

## 6.1 PROPERTIES OF EXPONENTS

KEY CONCEPT		For Your Notebook
<b>Properties of Exponents</b>		
Let $a$ and $b$ be real numbers and let $m$ and $n$ be integers.		
Property Name	Definition	Example
Product of Powers	$a^m \cdot a^n = a^{m+n}$ <i>Keep base/add exp.</i>	$5^3 \cdot 5^{-1} = 5^{3+(-1)} = 5^2 = 25$
Power of a Power	$(a^m)^n = a^{mn}$ <i>mult. exp.</i>	$(3^3)^2 = 3^{3 \cdot 2} = 3^6 = 729$
Power of a Product	$(ab)^m = a^m b^m$	$(2 \cdot 3)^4 = 2^4 \cdot 3^4 = 1296$
Negative Exponent	$a^{-m} = \frac{1}{a^m}, a \neq 0$	$7^{-2} = \frac{1}{7^2} = \frac{1}{49}$
Zero Exponent	$a^0 = 1, a \neq 0$	$(-89)^0 = 1$
Quotient of Powers	$\frac{a^m}{a^n} = a^{m-n}, a \neq 0$ <i>Keep base/subtract exp.</i>	$\frac{6^{-3}}{6^{-6}} = 6^{-3 - (-6)} = 6^3 = 216$
Power of a Quotient	$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}, b \neq 0$	$\left(\frac{4}{7}\right)^2 = \frac{4^2}{7^2} = \frac{16}{49}$

## SIMPLIFY.

$$1. (a^2 b^2 c^3)(a^2 bc)$$

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

$$2. (6x^2 y^3)(4xyz)$$

$$6x^3 y^4 z$$

$$3. (2ab^2)(-4a^3 b^3 c)$$

$$-8a^4 b^5 c$$

SIMPLIFY.

$$4. (2^2)^4 = 2^{2 \cdot 4} = 2^8 = 256$$

$$5. (3xy^2)^2 = 3^2 x^2 (y^2)^2 = 9x^2 y^4$$

product

$$6. (-2r^2s)^3 = (-2)^3 (r^2)^3 s^3 = -8r^6 s^3$$

$$7. (-2xy^3)^4 = (-2)^4 x^4 (y^3)^4 = 16x^4 y^{12}$$

SIMPLIFY.

$$8. (2a^2b)(4ab^2)$$

$$(2^2)(a^2)^1 b^1 (4ab^2)$$

$$\underline{4} a^4 b^2 \cdot \underline{4} ab^2$$

$$16a^5 b^4$$

$$9. 3x^2(-2xy)^2$$

$$3x^2 \cdot (-2)^2 (x)^2 (y)^2$$

$$\underline{3} x^2 \cdot \underline{4} x^2 y^2$$

$$10. (-xy^2)(-2x^2y)(-4xy)$$

$$(-1)^3 (x)^3 (y^2)^3 (-2)^2 (x^2)^2 (y)^2 \cdot -4xy$$

$$\underline{-1} x^3 y^6 \cdot \underline{4} x^4 y^2 \cdot \underline{-4} xy$$

$$16x^8 y^9$$

SIMPLIFY.

$$\begin{array}{r}
 11. \quad \frac{-24x^2y^2}{6xy^4} \\
 \downarrow \\
 -4x^{2-1}y^{2-4} \\
 -4xy^{-2} \\
 \hline
 \frac{-4x}{y^2}
 \end{array}$$

$$\begin{array}{r}
 12. \quad \frac{5ab^3c^4}{15b^5c^3} \\
 \downarrow \\
 \frac{1}{3}a^1b^{3-5}c^{4-3} \\
 \frac{1}{3}ab^{-2}c \\
 \hline
 \frac{1ac}{3b^2}
 \end{array}$$

$$\begin{array}{r}
 13. \quad \frac{8x^3y^5}{36x^7y^2} \\
 \downarrow \\
 \frac{2}{9}x^{3-7}y^{5-2} \\
 \frac{2}{9}x^{-4}y^3 \\
 \hline
 \frac{2y^3}{9x^4}
 \end{array}$$

SIMPLIFY.

$$\begin{array}{r}
 14. \quad \left( \frac{xy^2}{4x^2} \right)^2 \\
 \frac{x^2(y^2)^2}{4^2(x^2)^2} \\
 \frac{x^2y^4}{16x^4} \\
 \frac{y^4}{16x^2}
 \end{array}$$

$$\begin{array}{r}
 15. \quad \left( \frac{a^2bc^3}{2^4} \right)^4 \\
 \frac{(a^2)^4(b)^4(c^3)^4}{2^{16}} \\
 \frac{16}{a^8b^4c^{12}}
 \end{array}$$

$$\begin{array}{r}
 16. \quad \left( \frac{-6y^5}{3y^2} \right)^2 \\
 \left( -2y^3 \right)^2 \\
 (-2)^2(y^3)^2 \\
 4y^6
 \end{array}$$

SIMPLIFY.

17.  $\frac{x^2 y^1}{x^0 y^4}$

$\frac{x^2 y^{-3}}{y^3}$

$\frac{x^2}{y^3}$

18.  $\frac{(a^2 b^3)^0}{4}$

$\frac{1}{4}$

19.  $\left(\frac{xy^3 z^5}{yz^3}\right)^0$

1

SIMPLIFY.

20.  $\frac{x^{-3}}{y^{-1} z^4}$

$\frac{y^1}{x^3 z^4}$

21.  $\frac{x^{-2} y^2}{3x^5 y^{-3}}$

$\frac{x^{-7} y^5}{3}$

$\frac{y^5}{3x^7}$

22.  $\left(\frac{2x}{5y^3}\right)^{-2}$

$\frac{5^2 (y^3)^2}{2^2 x^2}$

$\frac{25 y^6}{4x^2}$

## ALL PROPERTIES TOGETHER

$$24. \frac{(3x^{-2}y^3)(5xy^8)}{(x^{-3}y^{-2})}$$

$$\frac{15x^{-1}y^{-5}}{x^{-12}y^{-2}}$$

$$15x^{-1-(-12)}y^{-5-(-2)}$$

$$15x^{11}y^{-3}$$

$$\frac{15x^{11}}{y^3}$$

$$25. (a^{-3}b^2)^4(-2a^3b^7)^{-3}$$

$$a^{-12}b^8 \cdot (-2)^{-3}a^{-9}b^{-21}$$

$$a^{-12}b^8 \cdot -\frac{1}{8}a^{-9}b^{-21}$$

$$-\frac{1}{8}a^{-21}b^{-13}$$

$$-\frac{1}{8a^{21}b^{13}}$$

## ALL PROPERTIES TOGETHER

$$26. \left(\frac{p^{-3}}{4r}\right)^{-3} \left(\frac{5r}{p^{-7}}\right)^{-2}$$

$$\left(\frac{4r}{p^{-3}}\right)^3 \left(\frac{p^{-7}}{5r}\right)^2$$

$$\frac{64r^3}{p^{-9}} \cdot \frac{p^{-14}}{25r^2}$$

$$\frac{64p^{-14}r^3}{25p^{-9}r^2}$$

$$\frac{64}{25}p^{-14-(-9)}r^{3-2}$$

$$\frac{64}{25}p^{-5}r$$

$$\frac{64r}{25p^5}$$

$$27. \left[\frac{(2xy^{-2})^{-2}}{(xy^{-4})^{-1}}\right]^{-2}$$