SOL 6.5 – Exponents, Squares, and Perfect Squares

6.5 The student will investigate and describe concepts of positive exponents and perfect squares.

Understanding the Standard:

- In exponential notation, the base is the number that is multiplied, and the exponent represents the number of times the base is used as a factor. In 8^3, 8 is the base and 3 is the exponent.
- A power of a number represents repeated multiplication of the number by itself (e.g., $8^3 = 8 \times 8 \times 8$ and is read "8 to the third power").
- Any real number other than zero raised to the zero power is 1. Zero to the zero power (0) is undefined.
- Perfect squares are the numbers that result from multiplying any whole number by itself (e.g., $36 = 6 \times 6 = 6^2$).
- Perfect squares can be represented geometrically as the areas of squares the length of whose sides are whole numbers (e.g., 1×1, 2×2, or 3×3). This can be modeled with grid paper, tiles, geoboards and virtual manipulatives.

SOL 6.5 – Exponents

The Meaning of Exponents:

- Where repeated addition is multiplication, repeated multiplication is the use of exponents
- The **Base** is the "**Big number**" which is the number to be repeated
- The **Exponent** is the "**Floaty number**" which tells how many times the **Base** is to be repeated.

Exponential Form	Word Form	Expanded Form	Standard Form
2^4	**2** to the **fourth power**	**2×2×2×2**	**16**

How to enter into the Calculator:

Problem: 3^5 → Type: **3** y^x **5** **=** → Answer: **243**

Problem: 4^7 → Type: **4** y^x **7** **=** → Answer: **16,384**

Problem: 10^2 → Type: **10** y^x **2** **=** → Answer: **100**

Problem: 10^3 → Type: **10** y^x **3** **=** → Answer: **1,000**

Problem: 10^4 → Type: **10** y^x **4** **=** → Answer: **10,000**

Problem: 10^5 → Type: **10** y^x **5** **=** → Answer: **100,000**

Problem: 10^6 → Type: **10** y^x **6** **=** → Answer: **1,000,000**

Powers of Ten:

- The place value system is based off of the powers of ten
- The number of the exponent tells how many zeros are on the number

Zero Power:

- Any number to the zero power equals one

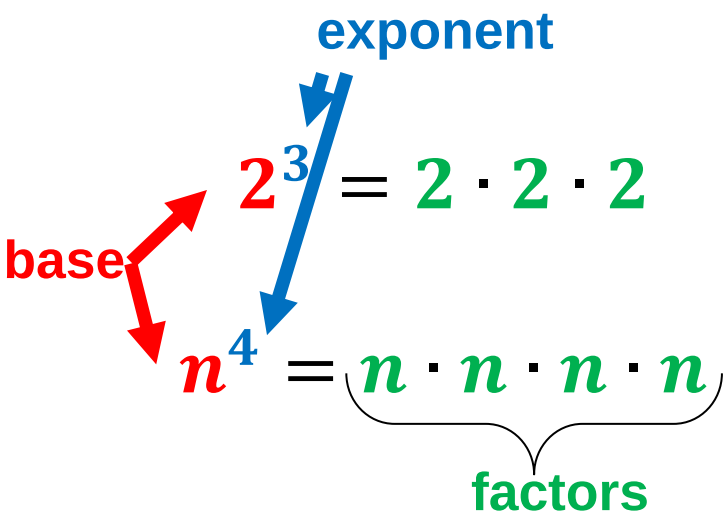
SOL 6.5 – Squares and Perfect Squares

Exponential Form	Word Form	Expanded Form	Standard From
1^2	1 squared	1×1	1
2^2	2 squared	2×2	4
3^2	3 squared	3×3	9
4^2	4 squared	4×4	16
5^2	5 squared	5×5	25
6^2	6 squared	6×6	36
7^2	7 squared	7×7	49
8^2	8 squared	8×8	64
9^2	9 squared	9×9	81
10^2	10 squared	10×10	100
11^2	11 squared	11×11	121
12^2	12 squared	12×12	144
13^2	13 squared	13×13	169
14^2	14 squared	14×14	196
15^2	15 squared	15×15	225
16^2	16 squared	16×16	256
17^2	17 squared	17×17	289
18^2	18 squared	18×18	324
19^2	19 squared	19×19	361
20^2	20 squared	20×20	400

Perfect Squares
– Remember the stackems

Vocabulary:

Exponential Form



Perfect Squares

$0^2 = 0 \cdot 0 = \mathbf{0}$
$1^2 = 1 \cdot 1 = \mathbf{1}$
$2^2 = 2 \cdot 2 = \mathbf{4}$
$3^2 = 3 \cdot 3 = \mathbf{9}$
$4^2 = 4 \cdot 4 = \mathbf{16}$
$5^2 = 5 \cdot 5 = \mathbf{25}$

$$\sqrt{16} = \sqrt{4 \cdot 4} = 4$$

perfect square

Powers of Ten

Exponential	Meaning	Value
10^4	$10 \cdot 10 \cdot 10 \cdot 10$	10,000
10^3	$10 \cdot 10 \cdot 10$	1000
10^2	$10 \cdot 10$	100
10^1	10	10
10^0	1	1

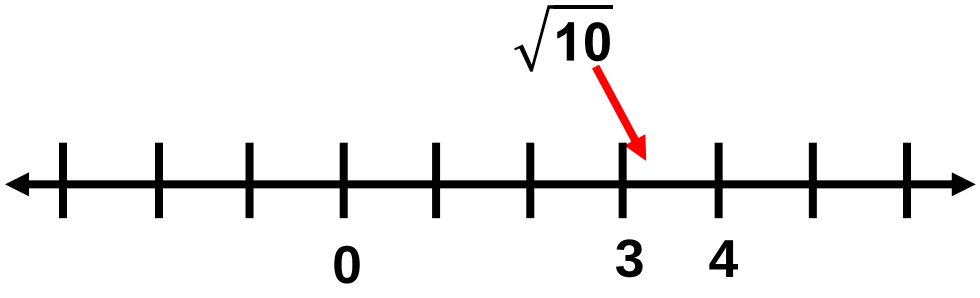
Square Root

radical symbol

$$\sqrt{36} = 6$$

$$\sqrt{36} = \sqrt{6 \cdot 6} = \sqrt{6^2} = 6$$

Squaring a number and taking a square root are inverse operations.



between $\sqrt{9}$ and $\sqrt{16}$

Essential Understandings:

What does exponential form represent?

repeated multiplication

Exponential form is a short way to write repeated multiplication of a common factor such as: $5 \times 5 \times 5 \times 5 \times 5 \times 5 = 5^6$

What is the relationship between perfect squares and a geometric square?

Basically they are the same shape.

A perfect square is the area of a geometric square whose side length is a whole #.

Essential Knowledge & Skills:

The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to

- Recognize and describe patterns with exponents that are natural numbers, by using a calculator.
- Recognize and describe patterns of perfect squares not to exceed 20^2, by using grid paper, square tiles, tables, and calculators.
- Recognize powers of ten by examining patterns in a place value chart: 10^4 = 10,000, 10^3 = 1000, 10^2 = 100, 10^1 = 10, 10^0 =1.