## Power Rule for Exponents

**Power Rule for Exponents** Assume that $b$ is a real number and that $m$ and $n$ represent positive integers. Then, $\left(b^m\right)^n = b^{mn}$

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For exercises 1 – 3, simplify and write answers in exponent form.

1. $\left(3^4\right)^5$

Note $(3\cdot3\cdot3\cdot3)(3\cdot3\cdot3\cdot3) = (3^4)^2 = 3^8$

$(3^4)^2$

$(3^4)^5 = \boxed{3^{20}}$

2. $\left(x^6\right)^8 = \boxed{x^{48}}$

3. $\left(d\cdot d^4\right)^3$

$= (d^5)^3$

$= \boxed{d^{15}}$

4. Evaluate the two expressions and compare the answers.

$\left(3^2\right)^4$ and $\left(3^4\right)^2$

$(3^2)^4 = \boxed{3^8}$

same as $(3^4)^2 = 8$

$(3\cdot3)(3\cdot3)(3\cdot3)(3\cdot3) = 3^8$

$(3\cdot3\cdot3\cdot3)(3\cdot3\cdot3\cdot3) = \boxed{3^8}$

$= 3^8$

Note: This is equal to $81\cdot81 = 6561$

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## The Properties $(ab)^m = a^m b^m$ and $\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$

**Power of a Product and Power of a Quotient** Assume that $a$ and $b$ are real numbers. Let $m$ represent a positive integer. Then,

$(ab)^m = a^m b^m$ $\qquad \left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}, \quad b \neq 0$

Ex: $(xy)^3 = (xy)(xy)(xy)$

$= (xxx)(yyy)$

$= x^3y^3$

simplify.

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

$= \frac{2\cdot2\cdot2}{5\cdot5\cdot5}$

$= \frac{2^3}{5^3}$

$= \boxed{\frac{8}{125}}$

For exercises 5 – 7, use the appropriate property to clear the parentheses.

5. $(-2a)^4$

$= (-2)^4 a^4$

$= \boxed{16a^4}$

6. $(3xy)^3$

$= 3^3 x^3 y^3$

$= \boxed{27x^3y^3}$

7. $\left(-\frac{c}{d}\right)^5$

see note on next page

Recall: * a negative number raised to an even power results in a positive number

* a negative number raised to an odd power results in a negative number.

Ex: $(-3)^4 = 81$

$(-3)^5 = -243$

$\neq$

$= -3^4 = -81$

$-3^5 = -243$

81
3
243

$$(ab)^m = a^m b^m$$

For exercises 8 – 14, simplify the expressions.

8. $6\left(c^3 d\right)^4$

$= 6(c^3)^4 (d)^4$

$= \boxed{6c^{12}d^4}$

Ex: $(-3x^4y^2)^2(-2x^5yz)^3$

$= (-3)^2 x^8 y^4 (-2)^3 x^{15} y^3 z^3$

$= 9x^8 y^4 (-8) x^{15} y^3 z^3$

$= \boxed{-72x^{23} y^7 z^3}$

9. $(-f)^6$

$= (-1f)^6$

$= (-1)^6 f^6$

$= 1 \cdot f^6 = \boxed{f^6}$

10. $\left(\frac{3}{s^3 t}\right)^2$

$= \left(\frac{3^2}{s^6 t^2}\right) = \boxed{\frac{9}{s^6 t^2}}$

11. $\frac{m^3\left(m^4\right)^3}{m^5}$

$= \frac{m^3 m^{12}}{m^5}$

$= \frac{m^{15}}{m^5} = m^{15-5}$

$= \boxed{m^{10}}$

12. $\left(r^3\right)^5\left(r^2\right)^6$

$r^{15} r^{12}$

$= \boxed{r^{27}}$

13. $\frac{\left(3ab^3\right)^4\left(a^5 b\right)^5}{\left(3a^3 b^3\right)^2}$

$= \frac{3^4 a^4 b^{12} a^{25} b^5}{3^2 a^6 b^6}$

$= \frac{81 a^{29} b^{17}}{9 a^6 b^6}$

$= \boxed{9a^{23} b^{11}}$

14. $\left(\frac{-5x^4}{y^5 z^2}\right)^3$

$= \frac{(-5)^3 x^{12}}{y^{15} z^6}$

$= \boxed{\frac{-125x^{12}}{y^{15} z^6}} = \boxed{-\frac{125x^{12}}{y^{15} z^6}}$

15. Simplify the expression using the properties of exponents. Assume that $a$, $b$, and $m$ represent positive integers.

$\left(\frac{a^2}{b^5}\right)^m$ $= \frac{a^{2m}}{b^{5m}}$