**POWERS & EXPONENTS**

exponent of 3

$$5^{3}$$

**Power** – numbers using an exponent and base

**Base** – the common factor in a power

base of 5

**Exponent** – the number of times the base is used as a factor

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| **POWER** | **STANDARD****FORM** |
| $$10^{3}$$ | 1,000 |
| $$10^{2}$$ | 100 |
| $$10^{1}$$ | 10 |
| $$10^{0}$$ | 1 |
| $$10^{-1}$$ | 0.1 |
| $$10^{-2}$$ | 0.01 |
| $$10^{-3}$$ | 0.001 |

Any number raised to the zero power is 1.

Any number raised to the 1st power is itself.

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| **POWER** | **WORDS** | **STANDARD****FORM** |
| $$2^{0}$$ | 2 to the zero power | 1 |
| $$2^{1}$$ | 2 to the first power | 2 |
| $$2^{2}$$ | 2 to the second power or 2 squared | 4 |
| $$2^{n}$$ | 2 to the nth power or 2 to the nth |  |

**Product of Powers**

Rule: To multiply powers with the same base, add their exponents.

Example: $3^{2}∙3^{4}=\left(3∙3\right)∙\left(3∙3∙3∙3\right)= 3^{6}$

NOTE: The sum of the original exponents is the exponent in the final product.

$$3^{2+4}= 3^{6}$$

**Quotient of Powers**

Rule: To divide powers with the same base, subtract their exponents.

Example: $\frac{5^{7}}{5^{4}}= \frac{5∙5∙5∙5∙5∙5∙5}{5∙5∙5∙5}= 5^{3}$

NOTE: The difference of the original exponents is the exponent in the final quotient.

$$5^{7-4}= 5^{3}$$

**Power of a Power**

Rule: To find the power of a power, multiply the exponents.

Example: $(6^{4})^{5}$ (read as, “six to the fourth to the fifth power”) = $\left(6∙6 ∙6 ∙6\right)∙(6∙6 ∙6 ∙6)∙(6∙6 ∙6 ∙6)∙(6∙6 ∙6 ∙6)∙(6∙6 ∙6 ∙6)= 6^{20}$

NOTE: The product of the original exponents, 4 and 5, is the final power of 20.

$$6^{4 × 5}= 6^{20}$$

*Simplify using the Laws of Exponents.*

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| 1.) $3 ∙ 3^{3}$ = | 2.) $-2a\left(3a^{4}\right)= $ |
| 3.) $-3x^{2}y∙4x^{5}= $ | 4.) $-2m\left(-8m^{5}\right)= $ |
| 5.) $5x^{3}∙6x^{12}$ =  | 6.) $-11n^{9}∙5n^{-3}$ =  |
| 7.) $\frac{6^{5}}{6^{3}}$ = | 8.) $\frac{x^{5}y^{6}}{xy^{2}}$ =  |
| 9.) $\frac{x^{10}}{x^{3}}$ = | 10.) $\frac{12w^{5}}{2w}= $ |
| 11.) $\frac{5^{6}∙ 7^{4}∙ 8^{3}}{5^{4} ∙ 7^{2} ∙ 8^{2}}= $ | 12.) $\frac{(-2)^{5}∙ 3^{4}∙ 5^{7}}{(-2)^{2} ∙ 3 ∙ 5^{3}}=$ |
| 13.)$ (2^{5})^{2}$ =  | 14.) $(w^{4})^{6}$ =  |
| 15.) $(4p^{3})^{2} $= | 16.) $(2x^{5}y^{11})^{3}$ =  |
| 17.) $(5x^{7})^{2}$ | 18.) $(3np^{4})^{3}$ |