

# Zero and Negative Exponents

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Score: \_\_\_\_\_ / 18

## Quick Review and Helpful Hints

Any *nonzero* base raised to the 0 power equals 1:  $x^0 = 1$ . A *negative* exponent means take the reciprocal:  $x^{-n} = \frac{1}{x^n}$ , and  $\frac{1}{x^{-n}} = x^n$ . To finish a problem, rewrite everything with positive exponents and then simplify.

▷ **Example:** Rewrite  $2^{-3}$  with a positive exponent and evaluate it. **Work:** A negative exponent means take the reciprocal:  $2^{-3} = \frac{1}{2^3}$ . Then  $2^3 = 8$ , so the value is  $\frac{1}{8}$ . ★ **Answer:**  $\frac{1}{8}$

## ◆ Practice Problems

Evaluate or rewrite each expression with positive exponents.

1. Evaluate  $7^0$

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2. Evaluate  $3^{-2}$

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3. Evaluate  $5^{-1}$

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4. Evaluate  $(-4)^0$

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5. Evaluate  $2^{-4}$

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6. Rewrite  $x^{-5}$  with a positive exponent

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7. Evaluate  $10^{-3}$

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8. Simplify  $\frac{1}{x^{-2}}$

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9. Evaluate  $4^0 + 3^0$

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10. Evaluate  $6^{-2}$

\_\_\_\_\_

11. Rewrite  $3x^{-2}$  with positive exponents

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12. Evaluate  $2^{-3}$

\_\_\_\_\_

13. Evaluate  $\left(\frac{1}{2}\right)^{-2}$

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14. Evaluate  $9^{-1}$

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## ◆ Word Problems

15. A scientist writes a measurement as  $10^{-2}$  meters. Express this as a fraction.

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16. A calculator displays  $5^0$  as a result. What number is this?

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17. The thickness of a sheet is  $2^{-4}$  inch. Write this thickness as a fraction.

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18. A science formula has the denominator  $4^{-1}$  in the expression  $\frac{1}{4^{-1}}$ . What is the simplified value?

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## Answer Keys

1.  $\boxed{1}$

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

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

4.  $\boxed{1}$

5.  $\boxed{\frac{1}{16}}$

6.  $\boxed{\frac{1}{x^5}}$

7.  $\boxed{\frac{1}{1000}}$

8.  $\boxed{x^2}$

9.  $\boxed{2}$

10.  $\boxed{\frac{1}{36}}$

11.  $\boxed{\frac{3}{x^2}}$

12.  $\boxed{\frac{1}{8}}$

13.  $\boxed{4}$

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

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

16.  $\boxed{1}$

17.  $\boxed{\frac{1}{16}}$

18.  $\boxed{4}$

### 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 Any nonzero number raised to the zero power equals 1 – a handy rule to memorize, so  $7^0 = 1$ . So the final answer is 1.

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 A negative exponent means take the reciprocal:  $3^{-2} = \frac{1}{3^2} = \frac{1}{9}$ .

So the final answer is  $\frac{1}{9}$ .

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  $5^{-1}$  is simply the reciprocal of 5, namely  $\frac{1}{5}$ . So the final answer is  $\frac{1}{5}$ .

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 zero power gives 1 even with a negative base, so  $(-4)^0 = 1$ . So the final answer is 1.

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 and raise:  $2^{-4} = \frac{1}{2^4} = \frac{1}{16}$ . So the final answer is  $\frac{1}{16}$ .

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 Move the factor to the denominator to make the exponent positive:  $x^{-5} = \frac{1}{x^5}$ . So the final answer is  $\frac{1}{x^5}$ .

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  $10^{-3} = \frac{1}{10^3} = \frac{1}{1000}$  – powers of ten make this quick. So the final answer is  $\frac{1}{1000}$ .

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 A negative exponent in the denominator jumps up top:  $\frac{1}{x^{-2}} = x^2$ . So the final answer is  $x^2$ .

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 Each term is 1 because of the zero power, so  $1 + 1 = 2$ . So the final answer is 2.

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:  $6^{-2} = \frac{1}{6^2} = \frac{1}{36}$ . So the final answer is  $\frac{1}{36}$ .

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 Only the  $x$  has the negative exponent, so it moves down while the 3 stays:  $3x^{-2} = \frac{3}{x^2}$ .

So the final answer is  $\frac{3}{x^2}$ .

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  $2^{-3} = \frac{1}{2^3} = \frac{1}{8}$ . So the final answer is  $\frac{1}{8}$ .

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 A negative exponent flips the fraction first:  $(\frac{1}{2})^{-2} = (\frac{2}{1})^2 = 4$ . So the final answer is 4.

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  $9^{-1}$  is the reciprocal of 9, namely  $\frac{1}{9}$ . 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  $10^{-2} = \frac{1}{10^2} = \frac{1}{100}$  meter. So the final answer is  $\frac{1}{100}$ .

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 Any nonzero base to the zero power is 1, so the display reads 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  $2^{-4} = \frac{1}{2^4} = \frac{1}{16}$  inch. So the final answer is  $\frac{1}{16}$ .

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 The negative exponent in the denominator moves up top:  $\frac{1}{4^{-1}} = 4$ . So the final answer is 4.



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