

6-4 Roots of Real Numbers

powers: raising a number to the *nth power* means using that number as a factor *n* times.

- 2nd power = squared
- 3rd power = cubed

$$\begin{array}{ccc} \sqrt{x} & \sqrt[4]{x} & \sqrt[3]{x} \\ x^2 & x^4 & x^3 \\ & x^2 & \end{array}$$

Examples of Powers

$$\begin{array}{l} 7^2 = 7 \cdot 7 = 49 \\ 5^4 = 5 \cdot 5 \cdot 5 \cdot 5 = 625 \\ 2^6 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 64 \end{array}$$

roots: the inverse operation of a power

- a root "undoes" a power of a number
- a *square root* finds the number that was squared.
- a *cube root* find the number that was cubed.
- a *nth root* finds the number that was taken to the nth power.

radicals

index

indices

$n \sqrt{b}$

radicand

$\sqrt{5x}$

$(3x)\sqrt{5}$

$3 \cdot \sqrt{5} \neq \sqrt[3]{5}$

$3 \times _ \times _ \times _ = 5$

$_ \times _ \times _ = 5$

Rules about Radicals

- when no index is given, assume **non-negative square root**.
- some radicals have more than one root.
 - the positive root is called the **principal root**.
 - if there is no positive root, then the **negative root** is the principal root.

Examples

$\sqrt{49}$	7
$-\sqrt{49}$	-7
$\pm\sqrt{49}$	± 7
$\sqrt[3]{-64}$	-4
$-\sqrt[4]{81}$	-3

$\sqrt[4]{81}$
 $4 \sqrt[4]{y} 81 = 3$
 $81 \overset{2^{rd}}{\sqrt{y}} 4$

Examples:

1. $\sqrt[3]{-8}$

-2

2. $\sqrt[5]{243}$

3

3. $\pm\sqrt{144}$

± 12

variables

$$\sqrt{x^{12}} = x^6$$

$$\sqrt[3]{x^{12}} = x^4$$

$$\sqrt[4]{x^{12}} = |x|^3$$

$$\sqrt[6]{x^{12}} = x^2$$

$$\sqrt[12]{x^{12}} = |x|$$

Is it divisible?
 $\div = \sqrt{\quad}$

$\overset{\text{even}}{\sqrt{\text{Variable}^{\text{even}}}} = |\text{Variable}|^{\text{odd}}$

4. $\pm\sqrt[2]{16x^2}$

$$\pm 4|x|$$

5. $\sqrt[4]{81}$

$$3$$

6. $-\sqrt[6]{64}$

$$-2$$

7. $\sqrt[5]{243a^{10}b^{15}c^{20}}$

$$3a^2b^3c^4$$

8. $-\sqrt{(m^3+5)^2}$

$$-(m^3+5)$$

$$-|m^3+5|$$

9. $\sqrt[5]{(x+2)^{15}}$

$$(x+2)^3$$

10. $\sqrt{(x^2+10x+25)}$

$$\sqrt{(x+5)^2}$$

$$|x+5|$$

Using a Calculator: calculate the following radicals to the ten-thousandths place. . - - - - ? 5 ↑

11. $\sqrt{77}$

8.7750

8.775

2.0000000

2
1.96

12. $-\sqrt[3]{19} \approx -2.6684$

