2.2 Skill Builder

Patterns and Relationships in Tables

Look at the patterns in this table.

Input	Output
1 ×2	2
2 ×2	4
3 ×2	6
4 ×2	8
5 ×2	10

+1 (input side) ... +2 (output side)

The input starts at 1 and increases by 1 each time.

The output starts at 2 and increases by 2 each time.

The input and output are also related.
Double the input to get the output.

Check

1. a) Describe the patterns in the table.

   b) What is the input in the last row?
      What is the output in the last row?

Input	Output
1	5
2	10
3	15
4	20
____	____

+1 ... +5

a) The input starts at _____, and increases by _____ each time.
The output starts at _____, and increases by _____ each time.
You can also multiply the input by _____ to get the output.

b) The input in the last row is 4 + _____ = _____.
The output in the last row is 20 + _____ = _____.

2. a) Describe the patterns in the table.

b) Extend the table 3 more rows.

Input	Output
10	100
9	90
8	80
7	70
6	60

a) The input starts at 10, and decreases by _____ each time.

The output starts at 100, and decreases by _____ each time.

You can also multiply the input by _____ to get the output.

b) To extend the table 3 more rows, continue to decrease the input by _____ each time.

Decrease the output by _____ each time.

Input	Output
5	____
____	____
____	____

Writing Numbers in Expanded Form

8000 is 8 thousands, or 8 × 1000

600 is 6 hundreds, or 6 × 100

Read it aloud.

50 is 5 tens, or 5 × 10

Check

1. Write each number in expanded form.

a) 7000 _____

b) 900 _____

c) 400 _____

d) 30 _____

▶ 2.2 Powers of Ten and the Zero Exponent

This table shows decreasing powers of 3.

Power	Repeated Multiplication	Standard Form	
3^5	$3 \times 3 \times 3 \times 3 \times 3$	243	÷3
3^4	$3 \times 3 \times 3 \times 3$	81	÷3
3^3	$3 \times 3 \times 3$	27	÷3
3^2	3×3	9	÷3
3^1	3	3	

Look for patterns in the columns.

The exponent decreases by 1 each time.   Divide by 3 each time.

The patterns suggest $3^0 = 1$ because $3 \div 3 = 1$.

We can make a similar table for the powers of any integer base except 0.

> **The Zero Exponent**
> A power with exponent 0 is equal to 1.

The base of the power can be any integer except 0.

Example 1 | Powers with Exponent Zero

Evaluate each expression.

  a) 6^0 **b)** $(-5)^0$

Solution

A power with exponent 0 is equal to 1.

  a) $6^0 = 1$ **b)** $(-5)^0 = 1$

The zero exponent applies to the number in the brackets.

Check

1. Evaluate each expression.

  a) $8^0 =$ _____   **b)** $-4^0 =$ _____

  c) $4^0 =$ _____   **d)** $(-10)^0 =$ _____

If there are no brackets, the zero exponent applies only to the base.

Example 2 | Powers of Ten

Write as a power of 10.

a) 10 000   b) 1000   c) 100   d) 10   e) 1

Solution

a) $10\ 000 = 10 \times 10 \times 10 \times 10$
$= 10^4$

b) $1000 = 10 \times 10 \times 10$
$= 10^3$

c) $100 = 10 \times 10$
$= 10^2$

Notice that the exponent is equal to the number of zeros.

d) $10 = 10^1$

e) $1 = 10^0$

Check

1. a) $5^1 =$ _____

b) $(-7)^1 =$ _____

c) $10^1 =$ _____

d) $10^0 =$ _____

Practice

1. a) Complete the table below.

Power	Repeated Multiplication	Standard Form
5^4	$5 \times 5 \times 5 \times 5$	625
5^3	$5 \times 5 \times 5$	_____
5^2	_____	_____
5^1	_____	_____

b) What is the value of 5^1?   _____

c) Use the table. What is the value of 5^0?   _____

2. Evaluate each power.

a) $2^0 =$ _____

b) $9^0 =$ _____

c) $(-2)^0 =$ _____

d) $-2^0 =$ _____

e) $10^1 =$ _____

f) $(-8)^1 =$ _____

> If there are no brackets, the exponent applies only to the base.

3. Write each number as a power of 10.

a) $10\ 000 = 10$—

b) $1\ 000\ 000 = 10$—

c) Ten million = _____

d) One = _____

e) $1\ 000\ 000\ 000 =$ _____

f) $10 =$ _____

4. Evaluate each power of 10.

a) $-10^6 =$ _____

b) $-10^0 =$ _____

c) $-10^8 =$ _____

d) $-10^1 =$ _____

5. One trillion is written as 1 000 000 000 000.
Write each number as a power of 10.

a) One trillion = $1\ 000\ 000\ 000\ 000 =$ _____

b) Ten trillion = $10 \times$ _____ = _____

c) One hundred trillion = _____ = _____

6. Write each number in standard form.

a) $5 \times 10^4 = 5 \times 10\ 000$

= _____

b) $(4 \times 10^2) + (3 \times 10^1) + (7 \times 10^0) = (4 \times 100) +$ _____

= _____

= _____

c) $(2 \times 10^3) + (6 \times 10^2) + (4 \times 10^1) + (9 \times 10^0)$

= _____

= _____

= _____

d) $(7 \times 10^3) + (8 \times 10^0) =$ _____

= _____

= _____