# Examples
# Exponents
# Advanced Order of Operations

Based on power point presentations by Pearson Education, Inc.
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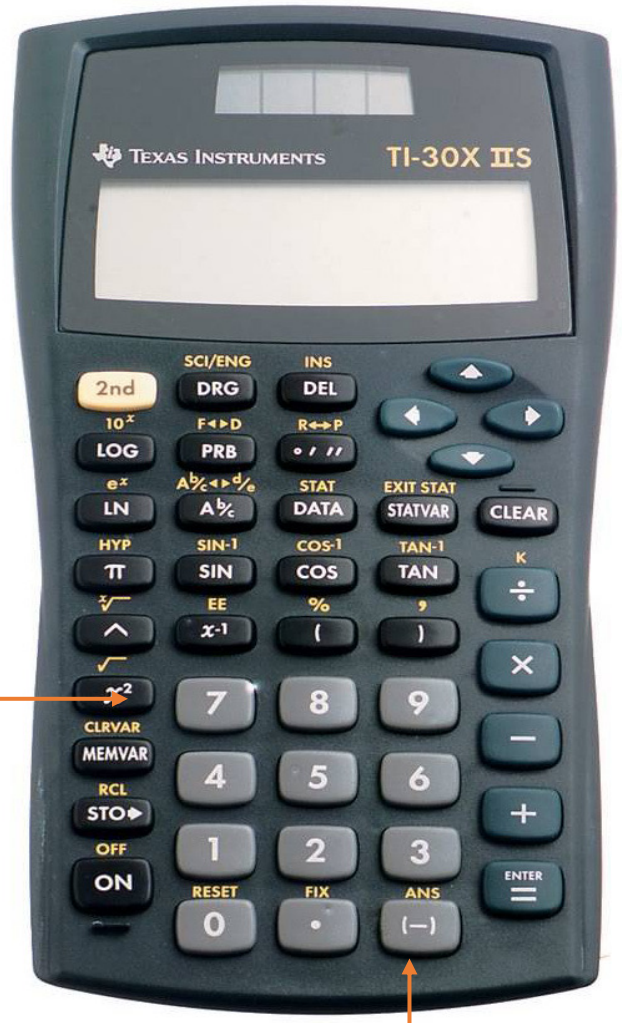
# Learning Objectives

1. Define and evaluate exponential expressions.
2. Use exponent rules.
3. Use the advanced Order of Operations given grouping symbols, exponents, multiplication, division, addition, and subtraction.

# Example 1: Evaluate Exponential Expressions




Evaluate $(-3)^2$ by hand and using a calculator.

$(-3)^2 = (-3)(-3) = 9$

Calculator:

Press the left parenthesis button (.
Press the negative sign button (–). Do not use the subtraction button!
Type **3**.
Press the right parenthesis button ).
Press the caret **^** button on the calculator.
Type **2** and press the ENTER button.

The answer is **9**.

# Example 2: Evaluate Exponential Expressions

Evaluate $3^2$ by hand and using a calculator.

The exponent 2 tell us to use the base 3 twice in a multiplication.

$3^2 = 3(3) = 9$

Calculator:

Actually, we can find second powers on the calculator in two different ways. In Example 1, we learned to use the **$x^2$** button to evaluate second powers as follows:

| 3 | $x^2$ | Enter |
|---|---|---|

However, we can also press the caret **^** button on the calculator followed by the index as follows:

| 3 | ^ | 2 | Enter |
|---|---|---|---|

# Example 3: Evaluate Exponential Expressions

Evaluate $4^3$ by hand and using the calculator.

The exponent 3 tell us to use the base 4 three times in a multiplication.

$4^3 = 4(4)(4) = 64$

Calculator:

Here we have no choice but to use the caret **^** button on the calculator as follows:

| | | | |
|---|---|---|---|
| *4* | ^ | *3* | *Enter* |

# Example 4: Evaluate Exponential Expressions

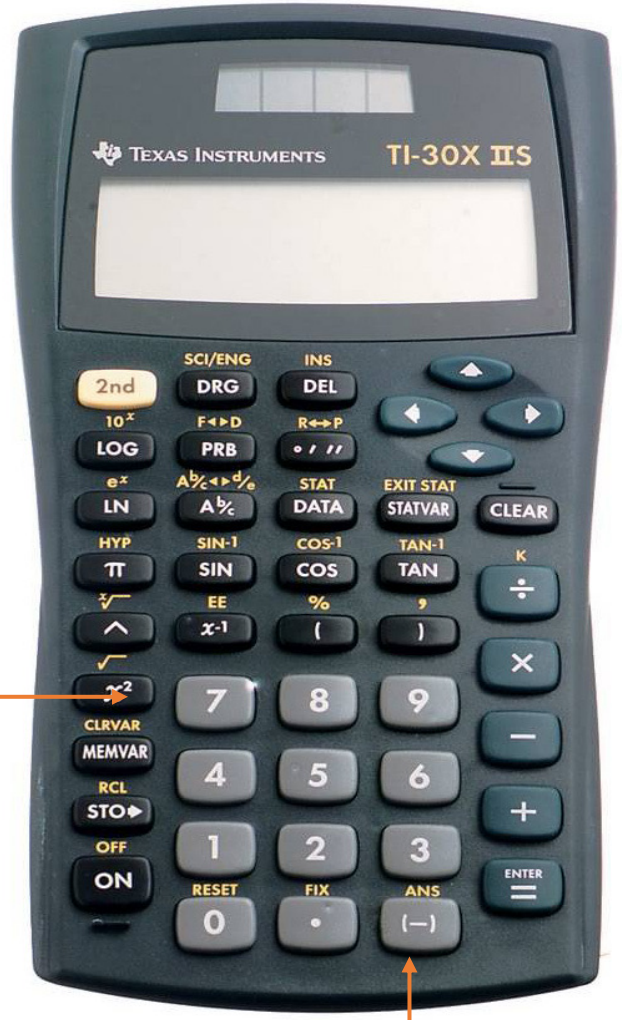
Evaluate $100^1$.

The exponent 1 tell us to use the base 100 one time in a multiplication.

$100^1 = 100$

NOTE: The value of any number with an exponent of *1* is the number itself. Customarily, the ***1*** is not written!

# Example 5: Evaluate Exponential Expressions




Evaluate $(-3)^2$.

$(-3)^2 = (-3)(-3) = 9$

On the calculator, press the left parenthesis button (.
Press the negative sign button (–). Do not use the subtraction button!
Type **3**.
Press the right parenthesis button ).
Press the caret **^** button on the calculator.
Type **2** and press the ENTER button.

The answer is **9**.

# Example 6: Evaluate Exponential Expressions

Use the *Negative Exponent Rule* to simplify the following exponential expressions without a calculator:

a. $8^{-2} = \frac{1}{8^2} = \frac{1}{8 \cdot 8} = \frac{1}{64}$

b. $5^{-3} = \frac{1}{5^3} = \frac{1}{5 \cdot 5 \cdot 5} = \frac{1}{125}$

c. $7^{-1} = \frac{1}{7^1} = \frac{1}{7}$

# Example 7: Evaluate Exponential Expressions

Use the *Power Rule for Fractions* to simplify the following exponential expressions without a calculator:

a. $\left(\frac{2}{5}\right)^3 = \frac{2^3}{5^3} = \frac{2\cdot 2\cdot 2}{5\cdot 5\cdot 5} = \frac{8}{125}$

b. $\left(\frac{3}{7}\right)^2 \cdot \left(\frac{1}{3}\right)^2 = \frac{3^2}{7^2} \cdot \frac{1^2}{3^2}$

$= \frac{3\cdot 3}{7\cdot 7} \cdot \frac{1\cdot 1}{3\cdot 3} = \frac{\cancel{9}}{49} \cdot \frac{1}{\cancel{9}}$

$= \frac{1}{49}$

# Example 8: Use the Advanced Order of Operations

Evaluate $7^2 – 20 \div 2^2 \cdot (2 + 3)^3$.

Given $7^2 – 20 \div 2^2 \cdot (2 + 3)^3$, we evaluate the parentheses first.

then $7^2 – 20 \div 2^2 \cdot 5^3$. Next, we evaluate both exponents:

$49 – 20 \div 4 \cdot 125$. Next, we evaluate division:

$49 – 5 \cdot 125$. Next, we evaluate multiplication:

$49 – 625$. Next, we evaluate subtraction:

$– 576$

# Example 9: Use the Advanced Order of Operations

Evaluate $6^2 – 24 \div 2^2 \cdot 3 + 1$.

Given $6^2 – 24 \div 2^2 \cdot 3 + 1$, we evaluate both exponent first.

then $36 – 24 \div 4 \cdot 3 + 1$. Next, we evaluate division:

$36 – 6 \cdot 3 + 1$. Next, we evaluate multiplication:

$36 – 18 + 1$. Next, we evaluate subtraction:

$18 + 1$. Next, we evaluate addition:

$19$

# Example 10: Use the Advanced Order of Operations

Evaluate $(-7)^0$ and $-7^0$.

We know that $(-7)^0$ equals 1.

In $-7^0$ only 7 is raised to the 0 power. Therefore, you must use the *Order of Operations* rule that states that exponents are evaluated before multiplication.

Now, $-7^0$ actually equals $-1(7^0)$. Given that $7^0$ equals 1, we find that $-7^0$ must equal $-1(1)$ or $-1$.

# Example 11: Use the Advanced Order of Operations

Evaluate $(-6)^2$ and $-6^2$.

We know that $(-6)^2$ equals $(-6) \cdot (-6)$ which equals 36.

In $-6^2$ only 6 is raised to the 2nd power. Therefore, you must use the *Order of Operations* rule that states that exponents are evaluated before multiplication.

Now, $-6^2$ actually equals $-1(6^2)$. Given that $6^2$ equals 36, we find that $-6^2$ must equal $-1(36)$ or $-36$.

# Example 12: Use the Advanced Order of Operations

Evaluate $(-4)^3$ and $-4^3$.

$(-4)^3 = (-4) \cdot (-4) \cdot (-4) = -64$

In $-4^3$ only 4 is raised to the 3rd power. Therefore, you must use the *Order of Operations* rule that states that exponents are evaluated before multiplication.

Now, $-4^3$ actually equals $-1(4^3)$. Given that $4^3$ equals 64, we find that $-4^3$ must equal $-1(64)$ or $-64$.