number in scientific notation is fairly simple: (first digit of the number) followed by (the decimal point) and then (all the rest of the digits of the number), times (10 to an appropriate power). The conversion is fairly simple.

- Write 124 in scientific notation.
  This is not a very large number, but it will work nicely for an example. To convert this to scientific notation, I first write "1.24". This is not the same number, but $(1.24)(100) = 124$ is, and $100 = 10^2$. Then, in scientific notation, 124 is written as 1.24×10^2.

- Actually, converting between "regular" notation and scientific notation is even simpler than I just showed; because all you really need to do is count decimal places.

- Write in decimal notation: 3.6×10^{12} (Sc Not → Standard: 3,600,000,000,000)
  Since the exponent on 10 is positive, I know they are looking for a LARGE number, so I'll need to move the decimal point to the right, in order to make the number LARGER. Since the exponent on 10 is "12", I'll need to move the decimal point twelve places over. First, I'll move the decimal point twelve places over. I make little loops when I count off the places, to keep track:

Then I fill in the loops with zeroes:



In other words, the number is 3,600,000,000,000, or 3.6 trillion

- Convert 93,000,000 to scientific notation. $9.3 * 10^7$
  This is a large number, so the exponent on 10 will be positive. The first "interesting" digit in this number is the leading 9, so that's where the decimal point will need to go. To get from where it is to right after the 9, the decimal point will need to move seven places to the left. Then the power on 10 will be a positive 7, and the answer is 9.3×10^7

+ Very Large Number

Scientific Notation and Standard Form (Decimal Notation) Practice

Write in standard form.

1) 4.0×10^3 4,000
2) 4.5×10^4 45,000 (45,000)
3) 6.5×10^5 650,000 (6,500,000)
4) 7.6×10^2 760
5) 8×10^3 8,000
6) 6.32×10^8 6,320,000,000

Write each number in scientific notation.

7) 465,000,000 $4.65 * 10^8$
8) 98,000,000,000 $9.8 * 10^{10}$
9) 373,000 $3.73 * 10^5$
10) 697,000,000,000 $6.97 * 10^{11}$
11) 54,000,000 $5.4 * 10^7$
12) 24,340,000 $2.434 * 10^7$

Use your calculator to evaluate the following. Write the answer in scientific notation and standard form.

	Scientific notation (3 significant digits)		Standard form
13) 7^{12}	$1.384 * 10^{10}$	7 zeros	13,840,000,000
14) 12^{15}	$1.541 * 10^{16}$	13 zeros	15,410,000,000,000,000
15) 4^{24}	$2.815 * 10^{14}$	11 zeroes	281,500,000,000,000
16) 18^9	$1.984 * 10^{11}$	8 zeros	198,400,000,000

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Scientific Notation and Standard Form (Decimal Notation) Notes

- By using exponents, we can reformat numbers. For very large or very **small** numbers, it is sometimes simpler to use "scientific notation" (so called, because scientists often deal with very large and very small numbers).
- The format for writing a number in scientific notation is fairly simple: (first digit of the number) followed by (the decimal point) and then (all the rest of the digits of the number), times (10 to an appropriate power). The conversion is fairly simple.

- **Write 0.000 000 000 043 6 in scientific notation.**
  In scientific notation, the number part (as opposed to the ten-to-a-power part) will be "4.36". So I will count how many places the decimal point has to move to get from where it is now to where it needs to be:

  0.00000000000436
  1 2 3 4 5 6 7 8 9 10 11

  Then the power on 10 has to be -11: "eleven", because that's how many places the decimal point needs to be moved, and "negative" because I'm dealing with a SMALL number. So, in scientific notation, the number is written as 4.36×10^{-11}

  remember: negative exponents ALWAYS result in fractions, and all fractions can be written as DECIMALS!

- **Convert 4.2×10^{-7} to decimal notation.**
  Since the exponent on 10 is negative, I am looking for a small number. Since the exponent is a seven, I will be moving the decimal point seven places. Since I need to move the point to get a *small* number, I'll be moving it to the left. The answer is 0.000 000 42

- **Convert 0.000 000 005 78 to scientific notation.**
  This is a small number, so the exponent on 10 will be negative. The first "interesting" digit in this number is the 5, so that's where the decimal point will need to go. To get from where it is to right after the 5, the decimal point will need to move nine places to the right. Then the power on 10 will be a negative 9, and the answer is 5.78×10^{-9}

Just remember: However many spaces you moved the decimal, that's the power on 10. If you have a small number (smaller than 1, in absolute value), then the power is negative; if it's a large number (bigger than 1, in absolute value), then the exponent is positive.

Warning: A negative on an exponent and a negative on a number mean two very different things! For instance:

$-0.00036 = -3.6 \times 10^{-4}$
$0.00036 = 3.6 \times 10^{-4}$
Given decimal values, NEGATIVE EXPONENT

$36{,}000 = 3.6 \times 10^{4}$
$-36{,}000 = -3.6 \times 10^{4}$
Given integers, POSITIVE EXPONENT

Don't confuse these!

Part 1) Write in standard form.

1) 4.82×10^{-5} 0.00004 82 2) 2.6×10^{-7} 0.00000026 3) 1.79×10^{-4} 0.000 179

4) -5.28×10^{5} −528,000 5) 7×10^{8} 700,000,000 6) -6.12×10^{-6} −0.000 006 12

Write each number in scientific notation.

7) 0.000 000 000 52 $5.2 * 10^{-10}$ 8) 0.000 000 041 $4.1 * 10^{-8}$ 9) 0.000 000 398 $3.98 * 10^{-7}$

10) 578,000,000 $5.78 * 10^{8}$ 11) 38,000,000,000 $3.8 * 10^{10}$ 12) 219,000 $2.19 * 10^{5}$