## Math 9 – Unit 1: Real Numbers

## **Lesson #5: Powers and Scientific Notations**

Learning Goal: We are learning to work with powers and expressing numbers in scientific notation

Powers, as the name suggests, are a powerful way to express repeated multiplication of the same number. Specifically, powers of 10 express very large and very small numbers in a manner which is convenient to read, write and compare.

In science and engineering, quite often you want to represent very large or very small numbers. For example, the Mass of earth is 5,970,000,000,000,000, 000, 000, 000 kg and the Size of a bacteria is 0.0000005 m. Is there a more convenient way to represent this without having to write a lot of zeros?

the number of times you multiply the base by itself. Yes! This can be achieved by using Scientific Notation. However, scientific notation utilizes powers, so we first need to discuss exponents.

A power has two parts. The base is the number used in the multiplication. An exponent indicates how many times the repeated multiplication occurs.

- exponent.

A power can be written in two forms. Exponential form is the same as the above example, then there is the expanded (or standard) form which shows the repeated multiplication.

 $4^3 = \sqrt{\times} \times \times = 64$ 

**Example 1:** Write the following in expanded form, then evaluate:

a)  $5^4$  b)  $(-3)^2$  c)  $-3^2$  the negative of 3 c)  $-3^2$   $= 5 \times 5 \times 5 \times 5 \times 5 = (-3) \times (-3)$  the negative of  $3^2$   $= \frac{2}{3} \times \frac{2$ 

e) 
$$4^{1} = 4$$
  $3 = 4$  f)  $4^{0}$   $4^$ 

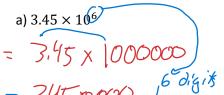
Powers of 10. Powers of 10 are quick to calculate and they are, well, powerful!

To evaluate a power of 10, the exponent indicates how many zeros will be behind the 1 or in front of the 1 if negative (with the decimal after the first zero).

$$10^{-5} = 0.000$$

When writing really large (or really small) numbers, we can use scientific notation to eliminate the need to write all the zeros and focus on the significant digits.

Scientific to Expanded: Write the full number from the scientific notation:



b) 
$$6.2 \times 10^{-7}$$



Earth is  $1.496 \times 10^8$  km from the sun, or

An atom of Hydrogen is  $1.674 \times 10^{-27}$  kg, or

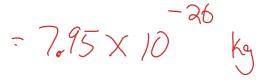


Expanded to Scientific: Convert the numbers to scientific notation. Keep 3 digits.

a) 0.000000432 7 zews

b) 82348709008713

Neptune is 4,497,000,000, km from the sun, or



## **Success Criteria:**

- I recognize the two parts of a power
- I can express powers in the expanded form and vice-versa
- I can express very big and very small numbers using scientific notation