2-3 Scientific Notation

- Light travels at 186,000 miles per second.
- The sun is ~ 93,000,000 miles away from Earth.
- It takes the light from the sun about 8 minutes to reach the Earth.
- How far does light travel in 1 year?
- There are 86,400 seconds in 1 day and ~365 days in 1 year.
- In 1 year, light travels 186,000 · 86,400 · 365 = 6,000,000,000,000 miles
- Or $6 \cdot 10^{12}$ written in scientific notation.

2-3 Scientific Notation

Power	Decimal	Fraction
10^4		-
10^3		-
10^2		-
10^1		-
10^0		-
10^{-1}		
10^{-2}		
10^{-3}		
10^{-4}		

2-3 Scientific Notation

Power	Decimal	Fraction
10^4	10,000	-
10^3	1,000	-
10^2	100	-
10^1	10	-
10^0	1	-
10^{-1}	.1	$\frac{1}{10}$
10^{-2}	.01	$\frac{1}{100}$
10^{-3}	.001	$\frac{1}{1000}$
10^{-4}	.0001	$\frac{1}{10000}$

So many zeros

- Scientists find very large and extremely small numbers interesting but not all the zeros.
- Scientific notation makes comparison and computing of large or small numbers easier.
- Important rule using scientific notation.
  - The first number must be at least one and less than ten.
    - $1 \leq n < 10$
- Scientific notation form
  - $n \cdot 10^x$ where n is a number at least one and less than 10 and x is the exponent of 10.

Numbers greater than 10

- Locate the decimal and move to the left so there is only one non-zero digit to the left.
- The resulting placement of the decimal will produce the n part of the standard scientific notational expression.
- Count the number of places that you moved the decimal in step 1.
- The number of places you moved the decimal is the x part of the expression.
- Example – Write in scientific notation
  - 23419
  - 2.3419 (Moved decimal 4 places to the left. x = 4)
  - $2.3419 \cdot 10^4$

Numbers less than 1

- Locate the decimal and move to the right so there is only one non-zero digit to the left.
- Moving the decimal to the right will give us a negative exponent.
- The resulting placement of the decimal will produce the n part of the standard scientific notational expression.
- Count the number of places that you moved the decimal in step 1.
- The number of places you moved the decimal is the -x part of the expression.
- Example – Write in scientific notation
  - .00784
    - 7.84 (Moved decimal 3 places to the right x = -3)
    - $7.84 \cdot 10^{-3}$
  - $10^{-3} = \frac{1}{10^3}$

Numbers between 1 and 10

- We don't need to move the decimal so the exponent will be zero.
- Example – Write in scientific notation
  - 7.92
    - $7.92 \cdot 10^0$

Scientific Notation

- Write in scientific notation
  - 123,876.3
    - $1.238763 \cdot 10^5$
  - 1,236,840
    - $1.236840 \cdot 10^6$
  - 4.22
    - $4.22 \cdot 10^0$
  - 0.00000000211
    - $2.11 \cdot 10^{-9}$
  - 0.00028
    - $2.8 \cdot 10^{-4}$

Scientific Notation

- Write in decimal notation
  - $8.09 \cdot 10^5$
    - 809,000
  - $3.43 \cdot 10^4$
    - 34,300
  - $1.2 \cdot 10^{-5}$
    - .000012
  - $5 \cdot 10^{-4}$
    - 0.0005

Rules of Exponents

- Product of Powers Rule

$$10^a \bullet 10^b = 10^{a+b}$$

- Quotient of Powers Rule

$$\frac{10^a}{10^b} = 10^{a-b}$$

- Zero Exponent Rule

$$10^0 = 1$$

- Negative Exponent Rule

$$10^{-n} = \frac{1}{10^n}$$

Multiplying using Scientific Notation

- Remember exponent rules
  - Multiplying - _____ exponents
  - Dividing - _____ exponents
- General format for multiplying
  - $(n \cdot 10^x)(m \cdot 10^y) = (nm) \cdot 10^{x+y}$
- Example
  - $(3 \cdot 10^4)(5 \cdot 10^2)$
  - $(3 \cdot 5)(10^4 \cdot 10^2)$
  - $(15)\ 10^{4+2}$
  - $15 \cdot 10^6$