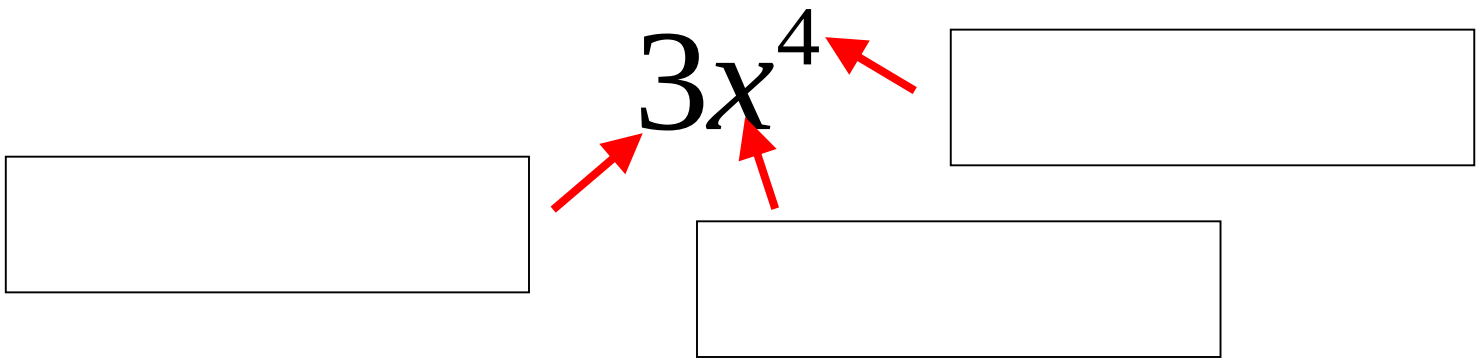
# SM3-A HANDOUT 7-1 (Properties of Exponents)

What is a power?

Power: An expression formed by repeated multiplication of the base.




The exponent applies to the number or variable immediately to its left, not to the coefficient !!!

No Exponent? $3x$

Usually, we don't write the exponent '1' (saves ink).

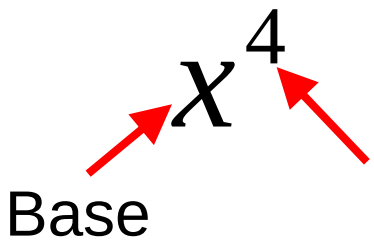
No Coefficient? $x^3$

Usually, we don't write the coefficient '1' (saves ink).

Negative? $-x^2$

Usually, we don't write the coefficient '-1', we just put the "negative symbol" (saves ink).

Factor: a number that is being multiplied.




means

$x^4 =$

Power: is repeated multiplication

multiplication: is repeated addition

$3x =$

(adding two terms)

$3x + 4x$

$2x^2 + 3x^2$

(multiplying two terms)

$x^2 * x^3$

# Exponents

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

Remember how to multiply fractions?

$$\left(\frac{2}{3x}\right)^3 = ? = \left(\frac{2}{3x}\right)\left(\frac{2}{3x}\right)\left(\frac{2}{3x}\right) = \frac{8}{27x^3}$$

$(4y)^2 = ?$

$\left(\frac{-2}{x}\right)^4 = ?$

$2(5x)^2 = ?$

$\left(\frac{x}{2}\right)^3 = ?$

## Multiply Powers Property

$$(x^2)(x^3) = (x*x)(x*x*x)$$

This is ‘x’ used as a factor how many times?

$$(x^2)(x^3) = x^2x^3 = x^{2+3} = x^5$$

‘x’ used as a factor five times

When you multiply powers having the same base, you add the exponents.

Exponent of a Power Property $(x^2)^3$

$$(x^2)^3 = (x*x)(x*x)(x*x)$$

This is ‘x’ used as a factor how many times?

$$(x^2)^3 = \quad = x^6$$

‘x’ used as a factor six times

$$(x^2)^3 = x^{2*3} = x^6$$

**you multiply the exponents.**

# Exponent of a Product Property

$$(xy)^2 = (xy)(xy) = x*y*x*y = x*x*y*y$$
$$= x^2y^2$$

$$(xy)^m = x^m y^m$$

This makes it seem like you can "distribute" in the exponent. This only works with the power of a product!! (It *does not* apply to the power of a sum.

$$(x-y)^2 \neq x^2 - y^2$$

$$(x-y)^2 = (x-y)(x-y) = x^2 - 2xy + y^2$$

Combination of
1. Power of a Product
2. Power of a Power

$$(3x^3y^4)^2 = (3^1x^3y^4)^2$$
$$= 3^2x^6y^8$$

Constants (integer, etc.) usually have an exponent of '1'.

'x' is a number, we just don't know what it is. You treat all numbers the same (whether they are variables or constants).

$$3x^2(4x^3) = ? \quad = 3*4*(x^2)(x^3) = 12x^5$$

You can re-arrange the order of multiplication.

Coefficients of the powers are handled separately from the base and the exponent.

$(x^2)^5 = ?$

$(5x^2)(2x^3) = ?$

$(2x)\left(\frac{1}{2}x^3\right) = ?$

$5(x)^3 x^4 = ?$

$(2y^5)^3 = ?$

What is the difference between?

$(x)^4 \; and \; \mathrm{x}^4$

$(x^2)^3 \text{ and } (x^3)^2$

$x^4 x^3 \text{ and } x^3 x^4$

$(x+1)^2 \text{ and } (x+1)(x+1)$

Watch the negatives!

$$(-x^3y^4)^2$$

$$= ((-1)^1 x^3 y^4)^2$$ Turn negative signs into multiplication by -1.

$$= (-1)^2 x^6 y^8$$

This way you will be able to tell if the simplified version is positive or negative.

$$= x^6 y^8$$

$$(-2x^2y^6)^3$$ Negative coefficients have an exponent of '1'.

$$= ((-2)^1 x^2 y^6)^3$$

$$= (-2)^3 x^6 y^{18}$$

A negative number raised to an odd exponent remains negative.

$$= -8x^6 y^{18}$$

simplify

$(-2x^2y^4z)^3$

$2(-m^4x^3)^5$

$-3(-2x^2yz^3)^4$