**Unit 1:**
**Lesson 01**  **Order of operations (PEMDAS)**

In arithmetic expressions it is important to know the **order** in which to do the operations. The correct order is given by **PEMDAS**:

- PEMDAS is a memory aid for the correct order: **parentheses, exponents, multiplication, division, addition, and subtraction**.

- Even though multiplication is listed before division, they are actually of the **same** priority.

- Even though addition is listed before subtraction, they are actually of the **same** priority.

- When deciding which of two operations of the same priority to do first, do them in a **left-to-right order**.

In the following examples, perform the arithmetic operations in the correct order to produce a final value for the expression.

**Example 1:** $2 \cdot 8 + 5 - 6 + 1 \cdot 3$

$$= 16 + 5 - 6 + 1 \cdot 3$$
$$= 16 + 5 - 6 + 3$$
$$= 21 - 6 + 3$$
$$= 15 + 3 = \boxed{18}$$

**Example 2:** $17 + 6 \cdot 3 \div 2$

$$= 17 + 18 \div 2$$
$$= 17 + 9$$
$$= \boxed{26}$$

**Example 3:** $2 \cdot (7 + 2) + 1 - 8/2$

$$= 2(9) + 1 - 8/2$$
$$= 18 + 1 - 8/2$$
$$= 18 + 1 - 4$$
$$= 19 - 4 = \boxed{15}$$

**Example 4:** $2 \cdot 3^2 - 15/3$

$$= 2 \cdot 9 - 15/3$$
$$= 18 - 15/3$$
$$= 18 - 5 = \boxed{13}$$

**Example 5:** $24 \div 2^2 \cdot 10 - 2(3 \cdot 5)$

$$= 24 \div 2^2 \cdot 10 - 2(15)$$
$$= 24 \div 4 \cdot 10 - 30$$
$$= 6 \cdot 10 - 30$$
$$= 60 - 30$$
$$= \boxed{30}$$

**Example 6:** $(18 - (12/2) + 3)/(4 + 1)$

$$= (18 - 6 + 3)/(4 + 1)$$
$$= (12 + 3)/(5)$$
$$= 15/5$$
$$= \boxed{3}$$

As a special case of parentheses, consider a fraction written in this form:

$$\frac{a + b}{c + d}$$

Rewrite with parentheses in this form $(a + b)/(c + d)$ and simplify in the parentheses first.

**Example 7:** $\dfrac{3 \cdot 2 + 6 \cdot 5}{28 - 25}$

$$= (3 \cdot 2 + 6 \cdot 5)/(28 - 25)$$
$$= (6 + 6 \cdot 5)/3$$
$$= (6 + 30)/3$$
$$= 36/3 = \boxed{12}$$

**Assignment:** In the following examples, perform the arithmetic operations in the correct order to produce a final value for the expression.

1. $8 + 4(7 - 2)$

$$= 8 + 4(5)$$
$$= 8 + 20$$
$$= \boxed{28}$$

2. $3(4 + 1) - 12 \div 2^2$

$$= 3(5) - 12 \div 2^2$$
$$= 3 \cdot 5 - 12 \div 4$$
$$= 15 - 12/4$$
$$= 15 - 3 = \boxed{12}$$

3. $11 - 22/11 + 2^3 \cdot 6$

$$= 11 - 22/11 + 8 \cdot 6$$
$$= 11 - 2 + 48$$
$$= 9 + 48$$
$$= \boxed{57}$$

4. $40 - 25 \div 5$

$$= 40 - 5$$
$$= \boxed{35}$$

5. $(6 \cdot 5)/(11 - 8)$

$$= 30/3$$
$$= \boxed{10}$$

6. $\dfrac{4 \cdot 3^2}{18 - 2 \cdot 3}$

$$= (4 \cdot 3^2)/(18 - 2 \cdot 3)$$
$$= (4 \cdot 9)/(18 - 6)$$
$$= 36/12$$
$$= \boxed{3}$$

7. $11 + 1 \cdot 2 - 4 \cdot 1 + 36 \div 3$

$= 11 + 2 - 4 \cdot 1 + 36 \div 3$
$= 11 + 2 - 4 + 36 \div 3$
$= 11 + 2 - 4 + 12$
$= 13 - 4 + 12$
$= 9 + 12 = \boxed{21}$

8. $200/2/2 \cdot 3 + 1$

$= 100/2 \cdot 3 + 1$
$= 50 \cdot 3 + 1$
$= \boxed{151}$

9. $\dfrac{10 \cdot 2 + 1 \cdot 12}{1 + 2 \cdot 3 - 3}$

$= (10 \cdot 2 + 1 \cdot 12)/(1 + 2 \cdot 3 - 3)$
$= (20 + 1 \cdot 12)/(1 + 6 - 3)$
$= (20 + 12)/(7 - 3)$
$= 32/4 = \boxed{8}$

10. $8 \cdot 5 - 2(22 \div 2) + 3(5 - 2)$

$= 8 \cdot 5 - 2(11) + 3(5 - 2)$
$= 8 \cdot 5 - 2(11) + 3(3)$
$= 40 - 2(11) + 3(3)$
$= 40 - 22 + 3(3)$
$= 40 - 22 + 9$
$= 18 + 9$
$= \boxed{27}$

11. $3(36 \div 9) + 2(80 - 60) - 3 \cdot 4$

$= 3(4) + 2(20) - 3 \cdot 4$
$= 12 + 2(20) - 3 \cdot 4$
$= 12 + 40 - 3 \cdot 4$
$= 12 + 40 - 12$
$= 52 - 12 = \boxed{40}$

12. $\dfrac{5 \cdot 2 + 48 \div 12}{9 - 2 - 5}$

$= (5\cdot 2 + 48 \div 12)/(9-2-5)$

$= (10 + 48 \div 12)/(7-5)$

$= (10 + 4)/2$

$= 14/2 = \boxed{7}$

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*13. $\{ 72 - 4[11 - 3(12/4)] \}/2$

$= \{72 - 4[11 - 3(3)]\}/2$

$= \{72 - 4[11 - 9]\}/2$

$= \{72 - 4[2]\}/2$

$= \{72 - 8\}/2 = 64/2 = \boxed{32}$

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*14. $\dfrac{15[\, 5 + 3(8 \div 4 + 2)\,] + 15}{7 - 45 \div [5 + 2(6 \div 3)]}$

$= (15[5 + 3(2+2)] + 15)/(7 - 45 \div [5 + 2\cdot 2])$

$= (15[5 + 3(4)] + 15)/(7 - 45 \div [5 + 4])$

$= (15[5 + 12] + 15)/(7 - 45 \div 9)$

$= (15[17] + 15)/(7 - 5)$

$= (255 + 15)/2$

$= 270/2 = \boxed{135}$