FIBO / MATH / ALGEBRA · UNIT 1 · NUMBER SENSE

Order of Operations — Lecture

Without agreed-upon rules, 3 + 4 × 2 could be 11 or 14. PEMDAS is the contract that makes every expression mean exactly one thing — learn the precedence ladder and the left-to-right pairs.

BY THE END OF THIS LESSON, YOU WILL BE ABLE TO

- ✓ Apply the PEMDAS precedence ladder to evaluate integer expressions
- ✓ Work the same-rung pairs (×/÷ and +/−) left to right
- ✓ Resolve nested grouping inside-out, including fraction bars as grouping
- ✓ Use order of operations to solve real bill, discount, and splitting problems

⏱ About 25 min · Needs: integers, integer operations · Unit 1 · Number Sense

Name: _____ **Date:** _____

Printable companion to the interactive lesson at fibotutors.com — full color. Worked examples and application solutions are shown in full; Try-It answers live in the separate Answer Key.

CONCEPTS

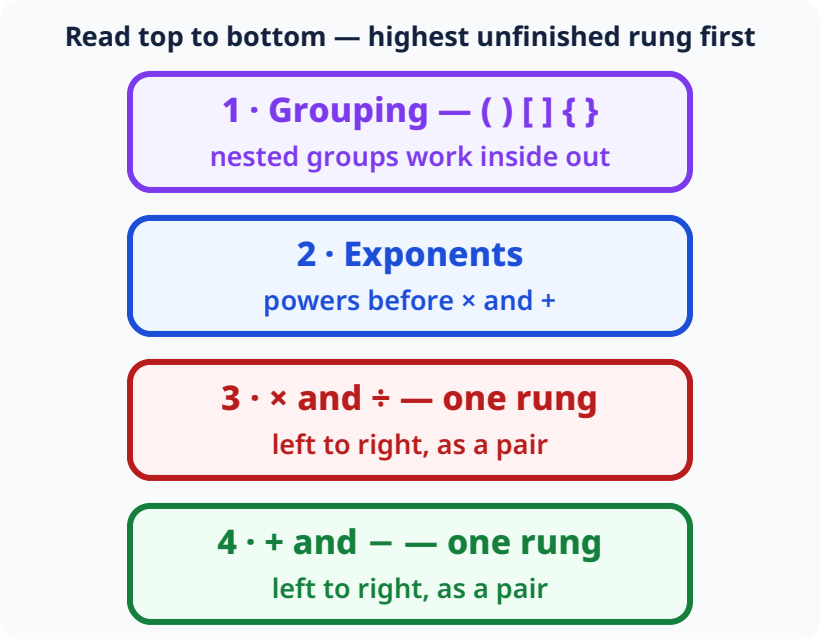
The Big Picture

Math is a language, and every language needs grammar. **PEMDAS** — Parentheses (grouping), Exponents, Multiplication/Division, Addition/Subtraction — is the grammar that guarantees *one* expression has *one* value.

Think of it as a **precedence ladder** with four rungs. You always finish the highest unfinished rung before stepping down. Two operations on the *same* rung are **partners, not rivals**: they take turns from left to right.

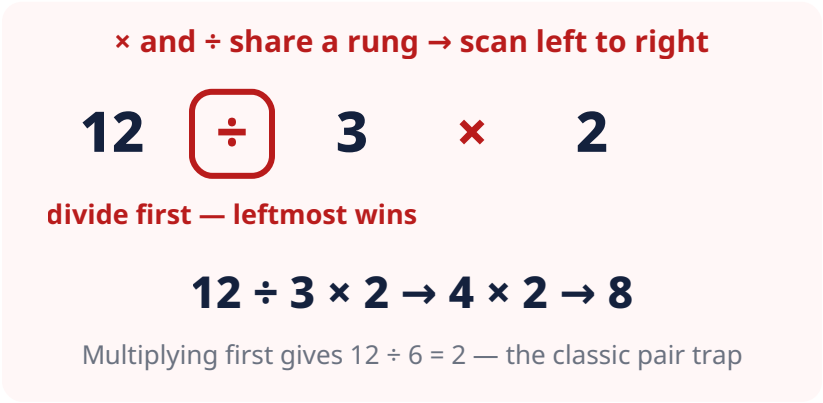
The two classic partner pairs: × and ÷ are one rung, and + and − are one rung. There is no "multiplication before division" — PEMDAS is four rungs, not six.

Read the ladder **top to bottom** — always do the highest unfinished rung first. The colors are your cheat code: purple = grouping, blue = exponents, red = ×/÷, green = +/−.



The four rungs of PEMDAS. Same rung? Work left to right — never "× before ÷".

The pair trap: in 12 ÷ 3 × 2, ÷ and × sit on the same red rung, so you scan left to right. The ÷ comes first — it wins.



Same rung → the leftmost operation wins: 12 ÷ 3 × 2 = 8.

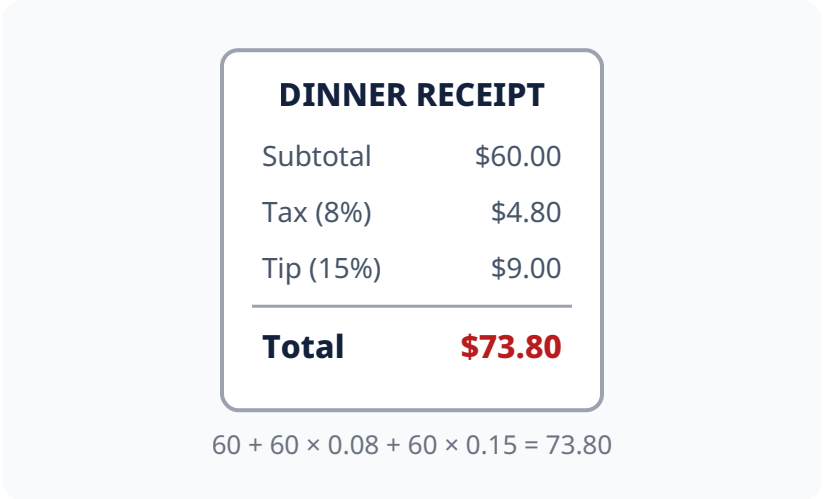
The formula, in one line: Grouping (inside-out) → Exponents → ×/÷ left to right → +/− left to right. And one bonus rule: the **fraction bar is a grouping symbol in disguise** — compute the whole top (and whole bottom) before dividing.

REAL LIFE FIRST

Math in the Wild

REAL LIFE FIRST

📷 Picture this: friends at a restaurant table splitting a paper check



A receipt *is* an order-of-operations expression: multiply for tax and tip first, then add. 60 + 4.80 + 9.00 = $73.80.

Your bill, in math: a $60 meal with 8% tax and a 15% tip on the subtotal is the expression **60 + 60 × 0.08 + 60 × 0.15**. The multiplications (tax and tip) outrank the additions, so you compute $4.80 and $9.00 first, then add: **$73.80**. Anyone who added first would owe the wrong amount.

Discounts flip the order: a $40 shirt at 25% off is 40 × 0.75 = $30 — the multiplication happens *before* you subtract anything, because the discount is one percentage of the whole. Grouping (sale price first) vs. no grouping (percent applied where it lands) is exactly what the ladder decides.

WORKED EXAMPLES

See Every Step

Example 1 — × outranks +

Step 1 Find the rungs: 3 + 4 is rung 4 (green), 4 × 2 is rung 3 (red). Red goes first.

Step 2 Multiply: 4 × 2 = 8. The expression becomes 3 + 8.

Step 3 Add: 3 + 8 = 11.

3 + 4 × 2 = 11

➜ Going straight left to right gives (3 + 4) × 2 = 14 — wrong. ×/÷ always outrank +/−.

✏️ Workspace — rework this example

✏️ Try It 1 — your turn

Evaluate 5 + 3 × 4.

(Answer in the separate Answer Key — try it on your own first!)

✏️ Workspace — solve the Try-It here

Example 2 — nested grouping, inside out

Step 1 Purple rung: find the innermost group: (4 − 1) = 3.

Step 2 The next layer out: [3 + 3] = 6.

Step 3 Now multiply: 2 × 6 = 12.

2 × [3 + (4 − 1)] = 12

➜ Always peel grouping inside out — never add across an unfinished inner group.

✏️ Workspace — rework this example

✏️ Try It 2 — your turn

Evaluate 5 × (2 + (6 − 4)).

(Answer in the separate Answer Key — try it on your own first!)

✏️ Workspace — solve the Try-It here

Example 3 — grouping, a pair, and an exponent

Step 1 Purple rung: $(8 + 4) = 12$ → the expression is $12 \div 3 + 2^2$.

Step 2 Blue rung: $2^2 = 4$ → now $12 \div 3 + 4$.

Step 3 Red rung: $12 \div 3 = 4$ → now $4 + 4$.

$(8 + 4) \div 3 + 2^2 = 4 + 4 = 8$

→ Four rungs, one pass each: group → exponent → ÷ → +.

✏️ Workspace — rework this example

✏️ Try It 3 — your turn

Evaluate $(10 - 2) \div 4 + 3^2$.

(Answer in the separate Answer Key — try it on your own first!)

✏️ Workspace — solve the Try-It here

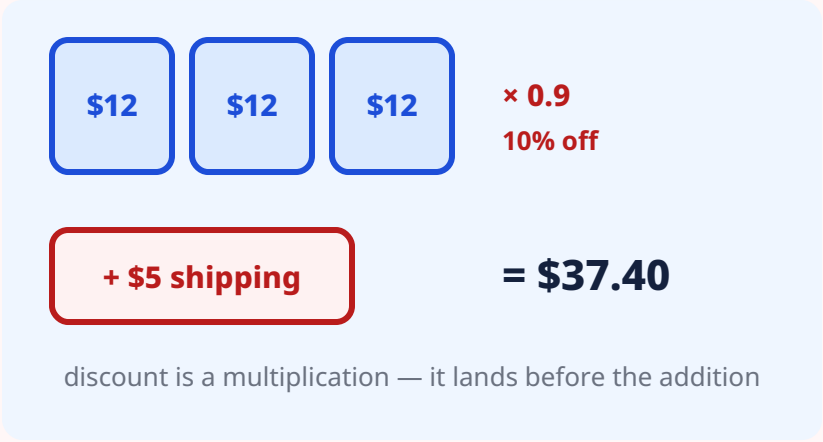
USE IT FOR REAL

Application Problems

USE IT FOR REAL

App 1 — Shirts on sale

You buy 3 shirts at $12 each with 10% off, plus $5 shipping. What is the total?



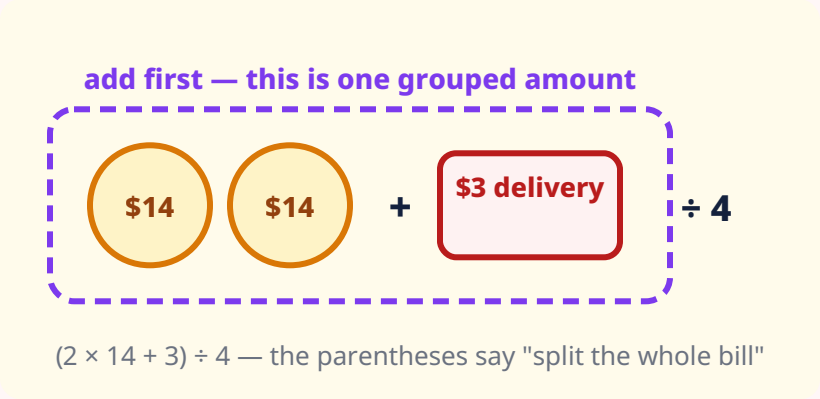
10% off means "times 0.9" — a multiplication that outranks the shipping addition.

Solution. Total = 3 × 12 × 0.9 + 5. Red rung first: 3 × 12 = 36, then 36 × 0.9 = 32.40. Green rung last: 32.40 + 5 = **$37.40**.

✏️ Workspace — solve it your way first, then compare

App 2 — Pizza split 4 ways

Two pizzas cost $14 each, plus a $3 delivery fee. Four friends split the bill evenly. How much does each pay?



The grouping brackets force "the whole bill" to be found before dividing by 4.

Solution. Each share = (2 × 14 + 3) ÷ 4. Purple rung: 2 × 14 = 28, then 28 + 3 = 31. Red rung: 31 ÷ 4 = **$7.75** each.

✏️ **Workspace — solve it your way first, then compare**

App 3 — The exponent surprise

A game starts you with 100 points, then subtracts 4 times the square of the level number. How many points at level 2?

$$100 \quad - \quad 4 \quad \times \quad \boxed{2^2}$$

exponent first

$$\rightarrow 100 - 4 \times 4 \rightarrow 100 - 16 \rightarrow 84$$

$2^2 = 4$ before the × 4 before the − from 100 — one rung at a time.

Solution. Points = $100 - 4 \times 2^2$. Blue rung: $2^2 = 4$. Red rung: $4 \times 4 = 16$. Green rung: $100 - 16 =$ **84 points**.

✏️ Workspace — solve it your way first, then compare

KEEP FOREVER

Key Points — Cheat Sheet

- The four rungs, in order: Grouping (inside-out) → Exponents → ×/÷ → +/−
- × and ÷ are one rung — work them **left to right**, never "× before ÷"
- + and − are one rung — work them **left to right**, never "+ before −"
- The fraction bar is a grouping symbol — compute the whole top (and bottom) before dividing
- Nested groups resolve inside out; parentheses are free — add them any time they clarify meaning
- Watch the sign: $\mathbf{-3^2 = -9}$, but $\mathbf{(-3)^2 = 9}$