Math Review

Scientific Notation:

Scientific notation is a shorthand way of writing and multiplying large (and small) numbers.

1,000,000,000,000	10^{12}	tera (T)	(trillions)
1,000,000,000	10^{9}	giga (G)	(billions)
1,000,000	10^{6}	mega (M)	(millions)
1000	10^{3}	kilo (k)	(thousands)
1	10^{0}	unity	
0.01	10^{-2}	centi (c)	(hundredth)
0.001	10^{-3}	milli (m)	(thousandth)
0.000001	10^{-6}	micro (μ)	(millionth)
0.000000001	10^{-9}	nano (n)	(billionth)

Using Scientific Notation:

To do numbers that are not divisible by ten, we ***multiply*** by an exponential number.

$$4{,}275{,}000{,}000 = 4.275 \times 1{,}000{,}000{,}000 = 4.275 \times 10^{9}$$

$$0.000374 = 3.74 \times 0.0001 = 3.74 \times 10^{-4}$$

<u>Using Scientific Notation:</u>

To ***<u>multiply</u>*** numbers using scientific notation, we ***<u>add</u>*** the exponents.

$10^3 \times 10^{-9} = 10^{(3)+(-9)} = 10^{-6}$

$(4\times10^2) \times (2 \times10^5) = (4\times2) \times 10^{(2)+(5)} = 8 \times 10^7$

To ***<u>divide</u>*** numbers using scientific notation, we ***<u>subtract</u>*** the exponents.

$$\frac{10^3}{10^{-9}} = 10^{(3)-(-9)} = 10^{12}$$

$$\frac{4\times10^2}{2\times10^5} = \frac{4}{2} \times 10^{(2)-(5)} = 2 \times 10^{-3}$$

Using Scientific Notation:

To ***raise a number to a power***, we ***multiply*** the exponents

$$\left(10^3\right)^2 = 10^{(3*2)} = 10^6$$

To ***changing from division to multiplication***, we ***change the sign*** of the exponent

$$\frac{5}{10^2} = 5x10^{-2}$$

Using Scientific Notation:

To ***add or subtract*** numbers using scientific notation, we work ***in front of*** the exponents, but they ***must*** have the ***same*** exponent.

$3.0 \times 10^2 + 2.6 \times 10^5 = 0.003 \times 10^5 + 2.6 \times 10^5$

$= 2.603 \times 10^5$

$1.0 \times 10^5 - 7.0 \times 10^2 = 1.0 \times 10^5 - 0.007 \times 10^5$

$= 0.993 \times 10^5$

Scientific Notation/Units Example

Density of Water

Density is mass per volume

For water: 1 gram / centimeter^3 (1g/cm^3)

What is this in kilograms / meters^3 ?

1000 g in 1 kg, so $\frac{1\,\text{kg}}{1000\,\text{g}} = 1$

100 cm in 1 m, so $\frac{100\,\text{cm}}{1\,\text{m}} = 1$

Scientific Notation/Units Example

Density of Water

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For water: 1 gram / centimeter^3 (1g/cm^3)

What is this in kilograms / meters^3 ?

$$\left(\frac{1\cancel{g}}{cm^{\cancel{3}\,2}}\right)\left(\frac{1kg}{10^3\,\cancel{g}}\right)\left(\frac{10^2\,\cancel{cm}}{m}\right)$$

WRONG UNITS!!!

Scientific Notation/Units Example

Density of Water

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For water: 1 gram / centimeter^3 (1g/cm^3)

What is this in kilograms / meters^3 ?

$$\left(\frac{1\cancel{g}}{cm^3}\right)\left(\frac{1kg}{10^3\cancel{g}}\right)\left(\frac{10^2 cm}{m}\right)^3$$

Scientific Notation/Units Example

Density of Water

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What is this in kilograms / meters^3 ?

$$\left(\frac{1\cancel{g}}{\cancel{cm^3}}\right)\left(\frac{1kg}{10^3\cancel{g}}\right)\left(\frac{\left(10^2\right)^3\cancel{cm^3}}{m^3}\right) = 10^{(0-3+2*3)}\frac{kg}{m^3}$$

$$= 10^3\frac{kg}{m^3}$$

How to ATTACK Word Problems

- **Identify** – Identify what the main question is
  - Read the problem carefully.
  - Underline the question. Sometimes there is not a question but a command of what to do (such as, "Find the product.")
- **Organize** – Organize the facts in the problem
  - Reread the problem. Cross out extra information.
  - Circle key numbers.
  - If the number is in word form, write the number above the words
  - Look for implied numbers

How to ATTACK Word Problems

- **Choose** – Choose which functions will serve you best in solving the problem
  - Choose your units
  - You may need multiple steps to solve the problem.
  - Find key words that tell what operation to use. Double underline them.
- **Work** – Work the problem.
  - Write out all the steps plus the answer
  - Write the equation and solve.
  - Label your answer.
- **Check**
  - Check your answer to be sure it makes sense.
  - Check your math.

Word Problem Example

You are in charge of a probe designed to measure the plasma density in the solar atmosphere. Your probe is using radio waves to send messages back to the Earth. The Earth is 150,000,000 km from the Sun. Find the time required for message to reach the Earth.

Identify

You are in charge of a probe designed to measure the plasma density in the solar atmosphere. Your probe is using radio waves to send messages back to the Earth. The Earth is 150,000,000 km from the Sun. Find the time required for message to reach the Earth.

Organize

Speed = $3x10^8$ m/s

~~You are in charge of a probe designed~~ ~~plasma density in the solar atmosphere.~~ Your probe is using radio waves to send messages back to the Earth. The Earth is 150,000,000 km from the Sun. Find the time required for message to reach the Earth.

Organize

- Time = ?
- Speed = $3x10^8$ m/s
- Distance = 150,000,000 km = $1.5x10^8$ km
  - Distance from the Earth to the Sun is also called 1 Astronomical Unit (AU)

Choose

- We will work with meters and seconds

There are 1000 m = 10^3 m = 1 km:

$$1 = \left(\frac{10^3 m}{km}\right)$$

Hence, in meters:

$$D = \left(\frac{1.5x10^8 km}{1}\right)\left(\frac{10^3 m}{km}\right)$$

$$= 1.5x10^{(8+3)} m$$

$$= 1.5x10^{11} m$$

Choose

- Time = ?
- Speed = 3×10^8 m/s
- Distance = 1.5×10^{11} m

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

OR

$$\text{time} = \frac{\text{distance}}{\text{speed}}$$

Work

$$\text{time} = \frac{\text{distance}}{\text{speed}} = \frac{1.5x10^{11}m}{3x10^{8}m/s}$$

$$= \frac{1.5}{3}x10^{(11-8)}m\frac{s}{m} = 0.5x10^{3}s$$

$$= 5x10^{2}s = 500s$$

$$= 500s\left(\frac{1\min}{60s}\right)$$

$$= 8.33\min$$

Check

- 500 s or 8.33 min.
- Does this answer make sense?
- Do we have the correct units?