

Algebraic Expressions and Properties of Real Numbers: practice solutions, Grade 9 – download the PDF

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

1 Parts of an expression



- a) The terms are separated by plus or minus signs, and each sign belongs to the term after it: $7x^2$, $-4x$, and 9 . There are 3 terms.
- b) The coefficient of $7x^2$ is 7 , and the coefficient of $-4x$ is -4 (the minus sign is part of the coefficient).
- c) The constant term is 9 .

2 Order of operations



- a) Multiply first: $5 + 12 = 17$.
- b) Parentheses first: $8 \cdot 4 = 32$.
- c) Divide first: $20 - 3 = 17$.
- d) The exponent applies only to 3: $2 \cdot 9 = 18$.

3**Evaluate a linear expression**

a) $4(3) + 7 = 12 + 7 = 19$.

b) $4(-2) + 7 = -8 + 7 = -1$.

c) $4(0) + 7 = 7$.

d) $4\left(\frac{1}{2}\right) + 7 = 2 + 7 = 9$.

4**Name the property**

a) Commutative property of multiplication (the order of the factors changes).

b) Associative property of addition (only the grouping changes).

c) Distributive property (3 multiplies both terms in the parentheses).

d) Additive identity property (adding 0 changes nothing).

e) Multiplicative inverse property (a number times its reciprocal is 1).

5**Combine the like terms**

a) $6a + 2a = 8a$.

b) y means $1y$, so $9 - 4 + 1 = 6$ and the result is $6y$.

c) $(3x - x) + (5 + 2) = 2x + 7$.

d) $(4m - m) + (3n + 2n) = 3m + 5n$. The m and n terms are not like terms, so they stay separate.

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Which set is smallest?

- a) -9 is a negative whole amount, so it is an integer (not whole, not natural).
- b) $\frac{2}{5}$ is a fraction of integers that is not an integer: rational.
- c) $\sqrt{25} = 5$, so it is a natural number.
- d) 10 is not a perfect square, so $\sqrt{10} \approx 3.162\dots$ never ends or repeats: irrational.

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Words to symbols

- a) $n + 9$.
- b) $7n$.
- c) $n - 4$.
- d) $\frac{n}{6}$.

8

Evaluate a quadratic expression

For $x = 3$: $2(9) - 15 + 1 = 18 - 15 + 1 = 4$.

For $x = -1$: $2(1) - 5(-1) + 1 = 2 + 5 + 1 = 8$.

For $x = 0.5$: $2(0.25) - 5(0.5) + 1 = 0.5 - 2.5 + 1 = -1$.

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Grouping symbols

- a) Exponent: $(-3)^2 = 9$. Then $4 \cdot 9 = 36$ and $36 \div 9 = 4$. Finally $-6 + 4 = -2$.
- b) Innermost parentheses: $1 + 3 = 4$. Brackets: $5 - 4 = 1$. Then $2 \cdot 1 = 2$ and $3 - 2 = 1$.

10 Use the distributive property



a) $5 \cdot 2x - 5 \cdot 3 = 10x - 15$.

b) $-3 \cdot 4y + (-3)(1) = -12y - 3$.

c) A minus sign in front means multiplying by -1 : $-7 + 2z$.

d) $\frac{1}{2} \cdot 8a + \frac{1}{2} \cdot 6 = 4a + 3$.

11 Distribute and combine



Distribute: $3x + 12 + 10x - 2$. Combine: $13x + 10$.

Check: the original for $x = 1$ is $3(5) + 2(4) = 15 + 8 = 23$, and $13(1) + 10 = 23$. They match.

12 Mental math with properties



a) Commutative and associative properties: $(25 \cdot 4) \cdot 17 = 100 \cdot 17 = 1,700$.

b) Distributive property: $8(50 + 3) = 400 + 24 = 424$.

c) Distributive property: $6(100 - 1) = 600 - 6 = 594$.

13 Concert tickets



a) Adults pay $12a$ dollars and students pay $8s$ dollars, so the total is $12a + 8s$.

b) $12(15) + 8(22) = 180 + 176 = 356$.

The concert collected \$356.

14 True or false?



- a) False. For $x = 2$: $5 - 2 = 3$ but $2 - 5 = -3$. Subtraction is not commutative.
- b) True, by the commutative property of addition.
- c) False. For $x = 1$: $2(4) = 8$ but $2 + 3 = 5$. The 2 must also multiply 3.
- d) False. $12 \div 6 = 2$ but $(12 \div 3) \cdot 2 = 4 \cdot 2 = 8$. Division is not associative.

15 A longer simplification



Distribute: $12x - 8 - 10x + 14 + x$. Notice $-2 \cdot (-7) = +14$.

Combine the x terms: $12 - 10 + 1 = 3$, so $3x$. Combine the constants: $-8 + 14 = 6$.

The result is $3x + 6$.

16 Perimeter of a rectangle



a) $P = 2(3x + 2) + 2(x + 5) = 6x + 4 + 2x + 10 = 8x + 14$.

b) For $x = 3$: $8(3) + 14 = 38$. As a check, the length is 11 cm and the width is 8 cm, so $2(11) + 2(8) = 38$.

The perimeter is 38 cm.

17 Phone plan



a) $25 + 0.10t$ dollars.

b) $25 + 0.10(240) = 25 + 24 = 49$, so the bill is \$49.

c) We need $25 + 0.10t = 60$, so $0.10t = 35$ and $t = 350$. Check: $25 + 35 = 60$. There were 350 texts.

18 Find the error

The student multiplied x by 3 but forgot to multiply -4 by 3, so the distributive property was applied to only one term.

Correct work: $3x - 12 + 2x = 5x - 12$. Test: for $x = 2$, the original is $3(-2) + 4 = -2$, and $5(2) - 12 = -2$ is right, while $5(2) - 4 = 6$ is wrong.

19 Shopping for notebooks

a) Ava pays $4n + 3$. Ben pays $6n - 2$. Together: $(4n + 3) + (6n - 2) = 10n + 1$.

b) $10(2.50) + 1 = 25 + 1 = 26$. Check separately: Ava $4(2.5) + 3 = 13$ and Ben $6(2.5) - 2 = 13$, total 26.

They spend \$26.

20 Always, sometimes, or never?

a) Always: $\frac{a}{b} + \frac{c}{d} = \frac{ad + bc}{bd}$, a fraction of integers.

b) Sometimes: $\sqrt{2} + \sqrt{2} = 2\sqrt{2}$ is irrational, but $\sqrt{2} + (3 - \sqrt{2}) = 3$ is rational.

c) Always: if $r \cdot x$ were rational for a rational $r \neq 0$, then x would be rational too.

d) Sometimes: $\sqrt{9} = 3$ is rational, but $\sqrt{10}$ is irrational.

21 Evaluate a fraction expression

Substitute: $\frac{(7 - (-3))^2}{2(5)} + 7(-3)$.

Numerator: $7 + 3 = 10$ and $10^2 = 100$. Denominator: 10. So the fraction is 10. Then $7(-3) = -21$.

The value is $10 - 21 = -11$.

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Fractions with distribution

Distribute: $\frac{3}{4} \cdot 8x = 6x$ and $\frac{3}{4} \cdot (-12) = -9$; then $\frac{1}{2} \cdot 6x = 3x$ and $\frac{1}{2} \cdot 4 = 2$.

Combine: $6x - 9 + 3x + 2 = 9x - 7$.

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