

# Negative Exponents and Negative Bases

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Score: \_\_\_\_\_ / 18

## Quick Review and Helpful Hints

A negative *exponent* means take the reciprocal:  $x^{-n} = \frac{1}{x^n}$ . A negative *base* needs care: an *even* exponent gives a positive result, an *odd* exponent gives a negative result. Watch the parentheses:  $(-2)^4$  has base  $-2$ , but  $-2^4$  means  $-(2^4)$ .

▶ **Example:** Evaluate  $(-2)^{-3}$ . **Work:** First handle the negative exponent:  $(-2)^{-3} = \frac{1}{(-2)^3}$ . Now  $(-2)^3 = -8$  (odd power of a negative base is negative). So the value is  $\frac{1}{-8} = -\frac{1}{8}$ . ★ **Answer:**  $-\frac{1}{8}$

### Practice Problems

Evaluate each expression. Watch the parentheses carefully.

- |                |       |                  |       |
|----------------|-------|------------------|-------|
| 1. $(-3)^2$    | _____ | 8. $(-4)^2$      | _____ |
| 2. $(-3)^3$    | _____ | 9. $-3^2$        | _____ |
| 3. $-2^4$      | _____ | 10. $(-10)^{-2}$ | _____ |
| 4. $(-2)^4$    | _____ | 11. $(-1)^{10}$  | _____ |
| 5. $(-5)^{-2}$ | _____ | 12. $(-2)^5$     | _____ |
| 6. $(-2)^{-3}$ | _____ | 13. $(-6)^{-1}$  | _____ |
| 7. $(-1)^7$    | _____ | 14. $(-3)^{-2}$  | _____ |

### Word Problems

15. A temperature change is modeled by  $(-2)^3$  degrees. What is its value? \_\_\_\_\_
16. In a repeating pattern, a term equals  $(-1)^{20}$ . What is its value? \_\_\_\_\_
17. A value in a formula is  $(-5)^{-2}$ . Write it as a fraction. \_\_\_\_\_
18. A spreadsheet compares two formulas,  $-4^2$  and  $(-4)^2$ , for a sign-error check. Find both values and explain why they differ. \_\_\_\_\_



## Answer Keys

1.  $\boxed{9}$

2.  $\boxed{-27}$

3.  $\boxed{-16}$

4.  $\boxed{16}$

5.  $\boxed{\frac{1}{25}}$

6.  $\boxed{-\frac{1}{8}}$

7.  $\boxed{-1}$

8.  $\boxed{16}$

9.  $\boxed{-9}$

10.  $\boxed{\frac{1}{100}}$

11.  $\boxed{1}$

12.  $\boxed{-32}$

13.  $\boxed{-\frac{1}{6}}$

14.  $\boxed{\frac{1}{9}}$

15.  $\boxed{-8}$

16.  $\boxed{1}$

17.  $\boxed{\frac{1}{25}}$

18.  $\boxed{-16 \text{ and } 16}$

### Step-by-Step Explanations

1. Start by naming the process: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is An even power makes a negative base positive:  $(-3)^2 = (-3)(-3) = 9$ . So the final answer is 9.

2. A good way to think about this is: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is An odd power keeps the result negative:  $(-3)^3 = -27$ . So the final answer is  $-27$ .

3. Step by step: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is No parentheses, so the power touches only the 2:  $-2^4 = -(16) = -16$ . So the final answer is  $-16$ .

4. Take it one move at a time: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is The parentheses include the sign, and an even power is positive:  $(-2)^4 = 16$ . Notice how this differs from  $-2^4$ ! So the final answer is 16.

5. Start by naming the process: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is Flip for the negative exponent, then square (even power stays positive):  $(-5)^{-2} = \frac{1}{(-5)^2} = \frac{1}{25}$ . So the final answer is  $\frac{1}{25}$ .

6. A good way to think about this is: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is Flip, then cube (odd power stays negative):  $(-2)^{-3} = \frac{1}{(-2)^3} = \frac{1}{-8} = -\frac{1}{8}$ . So the final answer is  $-\frac{1}{8}$ .

7. Step by step: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is An odd power of  $-1$  stays  $-1$ . So the final answer is  $-1$ .

8. Take it one move at a time: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is An even power of a negative base is positive, so  $(-4)^2 = 16$ . So the final answer is 16.

9. Start by naming the process: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is Without parentheses this means  $-(3^2) = -9$  - the sign is not squared. So the final answer is  $-9$ .

10. A good way to think about this is: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is Flip and square:  $(-10)^{-2} = \frac{1}{(-10)^2} = \frac{1}{100}$ . So the final answer is  $\frac{1}{100}$ .

11. Step by step: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is An even power of  $-1$  is 1. So the final answer is 1.

12. Take it one move at a time: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is An odd power of a negative base is negative:  $(-2)^5 = -32$ . So the final answer is  $-32$ .

13. Start by naming the process: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is The reciprocal of  $-6$  is  $-\frac{1}{6}$ , so  $(-6)^{-1} = -\frac{1}{6}$ . So the final answer is  $-\frac{1}{6}$ .

14. A good way to think about this is: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is Flip and square (even power, positive):  $(-3)^{-2} = \frac{1}{(-3)^2} = \frac{1}{9}$ . So the final answer is  $\frac{1}{9}$ .

15. Step by step: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is An odd power of a negative base is negative, so  $(-2)^3 = -8$  degrees. So the final answer is  $-8$ .

16. Take it one move at a time: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is An even power of  $-1$  is 1, so this pattern term equals 1. So the final answer is 1.

17. Start by naming the process: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is Flip, then square:  $(-5)^{-2} = \frac{1}{(-5)^2} = \frac{1}{25}$ . So the final answer is  $\frac{1}{25}$ .

18. A good way to think about this is: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is Without parentheses,  $-4^2 = -(16) = -16$ ; with them,  $(-4)^2 = 16$ . The parentheses decide whether the sign is squared. So the final answer is  $-16$  and 16.



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