

## Facts and Reminders

In algebra, there is a specific order in which operations are performed when evaluating an expression or solving equations.

This is the algebraic order of operations:

1. Do any work within parentheses ( ) or other grouping symbols [ ] first.
2. Do any work with exponents (powers) or roots.
3. Do any multiplication or division in order from left to right.
4. Do any addition and subtraction in order from left to right.

The acronym for this order of operations is PEMDAS.

Parentheses   Exponents   Multiplication   Division   Addition   Subtraction

A popular expression for remembering this is: **Please Excuse My Dear Aunt Sally.**

### Sample A

Read the problem.

$$4^2 + (9 - 3) = ?$$

Do the work in the parentheses first.

$$4^2 + 6 = ?$$

Do the exponents next.

$$4^2 = 4 \times 4 = 16, \text{ so}$$

$$16 + 6 = ?$$

Finally, add the numbers together.

$$16 + 6 = 22$$

Write your answer.

$$4^2 + (9 - 3) = 22$$

### Sample B

Read the problem.

$$5^2 - (4 \times 3) + 9 \div 3 \times 4 = ?$$

Do work in the parentheses first.

$$5^2 - 12 + 9 \div 3 \times 4 = ?$$

Do exponents next.

$$5^2 = 5 \times 5 = 25, \text{ so}$$

$$25 - 12 + 9 \div 3 \times 4 = ?$$

Multiply and divide in order from left to right.

$$25 - 12 + 3 \times 4 = ?$$

9 divided by 3 is 3, and 3 times 4 equals 12.

$$25 - 12 + 12 = ?$$

Add and subtract in order from left to right.

$$13 + 12 = ?$$

25 minus 12 is 13 and 13 plus 12 equals 25.

$$13 + 12 = 25$$

Write down your answer.

$$5^2 - (4 \times 3) + 9 \div 3 \times 4 = 25$$

### Using the Calculator

Many calculators are designed to follow the algebraic order of operations. You can use the following problem to see if your calculator is programmed to follow the algebraic order of operations.

$$8 \times 4 \div 2 + 3 \times 8 \div 4 = ?$$

If your calculator answer was 22, it follows the order of operations. (Unprogrammed calculators get an incorrect answer of 38.)

# PEMDAS

## Easy Applications

The acronym for this order of operations is PEMDAS.

**P**arentheses   **E**xponents   **M**ultiplication   **D**ivision   **A**ddition   **S**ubtraction

A popular expression for remembering this is **P**lease **E**xcuse **M**y **D**ear **A**unt **S**ally.

**Directions:** Study the Facts and Reminders page for this unit. Then find the numerical value of the following expressions using the correct order of operations.

1.  $9 \times 5 - 4 + 3 \times 4 =$  \_\_\_\_\_

2.  $12 + 8 \times 6 \div 2 \times 8 =$  \_\_\_\_\_

3.  $3 + 6 \times 8 - 5 \times 2 =$  \_\_\_\_\_

4.  $7 + 8 \div 4 + 3 - 2 =$  \_\_\_\_\_

5.  $22 \div 11 + 12 - 3 =$  \_\_\_\_\_

6.  $9 \times 8 - 6 \times 3 + 7 =$  \_\_\_\_\_

7.  $13 + 5 \times 6 \div 2 + 10 =$  \_\_\_\_\_

8.  $35 \div 7 \times 8 + 2 - 4 \times 2 =$  \_\_\_\_\_

9.  $100 \div 5 \times 5 + 4 - 9 =$  \_\_\_\_\_

10.  $88 \div 11 + 56 \div 8 + 12 - 5 =$  \_\_\_\_\_



Remember the following facts:

- The fraction bar ( $\frac{\quad}{\quad}$ ) means division.
- The raised dot ( $\bullet$ ) means multiplication.
- Numbers written next to parenthesis or parentheses next to each other also require multiplication.

**Directions:** Find the numerical value of these expressions.

11.  $5(8) - \frac{30}{5} + 4 \times 3 =$  \_\_\_\_\_

12.  $(7)(9) + \frac{9}{3} - 20 \times 3 =$  \_\_\_\_\_

13.  $8(9) + 10 \bullet 5 + 8 \bullet 2 =$  \_\_\_\_\_

14.  $3 + 8 \bullet 10 - 13 \times 3 =$  \_\_\_\_\_

15.  $17 + 5 - 6 \bullet 4 + \frac{12}{3} =$  \_\_\_\_\_

16.  $9 + \frac{44}{4} - 8 \times 2 + 20 - 3 =$  \_\_\_\_\_

**Parentheses and Exponents**

**Sample**

Read the problem.

$$3 + (2 \times 4) - 2^2 + 3 = ?$$

Do the work in the parentheses first.

$$3 + 8 - 2^2 + 3 = ?$$

Get the numerical value of the exponent next.

$$3 + 8 - 4 + 3 = ?$$

Add and subtract in order from left to right.

$$11 - 4 + 3 = ?$$

$$7 + 3 = ?$$

Record your answer.

$$3 + (2 \times 4) - 2^2 + 3 = 10$$

**Directions:** Study the Facts and Reminders page for this unit. Find the numerical value of each expression.

1.  $(2 \times 3) + 3^2 - 5 \times 3 = \underline{\hspace{2cm}}$

2.  $10^2 - (3 \times 30) + 8 = \underline{\hspace{2cm}}$

3.  $4 + (2 \times 10) - 2^2 = \underline{\hspace{2cm}}$

4.  $8 + (5 \times 5) - 3^2 = \underline{\hspace{2cm}}$

5.  $4^2 - 13 + (12 \times 2) = \underline{\hspace{2cm}}$

6.  $7^2 + 3(2 \times 4) - 3 = \underline{\hspace{2cm}}$

7.  $3 + 5^2 - (12 + 3) = \underline{\hspace{2cm}}$

8.  $9 + 4^2 - (5 \times 5) + 2 = \underline{\hspace{2cm}}$

9.  $11 - 2^2 + (3 \times 2) - 4 = \underline{\hspace{2cm}}$

10.  $2(4 \times 5) + 3^2 - 2^2 = \underline{\hspace{2cm}}$

11.  $18 - (3 \times 4) + 5^2 - 2 = \underline{\hspace{2cm}}$

12.  $7(4 \times 2) - 4^2 + (2 \times 9) = \underline{\hspace{2cm}}$

13.  $10^2 - 3 \times 4 + (6 \times 4) - 5 = \underline{\hspace{2cm}}$

14.  $12^2 + 3 - 2(2 \times 4) - 5^2 + 11 = \underline{\hspace{2cm}}$

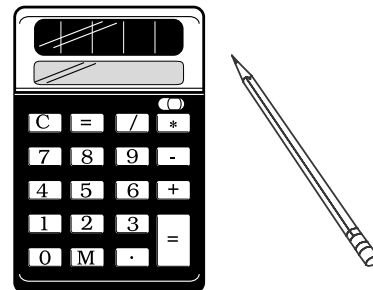
15.  $(15 + 7) \times 2 \times 3 - 6(4 \times 3) + 12 = \underline{\hspace{2cm}}$

16.  $(12 - 5) + (2 + 13) - 2^2 + 30 = \underline{\hspace{2cm}}$

# PEMDAS

## Using the Calculator

Check your calculator to determine if it is programmed to follow the algebraic order of operations. Find the numerical value of this expression:  $9 \times 10 \div 2 + 3 \times 12 \div 2 = ?$  Do not push the “equal” button between each operation. If your calculator follows the algebraic order of operations, you will get the correct answer which is 63. If it is not programmed, you will get an incorrect answer, 288.



**Directions:** Study the Facts and Reminders page for this unit. If you have a calculator programmed with the algebraic order of operations, use it to help you find the numerical value of these expressions. You can still use unprogrammed calculators to help you do individual multiplication or division calculations. Remember, you must still do the work inside the parentheses first and exponents next before running the expression through the calculator.

- $7 \times 3 + 6 - 5 \times 4 - 2 + 11 \times 3 = \underline{\hspace{2cm}}$
- $10 \times 14 - 6 + 15 \times 8 - 20 + 52 \div 2 + 13 = \underline{\hspace{2cm}}$
- $27 - 16 + 3 \times 16 - 6 \times 12 \div 3 + 59 - 18 = \underline{\hspace{2cm}}$
- $16 \times 3 - 7 \times 12 + 13 \times 6 + 21 \div 3 + 29 = \underline{\hspace{2cm}}$
- $28 \times 10 + 12 \times 17 - 13(5 + 2) - 19 + 38 = \underline{\hspace{2cm}}$
- $20(4 \times 5) - 12^2 + 6(9 \times 4) - 11 = \underline{\hspace{2cm}}$
- $7(5 - 2) + (7 \times 9) \div 3(2 + 5) + 13(2 + 1) = \underline{\hspace{2cm}}$
- $(12 \times 8) + (15 \times 4) - 6^2 + 5(9 + 1) + 17 = \underline{\hspace{2cm}}$
- $12 + 5(30 - 5) - 3^3 + 15(10 + 2) - 18 + 4 \times 2 = \underline{\hspace{2cm}}$
- $4(5 \times 3) - 2^2 + 3^2 - (3 \times 9) - 23 + 5 \times 3 + 16 = \underline{\hspace{2cm}}$

# Answer Key

## Page 46

1. 1
2. 1
3. 2
4. 3
5. 5
6. 8
7. 13
8. 21
9. 34
10. 55
11. 89
12. 144
13. 233
14. 377
15. 610
16. 987
17. 1597
18. 2584

## Page 48

1. 53
2. 15
3. 41
4. 10
5. 11
6. 61
7. 38
8. 34
9. 95
10. 22
11. 46
12. 6
13. 138
14. 44
15. 2
16. 21

## Page 49

1. 0
2. 18
3. 20
4. 24
5. 27
6. 70
7. 13
8. 2
9. 9
10. 45
11. 29
12. 58
13. 107
14. 117
15. 72
16. 48

## Page 50

1. 38
2. 273
3. 76
4. 78
5. 412
6. 461
7. 63
8. 187
9. 280
10. 46

## Page 52

1.  $f(n) = n + 4$
2.  $f(n) = n + 11$
3.  $f(n) = n - 6$
4.  $f(n) = n \times 3$
5.  $f(n) = n \times 4$
6.  $f(n) = n \div 9$
7.  $f(n) = n + 18$
8.  $f(n) = n - 3$
9.  $f(n) = n \times 5$
10. 24, 56, 88, 96, 120  
 $f(n) = n \times 8$
11. 15, 18, 19, 21, 25  
 $f(n) = n + 6$
12. 1, 3, 5, 10, 14  
 $f(n) = n - 5$
13. 30, 35, 40, 55, 75  
 $f(n) = n \times 5$
14. 10, 12, 13, 15, 16  
 $f(n) = n \div 6$
15. 17, 29, 44, 55, 68  
 $f(n) = n - 15$

## Page 53

1. 21, 33, 37, 41, 53, 69
2. 15, 18, 24, 27, 33, 42
3. 45, 61, 69, 77, 101
4. 4, 9, 16, 25, 36
5. 29, 25, 42, 51, 55
6. 5, 10, 17, 26, 37
7. 20, 29, 44, 53, 74, 89  
 $f(n) = (n \times 3) - 1$
8. 14, 13, 10, 8, 7, 5  
 $f(n) = (n \div 12) + 2$
9. 21, 29, 33, 45, 65, 81  
 $f(n) = (n \times 4) + 5$
10. 33, 39, 51, 63, 87, 105  
 $f(n) = (n \times 6) - 3$

## Page 54

1.  $f(n) = n + 2$
2.  $f(n) = n + 3$
3.  $f(n) = n + 1$
4.  $f(n) = n + 4$
5.  $f(n) = (n \times 2) + 2$
6.  $f(n) = n + 4$

## Page 56

1. -10
2. -8
3. +7
4. -16
5. -21
6. -24
7. -13
8. +10
9. +2
10. -13
11. -6

## Page 57

1. +6
2. -4
3. +16
4. -59
5. +11
6. -13
7. -22
8. +31
9. -23
10. -22
11. -21
12. -34
13. -110
14. -32
15. -56
16. -40
17. +450
18. -579
19. +176
20. -1
21. -198

## Page 58

1. -15
2. +25
3. -20
4. -18
5. -18
6. -21
7. -72
8. +90
9. +200
10. -144
11. +144
12. -100
13. +150
14. +150
15. -150
16. +400
17. -400
18. -400
19. +1,000
20. +1,000
21. -1,000

## Page 60

1. 10
2. 14
3. 0
4. 8
5. 11
6. 30
7. 15
8. 34
9. 15
10. 16
11. 10
12. 21
13. 27
14. 32
15. 59
16. 10
17. 99
18. 101
19. 35
20. 90
21. 26
22. 20
23. 0
24. 88
25. 25
26. 21
27. 5
28. 27
29. 28
30. 2
31. 21
32. 23
33. 6
34. 66
35. 16
36. 61
37. 57
38. 54

## Page 61

1.  $n = 11$
2.  $n = 3$
3.  $a = 4$
4.  $n = 25$
5.  $a = 15$
6.  $n = 26$
7.  $x = 27$
8.  $n = 10$
9.  $a = 20$
10.  $n = 31$
11.  $x = 25$
12.  $a = 14$
13.  $n = 24$
14.  $a = 91$
15.  $n = 27$
16.  $a = 65$
17.  $x = 38$
18.  $n = 66$

## Page 62

1.  $n = 5$
2.  $n = 11$
3.  $n = 3$
4.  $a = 4$
5.  $n = 7$
6.  $n = 10$
7.  $n = 5$
8.  $a = 6$
9.  $a = 15$
10.  $n = 20$
11.  $n = 60$
12.  $a = 60$
13.  $n = 16$
14.  $n = 60$
15.  $a = 64$
16.  $n = 160$
17.  $a = 70$
18.  $n = 40$