

# Algebra 1 Expressions Workbook

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# Evaluating Expressions

## WORKED EXAMPLE

$$\begin{aligned}
 x = 5 \quad 4x - 13 &= \underline{7} \\
 4x - 13 \text{ with } x = 5 & \\
 4 \times 5 = 20 & \\
 20 - 13 = 7 & \\
 4x - 13 = 7 &
 \end{aligned}$$

### 1. Evaluate expressions

Put the number in place of the letter, then work each one out.

1  $x = 4$   $8x - 16 =$  \_\_\_\_

2  $x = 12$   $2x - 6 =$  \_\_\_\_

3  $x = 9$   $2x + 15 =$  \_\_\_\_

4  $x = 3$   $4x + 9 =$  \_\_\_\_

5  $x = 9$   $2x - 1 =$  \_\_\_\_

6  $a = 3, b = 6$   $5a + b =$  \_\_\_\_

7  $x = 8$   $2x + 4 =$  \_\_\_\_

8  $x = 8$   $2x - 10 =$  \_\_\_\_

9  $x = 12$   $4x - 8 =$  \_\_\_\_

10  $x = 4$   $2x - 1 =$  \_\_\_\_

11  $x = 8$   $2x + 10 =$  \_\_\_\_

12  $x = 2$   $3x - 1 =$  \_\_\_\_

## 1. Evaluate expressions (continued)

Put the number in place of the letter, then work each one out.

13  $x = 7$   $2x - 4 =$  \_\_\_\_

14  $x = 8$   $3x + 10 =$  \_\_\_\_

15  $x = 9$   $4x - 19 =$  \_\_\_\_

16  $x = 6$   $3x - 11 =$  \_\_\_\_

17  $x = 6$   $4x + 8 =$  \_\_\_\_

18  $x = 3$   $4x - 9 =$  \_\_\_\_

19  $x = 4$   $2x - 4 =$  \_\_\_\_

20  $a = 4, b = 6$   $2a + b =$  \_\_\_\_

21  $x = 9$   $3x - 20 =$  \_\_\_\_

22  $x = 6$   $x^2 + 6 =$  \_\_\_\_

23  $x = 4$   $6x - 17 =$  \_\_\_\_

24  $x = 2$   $9x + 9 =$  \_\_\_\_

# Combining Like Terms

## WORKED EXAMPLE

$$2 + 5x + 7 + 7x$$

$$5 + 7 = 12$$

$$2 + 7 = 9$$

$$12x + 9$$

## 2. Collect like terms

Collect the like terms.

1  $1 + 5x + 4 + 3x$

2  $9 + 5x + 8 + 5x$

3  $3 + 3x + 7 + 7x$

4  $11 + 8x + 1 + 4x$

5  $8x + 13 - x - 7$

6  $6 + 6x + 10 + 4x$

7  $12x + 1 - 4x$

8  $10 + 2x + 1 + 6x$

9  $10x + 12 - 3x - 11$

10  $10x + 18 - 4x - 7$

11  $6 + 8x + 5 + 2x$

12  $8x + x + 10$

13  $9x + 20 - 8x$

14  $4x + 11 - 2x - 2$

15  $9x + 5 - 5x$

16  $8x + 15 - 3x$

17  $9 + 6x + 5 + 4x$

18  $11x + 19 - 6x - 13$

19  $5 + 4x + 5 + 8x$

20  $4x + 14 - 3x - 8$

21  $5x + 18 - 4x - 17$

22  $10x + 18 - 6x - 11$

23  $8x + 7 - 5x - 6$

24  $10 + 3x + 1 + x$

# The Distributive Property

## WORKED EXAMPLE

$$2(5 + 2x)$$

$$2 \times 5 = 10$$

$$2 \times 2x = 4x$$

$$4x + 10$$

### 3. Multiply out brackets

Multiply out each bracket.

1  $3(x + 8)$

2  $6(7x + 3)$

3  $4(2x + 5)$

4  $3(12 + 5x)$

5  $2(11 + 5x)$

6  $2(4x + 4)$

7  $5(8 + 5x)$

8  $4(3x - 6)$

9  $2(7x + 11)$

10  $7(3 + 4x)$

11  $8(x + 6)$

12  $2(9x + 10)$

13  $3(8x - 11)$

14  $7(2x + 7)$

15  $4(9 + 4x)$

16  $2(6x - 5)$

17  $7(6x + 4)$

18  $2(9 + 5x)$

19  $6(x - 4)$

20  $5(7x + 8)$

21  $3(5 + 4x)$

22  $9(5 + 2x)$

23  $3(3 + 3x)$

24  $8(3x - 4)$

WORKED EXAMPLE

$$|2 - 10| = \underline{8}$$

#### 4. Absolute value

Work out each one. The bars ask how far the number is from zero.

- 1  $|-4| + |2| = \underline{\quad}$
- 2  $|17| = \underline{\quad}$
- 3 How far apart are  $-12$  and  $1$  on the number line?  $\underline{\quad}$
- 4  $|-3| + |8| = \underline{\quad}$
- 5  $|11| + |-8| = \underline{\quad}$
- 6  $|-5| + |7| = \underline{\quad}$
- 7  $|-6| + |10| = \underline{\quad}$
- 8  $|7 - 19| = \underline{\quad}$
- 9  $|10| + |-10| = \underline{\quad}$
- 10  $|11| + |-2| = \underline{\quad}$
- 11 How far apart are  $-7$  and  $6$  on the number line?  $\underline{\quad}$
- 12  $|-5| + |11| = \underline{\quad}$
- 13  $|2| + |-3| = \underline{\quad}$
- 14 How far apart are  $-6$  and  $3$  on the number line?  $\underline{\quad}$
- 15  $|7 - 15| = \underline{\quad}$
- 16  $|7| + |-12| = \underline{\quad}$
- 17  $|3| + |-11| = \underline{\quad}$
- 18 How far apart are  $-5$  and  $4$  on the number line?  $\underline{\quad}$
- 19  $|3| + |-8| = \underline{\quad}$
- 20 How far apart are  $-6$  and  $5$  on the number line?  $\underline{\quad}$
- 21  $|11| + |-4| = \underline{\quad}$
- 22  $|-6| + |3| = \underline{\quad}$
- 23  $|-7| + |9| = \underline{\quad}$
- 24  $|4| + |-11| = \underline{\quad}$

## 5. Evaluate expressions

Put the number in place of the letter, then work each one out.

25  $a = 2, b = 7$   $3a + b =$  \_\_\_\_

26  $x = 8$   $2x - 14 =$  \_\_\_\_

27  $x = 6$   $7x - 4 =$  \_\_\_\_

28  $x = 7$   $2x + 18 =$  \_\_\_\_

29  $x = 7$   $5x + 4 =$  \_\_\_\_

30  $x = 11$   $4x - 14 =$  \_\_\_\_

31  $a = 5, b = 8$   $4a + b =$  \_\_\_\_

32  $x = 6$   $6x - 18 =$  \_\_\_\_

33  $x = 12$   $4x - 6 =$  \_\_\_\_

34  $a = 5, b = 5$   $3a + b =$  \_\_\_\_

# Answer Key (1 of 2)

## Evaluating Expressions

Evaluate expressions

- $8x - 16$  ( $x = 4$ )  $\rightarrow 16$
- $2x - 6$  ( $x = 12$ )  $\rightarrow 18$
- $2x + 15$  ( $x = 9$ )  $\rightarrow 33$
- $4x + 9$  ( $x = 3$ )  $\rightarrow 21$
- $2x - 1$  ( $x = 9$ )  $\rightarrow 17$
- $5a + b$  ( $a = 3, b = 6$ )  $\rightarrow 21$
- $2x + 4$  ( $x = 8$ )  $\rightarrow 20$
- $2x - 10$  ( $x = 8$ )  $\rightarrow 6$
- $4x - 8$  ( $x = 12$ )  $\rightarrow 40$
- $2x - 1$  ( $x = 4$ )  $\rightarrow 7$
- $2x + 10$  ( $x = 8$ )  $\rightarrow 26$
- $3x - 1$  ( $x = 2$ )  $\rightarrow 5$
- $2x - 4$  ( $x = 7$ )  $\rightarrow 10$
- $3x + 10$  ( $x = 8$ )  $\rightarrow 34$
- $4x - 19$  ( $x = 9$ )  $\rightarrow 17$
- $3x - 11$  ( $x = 6$ )  $\rightarrow 7$
- $4x + 8$  ( $x = 6$ )  $\rightarrow 32$
- $4x - 9$  ( $x = 3$ )  $\rightarrow 3$
- $2x - 4$  ( $x = 4$ )  $\rightarrow 4$
- $2a + b$  ( $a = 4, b = 6$ )  $\rightarrow 14$
- $3x - 20$  ( $x = 9$ )  $\rightarrow 7$
- $x^2 + 6$  ( $x = 6$ )  $\rightarrow 42$
- $6x - 17$  ( $x = 4$ )  $\rightarrow 7$
- $9x + 9$  ( $x = 2$ )  $\rightarrow 27$

## Combining Like Terms

Collect like terms

- $1 + 5x + 4 + 3x \rightarrow 8x + 5$
- $9 + 5x + 8 + 5x \rightarrow 10x + 17$
- $3 + 3x + 7 + 7x \rightarrow 10x + 10$
- $11 + 8x + 1 + 4x \rightarrow 12x + 12$
- $8x + 13 - x - 7 \rightarrow 7x + 6$
- $6 + 6x + 10 + 4x \rightarrow 10x + 16$
- $12x + 1 - 4x \rightarrow 8x + 1$
- $10 + 2x + 1 + 6x \rightarrow 8x + 11$
- $10x + 12 - 3x - 11 \rightarrow 7x + 1$
- $10x + 18 - 4x - 7 \rightarrow 6x + 11$
- $6 + 8x + 5 + 2x \rightarrow 10x + 11$
- $8x + x + 10 \rightarrow 9x + 10$
- $9x + 20 - 8x \rightarrow 1x + 20$
- $4x + 11 - 2x - 2 \rightarrow 2x + 9$
- $9x + 5 - 5x \rightarrow 4x + 5$
- $8x + 15 - 3x \rightarrow 5x + 15$
- $9 + 6x + 5 + 4x \rightarrow 10x + 14$
- $11x + 19 - 6x - 13 \rightarrow 5x + 6$
- $5 + 4x + 5 + 8x \rightarrow 12x + 10$
- $4x + 14 - 3x - 8 \rightarrow 1x + 6$

## Combining Like Terms (continued)

Collect like terms (continued)

- $5x + 18 - 4x - 17 \rightarrow 1x + 1$
- $10x + 18 - 6x - 11 \rightarrow 4x + 7$
- $8x + 7 - 5x - 6 \rightarrow 3x + 1$
- $10 + 3x + 1 + x \rightarrow 4x + 11$

## The Distributive Property

Multiply out brackets

- $3(x + 8) \rightarrow 3x + 24$
- $6(7x + 3) \rightarrow 42x + 18$
- $4(2x + 5) \rightarrow 8x + 20$
- $3(12 + 5x) \rightarrow 15x + 36$
- $2(11 + 5x) \rightarrow 10x + 22$
- $2(4x + 4) \rightarrow 8x + 8$
- $5(8 + 5x) \rightarrow 25x + 40$
- $4(3x - 6) \rightarrow 12x - 24$
- $2(7x + 11) \rightarrow 14x + 22$
- $7(3 + 4x) \rightarrow 28x + 21$
- $8(x + 6) \rightarrow 8x + 48$
- $2(9x + 10) \rightarrow 18x + 20$
- $3(8x - 11) \rightarrow 24x - 33$
- $7(2x + 7) \rightarrow 14x + 49$
- $4(9 + 4x) \rightarrow 16x + 36$
- $2(6x - 5) \rightarrow 12x - 10$
- $7(6x + 4) \rightarrow 42x + 28$
- $2(9 + 5x) \rightarrow 10x + 18$
- $6(x - 4) \rightarrow 6x - 24$
- $5(7x + 8) \rightarrow 35x + 40$
- $3(5 + 4x) \rightarrow 12x + 15$
- $9(5 + 2x) \rightarrow 18x + 45$
- $3(3 + 3x) \rightarrow 9x + 9$
- $8(3x - 4) \rightarrow 24x - 32$

## Absolute Value

Absolute value

- $|-4| + |2| \rightarrow 6$
- $|17| \rightarrow 17$
- How far apart are  $-12$  and  $1$  on the number line?  $\rightarrow 13$
- $|-3| + |8| \rightarrow 11$
- $|11| + |-8| \rightarrow 19$
- $|-5| + |7| \rightarrow 12$
- $|-6| + |10| \rightarrow 16$
- $|7 - 19| \rightarrow 12$
- $|10| + |-10| \rightarrow 20$
- $|11| + |-2| \rightarrow 13$
- How far apart are  $-7$  and  $6$  on the number line?  $\rightarrow 13$
- $|-5| + |11| \rightarrow 16$
- $|2| + |-3| \rightarrow 5$

# Answer Key (2 of 2)

## Absolute Value (continued)

Absolute value (continued)

- 14. How far apart are  $-6$  and  $3$  on the number line?  $\rightarrow 9$
- 15.  $|7 - 15| \rightarrow 8$
- 16.  $|7| + |-12| \rightarrow 19$
- 17.  $|3| + |-11| \rightarrow 14$
- 18. How far apart are  $-5$  and  $4$  on the number line?  $\rightarrow 9$
- 19.  $|3| + |-8| \rightarrow 11$
- 20. How far apart are  $-6$  and  $5$  on the number line?  $\rightarrow 11$
- 21.  $|11| + |-4| \rightarrow 15$
- 22.  $|-6| + |3| \rightarrow 9$
- 23.  $|-7| + |9| \rightarrow 16$
- 24.  $|4| + |-11| \rightarrow 15$

Evaluate expressions

- 25.  $3a + b$  ( $a = 2, b = 7$ )  $\rightarrow 13$
- 26.  $2x - 14$  ( $x = 8$ )  $\rightarrow 2$
- 27.  $7x - 4$  ( $x = 6$ )  $\rightarrow 38$
- 28.  $2x + 18$  ( $x = 7$ )  $\rightarrow 32$
- 29.  $5x + 4$  ( $x = 7$ )  $\rightarrow 39$
- 30.  $4x - 14$  ( $x = 11$ )  $\rightarrow 30$
- 31.  $4a + b$  ( $a = 5, b = 8$ )  $\rightarrow 28$
- 32.  $6x - 18$  ( $x = 6$ )  $\rightarrow 18$
- 33.  $4x - 6$  ( $x = 12$ )  $\rightarrow 42$
- 34.  $3a + b$  ( $a = 5, b = 5$ )  $\rightarrow 20$

# Solutions (1 of 4)

## Evaluating Expressions

Evaluate expressions

1.  $x = 4$     $8x - 16 =$          

$$8x - 16 \quad \text{with} \quad x = 4$$

$$8 \times 4 = 32$$

$$32 - 16 = 16$$

$$8x - 16 = 16$$

A letter is a number that has not been written down yet, and this question writes it down:  $x = 4$ . So put the value in where the letter is — in BRACKETS, which keeps whatever was being done to the letter being done to the number.

$8x$  means 8 TIMES  $x$ , and multiplying happens before adding or taking away however the line is written. So this multiplication comes first:  $8 \times 4 = 32$ .

Now the last bit:  $32 - 16 = 16$ . Doing it the other way round — taking away first and multiplying after — gives -96, which is why the order is the whole of this question.

So  $8x - 16$  is 16 when  $x = 4$ .

2.  $x = 12$     $2x - 6 =$          

$$2x - 6 \quad \text{with} \quad x = 12$$

$$2 \times 12 = 24$$

$$24 - 6 = 18$$

$$2x - 6 = 18$$

A letter is a number that has not been written down yet, and this question writes it down:  $x = 12$ . So put the value in where the letter is — in BRACKETS, which keeps whatever was being done to the letter being done to the number.

$2x$  means 2 TIMES  $x$ , and multiplying happens before adding or taking away however the line is written. So this multiplication comes first:  $2 \times 12 = 24$ .

Now the last bit:  $24 - 6 = 18$ . Doing it the other way round — taking away first and multiplying after — gives 12, which is why the order is the whole of this question.

So  $2x - 6$  is 18 when  $x = 12$ .

## Solutions (2 of 4)

### Combining Like Terms

Collect like terms

1.  $1 + 5x + 4 + 3x$

$$1 + 5x + 4 + 3x$$

$$5 + 3 = 8$$

$$1 + 4 = 5$$

$$8x + 5$$

There are two kinds of thing on this line and they cannot mix: the  $x$  terms, and the plain numbers. Sort them into two piles before adding anything — the  $x$  terms are  $5x$  and  $3x$ , and the numbers are 1 and 4.

Add up the  $x$  pile, keeping the signs:  $5 + 3 = 8$ , so  $8x$ .

Then the number pile, on its own:  $1 + 4 = 5$ .

So it is  $8x + 5$  — and that is finished, even though it is still two things. Squashing them into  $13x$  would be answering "8 whats and 5 whats?", and there is no answer to that until somebody says what  $x$  is.

2.  $9 + 5x + 8 + 5x$

$$9 + 5x + 8 + 5x$$

$$5 + 5 = 10$$

$$9 + 8 = 17$$

$$10x + 17$$

There are two kinds of thing on this line and they cannot mix: the  $x$  terms, and the plain numbers. Sort them into two piles before adding anything — the  $x$  terms are  $5x$  and  $5x$ , and the numbers are 9 and 8.

Add up the  $x$  pile, keeping the signs:  $5 + 5 = 10$ , so  $10x$ .

Then the number pile, on its own:  $9 + 8 = 17$ .

So it is  $10x + 17$  — and that is finished, even though it is still two things. Squashing them into  $27x$  would be answering "10 whats and 17 whats?", and there is no answer to that until somebody says what  $x$  is.

## Solutions (3 of 4)

### The Distributive Property

Multiply out brackets

1.  $3(x + 8)$

$$3(x + 8)$$

$$3 \times x = 3x$$

$$3 \times 8 = 24$$

$$3x + 24$$

The 3 outside multiplies EVERYTHING inside the bracket, not just the thing next to it. Draw an arrow from the 3 to each of the two terms before working anything out — that is what stops one of them being left behind.

First arrow:  $3 \times x = 3x$ .

Second arrow:  $3 \times 8 = 24$ .

Put the two together:  $3x + 24$ . Check it by putting a small number in for  $x$  on both forms — they should agree, because they are the same amount written two ways.

2.  $6(7x + 3)$

$$6(7x + 3)$$

$$6 \times 7x = 42x$$

$$6 \times 3 = 18$$

$$42x + 18$$

The 6 outside multiplies EVERYTHING inside the bracket, not just the thing next to it. Draw an arrow from the 6 to each of the two terms before working anything out — that is what stops one of them being left behind.

First arrow:  $6 \times 7x = 42x$ .

Second arrow:  $6 \times 3 = 18$ .

Put the two together:  $42x + 18$ . Check it by putting a small number in for  $x$  on both forms — they should agree, because they are the same amount written two ways.

## Solutions (4 of 4)

### Absolute Value

Absolute value

1.  $|-4| + |2| = \underline{\quad}$

$$\begin{array}{c} |-4| + |2| \\ |-4| = 4 \quad |2| = 2 \\ 4 + 2 = 6 \end{array}$$

The two bars ask for a DISTANCE: how far the thing between them is from zero. A distance is never negative, and that is a fact about distance rather than a rule about minus signs.

There are two sets of bars here, and each one is finished before they meet:  $|-4|$  is 4, and  $|2|$  is 2.

Only then add them:  $4 + 2 = 6$ . Adding  $-4$  and 2 FIRST would have given  $-2$ , which is the answer to a question nobody asked.

2.  $|17| = \underline{\quad}$

$$|17| = 17$$

The two bars ask for a DISTANCE: how far the thing between them is from zero. A distance is never negative, and that is a fact about distance rather than a rule about minus signs.

17 sits 17 steps from zero already, so there is nothing for the bars to change:  $|17| = 17$ . Half of these have no sign to remove, which is why "drop the minus" is not the lesson.