# Powers of negative bases

There are two cases to think of when we're simplifying powers of negative bases.

## Case 1: Actually not a negative base at all

If we have something that looks like $-b^a$, where $a$ and $b$ are both positive real numbers, it's really the same as $-1 \cdot b^a$. Notice how the $-1$ can be pulled out in front, leaving just $b^a$. Because $b$ is positive, this base actually isn't negative at all. This is just a case of raising a positive number to a power, and then changing the sign of the result by multiplying by $-1$. So when we see something like $-4^2$, it means the same thing as

$$-1(4^2)$$

$$-1(4 \cdot 4)$$

$$-1(16)$$

$$-16$$

This is because PEMDAS and the order of operations tells us that we need to take care of the exponent first, and then multiply by the negative sign.

## Case 2: A negative sign included in the parenthesis

If we have something that looks like $(-b)^a$, where $a$ and $b$ are both positive real numbers, then raise the $-b$ inside the parentheses to the power of $a$. In other words, this is the multiplication in which the negative integer $-b$ appears as a factor $a$ times (and there are no other factors).

This is the case most people think of when they perform operations with exponents. It means, for example, that $(-4)^2$ equals $(-4)(-4)$ or $16$.

Be careful not to confuse an expression like $(-b)^a$ with an expression like $-b^a$ (which was our Case 1 example). The $-b^a$ case means that we first raise the positive integer $b$ to the power of $a$, and then change the sign of the result (by placing a negative sign in front of it).

If $a$ is even, then $(-b)^a = b^a$, and if $a$ is odd, then $(-b)^a = -b^a$.

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**Example**

Simplify the expression.

$$-2^3$$

By PEMDAS and the order of operations, we have to take care of the exponent first, and then apply the negative sign. Remember that applying a negative sign is the same as multiplying by $-1$.

$$-2^3$$

$$-(2 \cdot 2 \cdot 2)$$

$$-(8)$$

$$-8$$

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Let's take a look at an example with a negative number inside parentheses.

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**Example**

Simplify the expression.

$$(-1)^4$$

Remember that $-1^4$ is different than $(-1)^4$. When we have $(-1)^4$, the negative sign is included in the parentheses. This means we need to raise the $-1$ inside the parentheses to the power of $4$, so it's the same thing as having four factors of $-1$.

$$(-1)^4$$

$$(-1)(-1)(-1)(-1)$$

Doing the multiplication form left to right (according to the order of operations), we get

$$(1)(-1)(-1)$$

$$(-1)(-1)$$

$$1$$

Or, since $4$ is even, then $(-1)^4 = 1^4 = 1$.