

## Investigation 3: The Second and Third Laws of Exponents

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CALCULATORS: Casio: *fx-260 Solar* • Casio: *fx-260 Solar School*

### Student Worksheet Investigation 3

You should complete the investigation of the first law of exponents before completing this activity. You are now going to use the calculator to explore what are known as the second and third laws of exponents.

#### Second Law of Exponents

Complete the table below using your calculator set to display numbers in scientific mode with one significant digit ( **MODE 8 1** ).

$(10^5) \div (10^4) =$			$(10^{10}) \div (10^3) =$	
$(10^7) \div (10^3) =$			$(10^{12}) \div (10^2) =$	
$(10^9) \div (10^6) =$			$(10^{15}) \div (10^{10}) =$	

For each example, look at the two exponents that were given and the exponent in your entry. You should see a pattern.

WITHOUT USING YOUR CALCULATOR, write what you think the answer for the following problem would be:  $(10^{11}) \div (10^8) =$  \_\_\_\_\_

Describe the pattern in your own words.

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Using your description, complete the following example by writing an exponent that is an expression containing  $a$  and  $b$ :  $(10^a) \div (10^b) = 10^?$

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Do you think that the pattern you discovered holds only for powers of ten or for other numbers as well?

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Before proceeding, set your calculator to the mode for normal calculation: **MODE 9**.

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<b>Student Worksheet Investigation 3 (continued)</b>
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Write your prediction using an exponent for each expression in the table below.

Value of Expression	Expression	Prediction	Value of Prediction
	$(2^8) \div (2^3)$		
	$(5^9) \div (5^7)$		
	$(2.4^6) \div (2.4^2)$		
	$(-3^{10}) \div (-3^7)$		

Find the value of each expression; write the answers in the column at the left.

Find the value of your predictions; write the answers in the column at the right.

Compare the entries in the column at the left and the column at the right. The values for each expression and its prediction should be the same. If any are not, first check your predictions with those of another classmate. If your predictions are correct, next check your values for the expressions and the predictions.

Finally, complete the following general rule:  $(x^a) \div (x^b) = x^?$ .

This is known as the second law of exponents.

### Third Law of Exponents

Complete the table below using your calculator set to display numbers in scientific mode with one significant digit ( **MODE 8 1** ).

$(10^4)^2 =$			$(10^8)^4 =$	
$(10^7)^3 =$			$(10^{12})^2 =$	
$(10^9)^2 =$			$(10^{15})^3 =$	

For each example, look at the two exponents that were given and the exponent in your entry. You should see a pattern. **WITHOUT USING YOUR CALCULATOR**, write what you think the answer for the following problem would be:  $(10^6)^5 =$  \_\_\_\_\_

Describe the pattern in your own words.

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### Student Worksheet Investigation 3 (continued)

Using your description, complete the following example by writing an exponent that is an expression containing  $a$  and  $b$ :  $(10^a)^b = 10^?$ .

\_\_\_\_\_

Do you think that the pattern you discovered holds only for powers of ten or for other numbers as well?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Before proceeding, set your calculator to the mode for normal calculation: **MODE 9**.

Write your prediction using an exponent for each expression in the table below.

Value of Expression	Expression	Prediction	Value of Prediction
	$(2^8)^3$		
	$(4^4)^4$		
	$(1.4^4)^2$		
	$(-3^5)^4$		

Find the value of each expression; write the answers in the column at the left.

Find the value of your predictions; write the answers in the column at the right.

Compare the entries in the column at the left and the column at the right. The values for each expression and its prediction should be the same. If any are not, first check your predictions with those of another classmate. If your predictions are correct, next check your values for the expressions and the predictions.

Finally, complete the following general rule:  $(x^a)^b = x^?$ .

This is known as the third law of exponents.