MTH1W

Math 9 – Unit 1: Real Numbers Name: Mr. Hagen

Lesson #5: Powers and Scientific Notations Date: Sept 16, 2021

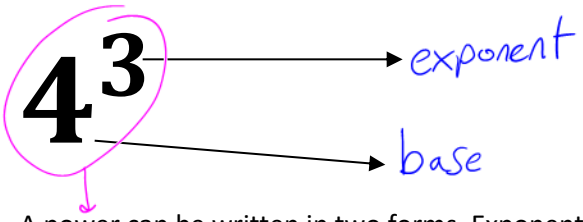
Learning Goal: We are learning to work with powers and expressing numbers in scientific notation

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?
Yes! This can be achieved by using Scientific Notation. However, scientific notation utilizes powers, so we first need to discuss exponents.

A power is a product of an identical factor

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



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.

$4^3 = 4 \times 4 \times 4$ or $(4)(4)(4)$

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

a) 5^4

$= 5 \times 5 \times 5 \times 5$

$= 625$

b) $(-3)^2$

$= (-3) \times (-3)$

$= 9$

c) -3^2

$= -(3^2)$

$= -9$

d) $\left(\frac{2}{3}\right)^3$

$= \frac{2}{3} \times \frac{2}{3} \times \frac{2}{3}$

$= \frac{8}{27}$

Now for some interesting ones:

e) 4^1

$= 4$

f) 4^0

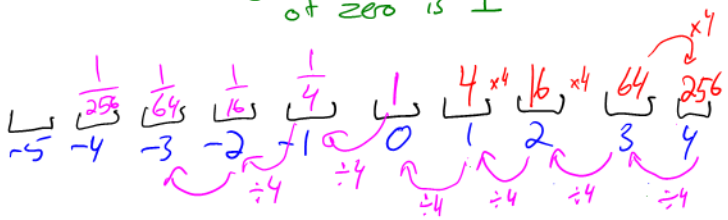
$= 1$

anything to the power of zero is 1

h) 4^{-1}

$= \frac{1}{4}$ or 0.25

i) $4^{-2} = \frac{1}{16}$



$\frac{1}{4} \div \frac{4}{1} \div \frac{4}{1}$

$\frac{1}{4} \times \frac{1}{4} \times \frac{1}{4}$

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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.

$10^5 =$ 100,000 $10^{-5} =$ 0.00001

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.

Example: Write the full number from the scientific notation:

a) 3.45×10^8 b) 6.2×10^{-5}

$= 3.45 \times 100000000$ 6.2×0.00001

$= 345,000,000$ $= 0.000062$

Example: Convert the numbers to scientific notation. Keep 3 digits.

a) 0.000000432 b) 82348709008713

$= 4.32 \times 10^{-7}$ 8.23×10^{13}

Applications:
1. Investigating Solar System

The table shows the average distance from each planet in our solar system to the sun.

(a) Complete the table by expressing the distance from each planet to the Sun in scientific notation.

Planet	Distance from Sun (km)	Distance from the Sun (Scientific Notation)
Earth	149,600,000	1.496×10^8
Jupiter	778,300,000	7.783×10^8
Mars	227,900,000	2.279×10^8
Mercury	57,900,000	5.79×10^7
Neptune	4,497,000,000	4.497×10^9

Pluto not a planet :)	5,900,000,000	5.9×10^9
Saturn	1,427,000,000	1.427×10^9
Uranus	2,870,000,000	2.87×10^9

(b) Order the planets from closest to the sun to farthest from the sun.

Mercury, Mars, Earth ....

2. This table shows the mass of one atom for five chemical elements. Use it to answer the question given.

Element	Mass of Atom (Scientific Form)	Mass of Atom (in kg)
Titanium	7.95×10^{-26}	0.000 000 000 000 000 0000 00 0000 795 kg
Lead	3.44×10^{-25}	0.0000344
Silver	1.79×10^{-25}	0.0000179
Lithium	1.15×10^{-26}	
Hydrogen	1.674×10^{-27}	

(a) Which is the heaviest element? Lead

(b) Which element is lighter, Silver or Titanium?

(c) List all five elements in order from lightest to heaviest.

Hydrogen, Lithium, Titanium, Silver, Lead.

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