

# Order of Operations and Evaluating Expressions

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Score: \_\_\_\_\_ / 24

## Quick Review

When an expression mixes more than one operation, follow **PEMDAS** from top to bottom. **P**arentheses (and any other grouping symbols like brackets or the bar of a fraction) come first. Then **E**xponents (powers and roots). Then **M**ultiplication and **D**ivision left to right — they're the same priority, so just go in reading order. Then **A**ddition and **S**ubtraction left to right, same idea. To **evaluate** an algebraic expression, substitute each variable's given value — always in parentheses — and then simplify with PEMDAS. The parentheses around substituted values are non-negotiable; they're how you avoid sign mistakes.

## PRACTICE

Simplify or evaluate each expression.

- |                                |       |  |       |
|--------------------------------|-------|--|-------|
| 1. $8 + 3 \times 2$            | _____ | 11. $\frac{m+n}{m-n}$ when $m = 7, n = 3$      | _____ |
| 2. $(8 + 3) \times 2$          | _____ | 12. $4(x - 1)^2 + 3$ when $x = 2$              | _____ |
| 3. $12 \div 4 + 5 \times 3$    | _____ | 13. $10 - 2(3 + 1)$                            | _____ |
| 4. $20 - 3^2 + 1$              | _____ | 14. $24 \div (4 + 2) \times 3$                 | _____ |
| 5. $4 \times (6 - 2)^2 \div 8$ | _____ | 15. $-2^2 + (-2)^2$                            | _____ |
| 6. $\frac{18}{3 + 6}$          | _____ | 16. $\frac{6 + 2 \cdot 3}{4 - 1}$              | _____ |
| 7. $-3 + (-4)^2 \div 2$        | _____ | 17. $5 - x^2$ when $x = -3$                    | _____ |
| 8. $5^2 - 4 \times 3 + 7$      | _____ | 18. $\sqrt{x + 5}$ when $x = 11$               | _____ |
| 9. $2x + 5$ when $x = 3$       | _____ | 19. $3a - b^2$ when $a = 4, b = 2$             | _____ |
| 10. $3a^2 - 2a$ when $a = -1$  | _____ | 20. $\frac{2x + y}{x - y}$ when $x = 5, y = 1$ | _____ |

## Word Problems

21. A phone plan costs \$25 for the base fee plus \$0.05 per text. If  $t$  is the number of texts, the monthly cost is  $25 + 0.05t$ . Find the cost for 120 texts.

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22. Marcus earns  $d$  dollars per hour and works  $h$  hours per week. His weekly pay after a \$15 parking deduction is  $dh - 15$ . Find his pay when  $d = 12$  and  $h = 20$ .

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23. A taxi fare is \$3.50 plus \$2 per mile. The total cost is  $3.50 + 2m$ . How much does an 8-mile ride cost?

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24. The area of a triangle is  $A = \frac{1}{2}bh$ . Find the area of a triangle with base 14 cm and height 9 cm.

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## Answer Keys

1. 14
2. 22
3. 18
4. 12
5. 8
6. 2
7. 5
8. 20
9. 11
10. 5
11.  $\frac{5}{2}$
12. 7

13. 2
14. 12
15. 0
16. 4
17. -4
18. 4
19. 8
20.  $\frac{11}{4}$
21. \$31
22. \$225
23. \$19.50
24. 63 cm<sup>2</sup>

### Step-by-Step Tutor Notes

1. Multiplication wins before addition. So  $3 \times 2 = 6$  first, then  $8 + 6 = 14$ . A common slip is doing left-to-right and getting  $11 \times 2 = 22$  — PEMDAS protects you from that.
2. Now the parentheses say “do me first.”  $8 + 3 = 11$ , then  $11 \times 2 = 22$ . Notice how the parentheses flipped which operation came first — that’s their whole job.
3. Multiplication and division are at the same level, and they happen before addition. So do both first:  $12 \div 4 = 3$  and  $5 \times 3 = 15$ . Then  $3 + 15 = 18$ .
4. Exponent first —  $3^2 = 9$ . Now it’s  $20 - 9 + 1$ , addition and subtraction left to right:  $20 - 9 = 11$ , then  $11 + 1 = 12$ .
5. Parentheses give  $6 - 2 = 4$ . Exponent gives  $4^2 = 16$ . Now go left to right:  $4 \times 16 = 64$ , then  $64 \div 8 = 8$ .
6. The fraction bar is a grouping symbol — it tells you to finish the denominator before dividing. So  $3 + 6 = 9$ , then  $18 \div 9 = 2$ .
7. Watch this one:  $(-4)^2$  is a negative being squared, and two negatives multiply to a positive, so  $(-4)^2 = 16$ . Divide:  $16 \div 2 = 8$ . Then  $-3 + 8 = 5$ .
8. Power first:  $5^2 = 25$ . Multiplication next:  $4 \times 3 = 12$ . Then left to right with  $-$  and  $+$ :  $25 - 12 = 13$ ,  $13 + 7 = 20$ .
9. Start by substituting the given value or values carefully, using parentheses when a value is negative. Substitute 3 for  $x$  in parentheses —  $2(3) + 5$ . Multiply: 6. Add:  $6 + 5 = 11$ . That confirms the final answer is 11.
10. Always wrap a negative substitution in parentheses.  $3(-1)^2 - 2(-1)$ . Square first:  $(-1)^2 = 1$ , giving  $3(1) = 3$ . Then the  $-2(-1) = +2$ . So  $3 + 2 = 5$ .
11. Top and bottom each act like their own grouped expression. Top:  $7 + 3 = 10$ . Bottom:  $7 - 3 = 4$ . So  $\frac{10}{4} = \frac{5}{2}$ .
12. Substitute:  $4(2 - 1)^2 + 3$ . Inside the parens first: 1. Square:  $1^2 = 1$ . Multiply:  $4(1) = 4$ . Add:  $4 + 3 = 7$ .
13. Keep the order of operations in view, then simplify without skipping the sign check. Parentheses first:  $3 + 1 = 4$ . Then multiplication:  $2 \cdot 4 = 8$ . Subtract last:  $10 - 8 = 2$ . After simplifying, the answer is 2.
14. Parens:  $4 + 2 = 6$ . Now  $24 \div 6 \times 3$ . Same-level operations go left to right:  $24 \div 6 = 4$ , then  $4 \times 3 = 12$ . (Going right to left would give the wrong answer of  $\frac{24}{18}$ .)
15. The two halves look the same but they’re not.  $-2^2$  means the negative of  $2^2$ , which is  $-4$ , because the exponent only applies to the 2. But  $(-2)^2$  squares the whole  $-2$ , giving  $+4$ . So  $-4 + 4 = 0$ .
16. Treat top and bottom as separate PEMDAS problems. Top: multiply first ( $2 \cdot 3 = 6$ ), then add ( $6 + 6 = 12$ ). Bottom:  $4 - 1 = 3$ . Then  $12 \div 3 = 4$ .
17. Substitute in parentheses:  $5 - (-3)^2$ . Square first:  $(-3)^2 = 9$ . Then subtract:  $5 - 9 = -4$ .
18. The radical groups like parentheses, so finish what’s under it first:  $11 + 5 = 16$ . Then  $\sqrt{16} = 4$ .
19. Substitute:  $3(4) - (2)^2$ . Exponent first:  $(2)^2 = 4$ . Multiply:  $3(4) = 12$ . Subtract:  $12 - 4 = 8$ .
20. Top:  $2(5) + 1 = 10 + 1 = 11$ . Bottom:  $5 - 1 = 4$ . So  $\frac{11}{4}$ . Leave it as an improper fraction — it’s already in lowest terms.
21. Substitute  $t = 120$  into the expression:  $25 + 0.05(120)$ . Multiplication before addition:  $0.05 \times 120 = 6$ . Then  $25 + 6 = 31$  dollars. That’s \$25 for the plan plus \$6 for the texts.
22. Start by replacing the variables with the given values:  $12 \times 20 - 15$ . Multiplication comes before subtraction, so  $12 \times 20 = 240$ . Now subtract the parking deduction:  $240 - 15 = 225$ . His pay after parking is \$225.
23. Substitute  $m = 8$ :  $3.50 + 2(8)$ . Multiply first:  $2 \times 8 = 16$ . Add:  $3.50 + 16 = 19.50$  dollars.
24. Substitute  $b = 14$  and  $h = 9$ :  $A = \frac{1}{2}(14)(9)$ . Pair off the easy multiplication first — half of 14 is 7. Now  $7 \times 9 = 63$ . So the area is 63 square centimeters.



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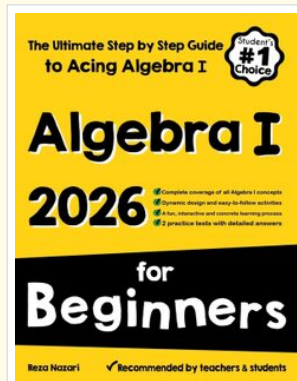
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