

Important Rules to Remember !!

Exponent Laws

Product of powers:	$a^m \cdot a^n = a^{m+n}$
Quotient of powers:	$a^m \div a^n = a^{m-n}, a \neq 0$
Power of a power:	$(a^m)^n = a^{mn}$
Power of a product:	$(ab)^m = a^m b^m$
Power of a quotient:	$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}, b \neq 0$

Warm Up Questions

Simplify by writing as a single power.

$$1. \frac{(b^9 \cdot b^{-7} \cdot b^3)^2 \times (b^4 \cdot b^{-3})^2}{b^{-14}}$$

$$2. \frac{(a^3)^2 \cdot (a^{1/2})^3}{(a^{3/2})^4}$$

$$3. \frac{(-3/5)^{-3/4} \cdot (-3/5)^{1/2}}{(-3/5)^{5/4}}$$

$$\frac{(b^9 \cdot b^{-7} \cdot b^3)^2 \times (b^4 \cdot b^{-3})^2}{b^{-14}}$$

$$= \frac{(b^{9+(-7)+3})^2 \times (b^{4+(-3)})^2}{b^{-14}}$$

$$= \frac{(b^5)^2 \times (b^1)^2}{b^{-14}} \quad \checkmark$$

$$= \frac{b^{5 \cdot 2} \times b^{1 \cdot 2}}{b^{-14}}$$

$$= \frac{b^{10} \times b^2}{b^{-14}} \quad \checkmark$$

$$= \frac{b^{10+2}}{b^{-14}}$$

$$= \frac{b^{12}}{b^{-14}} \quad \checkmark$$

$$= b^{12 - (-14)}$$

$$= \textcircled{b^{26}} \quad \checkmark$$

$$\frac{(a^3)^2 \cdot (a^{1/2})^3}{(a^{3/2})^4}$$

Multiply straight across

$$= \frac{a^{3 \cdot 2} \cdot a^{\frac{1}{2} \cdot 3}}{a^{\frac{3}{2} \cdot 4}}$$

$$\rightarrow \frac{1}{2} \times \frac{3}{1} = \frac{3}{2}$$

$$\rightarrow \frac{3}{2} \times \frac{4}{1} = \frac{12}{2} = 6$$

$$= \frac{\cancel{a^6} \cdot a^{\frac{3}{2}}}{\cancel{a^6}}$$

Add/Subtract fractions get a common denominator

$$= \frac{a^{6 + \frac{3}{2}}}{a^6}$$

$$\frac{6}{1} + \frac{3}{2}$$

$$\frac{12}{2} + \frac{3}{2} = \frac{15}{2}$$

$$= \frac{a^{\frac{15}{2}}}{a^6}$$

$$= a^{\frac{15}{2} - \frac{6}{1}}$$

$$\frac{15}{2} - \frac{6}{1}$$

$$\frac{15}{2} - \frac{12}{2} = \frac{3}{2}$$

$$= a^{\frac{3}{2}}$$

$$\frac{(-3/5)^{-3/4} \cdot (-3/5)^{1/2}}{(-3/5)^{5/4}}$$

$$= \frac{\left(\frac{-3}{5}\right)^{-\frac{3}{4} + \frac{1}{2}}}{\left(\frac{-3}{5}\right)^{5/4}}$$

$$\rightarrow -\frac{3}{4} + \frac{1}{2} = \frac{-6}{8} + \frac{4}{8} = \frac{-2}{8} = -\frac{1}{4}$$

$$= \frac{\left(\frac{-3}{5}\right)^{-\frac{1}{4}}}{\left(\frac{-3}{5}\right)^{5/4}}$$

$$= \left(\frac{-3}{5}\right)^{-\frac{1}{4} - \frac{5}{4}}$$

$$= \left(\frac{-3}{5}\right)^{-\frac{6}{4}}$$

$$= \left(\frac{-3}{5}\right)^{-\frac{3}{2}}$$

$$= \left(\frac{5}{-3}\right)^{\frac{3}{2}}$$

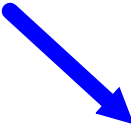
$$= \left(\frac{-5}{3}\right)^{\frac{3}{2}}$$

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$$\begin{aligned} & \frac{(b^9 \cdot b^{-7} \cdot b^3)^2 \times (b^4 \cdot b^{-3})^2}{b^{-14}} \\ &= \frac{(b^5)^2 \times (b^1)^2}{b^{-14}} \\ &= \frac{b^{10} \times b^2}{b^{-14}} \\ &= \frac{b^{12}}{b^{-14}} \\ &= b^{26} \end{aligned}$$


$$\frac{(a^3)^2 \cdot (a^{1/2})^3}{(a^{3/2})^4}$$
$$= \frac{a^6 \cdot a^{3/2}}{a^{12/2}} \rightarrow \begin{array}{l} 6/1 + 3/2 \\ 12/2 + 3/2 \\ = 15/2 \end{array}$$
$$= \frac{a^{15/2}}{a^{12/2}} \rightarrow \begin{array}{l} 15/2 - 12/2 \\ = 3/2 \end{array}$$
$$= a^{3/2}$$

$$\frac{(-3/5)^{-3/4} \cdot (-3/5)^{1/2}}{(-3/5)^{5/4}}$$



-3/4	+	1/2
-3/4	+	2/4
		-1/4

$$= \frac{(-3/5)^{-1/4}}{(-3/5)^{5/4}}$$



-1/4	-	5/4
		-6/4
		Reduce !!
		-3/2

$$= (-3/5)^{-3/2}$$
$$= (-5/3)^{3/2}$$

What happens when there's more than one base?

$$\begin{aligned} 1. \quad & a^4 \times a^{-4} \times b^3 \times a^2 \times b^{-4} \\ & = \underline{a^4} \times \underline{a^{-4}} \times \underline{b^3} \times \underline{a^2} \times \underline{b^{-4}} \\ & = a^2 \times b^{-1} \\ & = a^2 \times \left(\frac{1}{b}\right)^1 \\ & = \frac{a^2}{b} \end{aligned}$$

$$2. \quad (a^3b^2)^3$$
$$= a^9b^6$$

$$\begin{aligned} 3. \quad & \frac{(a^5b^3)^2}{a^3b^{-2}} \\ &= \frac{a^{10}b^6}{a^3b^{-2}} \\ &= a^{10-3} b^{6-(-2)} \\ &= a^7b^8 \end{aligned}$$

$$\frac{(a^5b^3)^2}{a^3b^{-2}}$$

$$= \frac{a^{5 \cdot 2} b^{3 \cdot 2}}{a^3 b^{-2}}$$

$$= \frac{a^{10} b^6}{a^3 b^{-2}}$$

$$= \frac{a^{10-3} b^{6-(-2)}}{1}$$

$$= (a^7 b^8)$$

$$\begin{aligned} 4. \quad & \frac{10c^8d^{-2}}{2c^4d^5} = 5c^4d^{-7} = \frac{5c^4}{d^7} \\ & = 5c^4d^{-7} \\ & = \frac{5c^4}{d^7} \end{aligned}$$

$$\begin{aligned} 5. \quad & \frac{(4d^3c^{-3})(3d^6c^7)}{(2d^3c)^2} \\ & = \frac{12d^9c^4}{4d^6c^2} \\ & = 3d^3c^2 \end{aligned}$$

$$\begin{aligned} 6. & \left(\frac{(-10a^2b)^2}{10a^5b^{11}} \right)^{-1} \\ &= \left(\frac{100a^4b^2}{10a^5b^{11}} \right)^{-1} \\ &= \left(10a^{-1}b^{-9} \right)^{-1} \\ &= 10^{-1}ab^9 \\ &= \frac{ab^9}{10} \end{aligned}$$

Homework

$$\textcircled{1} \quad \frac{a^4 b^3 \times 12 a b^{-3}}{(2 a^{-2} b^3)^2}$$

$$= \frac{12 a^{4+1} b^{3+(-3)}}{2^2 a^{-2 \cdot 2} b^{3 \cdot 2}}$$

$$= \frac{12 a^5 b^0}{2^2 a^{-4} b^6}$$

$$= \frac{12 a^5 b^0}{4 a^{-4} b^6}$$

$$= 3 a^{5-(-4)} b^{0-6}$$

$$= 3 a^9 b^{-6}$$

$$= \frac{3 a^9}{b^6}$$

$$\textcircled{2} \quad \left(\frac{4 m^5 n^{-2} \times 2 m^{-3}}{2 m^2} \right)^2$$

$$= \left(\frac{8 m^{5+(-3)} n^{-2}}{2 m^2} \right)^2$$

$$= \left(\frac{8 m^2 n^{-2}}{2 m^2} \right)^2$$

$$= \left(4 m^{2-2} n^{-2} \right)^2$$

$$= \left(4 m^0 n^{-2} \right)^2 \quad \rightarrow m^0 = 1$$

$$= \left(\frac{4}{n^2} \right)^2$$

$$= \frac{4^2}{(n^2)^2}$$

$$= \frac{16}{n^4}$$

$$\textcircled{3} \left[\frac{x^3 y^4 \cdot x^{-7}}{x^5 (y^{-2})^3} \right]^3$$

$$= \left(\frac{x^{-4} y^4}{x^5 y^{-6}} \right)^3$$

$$= \left(x^{-9} y^{10} \right)^3$$

$$= x^{-27} y^{30}$$

$$= \left(\frac{y^{30}}{x^{27}} \right)$$

$$\textcircled{4} \frac{5m^2 n^{-3}}{1} \times \frac{9m^3 n^2}{3m^{-2}}$$

$$= \frac{45m^5 n^{-1}}{3m^{-2}}$$

$$= 15m^7 n^{-1}$$

$$= \left(\frac{15m^7}{n^{-1}} \right)$$

$$\begin{aligned} \textcircled{5} & (a^5 b^{-2})^3 \times 3b^4 \\ &= a^{15} b^{-6} \times 3b^4 \\ &= 3a^{15} b^{-2} \\ &= \frac{3a^{15}}{b^2} \end{aligned}$$

$$\begin{aligned} \textcircled{6} & \frac{8a^2 b^0}{a^{-3} b^5} \\ &= 8a^5 b^{-5} \\ &= \frac{8a^5}{b^5} \end{aligned}$$

$$\textcircled{7} \quad \frac{(10ab^{-3})^2 \times (2a^{-1}b^2)^2}{10^2 a^4 b^{-2}}$$

$$= \frac{100a^2 b^{-6} \times 4a^{-2} b^4}{100a^4 b^{-2}}$$

$$= \frac{400a^0 b^{-2}}{100a^4 b^{-2}}$$

$$= 4a^{-4} b^0 \quad b^0 = 1$$

$$= \frac{4}{a^4}$$

$$\textcircled{8} \quad \frac{(x^4 y^4)^6}{(x^{-3})^2 y^5}$$

$$= \frac{x^8 y^8}{x^{-6} y^5}$$

$$= \frac{x^{14} y^3}{1}$$

$$\textcircled{9} \left(\frac{10a^2b^{-3}}{2a^{-3}b^2} \right)^2$$

$$= (5a^5b^{-5})^2$$

$$= 25a^{10}b^{-10}$$

$$= \frac{25a^{10}}{b^{10}}$$

$$\textcircled{10} \frac{4^2 u^{-1} v^4}{(2u^3v)^3}$$

$$= \frac{16 u^{-1} v^4}{8u^9 v^3}$$

$$= 2u^{-10} v^1$$

$$= \frac{2v}{u^{10}}$$

$$\textcircled{11} \quad \frac{4b^{-5} \times 2a^7}{2^2 b^{-3} a^5}$$

$$= \frac{8a^7 b^{-5}}{4a^5 b^{-3}}$$

$$= 2a^2 b^{-2}$$

$$= \frac{2a^2}{b^2}$$

$$\textcircled{12} \quad \left(\frac{3x^0 y^3}{x^0 y^3} \right)^3$$

$$= (3x^0 y^3)^3$$

$$= 27x^0 y^9$$

$$= 27y^9$$

$$\begin{aligned}
 (13) \quad & x^{\frac{1}{2}} y^3 a x^{\frac{2}{3}} y^{\frac{1}{3}} \\
 = & x^{\frac{1}{2} + \frac{2}{3}} y^{\frac{3}{1} + \frac{1}{3}} \\
 = & x^{\frac{3}{6} + \frac{4}{6}} y^{\frac{3}{3} + \frac{1}{3}} \\
 = & x^{\frac{7}{6}} y^{\frac{10}{3}}
 \end{aligned}$$

$$\begin{aligned}
 (14) \quad & \frac{a^{\frac{1}{4}} b^2}{a^{\frac{1}{3}} b^{\frac{1}{2}}} \\
 = & a^{\frac{1}{4} - \frac{1}{3}} b^{2 - \frac{1}{2}} \\
 = & a^{\frac{3}{12} - \frac{4}{12}} b^{4/2 - 1/2} \\
 = & a^{-\frac{1}{12}} b^{3/2} \\
 = & \frac{b^{3/2}}{a^{1/12}}
 \end{aligned}$$

$$\frac{3}{6} = \frac{1}{2}$$

$$\frac{12}{15} = \frac{4}{5}$$