EXTEND 10-1

Graphing Calculator Lab

Fractional Exponents

You have studied the properties of exponents that are whole numbers. You can use a calculator to explore the meaning of fractional exponents.

ACTIVITY

Step 1 Evaluate $9^{\frac{1}{2}}$ and $\sqrt{9}$.

KEYSTROKES: 9 [^] [(] 1 [÷] 2 [)] [ENTER] 3

KEYSTROKES: [2nd] [$\sqrt{\ }$] 9 [ENTER] 3

Record the results in a table like the one at the right.

Expression	Value	Expression	Value
$9^{\frac{1}{2}}$	3	$\sqrt{9}$	3
$16^{\frac{1}{2}}$		$\sqrt{16}$	
$8^{\frac{1}{3}}$		$\sqrt[3]{8}$	
$27^{\frac{1}{3}}$		$\sqrt[3]{27}$	
$8^{\frac{2}{3}}$		$\sqrt[3]{8^2}$	
$16^{\frac{3}{4}}$		$\sqrt[4]{8^3}$	

Step 2 Use calculator to evaluate each expression. Record each result in your table. To find a root other than a square root, choose the $\sqrt[x]{\ }$ function from the [MATH] menu.

1A. Study the table. What do you observe about the value of an expression of the form $a^{\frac{1}{n}}$?

1B. What do you observe about the value of an expression of the form $a^{\frac{m}{n}}$?

Analyze the Results

1. Recall the Power of a Power Property. For any number a and all integers m and n, $(a^m)^n = a^{m \cdot n}$. Assume that fractional exponents behave as whole number exponents and find the value of $\left(b^{\frac{1}{2}}\right)^2$.

$$\left(b^{\frac{1}{2}}\right)^2 = b^{\frac{1}{2} \cdot 2} \quad \text{Power of a Power Property}$$

$$= b^1 \text{ or } b \quad \text{Simplify.}$$

Thus, $b^{\frac{1}{2}}$ is a number whose square equals b. So it makes sense to define $b^{\frac{1}{2}} = \sqrt{b}$. Use a similar process to define $b^{\frac{1}{n}}$.

2. Define $b^{\frac{m}{n}}$. Justify your answer.

Write each expression as a power of x.

3. $\dfrac{\sqrt{x}}{(\sqrt[4]{x})(x)}$

4. $\dfrac{(x)(\sqrt[3]{x})}{(\sqrt{x})(\sqrt[5]{x})}$

Write each root as an expression using a fractional exponent. Then evaluate the expression.

5. $\sqrt{49}$ **6.** $\sqrt[4]{81}$ **7.** $\sqrt{4^3}$ **8.** $\sqrt[3]{125^2}$