Name: ______________________________ Date: ______________________

Master 4.1a Activate Prior Learning: Square Roots and Cube Roots

When a number x can be written as the product of two equal factors, then the square root of x, represented by $\sqrt{x}$, is one of these factors.
For example, $\sqrt{64} = 8$ because $8^2 = 64$.

The square root of a perfect square is always a rational number.

The cube root of a number x, represented by $\sqrt[3]{x}$, is one of three equal factors of the number.
For example, $\sqrt[3]{64} = 4$ because $4^3 = 64$.

The cube root of a perfect cube is always a rational number.

You can use groupings of prime factors to calculate square roots of perfect squares and cube roots of perfect cubes.

$$\begin{aligned}\sqrt{256} &= \sqrt{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2} \\ &= \sqrt{(2 \cdot 2 \cdot 2 \cdot 2) \cdot (2 \cdot 2 \cdot 2 \cdot 2)} \\ &= \sqrt{(2 \cdot 2 \cdot 2 \cdot 2)^2} \\ &= 2 \cdot 2 \cdot 2 \cdot 2 \\ &= 16\end{aligned}$$

$$\begin{aligned}\sqrt[3]{125} &= \sqrt[3]{5 \cdot 5 \cdot 5} \\ &= \sqrt[3]{5^3} \\ &= 5\end{aligned}$$

Check Your Understanding

1. Use mental math to calculate each root.

a) $\sqrt{36}$ **b)** $\sqrt{144}$ **c)** $\sqrt[3]{27}$ **d)** $\sqrt[3]{-64}$

2. Use mental math to calculate each root.

a) $\sqrt{3 \cdot 3 \cdot 3 \cdot 3}$ **b)** $\sqrt{2^{12}}$ **c)** $\sqrt[3]{5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5}$ d) $\sqrt[3]{9^6}$

3. **a)** A square has an area of 196 cm^2. Calculate its side length.
b) A cube has a volume of 216 cm^3. Calculate its edge length.

4. Use a calculator to calculate each square root.
Write the answer to 2 decimal places where necessary.

a) $\sqrt{289}$ **b)** $\sqrt{3.24}$ **c)** $\sqrt{1000}$ **d)** $\sqrt{\frac{3}{5}}$

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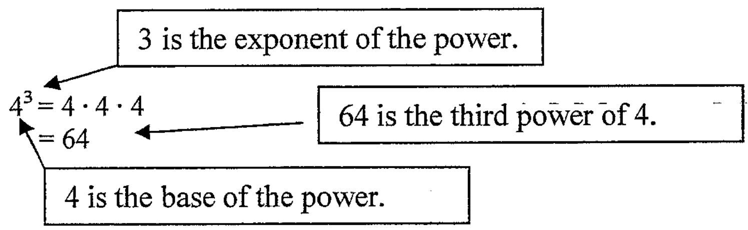
Master 4.1b Activate Prior Learning: Powers with Integer Bases

A **power** with a positive integer exponent represents repeated multiplication; for example, the power $2^5 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$.
A power has a **base** and an **exponent.**
The exponent represents the number of equal factors in a power.



You can use mental math to calculate powers such as 2^5 and a calculator to calculate powers such as $(-9)^5$.

Check Your Understanding

1. Write each expression as a power.

a) $3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3$
b) $(-7)(-7)(-7)(-7)(-7)(-7)(-7)(-7)$
c) $10 \cdot 10 \cdot 10 \cdot 10$
d) $(-5)(-5)(-5)$

2. Write each power as repeated multiplication.

a) 7^6 **b)** $(-17)^5$
c) 100^3 **d)** $(-99)^4$

3. Use mental math to calculate each power.

a) 3^3 **b)** 2^4
c) $(-5)^2$ **d)** $(-4)^3$

4. Use a calculator to calculate each power.

a) 13^5 **b)** 72^4
c) $(-24)^4$ **d)** $(-8)^9$

5. A shelf contains 8 boxes. Each box contains 8 cartons.
Each carton contains 8 pens. Write the number of pens as a power.
How many pens are on the shelf?

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Master 4.1c Activate Prior Learning: Exponent Laws

Product of powers law

$a^m \cdot a^n = a^{m+n}$

When the bases of the powers are the same, add the exponents.

$$\begin{aligned} 2^3 \cdot 2^4 &= 2^{3+4} \\ &= 2^7 \end{aligned}$$

Quotient of powers law

$\frac{a^m}{a^n} = a^{m-n}$

When the bases of the powers are the same, subtract the exponents.

$$\begin{aligned} \frac{3^9}{3^5} &= 3^{9-5} \\ &= 3^4 \end{aligned}$$

Power of a power law

$(a^m)^n = a^{mn}$

Multiply the exponents.

$$\begin{aligned} (4^2)^5 &= 4^{2 \cdot 5} \\ &= 4^{10} \end{aligned}$$

Check Your Understanding

1. Write as a single power.

   a) $3^2 \cdot 3^5$ **b)** $(-4)^7(-4)^6$ **c)** $(-5)^{10} \div (-5)^8$ **d)** $\frac{2^{12}}{2^7}$

2. Write as a single power.

   a) $(4^2)^5$ **b)** $\left[(-3)^4\right]^3$ **c)** $\left[(-5)^2\right]^4$ **d)** $\left[(-4)^3\right]^5$

3. Why can you not use the exponent laws to calculate $2^6 \cdot 3^4$?

4. How do you know that $(4^2)^3 = (4^3)^2$?