**Definitions**

1. \( a^n = a \cdot a \cdot a \cdot a \cdots a \) (n times)

2. \( a^0 = 1 \quad a \neq 0 \)

3. \( a^{-n} = \frac{1}{a^n} \quad a \neq 0 \)

4. \( a^{\frac{m}{n}} = \sqrt[n]{a^m} \)

**Examples**

3\(^4 = 3 \cdot 3 \cdot 3 \cdot 3 \)

142,697\(^0 = 1 \)

5\(^{-3} = \frac{1}{5^3} \)

7\(^3 = 3\sqrt{7^2} \)

**Combining**

1. Multiplication: \( a^x a^y = a^{x+y} \)

\[ 6^3 \cdot 6^4 = 6^{3+4} = 6^7 \]

2. Division: \( \frac{a^x}{a^y} = a^{x-y} \quad a \neq 0 \)

\[ \frac{5^9}{5^2} = 5^{9-2} = 5^7 \]

3. Powers: \( (a^x)^y = a^{xy} \)

\[ (3^4)^7 = 3^{4 \cdot 7} = 3^{28} \]

**Distributing**

1. \( (a \cdot b)^x = a^x \cdot b^x \)

\[ (2 \cdot 3)^7 = 2^7 \cdot 3^7 \]

2. \( \left( \frac{a}{b} \right)^x = \frac{a^x}{b^x} \)

\[ \left( \frac{2}{3} \right)^5 = \frac{2^5}{3^5} \]

**Careful!!**

\[ (a + b)^n \neq a^n + b^n \]
Practice

Simplify. Final answers should be expressed as positive exponents only.

1. \( \left( \frac{3a^5b^3}{a^3b^6} \right)^4 \)

2. \( \left( \frac{-z}{z^5} \right)^5 \)

3. \( \left( \frac{3r^{-4}s^{-1}}{r^{-3}s^{-3}} \right)^{-3} \)

4. \( \left( \frac{3a^5b^3}{a^3b^6} \right)^0 \)

5. \( \frac{(u^2v^{-3})^{-1}(u^{-1}v^2)^3}{(u^{-3}v)^2} \)

Solutions

1. \( \frac{81a^8}{b^{12}} \)

2. 1

3. \( \frac{1}{27r^{12}s^6} \)

4. 1

5. \( uv^7 \)