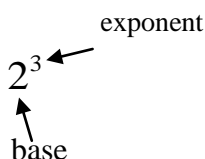


Pre-Algebra Notes – Integer Exponents and Scientific Notation

Rules of Exponents

CCSS 8.EE.A.1: *Know and apply the properties of integer exponents to generate equivalent numerical expressions.*

Review with students that an **exponent** is the superscript which tells how many times the base is used as a factor.



In the number 2^3 , read “2 to the third power” or “2 cubed”, the 2 is called the *base* and the 3 is called the *exponent*.

Examples:

$$2^3 = 2 \cdot 2 \cdot 2$$
$$5^2 = 5 \cdot 5$$
$$6^4 = 6 \cdot 6 \cdot 6 \cdot 6$$

To write an exponential in standard form, compute the products. i.e. $5^2 = 5 \cdot 5 = 25$


Since we will be addressing powers of 10 in scientific notation, emphasize this in your examples.

Examples:

$$10^1 = 10$$
$$10^2 = 100$$
$$10^3 = 1000$$

What pattern allows you to find the value of an exponential with base 10 quickly?

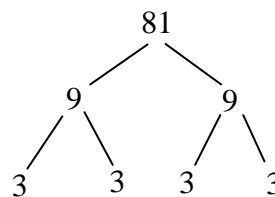
Answer: The number of zeroes is equal to the exponent!

 **Caution: If a number does not have an exponent visible, it is understood to have an exponent of ONE!**

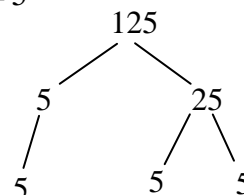
Let's practice writing numbers in exponential form.



Examples: Write 81 with a base of 3.
 $81 = 3^4$, $81 = 3 \cdot 3 \cdot 3 \cdot 3$, therefore $81 = 3^4$



Write 125 with a base of 5.
 $125 = 5^3$, $125 = 5 \cdot 5 \cdot 5$, therefore $125 = 5^3$



In algebra, we often have to find the products and quotients of algebraic expression. For example, what is the product of the problem below?

$$x^3 \cdot x^2 = ?$$

▼ Caution: Many students will jump to an answer of x^6 , which is incorrect. Watch for this error!

Have students rewrite each term in expanded form, and then convert it back to exponential form.

$$\text{Since } x^3 = x \cdot x \cdot x$$

$$\text{and } x^2 = x \cdot x,$$

$$x^3 \cdot x^2 = (x \cdot x \cdot x) \cdot (x \cdot x) \text{ or } x^5.$$

We do not multiply the exponents as we might suspect: we *add* them!

Let's try a few more problems to verify our conjecture:

Examples: $x^4 \cdot x^3 = (x \cdot x \cdot x \cdot x) \cdot (x \cdot x \cdot x) \text{ or } x^7$ *ie,* $x^4 \cdot x^3 = x^{4+3} \text{ or } x^7$
 $x \cdot x^5 = x \cdot (x \cdot x \cdot x \cdot x \cdot x) \text{ or } x^6$ *ie,* $x \cdot x^5 = x^{1+5} \text{ or } x^6$

We are now ready to state the rule for multiplying exponential expressions with the same base.

*When multiplying powers with the same base, add their exponents;
that is, $x^a \cdot x^b = x^{a+b}$.*

What might we suspect about the rule for division?



Since division is the inverse of multiplication, and multiplying exponential expressions involves the addition of exponents, what would division of exponential expressions involve? (Note how confusing this all seems!) We might suggest subtraction is the key here; we can show this to be true with a few examples:

Example:
$$\frac{x^5}{x^2} = \frac{x \cdot x \cdot x \cdot \cancel{x} \cdot \cancel{x}}{\cancel{x} \cdot \cancel{x}}$$

$$= x \cdot x \cdot x$$

$$= x^3$$
ie, $\frac{x^5}{x^2} = x^{5-2}$ *or* x^3

Example:
$$\frac{x^6}{x} = \frac{x \cdot x \cdot x \cdot x \cdot x \cdot \cancel{x}}{\cancel{x}}$$

$$= x \cdot x \cdot x \cdot x \cdot x$$

$$= x^5$$
ie, $\frac{x^6}{x} = x^{6-1}$ *or* x^5

Let's now state the rule:

*When dividing powers with the same base, subtract their exponents
(subtract the exponent in the denominator from the exponent in the numerator);*

that is, $\frac{x^a}{x^b} = x^{a-b}$

▼ Emphasize with students to be careful with their integer operations now—they may have the tendency to add when they should multiply. A simple example is to look at the following product: $2x^3 \cdot 4x^4$. The answer is $8x^7$, of course. Common errors are to multiply all numbers involved, arriving at the incorrect answer of $8x^{12}$; or to add all numbers, arriving at the incorrect answer of $6x^7$. Look at the following example for other errors to watch for.

Example: $\frac{8x^6}{4x^3} = 2x^3$; but watch for answers of

⇒ subtracting everything: $4x^3$

⇒ dividing everything: $2x^2$

Example: $3a^5 \cdot 5a^2 = 15a^7$; but watch for answers of

⇒ adding everything: $8a^7$

⇒ multiplying everything: $15a^{10}$

At this point, students will probably be feeling that math rules do not always make sense! Emphasize that they can always go back to expanding the expression to notation without exponents to arrive at the answer.

To see what happens when you raise a power to a power, use the order of operations.



$$\begin{aligned}
 (5^3)^2 &= (5 \cdot 5 \cdot 5)^2 && \text{Evaluate the power inside the parentheses.} \\
 &= (5 \cdot 5 \cdot 5)(5 \cdot 5 \cdot 5) && \text{Evaluate the power outside the parentheses.} \\
 &= 5^6
 \end{aligned}$$

When raising a power to a power, keep the base and multiply the exponents;

$$\text{that is, } (x^a)^b = x^{a \cdot b}$$

Examples:

$$\begin{aligned}
 (7^3)^5 &= 7^{3 \cdot 5} \\
 &= 7^{15}
 \end{aligned}$$

$$\begin{aligned}
 (5^{10})^{-6} &= 5^{10(-6)} \\
 &= 5^{-60}
 \end{aligned}$$

$$\begin{aligned}
 (3^{-7})^{-2} &= 3^{-7(-2)} \\
 &= 3^{14}
 \end{aligned}$$

Negative and Zero Exponents

Pattern development is a very effective way to introduce the concept of negative and zero exponents. Consider the following pattern that students should have seen previously.

$$\begin{array}{rcl}
 2^4 = 2 \cdot 2 \cdot 2 \cdot 2 = 16 & \begin{array}{l} \searrow \\ \swarrow \end{array} & \div 2 \\
 2^3 = 2 \cdot 2 \cdot 2 = 8 & \begin{array}{l} \swarrow \\ \searrow \end{array} & \div 2 \\
 2^2 = 2 \cdot 2 = 4 & \begin{array}{l} \searrow \\ \swarrow \end{array} & \div 2 \\
 2^1 = 2 = 2 & \begin{array}{l} \swarrow \\ \searrow \end{array} & \div 2 \\
 2^0 = 1 & \begin{array}{l} \swarrow \\ \searrow \end{array} & \div 2
 \end{array}$$



As we review this pattern, students should see that each time the exponent is decreased by 1, the expanded form contains one less factor of 2 and the product is half of the preceding product.

$$\begin{array}{rcl}
 2^4 = 2 \cdot 2 \cdot 2 \cdot 2 = 16 & \searrow & \div 2 \\
 2^3 = 2 \cdot 2 \cdot 2 = 8 & \swarrow & \\
 2^2 = 2 \cdot 2 = 4 & \searrow & \div 2 \\
 2^1 = 2 = 2 & \swarrow & \\
 2^0 = 1 & \searrow & \div 2 \\
 2^{-1} = & \swarrow & \div 2 \\
 2^{-2} = & \searrow & \div 2
 \end{array}$$

Following this pattern, $1 \div 2$ is $\frac{1}{2}$.

Continuing this pattern, $\frac{1}{2} \div 2 = \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{2^2} = \frac{1}{4}$

So $2^{-1} = \frac{1}{2^1}$, and $2^{-2} = \frac{1}{2^2} = \frac{1}{4}$.

Looking at powers of 10, $10^{-1} = \frac{1}{10^1} = \frac{1}{10}$ or 0.1

$$10^{-2} = \frac{1}{10^2} = \frac{1}{10 \cdot 10} = \frac{1}{100} \text{ or } 0.01$$

$$10^{-3} = \frac{1}{10^3} = \frac{1}{10 \cdot 10 \cdot 10} = \frac{1}{1,000} \text{ or } 0.001$$

Applying Exponents: Scientific Notation

CCSS 8.EE.A.3: Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities.

A number is written in **scientific notation** if it has the form $x \times 10^n$ where $1 \leq x < 10$ and n is an integer. An example of a number written in scientific notation is 4.23×10^5 .



To convert a number written in scientific notation to standard form, the exponent tells you how many times to move the decimal point to the right or left.

Example: Write 4.23×10^5 in standard form.

The exponent 5 indicates you move the decimal point 5 places to the *right*.

$$4.23 \times 10^5 = 423,000$$

Why does this work? Rewrite the problem using product form, and then do the multiplication.

$$4.23 \times 10^5 = 4.23 \times 100,000 = 423,000$$

Example: Write 5.4×10^7 in standard form.

The exponent 7 indicates you move the decimal point 7 places to the *right*.

$$5.4 \times 10^7 = 54,000,000$$

Example: Write 7.3×10^{-4} in standard form.

The exponent -4 indicates you move the decimal point 4 places to the *left*.

$$7.3 \times 10^{-4} = 0.00073$$

Why does this work? Rewrite the problem using product form, and then do the multiplication.

$$7.3 \times 10^{-4} = 7.3 \times 0.0001 = 0.00073$$

Example: Write 2.234×10^{-2} in standard form.

The exponent -2 indicates you move the decimal point 2 places to the *left*.

$$2.234 \times 10^{-2} = 0.02234$$

To convert a number in standard form to scientific notation, rewrite the number as a product of a power of 10 and a number greater than or equal to 1 but less than 10.

Example: Write 630 in scientific notation.

Rewrite 630 in product form: $6.3 \times 10^?$

How many places do you need to move the decimal point to get 630?

2 places to the right, so $630 = 6.3 \times 10^2$



Example: Write 735,000 in scientific notation.

Rewrite 735,000 in product form: $7.35 \times 10^?$

How many places do you need to move the decimal point to get 735,000?

5 places to the right, so $735,000 = 7.35 \times 10^5$

Example: Write 0.0049 in scientific notation.

Rewrite 0.0049 in product form: $4.9 \times 10^?$

How many places do you need to move the decimal point to get 0.0049?

3 places to the left, so $0.0049 = 4.9 \times 10^{-3}$

Example: Write 0.03087 in scientific notation.

$0.03087 = 3.087 \times 10^{-2}$

Rewriting numbers in scientific notation will allow us to multiply very large or very small numbers quickly. It also will help to avoid errors that occur with so many zeroes. Look at the following examples.

Example: The distance from Earth to the Moon is about 380,000 km. Suppose a space capsule travels this distance 2000 times. How many kilometers does the capsule travel?

We know how to rewrite the numbers in scientific notation:

$$380,000 = 3.8 \times 10^5$$

$$2000 = 2.0 \times 10^3$$

To find the total distance travelled, we must multiply:

$$380,000 \times 2000 = (3.8 \times 10^5)(2 \times 10^3)$$

$$= (3.8 \times 2)(10^5 \times 10^3)$$

$$= 7.6 \times 10^8$$

$$= 760,000,000$$

The total distance travelled is 760,000,000 km.



Example: The smallest flowering plant in the world weighs about 0.00015 g. How much would one million of these plants weigh?

Rewrite the numbers using scientific notation:

$$0.00015 = 1.5 \times 10^{-4}$$

$$1 \text{ million} = 1,000,000 = 1 \times 10^6$$

To find the total weight, we must multiply:

$$(0.00015)(1 \text{ million}) = (1.5 \times 10^{-4})(1 \times 10^6)$$

$$= (1.5 \times 1)(10^{-4} \times 10^6)$$

$$= 1.5 \times 10^2$$

$$= 150$$

The total weight of the plants would be 150 g.

Ordering Numbers Using Scientific Notation

To compare numbers written in scientific notation, first compare the powers of 10, and then compare the decimal parts.

Example: Order 8.5×10^4 , 8.8×10^3 , 8900 from least to greatest.

A. *First, write all numbers in scientific notation as necessary.*

$$8900 = 8.9 \times 10^3$$

B. *Order the numbers with different powers of 10.*

Because $10^3 < 10^4$,

we know $8.8 \times 10^3 < 8.5 \times 10^4$

and $8.9 \times 10^3 < 8.5 \times 10^4$

C. *Order the numbers with the same power of 10.*

Because $8.8 < 8.9$,

We know $8.8 \times 10^3 < 8.9 \times 10^3$

D. *Write the original number in order from least to greatest.*

$$8.8 \times 10^3; 8900; 8.5 \times 10^4$$



Operations in Scientific Notation

CCSS 8.EE.A.4: Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used.

One of the properties of quantities with exponents is that numbers with exponents can be added and subtracted only when they have the same base and same exponent. Since all numbers in scientific notation have the same base (10), we need only worry about the exponents. To be added or subtracted, two numbers in scientific notation must be manipulated so that their bases have the same exponent--this will ensure that corresponding digits in their coefficients have the same place value.

Here are the steps to **adding or subtracting** numbers in scientific notation:

1. **Determine the number by which to increase the smaller exponent so it is equal to the larger exponent.**
2. **Increase the smaller exponent by this number and move the decimal point of the number with the smaller exponent to the left the same number of places. (i.e. divide by the appropriate power of 10 .)**
3. **Add or subtract the new coefficients.**
4. **If the answer is not in scientific notation (i.e. if the coefficient is not between 1 and 10) convert it to scientific notation.**

Example: $(2.456 \times 10^5) + (6.0034 \times 10^8) = ?$

1. $8 - 5 = 3$. The smaller exponent must be increased by 3.
2. $2.456 \times 10^5 = 0.002456 \times 10^8$
3. $(0.002456 \times 10^8) + (6.0034 \times 10^8) = (0.002456 + 6.0034) \times 10^8$
 $= 6.005856 \times 10^8$
4. 6.005856×10^8 is in scientific notation.

Thus, $(2.456 \times 10^5) + (6.0034 \times 10^8) = 6.005856 \times 10^8$.

Example: $(5.10802 \times 10^3) - (6.1 \times 10^{-2}) = ?$

1. $3 - (-2) = 5$. The smaller exponent must be increased by 5.
2. $6.1 \times 10^{-2} = 0.000061 \times 10^3$
3. $(5.10802 \times 10^3) - (0.000061 \times 10^3) = (5.10802 - 0.000061) \times 10^3$
 $= 5.107959 \times 10^3$
4. 5.107959×10^3 is in scientific notation.

Thus, $(5.10802 \times 10^3) - (6.1 \times 10^{-2}) = 5.107959 \times 10^3$.



Example: $(3.5 \times 10^{18}) + (5.3 \times 10^{12}) = ?$

1. $18 - 12 = 6$. The smaller exponent must be increased by 6.
2. $5.3 \times 10^{12} = 0.0000053 \times 10^{18}$
3. $(3.5 \times 10^{18}) + (0.0000053 \times 10^{18}) = (3.5 + 0.0000053) \times 10^{18}$
 $= 3.5000053 \times 10^{18}$
4. 3.5000053×10^{18} is in scientific notation.

Thus, $(3.5 \times 10^{18}) + (5.3 \times 10^{12}) = 3.5000053 \times 10^{18}$.

Example: $(1.4 \times 10^{-5}) - (5.67 \times 10^{-6}) = ?$

1. $-5 - (-6) = 1$. The smaller exponent must be increased by 1.
2. $5.67 \times 10^{-6} = 0.567 \times 10^{-5}$
3. $(1.4 \times 10^{-5}) - (0.567 \times 10^{-5}) = (1.4 - 0.567) \times 10^{-5}$
 $= 0.833 \times 10^{-5}$
4. $0.833 \times 10^{-5} = 8.33 \times 10^{-6}$ in scientific notation.

Thus, $1.4 \times 10^{-5} - 5.67 \times 10^{-6} = 8.33 \times 10^{-6}$.

Let's add a step where one of the numbers is in decimal form.

Example: $480,100 - (2.21 \times 10^6) = ?$

First rewrite 480,100 in scientific notation: 4.801×10^5

1. $6 - 5 = 1$. The smaller exponent must be increased by 1.
2. $4.801 \times 10^5 = 0.4801 \times 10^6$
3. $(0.4801 \times 10^6) - (2.21 \times 10^6) = (0.4801 - 2.21) \times 10^6$
 $= -1.7299 \times 10^6$
4. -1.7299×10^6 is in scientific notation.

Thus, $480,100 - (2.21 \times 10^6) = -1.7299 \times 10^6$.

Quantities with exponents can be multiplied and divided easily if they have the same base. Since all numbers in scientific notation have base 10, we can always multiply them and divide them.

Steps for Multiplication in Scientific Notation

- 1) Regroup (using the commutative and associative properties of multiplication)
- 2) Simplify; apply the products of powers property (add exponents)
- 3) If necessary, rewrite in scientific form.



Let's try an **Example:**

$$\begin{aligned}(3 \times 10^4)(2 \times 10^5) &= \\ \text{step 1} &= (3 \times 2)(10^4 \times 10^5) \\ \text{step 2} &= 6 \times 10^9\end{aligned}$$

But what happens if the coefficient is more than 10 when using scientific notation?

Example: $(5 \times 10^3)(6 \times 10^3) =$

$$\begin{aligned}\text{step 1} &= (5 \times 6)(10^3 \times 10^3) \\ \text{step 2} &= 30 \times 10^6\end{aligned}$$

While our value is correct, our answer is not written in scientific notation. No problem. We must move the decimal point to the left until the coefficient is between 1 and 10. For each place we move the decimal, the exponent will be raised 1 power of 10. So we rewrite

$$\text{step 3} \quad 30 \times 10^6 \text{ as } 3.0 \times 10^7 \text{ or } 3 \times 10^7 \text{ in scientific notation.}$$

More Examples:

$$\begin{aligned}(2.2 \times 10^3)(7.1 \times 10^4) &= (2.2 \times 7.1)(10^3 \times 10^4) \\ &= 15.62 \times 10^7 \\ &= 1.562 \times 10^8 \text{ in scientific notation}\end{aligned}$$

$$\begin{aligned}(7 \times 10^4)(5 \times 10^6)(3 \times 10^2) &= (7 \times 5 \times 3)(10^4 \times 10^6 \times 10^2) \\ &= 105 \times 10^{12} \\ &= 1.05 \times 10^{14} \text{ in scientific notation}\end{aligned}$$

What happens when the exponent(s) are negative?

We still add the exponents, but remember to use the rules of addition of signed numbers.

Example: $(3 \times 10^{-3})(3 \times 10^{-3}) = (3 \times 3)(10^{-3} \times 10^{-3})$

$$= 9 \times 10^{-6}$$

Example: $(2 \times 10^{-3})(3 \times 10^8) = (2 \times 3)(10^{-3} \times 10^8)$

$$= 6 \times 10^5$$



Rules for Division in Scientific Notation

- 1) Regroup as a product of two fractions
- 2) Simplify; apply the products of powers property (subtract exponents)
- 3) If necessary, rewrite in scientific form

Let's try an **Example:**

$$\frac{(6 \times 10^6)}{(2 \times 10^3)} =$$
$$\text{step 1} = \left(\frac{6}{2}\right)\left(\frac{10^6}{10^3}\right)$$
$$\text{step 2} = 3 \times 10^3$$

Example:

$$\frac{(2 \times 10^7)}{(8 \times 10^3)} =$$
$$\text{step 1} = \left(\frac{2}{8}\right)\left(\frac{10^7}{10^3}\right)$$
$$\text{step 2} = 0.25 \times 10^4$$

While the value is correct, it is not written in scientific notation. Since the coefficient is not between 1 and 10, we must move the decimal point to the right until the coefficient is between 1 and 10. For each place we move the decimal, the exponent will be lowered 1 power of ten. So we rewrite

$$\text{step 3} = 0.25 \times 10^4 = 2.5 \times 10^3 \text{ in scientific notation.}$$

What happens when the exponents are negative?

We will still subtract the exponents (applying the rules for subtracting signed numbers).

Example:

$$\frac{(9 \times 10^{-6})}{(3 \times 10^{-3})} = \left(\frac{9}{3}\right)\left(\frac{10^{-6}}{10^{-3}}\right)$$
$$= 3 \times 10^{-3}$$



Word Problems Using Scientific Notation

Using scientific notation, solve the following problems.

Example: *The speed of light is 3×10^8 meters/second. If the sun is approximately 1.5×10^{11} meters from Earth, determine how many seconds it takes light to reach the Earth. Express your answer in both standard notation and scientific notation.*

To determine the time, $t = \frac{d}{r}$, where t is time, d is distance, and r is rate. So we have

$$\begin{aligned} t &= \frac{1.5 \times 10^{11}}{3 \times 10^8} \\ &= 0.5 \times 10^3 \\ &= 5.0 \times 10^2 \text{ seconds} \\ &= 500 \text{ seconds} \end{aligned}$$

At this point, we may want to convert this into minutes:

$$500 \text{ seconds} \bullet \frac{1 \text{ minute}}{60 \text{ seconds}} = 8\frac{1}{3} \text{ minutes}$$

Example: *The Earth is a space ship. It travels about 960,000,000 km a year. How far has it traveled in 4,000,000,000 years?*

To determine the distance, $d = rt$.

$d = 960,000,000 \times 4,000,000,000$ This computation leaves lots of room for error! However, using scientific notation:

$$\begin{aligned} d &= (9.6 \times 10^8)(4 \times 10^9) \\ &= 38.4 \times 10^{17} \\ &= 3.84 \times 10^{18} \text{ km the Earth has traveled} \end{aligned}$$

CCSS 8.EE.A.3: *Express how many times as much one number expressed in scientific notation is than another.*

Example: *At times Neptune is about 2,700,000,000 miles from the Earth. Mercury is about 135,000,000 miles from Earth. Determine how many times further it is from the Earth to Neptune than it is from Earth to Mercury.*

Neptune is 2.7×10^9 miles from Earth

Mercury is 1.35×10^8 miles from Earth

$$\frac{\text{Neptune}}{\text{Mercury}} = \frac{2.7 \times 10^9}{1.35 \times 10^8}$$

$$\approx 2 \times 10^1 \text{ or } 20 \text{ times;}$$

Neptune is about 20 times as far from Earth as Mercury.



CCSS 8.EE.A.4: Using scientific notation and choose units of appropriate size for measurements of very large or very small quantities.

With very large or very small numbers it is important to know what units we are dealing with. For example, having 4.9×10^7 dollars would be more than ten times the amount of money needed to retire while most financial experts would say that 4.9×10^7 cents would only be about half of what is necessary for retirement. As another example, consider the fact that Mars is on average about 7.8×10^7 km from Earth. It would not make sense to report this distance in millimeters because of how huge that number really is.

When deciding on which unit of measurement to use in any given situation, just use common sense. If we're talking about the distance between towns, miles will work better than inches. If we're talking about how quickly your toenails grow, meters per day would (hopefully) be inappropriate while millimeters per day might do nicely.

The point is, people strongly prefer numbers that aren't really big or really small. So this is why we have so many different kinds of units!

Obviously, our calculators do not give you appropriate units. You need to keep track of what unit of measurement goes with each calculation.

Practice choosing units of appropriate size. Some suggestions are:

Choose the most appropriate unit of measurement for the given situation.

1. *The amount a rock deteriorates:* grams per second, grams per minute, or grams per year
2. *The amount of lava coming from a volcano:* fluid ounces per hour, cups per hour, or gallons per hour
3. *The speed human hair grows:* inches per year, feet per year, or yards per year
4. *The growth of coral:* centimeters per year, kilometers per day, or kilometers per year
5. *The growth of a tree:* inches per hour, inches per year, yards per year
6. *Speed of a swimming dolphin:* centimeters per hour, meters per hour, kilometers per hour
7. *The rate of water flow from a shower head:* fluid ounces per minute, cups per minute, gallons per minute
8. *A cell phone measures 2.3×10^{-5} kilometers in thickness. Would this be best expressed using: kilometers, meters, or centimeters?*
9. *The average pace for a biker is 3.2×10^6 centimeters per hour. Would this be best expressed using: kilometers, meters, or centimeters?*
10. *A bullet travels 3.4×10^5 millimeters per second. Would this be best expressed using: millimeters, centimeters, or meters per second?*



Scientific Notation on the Calculator

CCSS 8.EE.A.4: Interpret scientific notation that has been generated by technology.

In working with calculators, it is important that students recognize scientific notation. Students should recognize that the output of $2.45\text{E}23$ is 2.45×10^{23} and $3.5\text{E}-4$ is 3.5×10^{-4} . Students should know that to enter scientific notation they will use E or EE (scientific notation), * (multiplication), and ^ (exponent) symbols.

