

Exponent Rules Worksheet

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Product, quotient and power rules · simplify fully · no calculator

Name _____ Date _____ Score _____

/30

THE RULES ON ONE LINE

Product $x^m \cdot x^n = x^{m+n}$ • **Quotient** $\frac{x^m}{x^n} = x^{m-n}$ • **Power** $(x^m)^n = x^{mn}$

Product to a power $(xy)^n = x^n y^n$ • **Zero** $x^0 = 1$ • **Negative** $x^{-n} = \frac{1}{x^n}$

Every rule needs the *same base*. $x^3 \cdot y^4$ does not simplify. Leave no negative exponents in a final answer.

SECTION A Product rule

When the bases match, *add* the exponents: $x^m \cdot x^n = x^{m+n}$. Multiply any coefficients.

1 $x^3 \cdot x^5$

Answer _____

4 $(3a^2)(4a^5)$

Answer _____

2 $2x^4 \cdot 5x^3$

Answer _____

5 $m^6 \cdot m^0$

Answer _____

3 $y^2 \cdot y^7 \cdot y$

Answer _____

6 $(-2x^3)(3x^4)$

Answer _____

SECTION B Quotient rule

When the bases match, *subtract* the exponents: $\frac{x^m}{x^n} = x^{m-n}$. Divide any coefficients.

7 $\frac{x^9}{x^4}$

Answer _____

10 $\frac{20m^8}{5m^3}$

Answer _____

8 $\frac{12y^7}{3y^2}$

Answer _____

11 $\frac{x^4}{x^7}$

Answer _____

9 $\frac{a^5}{a^5}$

Answer _____

12 $\frac{-18b^6}{6b^2}$

Answer _____

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Powers of products, zero and negative exponents

SECTION C Power of a power, power of a product

 $(x^m)^n = x^{mn}$, and a power outside brackets applies to *every* factor inside.

13 $(x^3)^4$

Answer _____

14 $(2x^5)^3$

Answer _____

15 $(a^2b^3)^4$

Answer _____

16 $(3m^4)^2$

Answer _____

17 $((x^2)^3)^2$

Answer _____

18 $(-2y^3)^3$

Answer _____

SECTION D Zero and negative exponents

 $x^0 = 1$ for any non-zero x , and $x^{-n} = \frac{1}{x^n}$. Leave no negative exponent in the answer.

19 5^0

Answer _____

20 x^{-3}

Answer _____

21 $2x^{-4}$

Answer _____

22 $(3x)^0$

Answer _____

23 $\left(\frac{1}{2}\right)^{-2}$

Answer _____

24 $\frac{y^{-1}}{y^{-4}}$

Answer _____

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Combined rules and reasoning · show the step where each rule is used

SECTION E Put the rules together

More than one rule applies to each of these. Work outwards from the brackets first.

$$25 \quad \frac{(2x^3y^2)^3}{4x^2y}$$

Answer

$$26 \quad \frac{x^5y^{-2}}{x^2y^3}$$

Answer

$$27 \quad (3a^2)^2 \cdot a^{-3}$$

Answer

$$28 \quad (x^4)^{-2} \cdot x^{10}$$

Answer

SECTION F Explain your reasoning

Write a sentence or two for each.

$$29 \quad \text{Use the quotient rule on } \frac{x^5}{x^5} \text{ to explain why } x^0 = 1.$$

Answer

$$30 \quad \text{A student writes } (x^3)^4 = x^7. \text{ Explain the error and give the correct answer.}$$

Answer

THE MISTAKE TO AVOID

Adding exponents when the rule calls for multiplying. $x^3 \cdot x^4 = x^7$ (a product, so add), but $(x^3)^4 = x^{12}$ (a power of a power, so multiply). And a coefficient takes the outside power too: $(2x^5)^3 = 8x^{15}$, not $2x^{15}$.

Answer Key

ANSWER KEY · PAGE 1 OF 2

Each simplification verified numerically at build time.

SECTION A

1. $x^3 \cdot x^5 = x^8$

2. $2x^4 \cdot 5x^3 = 10x^7$

3. $y^2 \cdot y^7 \cdot y = y^{10}$

4. $(3a^2)(4a^5) = 12a^7$

5. $m^6 \cdot m^0 = m^6$

6. $(-2x^3)(3x^4) = -6x^7$

SECTION B

7. $\frac{x^9}{x^4} = x^5$

8. $\frac{12y^7}{3y^2} = 4y^5$

9. $\frac{a^5}{a^5} = 1$

10. $\frac{20m^8}{5m^3} = 4m^5$

11. $\frac{x^4}{x^7} = \frac{1}{x^3}$

12. $\frac{-18b^6}{6b^2} = -3b^4$

SECTION C

13. $(x^3)^4 = x^{12}$

14. $(2x^5)^3 = 8x^{15}$

15. $(a^2b^3)^4 = a^8b^{12}$

16. $(3m^4)^2 = 9m^8$

17. $((x^2)^3)^2 = x^{12}$

18. $(-2y^3)^3 = -8y^9$

Answer Key

ANSWER KEY · PAGE 2 OF 2

Each simplification verified numerically at build time.

SECTION D

$$19. 5^0 = 1$$

$$20. x^{-3} = \frac{1}{x^3}$$

$$21. 2x^{-4} = \frac{2}{x^4}$$

$$22. (3x)^0 = 1$$

$$23. \left(\frac{1}{2}\right)^{-2} = 4$$

$$24. \frac{y^{-1}}{y^{-4}} = y^3$$

SECTION E

$$25. \frac{(2x^3y^2)^3}{4x^2y} = 2x^7y^5$$

$$26. \frac{x^5y^{-2}}{x^2y^3} = \frac{x^3}{y^5}$$

$$27. (3a^2)^2 \cdot a^{-3} = 9a$$

$$28. (x^4)^{-2} \cdot x^{10} = x^2$$

SECTION F

29. $\frac{x^5}{x^5} = x^{5-5} = x^0$. But any non-zero number divided by itself is 1, so $x^0 = 1$. It does not hold for $x = 0$, because $\frac{0}{0}$ is undefined.

30. They added the exponents instead of multiplying. Adding is for a *product* of matching bases; a power raised to a power multiplies. $(x^3)^4 = x^{12}$.