Name: _____   **Date: _____**

Day 2: Order of Operations

Order of Operations

1. Evaluate expressions inside **grouping symbols**. Usually these are just <u>parentheses.</u>
    Note: you must follow the order of operations within the grouping symbols.

    - Grouping symbols include: <u>Parentheses</u>, <u>Radicals</u>, <u>Brackets</u> and <u>Braces</u>.

    - Example: $(4+2)^2 \bullet 2$

2. Evaluate **<u>powers</u>** and **<u>roots</u>**. This is usually remembered with the word <u>exponents.</u>
    - Example: $6^2 + 4$

3. **Multiply** and **divide** from **<u>left to right.</u>**
    - Remember, you can express multiplication by using parentheses or the symbols $\bullet$ or x.

          $3(4) =$ $7 \bullet 6 =$ $8 \times 5 =$

    - Division can be expressed using either ÷ or a fraction bar. To evaluate an expression with a fraction bar, evaluate the numerator and the denominator separately before you divide.

          $$\frac{6(10)}{4+6}$$

    - Example: 12 ÷ 3(3) → Simplify 12 ÷ 3 before multiplying.

4. **Add** and **subtract** from **<u>left to right.</u>**

    - Example: 12 – 7 + 3 → Simplify 12-7 before doing addition

Rules for Order of Operations	
	Example # 1

	Example # 1	

P Parentheses

E Exponents

Left ——— to ——→ Right

M Multiplication | **D** Division

Left ——— to ——→ Right

A Addition | **S** Subtraction

Evaluate $12 - 2 \times 4$

$12 - (2 \times 4)$

$(12 - 8)$

4

Steps

P

E

M→D

A↔S

Evaluate	Steps
Example # 2 $5 - 3 + 6$ $[5 - 3] + 6$ $2 + 6$ Solution: ___8___ (8) 	1. P 2. E 3. M or D 4. A or S Left to Right
Example #3 $20 \div 4(6)$ $20 \div 4(6)$ $5(6)$ 30 Solution: ___30___	1) P 2) E 3) M or D Left to 4) A or S Right
Example #4 $5^2 - 10 \div 5$ $5^2 - 10 \div 5$ $5^2 = 5 \cdot 5 = 25$ $25 - 10 \div 5$ $25 - 2$ Solution: ___23___ 23	1) P 2) E 3) M or D 4) A or S

Example # 1	**Steps**	Example # 2

Evaluate the expression below. Show your work.
 	
$10 - 7 + 9$
	1.
	
	2.
	
	3.
	
	4.
		Kylee tries to evaluate 5 x 1 + 6, as shown below.
		   1) 5 x 6
		   2) 30 is my answer.
		After Ms. Napolitano collected Kylee's work, she realized that Kylee was incorrect. Explain why her answer is incorrect, then state the correct answer.
		
		_____
		÷ _____
		_____
		_____

Answer: _____		

Example # 3

Evaluate the expression below. Show your work.

$5 + 3^2 - 10$

Answer: _____

P	
Parentheses	
E	
Exponents	
Left ———— to ————→ Right	
M	D
Multiplication	Division
Left ———— to ————→ Right	
A	S
Addition	Subtraction

Guided Practice:

Evaluate	Steps
Example # 1 $(6 - 4)^3 + 8$ $2^3 + 8$ $2 \cdot 2 \cdot 2 + 8$ $8 + 8 = 16$ Solution: __16__ 16	1. P 2. E 3. M or D 4. A or S
Example #2 $4^2 - 3 \times 3 + 7$ $4^2 \ 3 \times 3 + 7$ $16 - 3 \times 3 + 7$ $16 - 9 + 7$ $7 + 7$ Solution: __14__ 14	1. P 2. E 3. M or D 4. A or S

Example #1 $7 - 4 + 9$	Example #2 $7 + 4 - 9$

Example #1

$7 - 4 + 9$

P
Parentheses

E
Exponents

Left _____ to _____ → Right

M   D
Multiplication   Division

Left _____ to _____ → Right

A   S
Addition   Subtraction

Solution:_____

Example #2

$7 + 4 - 9$

P
Parentheses

E
Exponents

Left _____ to _____ → Right

M   D
Multiplication   Division

Left _____ to _____ → Right

A   S
Addition   Subtraction
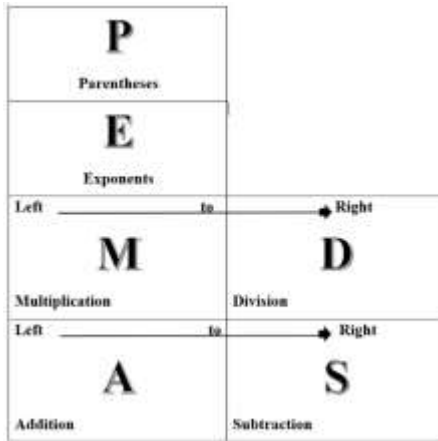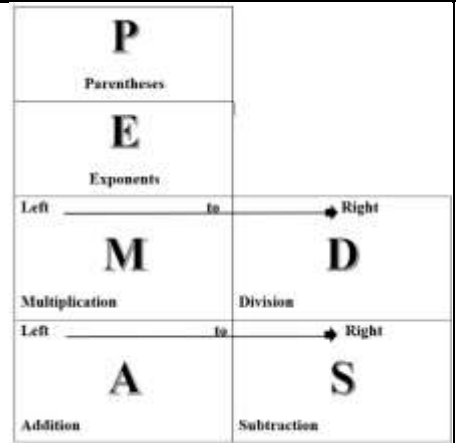
Solution:_____

Example #3 $16 \div 2 + 3^2$	1) 2) 3) 4)
Solution:_____	
Example #4 $18 + (9 - 3) \div 3$	1) 2) 3) 4)
Solution:_____	
Example #5 $4^2 + 1^3$	1) 2) 3) 4)
Solution:_____	

Example #3

Two students simplified the expression below. Susan said that the answer is 16 and Richard said the answer is 17. Which student is correct? What error do you think the student who had the incorrect answer made?

Susan's Work

$$5 \times 4 - 2^3 \div 2$$
$$= 5 \times 4 - 8 \div 2$$
$$= 20 - 8 \div 2$$
$$= 20 - 4$$
$$= 16$$

Richard's Work

$$5 \times 4 - 2^3 \div 2$$
$$= 5 \times 4 - 6 \div 2$$
$$= 20 - 6 \div 2$$
$$= 20 - 3$$
$$= 17$$

Evaluate	Steps
Example # 2	

Example # 2

Evaluate $7 + 60 \div (3 \times 5)$.

$7 + 60 \div 15$

$7 + 4$

11

Solution: 11

PEMDAS chart — P (Parentheses) circled, E (Exponents), M (Multiplication)/D (Division) Left to Right with D circled, A (Addition) circled / S (Subtraction)
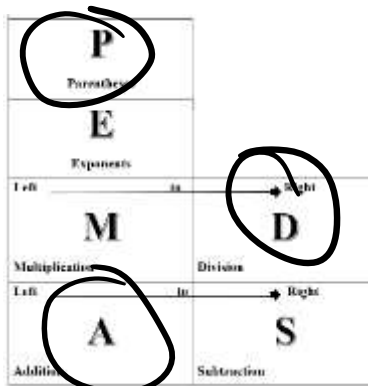
Example #3

Simplify the expression: $5 \times 2^2 - 8 \div 2$

$5 \times 2^2 - 8 \div 2$

$5 \times 4 - 8 \div 2$

$20 - 8 \div 2$

$20 - 16$

4

Solution: 4
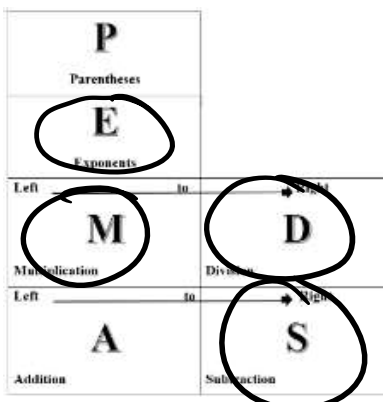
PEMDAS chart — P (Parentheses), E (Exponents) circled, M (Multiplication) circled / D (Division), A (Addition) / S (Subtraction) circled — left to Right

Example #4

Evaluate $30 \div (7 + 2^3) \times 6$.

$30 \div (7 + 2^3) \times 6$

$30 \div (7 + 8) \times 6$

$30 \div 15 \times 6$

2×6

12

Solution: 12

PEMDAS chart — P (Parentheses) circled, E (Exponents), M (Multiplication) circled / D (Division) circled, A (Addition) / S (Subtraction) — Left to Right
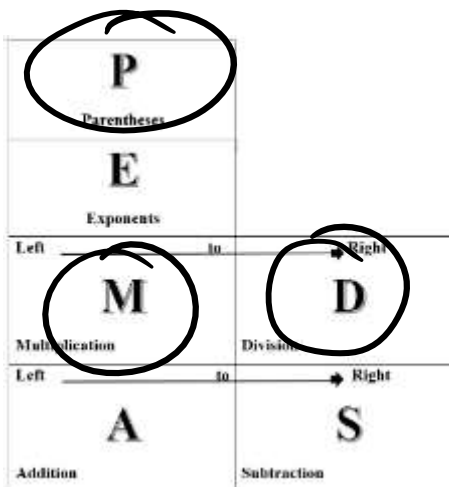
Example # 1

✳Error Analysis✳

Describe and correct the error that Ms. Peterson made when solving the problem on the right.

$$\times \quad \begin{array}{l} 8 - 4 + 3 = 8 - 7 \\ \qquad = 1 \end{array}$$

Error:

_____

_____

Now, solve the problem correctly:

Answer: _____

Example # 2

Evaluate the expression below. Show your work.

$15 - (12 - 7)^2 \div 5$

P
Parentheses
E
Exponents

Left ———to——→ Right	
M	D
Multiplication	Division

Left ———to——→ Right	
A	S
Addition	Subtraction

Example # 3

Kylee tries to evaluate $4^2 \times 1 + 6$, as shown below.

$4^2 \times 1 + 6$

$= 4^2 \times 7$

$= 16 \times 7$

$= 112$

After Ms. Napolitano collected Kylee's work, she realized that Kylee was incorrect. Explain why her answer is incorrect, then state the correct answer.

_____

_____

_____

_____

_____

_____

Example # 4

Simplify: $10 \div 2 - 3 + 2^4$

P
Parentheses
E
Exponents

Left ———to——→ Right	
M	D
Multiplication	Division

Left ———to——→ Right	
A	S
Addition	Subtraction

Independent Practice

1. In the expression 5^7, the 7 is the

a. base
b. root
c. multiple
d. exponent

2. In the expression 4^3 the 4 is the

a. base
b. multiple
c. exponent
d. answer

3a. Which expression below shows 7^3 in expanded form?

a. 7 x 3
b. 3 x 3 x 3 x 3 x3 x 3 x 3
c. 7 x 7 x 7
d. 7 + 7 + 7

4) In what order should the operations be performed to evaluate the expression

$$2 \times 4 - 6 \div 3 + 1?$$

(a) x, ÷, −, +   (b) x, −, ÷, +

(c) x, ÷, +, −   (d) x, +, −, ÷

5) Which operation should be done **last** when evaluating $5^3 - 2^4 \div 4$?

(a) Find 5^3 (b) Find 2^4

(c) Subtract   (d) Divide

6) Simplify. $9 \cdot 6 + 27 \div 3^2$

Answer: _____

7) Four scholars were asked to evaluate the expression $3^3 - 24 \div 6$. Who responded correctly?

    (a) Mike's answer: 0.5   (b) Jenry's answer: 5

    (c) Cory's answer: 21   (d) Kenneth's answer: 23

Final CFU

Simplify the expression: $12 - 2^2 + 5 \cdot 6$

Answer: _____

Day 2
Practice Makes Perfect

Rewrite the expression as repeated multiplication and simplify

1. 5^2 _____   _____

2. 3^2 _____   _____

3. 7^1 _____   _____

4. 5^0 _____   _____

5. $6^2 \times 3^3$ _____   _____

6. Square each number:

a. 5 _____   b. $\left(\frac{3}{4}\right)$ _____   c. 10 _____

7. Simplify each expression below.

a. 6^2	b. 4^3	c. 5^1
A. 8 B. 12 C. 36 D. 216	A. 64 B. 7 C. 12 D. 56	A. 5 B. 10 C. 25 D. 6

8. Johnny said that the expression below can be simplified by multiplying 36x3. Is he correct? Explain why or why not.

36^3

_____

_____

_____

Evaluate the expression.

9.) $10 - 6 + 8$

10.) $35 - 20 \div 5$

11.) $4 \cdot 7^2$

Answer: _____

Answer: _____

Answer: _____

12.) $3^2 - 6 \div 3$

13.) $12.4 + 25 \div 5^2$

14.) $12^2 - 48 \div \frac{1}{2}$

Answer: _____

Answer: _____

Answer: _____

15.) $28 \div 2^2 - 36 \div 3^2$

16.) $168 \div 2^3 + 3^3 - 20$

Answer: _____

Answer: _____

17.) The numerical expression $8 + 12 \div 4$ was evaluated in two different ways, resulting in different values.

Solution A
$8 + 12 \div 4$
$20 \div 4$
5

Solution B
$8 + 12 \div 4$
$8 + 3$
5

Which is the correct solution? How do you know?

_____

_____

_____

Complete the statement using +, −, × or ÷ to make the statement true.

18.) 2^3 _____ 5 _____ 6 _____ 10 = 5

19.)   14 _____ 7 _____ 5 = 20 ÷ 4 × 2