# Properties of Exponents

| | |
|---|---|
| $a^0 = 1$<br>($0^0$ is undefined) | Any number or variable (except zero) raised to the zero power equals 1.<br>$7^0 = 1 \quad y^0 = 1 \quad (-5)^0 = 1 \quad -2(x-3)^0 = -2$ |
| $a^1 = a$ | Any number or variable raised to the 1st power equals itself<br>$7^1 = 7 \quad y^1 = y \quad (-5)^1 = -5 \quad -2(x-3)^1 = -2(x-3)$ |
| $a^m a^n = a^{(m+n)}$ | To MULTIPLY the SAME base, keep the base and ADD the exponents<br>$x^2x^5 = (x \cdot x)(x \cdot x \cdot x \cdot x \cdot x) = x^{2+5} = x^7$<br>$4^3 \cdot 4^5 = (4 \cdot 4 \cdot 4)(4 \cdot 4 \cdot 4 \cdot 4 \cdot 4) = 4^{3+5} = 4^8$<br>$(x+6)^4(x+6)^{11} = (x+6)^{4+11} = (x+6)^{15}$ |
| $(a^m)^n = a^{(mn)}$ | To Raise a POWER to a POWER, keep the base and MULTIPLY the exponents<br>$(x^2)^5 = (x \cdot x)(x \cdot x)(x \cdot x)(x \cdot x)(x \cdot x) = x^{2 \cdot 5} = x^{10}$<br>$(3^4)^2 = (3 = 3^{2 \cdot 4} = 3^8$<br>$((x+6)^4)^{11} = (x+6)^{4 \cdot 11} = (x+6)^{44}$ |
| $\frac{a^m}{a^n} = a^{(m-n)}$ | To DIVIDE the SAME base, keep the base and SUBTRACT the exponents<br>$\frac{x^5}{x^2} = x^{5-2} = x^3 \quad OR \quad \frac{x^5}{x^2} = \frac{x \cdot \cancel{x \cdot x} \cdot x \cdot x}{\cancel{x \cdot x}} = \frac{x \cdot x \cdot x}{1} = x^3$<br>$\frac{5^3}{5^6} = 5^{3-6} = 5^{-3} = \frac{1}{5^3} = \frac{1}{125} \quad OR \quad \frac{5^3}{5^6} = \frac{\cancel{5 \cdot 5 \cdot 5}}{\cancel{5 \cdot 5 \cdot 5} \cdot 5 \cdot 5 \cdot 5} = \frac{1}{5 \cdot 5 \cdot 5} = \frac{1}{125}$ |
| $a^{-m} = \frac{1}{a^m}$ | A NEGATIVE exponent moves the number or variable that it touches across the fraction bar and makes the exponent positive.<br>$3^{-2} = \frac{3^{-2}}{1} = \frac{1}{3^2} = \frac{1}{9} \qquad \frac{4^{-3}x^7}{n^6x^{-2}} = \frac{x^7x^2}{4^3n^6} = \frac{x^{(7+2)}}{4^3n^6} = \frac{x^9}{64n^6}$ |
| $(ab)^n = a^n b^n$ | An exponent outside of a term is applied to every factor in that term<br>$(5xy^3)^2 = 5^2x^2y^{3 \cdot 2} = 25x^2y^6$<br>This does **NOT** apply if you are adding or subtracting inside the parenthesis<br>*Watch out*!!!! $(x+5)^3 \neq x^3 + 5^3$ !!!!! (They are **NOT** equal)<br>$(x+5)^3 = (x+5)(x+5)(x+5) = x^3 + 15x^2 + 75x + 125$ |
| $(\frac{a}{b})^n = \frac{a^n}{b^n}$ | An exponent outside of a fraction is applied to both the numerator and denominator of the fraction (both top and bottom)<br>$(\frac{9}{k})^2 = \frac{9^2}{k^2} = \frac{81}{k^2}$ |
| $a^{\frac{n}{m}} = \sqrt[m]{a^n}$ | The denominator of the rational exponent becomes the index of a radical.<br>$27^{\frac{2}{3}} = (\sqrt[3]{27})^2 = 3^2 = 9$ |