

# Division Property of Exponents

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

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

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## Quick Review and Helpful Hints

When you divide powers with the *same base*, keep the base and *subtract* the exponents:  $\frac{x^a}{x^b} = x^{a-b}$  (for  $x \neq 0$ ). When a quotient is raised to a power, the power applies to top and bottom:  $\left(\frac{x}{y}\right)^a = \frac{x^a}{y^a}$ . Divide the number coefficients separately from the variables.

▶ **Example:** Simplify  $\frac{x^7}{x^3}$ . **Work:** The base  $x$  is the same on top and bottom, so keep the base and subtract the exponents:  $7 - 3 = 4$ . ★ **Answer:**  $x^4$

## ◆ Practice Problems

Simplify each quotient. Assume no variable equals zero.

1.  $\frac{x^6}{x^2}$  \_\_\_\_\_

8.  $\left(\frac{x}{y}\right)^3$  \_\_\_\_\_

2.  $\frac{y^9}{y^5}$  \_\_\_\_\_

9.  $\frac{15a^6}{5a^4}$  \_\_\_\_\_

3.  $\frac{2^8}{2^3}$  \_\_\_\_\_

10.  $\frac{b^{12}}{b^7}$  \_\_\_\_\_

4.  $\frac{a^{10}}{a}$  \_\_\_\_\_

11.  $\frac{20m^9}{4m^9}$  \_\_\_\_\_

5.  $\frac{m^5}{m^5}$  \_\_\_\_\_

12.  $\frac{p^5q^8}{p^2q^3}$  \_\_\_\_\_

6.  $\frac{12x^7}{4x^2}$  \_\_\_\_\_

13.  $\frac{x^{10}}{x^4}$  \_\_\_\_\_

7.  $\frac{x^8y^4}{x^3y}$  \_\_\_\_\_

14.  $\frac{6^9}{6^6}$  \_\_\_\_\_

## ◆ Word Problems

15. A rectangle has area  $x^9$  square units and width  $x^4$  units. Its length is area divided by width. Write the length as a power of  $x$ . \_\_\_\_\_

16. A jar holds  $10^8$  tiny grains, split equally among  $10^2$  bags. How many grains per bag? Write the answer as a power of 10. \_\_\_\_\_

17. The volume of a box is  $24y^7$  and its base area is  $6y^3$ . The height is volume divided by base area. Find the height. \_\_\_\_\_

18. A design file scales both the width and height by the same factor  $a^6$ . The ratio includes  $\frac{a^6}{a^6}$ . Simplify the ratio factor. \_\_\_\_\_



## Answer Keys

1.  $x^4$

2.  $y^4$

3.  $2^5$

4.  $a^9$

5.  $1$

6.  $3x^5$

7.  $x^5y^3$

8.  $\frac{x^3}{y^3}$

9.  $3a^2$

10.  $b^5$

11.  $5$

12.  $p^3q^5$

13.  $x^6$

14.  $6^3$

15.  $x^5$

16.  $10^6$

17.  $4y^4$

18.  $1$

### 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 Dividing powers of the same base cancels matching factors, so you subtract the exponents:  $6 - 2 = 4$ , giving  $x^4$ . So the final answer is  $x^4$ .

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 Subtract the exponents:  $9 - 5 = 4$ , so  $y^4$ . So the final answer is  $y^4$ .

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 Keep the base 2 and subtract:  $8 - 3 = 5$ , so  $2^5$  (which is 32). So the final answer is  $2^5$ .

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 lone  $a$  is  $a^1$ , so  $10 - 1 = 9$ , giving  $a^9$ . So the final answer is  $a^9$ .

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 Equal exponents subtract to 0, and  $m^0 = 1$  - any quantity divided by itself is 1. So the final answer is 1.

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 Handle numbers and variables separately:  $12 \div 4 = 3$  and  $x^{7-2} = x^5$ , giving  $3x^5$ . So the final answer is  $3x^5$ .

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 Subtract exponents base by base:  $x^{8-3} = x^5$  and  $y^{4-1} = y^3$ , so  $x^5y^3$ . So the final answer is  $x^5y^3$ .

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 power on a quotient reaches top and bottom:  $\frac{x^3}{y^3}$ . So the final answer is  $\frac{x^3}{y^3}$ .

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 Divide the coefficients ( $15 \div 5 = 3$ ) and subtract exponents ( $6 - 4 = 2$ ):  $3a^2$ . So the final answer is  $3a^2$ .

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 Subtract the exponents:  $12 - 7 = 5$ , so  $b^5$ . So the final answer is  $b^5$ .

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 The variables cancel completely ( $m^{9-9} = m^0 = 1$ ), leaving just  $20 \div 4 = 5$ . So the final answer is 5.

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 Subtract within each base:  $p^{5-2} = p^3$  and  $q^{8-3} = q^5$ , giving  $p^3q^5$ . So the final answer is  $p^3q^5$ .

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 Subtract the exponents:  $10 - 4 = 6$ , so  $x^6$ . So the final answer is  $x^6$ .

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 Same base 6, subtract:  $9 - 6 = 3$ , so  $6^3$ . So the final answer is  $6^3$ .

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 Length is area divided by width:  $\frac{x^9}{x^4} = x^5$ . So the final answer is  $x^5$ .

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 Split the grains evenly among the bags:  $\frac{10^8}{10^2} = 10^6$  per bag. So the final answer is  $10^6$ .

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 Height is volume over base area:  $\frac{24y^7}{6y^3} = 4y^4$ . So the final answer is  $4y^4$ .

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 A quantity divided by itself is 1, since  $a^{6-6} = a^0 = 1$ . So the final answer is 1.



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