

**Day 21: Fractional Exponent Investigation****I. Consider the following pattern:**

A. Fill in the blanks based off of the examples.

$$2^4 = 2 \cdot 2 \cdot 2 \cdot 2 = 16$$

$$2^3 = \underline{\quad} \cdot \underline{\quad} \cdot \underline{\quad} = \underline{\quad}$$

$$2^2 = \underline{\quad} \cdot \underline{\quad} = \underline{\quad}$$

$$2^1 = \underline{\quad}$$

$$2^0 = \underline{\quad}$$

$$2^{-1} = \underline{\quad}$$

$$2^{-2} = \frac{1}{2^2} = \frac{1}{2} \square \frac{1}{2} = \underline{\quad}$$

$$2^{-3} = \underline{\quad} = \underline{\quad} \cdot \underline{\quad} \cdot \underline{\quad} = \underline{\quad}$$

$$2^{-4} = \underline{\quad} = \underline{\quad} \cdot \underline{\quad} \cdot \underline{\quad} \cdot \underline{\quad} = \underline{\quad}$$

B. Now consider  $2^{\frac{1}{2}}$ . Where would this fit in the pattern above? Draw an arrow where you think  $2^{\frac{1}{2}}$  should be placed. What do you think the value will be?My estimated value of  $2^{\frac{1}{2}}$ : 

- Now enter  $2^{\frac{1}{2}}$  in your calculator. What is the most specific number classification for the result?
- What is another key sequence on your calculator to find  $2^{\frac{1}{2}}$ ?

C. Now consider  $2^{\frac{1}{3}}$ . Where would this fit in the pattern above? Draw an arrow where you think  $2^{\frac{1}{3}}$  should be placed. What do you think the value will be?My estimated value of  $2^{\frac{1}{3}}$ :  Calculator value:  Number classification:

- What is another key sequence on your calculator to find  $2^{\frac{1}{3}}$ ?

D. Evaluate the following using your calculator:

$$36^{\frac{1}{2}} = \quad \quad 81^{\frac{1}{2}} = \quad$$

$$64^{\frac{1}{2}} = \quad \quad 144^{\frac{1}{2}} = \quad$$

$$25^{\frac{1}{2}} = \quad$$

Write a statement about what the exponent  $\frac{1}{2}$  represents.Try to write this symbolically in *radical form*:  $a^{\frac{1}{2}} =$

E. Based on your observations from part D, try to evaluate the following **without** your calculator.

$$8^{\frac{1}{3}} =$$

$$27^{\frac{1}{3}} =$$

$$1000^{\frac{1}{3}} =$$

$$125^{\frac{1}{3}} =$$

Write a statement about what the exponent  $\frac{1}{3}$  represents?

Try to write this symbolically in *radical form*:  $a^{\frac{1}{3}} =$

F. Look back at parts D and E to complete the following symbolic rule in *radical form*:

$$a^{\frac{1}{n}} =$$

## II. Practice:

A. Rewrite in radical form, then simplify completely.

a.  $100^{\frac{1}{2}} =$

b.  $125^{\frac{1}{3}} =$

c.  $17^{\frac{1}{2}} =$

d.  $64^{\frac{1}{3}} =$

e.  $16^{\frac{1}{4}} =$

f.  $16^{\frac{3}{4}} =$

g.  $\left(8^{\frac{1}{2}}\right)^2 =$

h.  $\left(8^{\frac{1}{3}}\right)^3 =$

i.  $\left(8^4\right)^{\frac{1}{4}} =$

**Notes:** Fractional Exponents with a numerator  $\neq 1$

B. Rewrite in exponential form, then simplify completely.

a.  $\sqrt{81} =$

b.  $\sqrt[3]{125} =$

c.  $\sqrt[4]{20} =$

d.  $\sqrt[3]{-64} =$

e.  $\sqrt[3]{8} =$

f.  $\left(\sqrt[3]{x}\right)^4 =$

g.  $\left(\sqrt{98}\right)^2 =$

h.  $\left(\sqrt[3]{98}\right)^3 =$

i.  $\left(\sqrt[4]{98}\right)^4 =$

### III. Extension:

Based on what you have learned, evaluate the following without a calculator.

a.  $(27)^{\frac{2}{3}}$

b.  $1^{3.5}$

c.  $\left(\frac{1}{32}\right)^{\frac{1}{5}}$

d.  $(-27)^{-\frac{2}{3}}$

e.  $4^{2.5}$

f.  $\left(\frac{1}{16}\right)^{\frac{3}{4}}$

g.  $216^{\frac{1}{3}} =$

h.  $16^{\frac{1}{4}} =$

i.  $25^{\frac{3}{2}} =$

j.  $(x^6)^{\frac{1}{2}} =$

k.  $(9x^2)^{0.5} =$

l.  $(4x^{0.5})^{0.5} =$

m.  $\left((8x^3)^2\right)^{\frac{1}{3}} =$

n.  $(9x^{-5}y^2)^{\frac{-1}{2}} =$

o.  $\left((-4x^3y^{-2})^3\right)^{-0.5} =$

### Summarize:

In your own words, summarize how to simplify the following types of exponents:

a. Zero Exponents, like  $2^0$ .

b. Negative Exponents, like  $3^{-2}$ .

c. Fractional Exponents, like  $(4)^{\frac{1}{2}}$ .