

**Definitions**

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

2.  $a^0 = 1$   $a \neq 0$

3.  $a^{-n} = \frac{1}{a^n}$   $a \neq 0$

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

**Examples**

$3^4 = 3 \cdot 3 \cdot 3 \cdot 3$

$142,697^0 = 1$

$5^{-3} = \frac{1}{5^3}$

$7^{\frac{2}{3}} = \sqrt[3]{7^2}$

**Combining**

1. Multiplication:  $a^x a^y = a^{x+y}$

$6^3 \cdot 6^4 = 6^{3+4} = 6^7$

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

$\frac{5^9}{5^2} = 5^{9-2} = 5^7$

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

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

**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.  $\frac{(-z)^5}{-z^5}$

3.  $\left(\frac{3r^{-4}s^{-1}}{r^{-8}s^{-3}}\right)^{-3}$

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.  $uv^7$