How to Understand Any Physics Equation

Case Study: Newton's Second Law

By SpideyPhysics

1. Name the Equation

Knowing what you're looking at helps your brain categorize information.
F = ma → *Newton's Second Law*

2. Define Every Symbol (with Units)

Write what each letter means and include its standard unit:

- **F** = Force [Newtons, N]
- **m** = Mass [kilograms, kg]
- **a** = Acceleration [meters/second^2, m/s^2]

Tip: Units help anchor understanding — don't skip them.

3. Rewrite in Equivalent Forms

Show how the equation links to calculus and related forms:

- $F = m \cdot \frac{dv}{dt}$ (acceleration as derivative of velocity)
- $F = m \cdot \frac{d^2x}{dt^2}$ (acceleration as second derivative of position)

4. Recognize Functions of Time

Position, velocity, and acceleration are often functions of time:

- $x(t)$ = position
- $v(t)$ = velocity
- $a(t)$ = acceleration

Understanding this helps when solving motion problems.

5. Expand the Left Side (Net Force)

When multiple forces act: $\sum F = ma$. Examples:

- Tension – Weight = ma
- Thrust – Drag – Gravity = ma

6. Specify the Type of Force

Recognize the source of force:

- Friction: $F_k = \mu N$
- Spring: $F = -kx$
- Electric: $F = qE$
- Gravity: $F = mg$
- Universal Gravitation: $F = \frac{Gm_1m_2}{r^2}$

Apply to Any Equation

Next time you see an equation like $V = IR$ or $W = Fd\cos\theta$, ask:

- What does it describe?
- What do the symbols mean?
- Are there alternate forms?
- Are the variables time-dependent?

Key Takeaway

Don't just memorize — deconstruct. Every equation is a story. Learn to read it.

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Try It Yourself!

Apply the same process to a new equation

Equation: $W = Fd\cos\theta$

1. Name the Equation

2. Define Every Symbol (with Units)

- $W =$ _____
- $F =$ _____
- $d =$ _____
- $\theta =$ _____

3. Rewrite in Equivalent Forms

4. Recognize Functions of Time

5. Expand the Left Side

6. Specify the Type of Force

Bonus: Apply the same method to $V = IR$ or $KE = \frac{1}{2}mv^2$ You're now thinking like a physicist!