



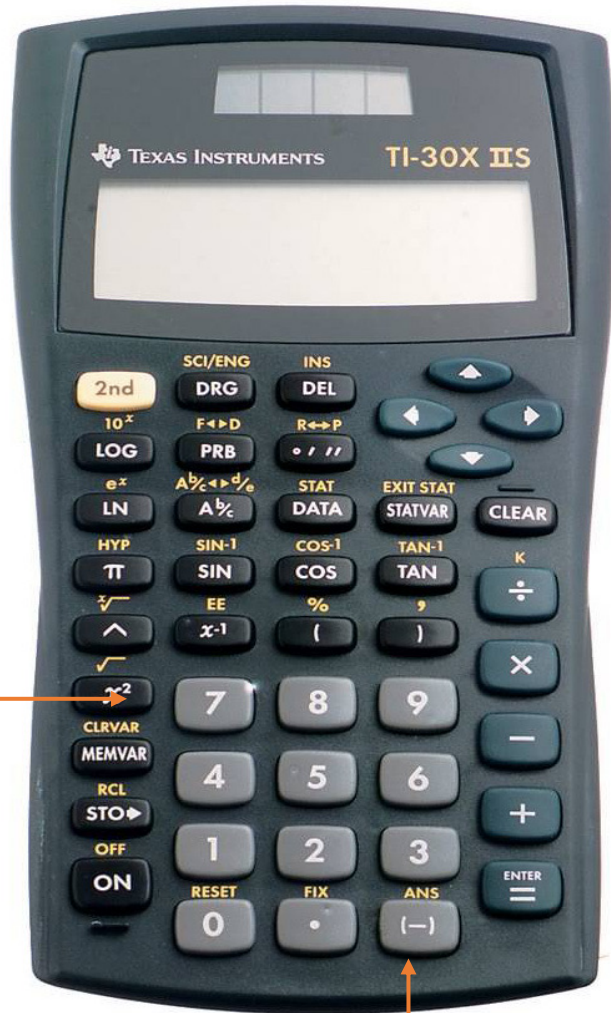
Examples Exponential Expressions Advanced Order of Operations

Based on power point presentations by Pearson Education, Inc.
Revised by Ingrid Stewart, Ph.D.

Learning Objectives

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

Example 1: Evaluate Exponential Expressions



power

negative sign – don't confuse
with subtraction sign!

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 \wedge 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	<i>Enter</i>
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However, we can also press the caret \wedge button on the calculator followed by the index as follows:

3	\wedge	2	<i>Enter</i>
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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
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Example 4: Evaluate Exponential Expressions

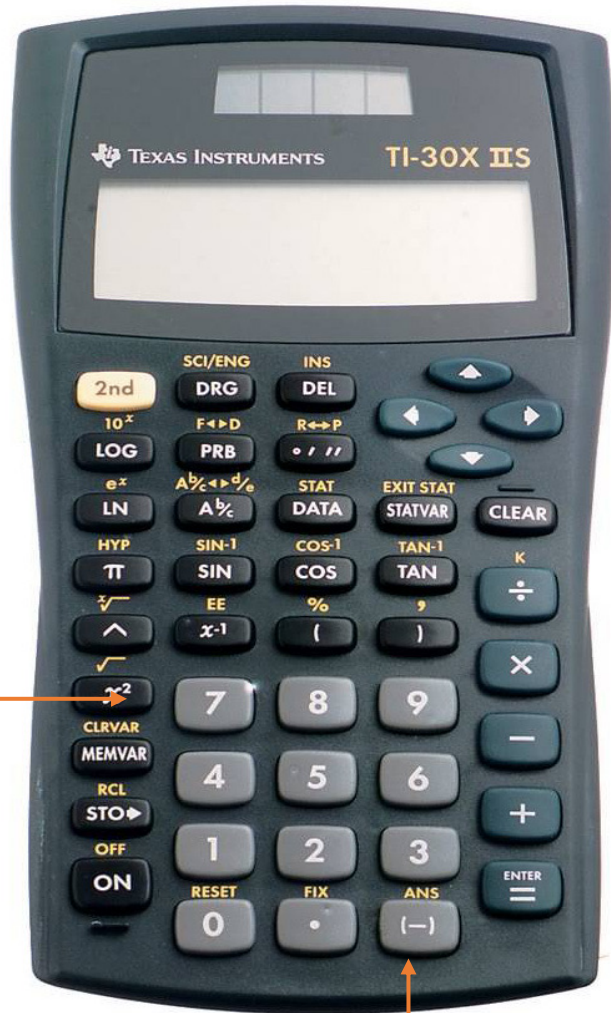
Evaluate 100^1 .

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



power

negative sign – don't confuse
with subtraction sign!

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 \wedge 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:

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

$$\begin{aligned} \text{b. } \left(\frac{3}{7}\right)^2 \cdot \left(\frac{1}{3}\right)^2 &= \frac{3^2}{7^2} \cdot \frac{1^2}{3^2} \\ &= \frac{3 \cdot 3}{7 \cdot 7} \cdot \frac{1 \cdot 1}{3 \cdot 3} = \frac{\cancel{9}}{49} \cdot \frac{1}{\cancel{9}} \\ &= \frac{1}{49} \end{aligned}$$

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:

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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 .