Order of Operations—Explanation & Practice

The **properties of real numbers** are often used to rewrite algebraic expressions.

The Order of Operations Agreement	
To simplify an expression with more than one operation follow these steps:	
Step 1	Perform operations inside grouping symbols. Grouping symbols include parentheses ( ), brackets [ ], braces { }, the fraction bar, and the absolute value symbol | |.
Step 2	Simplify exponential expressions.
Step 3	Perform multiplication and division as they occur from left to right.
Step 4	Perform addition and subtraction as they occur from left to right.

Use the saying Please Excuse My Dear Aunt Sally to remember the order of operations:

Please: **Parentheses** – Perform the operations within grouping symbols first (parentheses, fraction bar, etc.), in the order given in steps 2, 3, and 4.

Excuse: **E**xponents – Perform the operations indicated by exponents.

My **D**ear: **Multiply** and **Divide** – Perform only multiplication and division as they appear from left to right.

Aunt **S**ally: **Add** and **Subtract** – Perform addition and subtraction as they appear from left to right.

Simplify: $12 - 24(8 - 5) \div 2^2$

. $12 - 24(8 - 5) \div 2^2$ Step 1) Perform operations inside grouping symbols

$12 - 24\ (3) \div 2^2$ Step 2) Simplify exponential expressions.

$12 - 24(3) \div 4$ Step 3) Perform multiplication and division as they occur from left to right

$12 - 72 \div 4$

$12 - 18$

$12 + (-18)$ Step 4) Perform addition and subtraction as they occur from left to right.

-6

One or more of the previous steps may not be needed to simplify an expression. In that case, proceed to the next step in the Order of Operations Agreement.

Simplify: $\frac{4+8}{2+1} - (3-1) + 2$

$\frac{4+8}{2+1} - (3-1) + 2$ Perform operation inside grouping symbols.

$\frac{12}{3} - 2 + 2$ Perform multiplication and division as they occur from left to right.

$4 - 2 + 2$ Perform addition and subtraction as they occur from left to right.

$4 + (-2) + 2$

$2 + 2$

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When an expression has grouping symbols inside grouping symbols, perform the operations inside the inner grouping symbols first.

Simplify: $6 \div [4 - (6 - 8)] + 2^2$

$6 \div [4 - (6 - 8)] + 2^2$ Perform operations inside grouping symbols.

$6 \div [4 - (-2)] + 2^2$

$6 \div [4 + 2] + 2^2$

$6 \div 6 + 2^2$ Simplify exponential expressions.

$6 \div 6 + 4$

$1 + 4$ Perform multiplication and division from left to right.

5 Perform addition and subtraction from left to right.

More Examples of Simplifying Expressions Using the Order of Operations

1) $8 - 10 \div 2$ Divide
$8 - 5$ Subtract
3

2) $(6 - 4)(6)$ Subtract inside parentheses
$2(6)$ Multiply
12

3) $54 \div 6 \bullet 3$ — Neither multiplication nor division takes precedence over the other, so perform the operations from left to right.

$9 \bullet 3$

27

4) $7 \bullet 9 + 6 \bullet 2$ — Multiply

$63 + 12$ — Add

75

5) $25 - 6 \div 3 + 8 \bullet 4$ — Divide and multiply

$25 - 2 + 32$ — Subtract

$23 + 32$ — Add

55

6) $5 \bullet 9 + 9 - 6\,(7+1)$ — Add in ( ) first

$5 \bullet 9 + 9 - 6 \bullet 8$ — Multiply

$45 + 9 - 48$ — Add

$54 - 48$ — Subtract

6

7) $3 \bullet 4^3 - 8 \bullet 3^2 + 11$ — Exponents

$3 \bullet 64 - 8 \bullet 9 + 11$ — Multiply

$192 - 72 + 11$ — Subtract

$120 + 11$ — Add

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8) $(2^2 + 2 \bullet 3)^2 + 3^2$ — Perform operations inside parentheses using proper order:

$(2^2 + 2 \bullet 3)^2 + 3^2$ — Inside the parentheses: exponents

$(4 + 2 \bullet 3)^2 + 3^2$ — Inside the parentheses: multiply

$(4 + 6)^2 + 3^2$ — Inside the parentheses: add

$10^2 + 3^2$ — No more grouping symbols; note the exponents

$100 + 9$ — Add

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Practice

1. $(2 + 8) – (7 – 3)$
2. $5(6 – 4) + 2(8 – 5)$
3. $(7 + 3) \cdot 6 + 5$
4. $7 + (3 \cdot 6) + 5$
5. $4 \cdot 3 + 6 \cdot 5$
6. $4 \cdot 14 – 9 \div 3 + 6 \cdot 2$
7. $24 \div 6 + 6 – 3(5 – 3)$
8. $5 \cdot 2^3 – 2 \cdot 4^2 + 25 – 7 \cdot 3$
9. $(3^3 – 12 \div 4)^2 + 5^2$
10. $2 \cdot [4 + 3(7 – 2)]$
11. $3 + [2(16 + 9)]$
12. $[5(x + 2)] – 3x$
13. $(3x + 5) + 4(2x + 7)]$
14. $16x – [5(2x + 7)]$
15. $[37(6x – 5x)] – 35x$
16. $[4(2x – 5) + 7] + [3(x + 3) + 5x]$
17. $[7(x + 5) – 19] – [4(x - 6) + 10]$
18. $3\{[6(x – 2) + 4] – [2(2x – 5) + 6]\}$
19. $[(3 \cdot 2x) + 5] + \{4x – [7(x + 2)]\}$
20. $\frac{7+5}{8-2\cdot 2} \cdot 2^2 + 3$

Answer Key

1. 6
2. 16
3. 65
4. 30
5. 42
6. 65
7. 4
8. 12
9. 601
10. 38
11. 53
12. $2x + 10$
13. $11x + 33$
14. $6x – 35$
15. $2x$
16. $16x – 4$
17. $3x + 30$
18. $6x – 12$
19. $3x – 9$
20. 15