

THE ORDER OF OPERATIONS

When performing calculations involving several mathematical operations (+, -, x, ÷, powers, and/or roots) **we need to all agree to perform the operations in the same order every time.** If we didn't do this it would be possible to arrive at different answers for the same setup - an intolerable situation in mathematics.

The Order of Operations specifies that we are to:

- 1. First, do all calculations within grouping symbols (parentheses, brackets, and fraction bars).**
- 2. Next, evaluate any exponents (powers and roots).**
- 3. Then, perform all multiplications and divisions as we come to them from left to right.**
- 4. Finally, perform all additions and subtractions as we come to them from left to right.**

If you have trouble remembering these rules, you may find it helpful to memorize the sentence: “**Please Excuse My Dear Aunt Sal.” As shown below, the first letter of each word of the sentence is associated with the operations as we are to perform them:**

<u>P</u> lease:	<u>E</u> xcuse:	<u>M</u> y <u>D</u> ear:	<u>A</u> unt <u>S</u> al:
<u>P</u> arentheses	<u>E</u> xponents	<u>M</u> ultiplication & <u>D</u> ivision (from Left to Right)	<u>A</u> ddition & <u>S</u> ubtraction (from Left to Right)

BASIC EXAMPLES:

- a) $3 + (12 - 4) \div 2 =$
 $3 + 8 \div 2 =$ (Simplify quantities in parentheses)
 $3 + 4 =$ (Multiplication & Division as we come to it L \Rightarrow R)
 7 (Addition & Subtraction as we come to it L \Rightarrow R)
- b) $3 \cdot 12 - 4 \div 2 =$
 $36 - 2 =$ (No parentheses. Multiplication & Division as we come to it L \Rightarrow R)
 34 (Addition & Subtraction as we come to it L \Rightarrow R)

ADVANCED EXAMPLES:

- c) $\frac{5 \cdot (12 - 4)}{6 + 2 \cdot 7} =$ (Fraction Bar is grouping symbol. Thus, can simplify numerator and denominator independently)
 $\frac{5 \cdot 8}{6 + 14} =$ (Top: Simplify quantities in parentheses
Bottom: Multiplication & Division as we come to it L \Rightarrow R)
 $\frac{40}{20} =$ (Top: Multiplication & Division as we come to it L \Rightarrow R
Bottom: Addition & Subtraction as we come to it L \Rightarrow R)
 2 (Multiplication & Division as we come to it L \Rightarrow R)
- d) $3 + 5 \cdot 8 \div 2^2 =$
 $3 + 5 \cdot 8 \div 4 =$ (No parentheses or grouping symbols. Simplify exponents)
 $3 + 40 \div 4 =$ (Multiplication & Division as we come to it L \Rightarrow R)
 $3 + 10 =$ (Multiplication & Division as we come to it L \Rightarrow R)
 13 (Addition & Subtraction as we come to it L \Rightarrow R)
- e) $3 + 5 \cdot (8 \div 2)^2 =$
 $3 + 5 \cdot (4)^2 =$ (Simplify quantities in parentheses)
 $3 + 5 \cdot (16) =$ (Simplify exponents)
 $3 + 80 =$ (Multiplication & Division as we come to it L \Rightarrow R)
 $83 =$ (Addition & Subtraction as we come to it L \Rightarrow R)

SIMPLIFY ALL PROBLEMS USING THE PROPER ORDER OF OPERATIONS.

- A. $7 + 2 * 5 =$ B. $(7 + 2) * 5 =$ C. $15 - 9 \div 3 =$
D. $(15 - 9) \div 3 =$ E. $8 + 12 \div 4 - 2 =$ F. $(8 + 12) \div (4 - 2) =$
G. $8 + 12 \div (4 - 2) =$ H. $(8 + 12) \div 4 - 2 =$ I. $5 \bullet 16 \div 8 - 4 \bullet 2 =$
J. $5 \bullet (16 \div 8) - 4 \bullet 2 =$ K. $5 \bullet 16 \div (8 - 4) \bullet 2 =$ L. $30 - 15 \div 3 + 2 * 6 =$
M. $(30 - 15) \div 3 + 2 * 6 =$ N. $30 - 15 \div (3 + 2) * 6 =$ O. $(30 - 15) \div (3 + 2) * 6 =$
P. $85 - 75 \div 5 =$ Q. $(85 - 75) \div 5 =$ R. $315 \div 21 - 6 * 2 =$
S. $315 \div (21 - 6) * 2 =$ T. $1 + 2 \bullet 6 \div 3 =$ U. $(1 + 2) \bullet 6 \div 3 =$
V. $198 \div 9 - 6 + 3 * 2 =$ W. $198 \div (9 - 6) + 3 * 2 =$ X. $198 \div 9 - (6 + 3) * 2 =$

PROBLEMS 1 – 29 BELOW, AND THEIR SOLUTIONS, WERE CREATED AND VERIFIED BY THE FOLLOWING MEMBERS OF THE SPRING 1999 KENNEBEC LEARNING CENTER GENERAL MATH CLASS: SANDRA CURTIS, RITA STANTON, DEBBIE ROY, AND LISA WOOD.

1. $9 + 2 * 8 =$ 2. $(9 \bullet 2) + 6 =$ 3. $(8 + 7) \bullet 4 =$
4. $4 * (6 - 2) =$ 5. $3 * 3(5) =$ 6. $(5) + (8) =$
7. $(10 + 9) \bullet 8(7 - 2) =$ 8. $7 + 2 * 8 =$ 9. $13 + 27 \bullet 6(5 + 1) =$
10. $6 * (4 \div 4) =$ 11. $8 \div 2 * 5 =$ 12. $(9 \div 3) \bullet 7(5 + 5) =$
13. $(3) * (4) \bullet (9) =$ 14. $4(3) * (6) =$ 15. $9 \bullet 2(10 + 1) =$
16. $5 * 5(9 + 5) =$ 17. $9 \div 3 \bullet 5 + (8 - 2) =$ 18. $20 - 8(2) =$
19. $60 \div 10(3) + 2$ 20. $5 \times (3) =$ 21. $(3) \times 7 =$
22. $6 \bullet 2 + 8 =$ 23. $4 + 2 - 2 * 3 =$ 24. $18 - 9 \div 3 =$
25. $4(8 + 3) =$ 26. $2 + 5 \times 6 =$ 27. $3 + 2 \times 4 =$
28. $10(9 - 4) + 2 =$ 29. $5 + (5)(5)$

ANSWER KEY

- A. 17 B. 45 C. 12 D. 2 E. 9 F. 10
G. 14 H. 3 I. 2 J. 2 K. 40 L. 37
M. 17 N. 12 O. 18 P. 70 Q. 2 R. 3
S. 42 T. 5 U. 6 V. 22 W. 72 X. 4
1. 25 2. 24 3. 60 4. 16 5. 45 6. 13
7. 760 8. 23 9. 985 10. 6 11. 20 12. 210
13. 108 14. 72 15. 198 16. 350 17. 21 18. 4
19. 20 20. 15 21. 21 22. 20 23. 0 24. 15
25. 44 26. 32 27. 11 28. 52 29. 30

SOLVE THE FOLLOWING MULTI-STEP DECIMAL WORD PROBLEMS

PROBLEMS 1 – 4 BELOW, AND THEIR SOLUTIONS, WERE CREATED AND VERIFIED BY THE FOLLOWING MEMBERS OF THE SPRING 1999 KENNEBEC LEARNING CENTER GENERAL MATH CLASS: SANDRA CURTIS, RITA STANTON, DEBBIE ROY, AND LISA WOOD.

1. Sue went to the store and bought two pounds of bologna at \$1.99 a pound, one 10-lb. bag of potatoes for \$2.99, and two 1-lb. bags of broccoli at 99¢ a pound. What was the total?
2. Siera bought a chair for \$99.00, a couch for \$99.00, and a recliner for \$159.00. How much was left out of the \$500.00 she had to spend on furniture?
3. Mary went to the store to buy 4 pounds of bananas at 89¢ per lb., 5 pounds of grapes at 69¢ per lb., and 6 oranges at 3 for \$1.09. She gave the clerk a \$20 bill. How much money should she get back?
4. Jack wanted to build a doghouse for his dog. He went to the lumberyard to get the materials he needed:
 - 21 boards at \$2.59 per board
 - 2 lbs. of nails at 69¢ per lb.
 - 1 bundle of shingles at \$29 a bundle
 - 1 gallon of paint at \$35 a gallon

What will his total bill be?

ANSWER KEY

1. \$8.95 2. \$143.00 3. \$10.81 4. \$119.77