

Exponent Rules and Polynomials: practice solutions, Grade 9 – download the PDF

Written solutions to the chapter problems. Check each step, then correct yourself.

1 Product rule



Add the exponents of the same base and multiply the coefficients.

a. $x^{4+7} = x^{11}$.

b. $6 \cdot 2 = 12$ and $a^{3+5} = a^8$, so $12a^8$.

c. $(-3)(5) = -15$ and $m^{1+4} = m^5$, so $-15m^5$.

d. $y = y^1$, so $y^{1+9} = y^{10}$.

2 Quotient rule



a. $z^{12-5} = z^7$.

b. $24 \div 6 = 4$ and $b^{8-2} = b^6$, so $4b^6$.

c. $18 \div 9 = 2$, $x^{5-2} = x^3$, $y^{3-1} = y^2$, so $2x^3y^2$.

3 Numerical powers



- a. $2^{3+4} = 2^7 = 128$.
- b. $(3^2)^2 = 3^4 = 81$.
- c. Each zero power is 1, so $1 + 1 = 2$.
- d. $10^{3-1} = 10^2 = 100$.

4 Power of a power



- a. $x^{3 \cdot 5} = x^{15}$.
- b. $2^3 \cdot y^{12} = 8y^{12}$.
- c. $(-1)^4 a^8 = a^8$ (an even power of a negative is positive).
- d. $x^3 y^6$.

5 Negative exponents as numbers



- a. $2^{-3} = \frac{1}{2^3} = \frac{1}{8}$.
- b. $10^{-2} = \frac{1}{100} = 0.01$.
- c. $\left(\frac{1}{3}\right)^{-2} = \frac{1}{(1/3)^2} = \frac{1}{1/9} = 9$.
- d. $(-2)^{-3} = \frac{1}{(-2)^3} = -\frac{1}{8}$.

6 Scientific notation conversions



- a. 3.6×10^6 (6 places).
- b. 7.2×10^{-3} (3 places to the right).
- c. $5.1 \times 10^4 = 51,000$.
- d. $9 \times 10^{-5} = 0.00009$.

7 Name that polynomial



- a. One term: monomial, degree 1.
- b. Two terms: binomial, degree 2.
- c. Three terms: trinomial, degree 3.
- d. One term: monomial, degree 0 (a constant).

8 Adding polynomials



Group like terms: $(4x^2 + x^2) + (-3x + 9x) + (8 - 2)$.

Result: $5x^2 + 6x + 6$.

9 Subtracting polynomials



Change every sign of the second polynomial: $7x^2 + 2x - 5 - 3x^2 + 6x - 4$.

Group: $4x^2 + 8x - 9$.

10 Monomial times polynomial



Distribute $-2x$: $-2x \cdot 3x^2 = -6x^3$, $-2x \cdot (-5x) = +10x^2$, $-2x \cdot 4 = -8x$.

Result: $-6x^3 + 10x^2 - 8x$.

11 Product of two binomials



a. $x^2 + 4x + 7x + 28 = x^2 + 11x + 28$.

b. $x^2 + 2x - 6x - 12 = x^2 - 4x - 12$.

c. $x^2 - 3x - 5x + 15 = x^2 - 8x + 15$.

12 Special products



a. $x^2 + 2 \cdot 9 \cdot x + 81 = x^2 + 18x + 81$.

b. $(2x)^2 - 2 \cdot 2x \cdot 1 + 1 = 4x^2 - 4x + 1$.

c. $(5x)^2 - 3^2 = 25x^2 - 9$.

13 Only positive exponents



a. $x^{-4+9} = x^5$.

b. Only a has a negative exponent: $\frac{6b^3}{a^2}$.

c. $x^{2-8} = x^{-6} = \frac{1}{x^6}$.

d. $3^2 \cdot y^{-2} = \frac{9}{y^2}$.

14 Scientific notation arithmetic



a. $8 \times 10^{6+3} = 8 \times 10^9$.

b. $3 \times 10^{7-2} = 3 \times 10^5$.

c. $30 \times 10^2 = 3 \times 10^1 \times 10^2 = 3 \times 10^3$ (the 30 had to be rewritten as 3×10).

15 The community garden



- a. Area = length $\times$ width = $(x + 8)(x + 3) = x^2 + 3x + 8x + 24 = x^2 + 11x + 24$.
- b. With $x = 12$: $144 + 132 + 24 = 300$. Check: the garden is 20 ft by 15 ft, and $20 \times 15 = 300$. The area is 300 square feet (about 27.9 square meters).

16 True or false?



- a. False: the middle term is missing. $(x + 3)^2 = x^2 + 6x + 9$; test $x = 1$: 16 versus 10.
- b. False: exponents are added, so $x^2 \cdot x^3 = x^5$.
- c. False: the 2 is cubed too, so $(2x)^3 = 8x^3$.
- d. False: any nonzero number to the power 0 equals 1, so $5^0 = 1$.
- e. True: the middle terms $+ab$ and $-ab$ cancel.

17 A cubic product



Distribute: $2x \cdot x^2 = 2x^3$, $2x \cdot 4x = 8x^2$, $2x \cdot (-1) = -2x$, $-3 \cdot x^2 = -3x^2$, $-3 \cdot 4x = -12x$, $-3 \cdot (-1) = 3$.

Combine: $2x^3 + 5x^2 - 14x + 3$.

Check at $x = 2$: factored form gives $(1)(4 + 8 - 1) = 11$; expanded form gives $16 + 20 - 28 + 3 = 11$. The results match.

18 Combined expansion



$(x + 4)^2 = x^2 + 8x + 16$ and $(x - 2)(x + 5) = x^2 + 3x - 10$.

Subtract, flipping every sign of the second result:

$$x^2 + 8x + 16 - x^2 - 3x + 10 = 5x + 26.$$

19 Mental math with identities

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a. $62^2 = (60 + 2)^2 = 3600 + 240 + 4 = 3844$.

b. $38 \times 42 = (40 - 2)(40 + 2) = 1600 - 4 = 1596$.

20 Simplify a quotient of powers

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Numerator: $(2x^3)^2 = 4x^6$, then $4x^6 \cdot 3x^{-1} = 12x^5$.

Divide: $\frac{12x^5}{6x^4} = 2x^{5-4} = 2x$.

21 Light from the Sun

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a. Time = distance $\div$ speed = $\frac{1.5 \times 10^{11}}{3 \times 10^8} = 0.5 \times 10^3 = 5 \times 10^2$ seconds.

b. $500 \div 60 \approx 8.3$. Sunlight takes about 8.3 minutes.

22 A square with a corner removed

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a. $(3x + 2)^2 = 9x^2 + 12x + 4$ and $(x + 1)^2 = x^2 + 2x + 1$. Remaining area:
 $9x^2 + 12x + 4 - x^2 - 2x - 1 = 8x^2 + 10x + 3$.

b. For $x = 2$: $8 \cdot 4 + 20 + 3 = 55$. Check: $8^2 - 3^2 = 64 - 9 = 55$. The area is 55 square centimeters.

23 Find the missing numbers

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a. We need $a + b = 9$ and $ab = 20$. The pair 4 and 5 works: $4 + 5 = 9$, $4 \cdot 5 = 20$. So
 $(x + 4)(x + 5)$.

b. The middle term is $2k = 14$, so $k = 7$; then $m = k^2 = 49$.



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