

H1. Impedance and Phase in One Diagram

H2. The Phasor-Diagram Solution of a Series LCR Circuit

H4. Mastering the geometry behind Alternating Currents.

- Current modeled as: $i = i_m \sin(\omega t + \phi)$
- Say goodbye to complex vector algebra.
- Turn AC voltage into a simple geometry problem.



H1: The Three Phasor Components

H3: How voltage behaves relative to current (I)

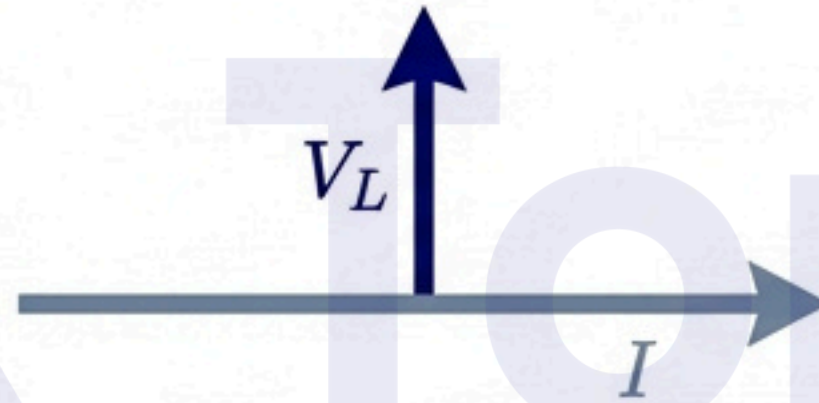
IN PHASE



Voltage and current move together.

$$v_{Rm} = i_m R$$

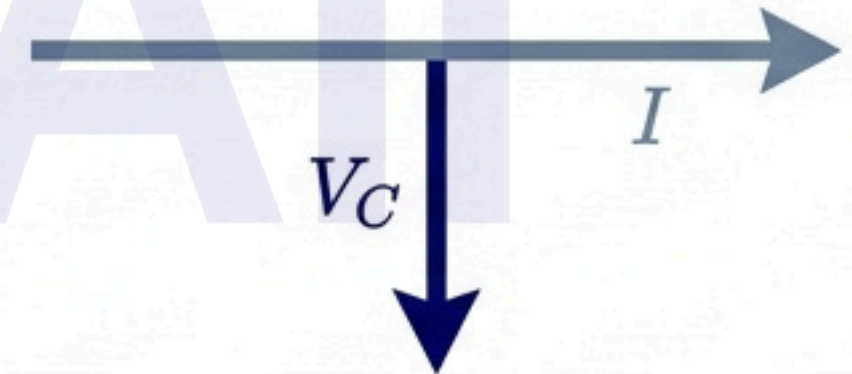
LEADS BY $\pi/2$



Voltage peaks before current.

$$v_{Lm} = i_m X_L$$

LAGS BY $\pi/2$



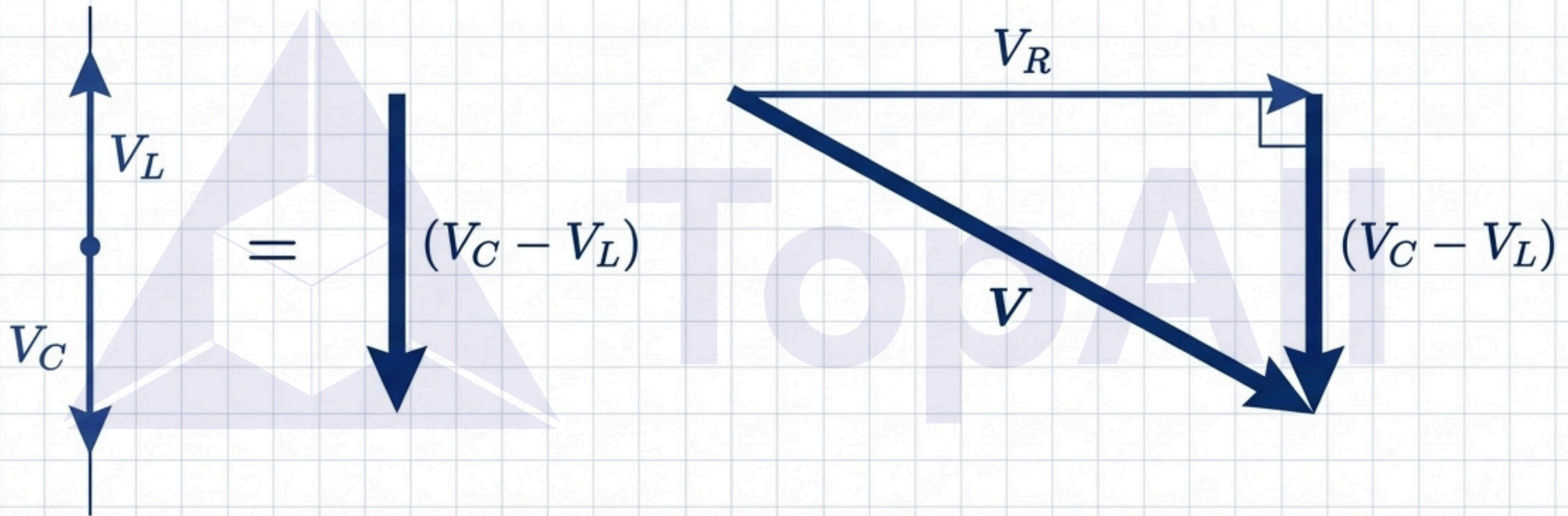
Voltage peaks after current.

$$v_{Cm} = i_m X_C$$

H1: Constructing the Phasor Triangle

H2 Vector addition simplifies the circuit

HERO DIAGRAM



* **Combine Opposites:** V_C and V_L are exactly 180° out of phase. They collapse into a single vertical vector: $(V_C - V_L)$.

* **Add the Base:** V_R is horizontally aligned with the current I .

* **Draw the Hypotenuse:** The net applied voltage V connects the start of V_R to the tip of $(V_C - V_L)$.



You've Learned the Theory. Let's Test Them Now.

$$E=mc^2$$



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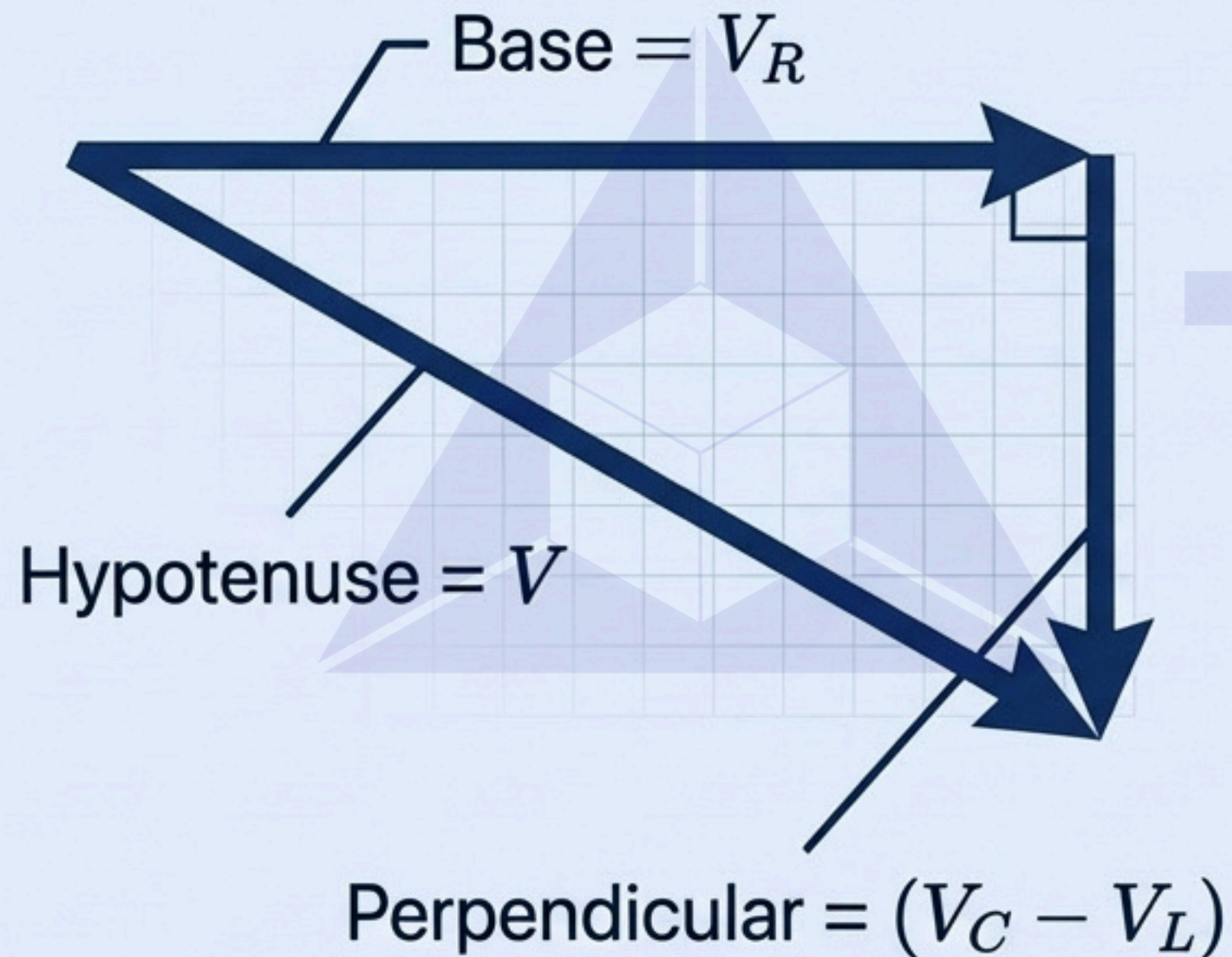
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Deriving Net Applied Voltage

Applying Pythagoras to AC Circuits



Because V_R and $(V_C - V_L)$ sit at a perfect 90° angle, we apply the Pythagorean theorem:

Step 1: $V^2 = V_R^2 + (V_C - V_L)^2$

Step 2: Substitute amplitude values (v_{Rm}, v_{Cm}, v_{Lm}) :

Final Form: $v_m^2 = v_{Rm}^2 + (v_{Cm} - v_{Lm})^2$

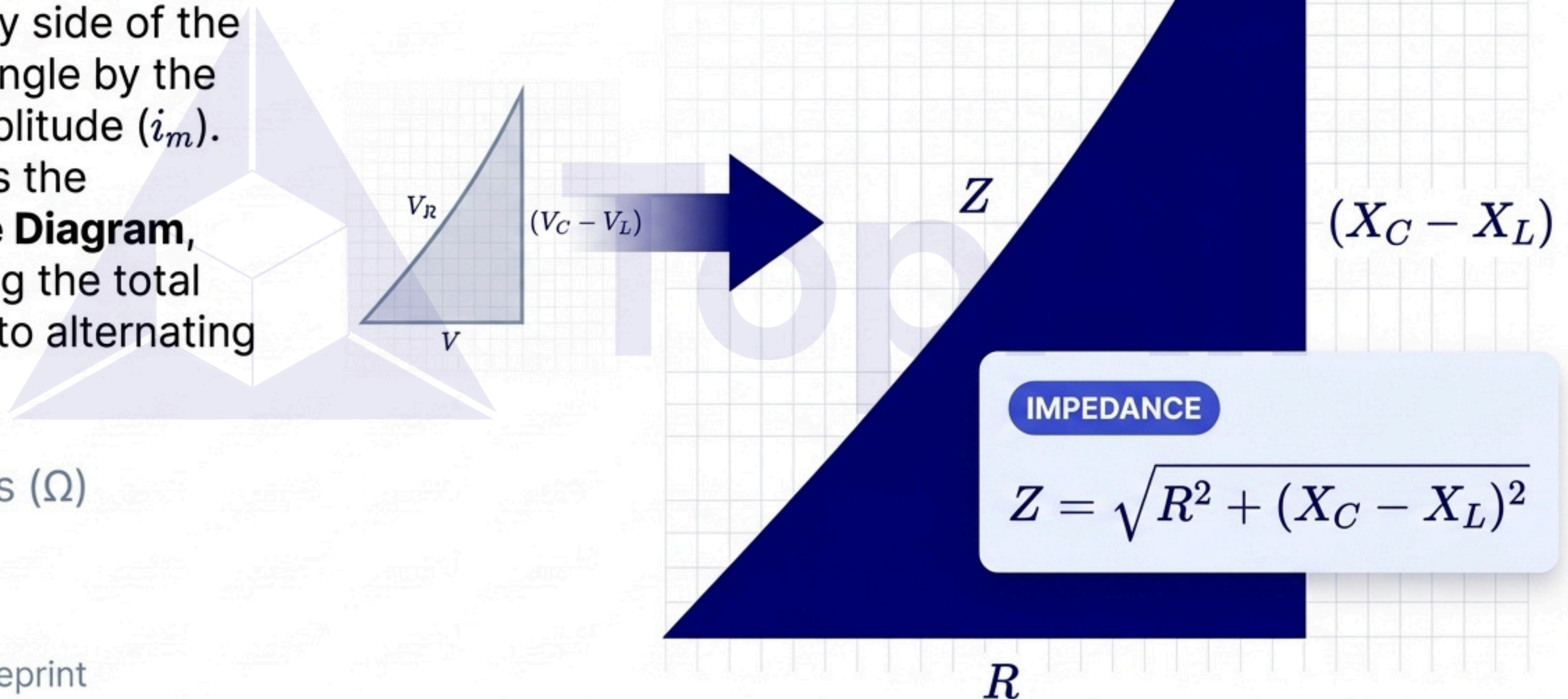
EXAM TIP: Always treat voltage amplitudes like lengths of a triangle!

H1: The Impedance Formula (Z)

H2: From Voltage to Resistance Equivalent

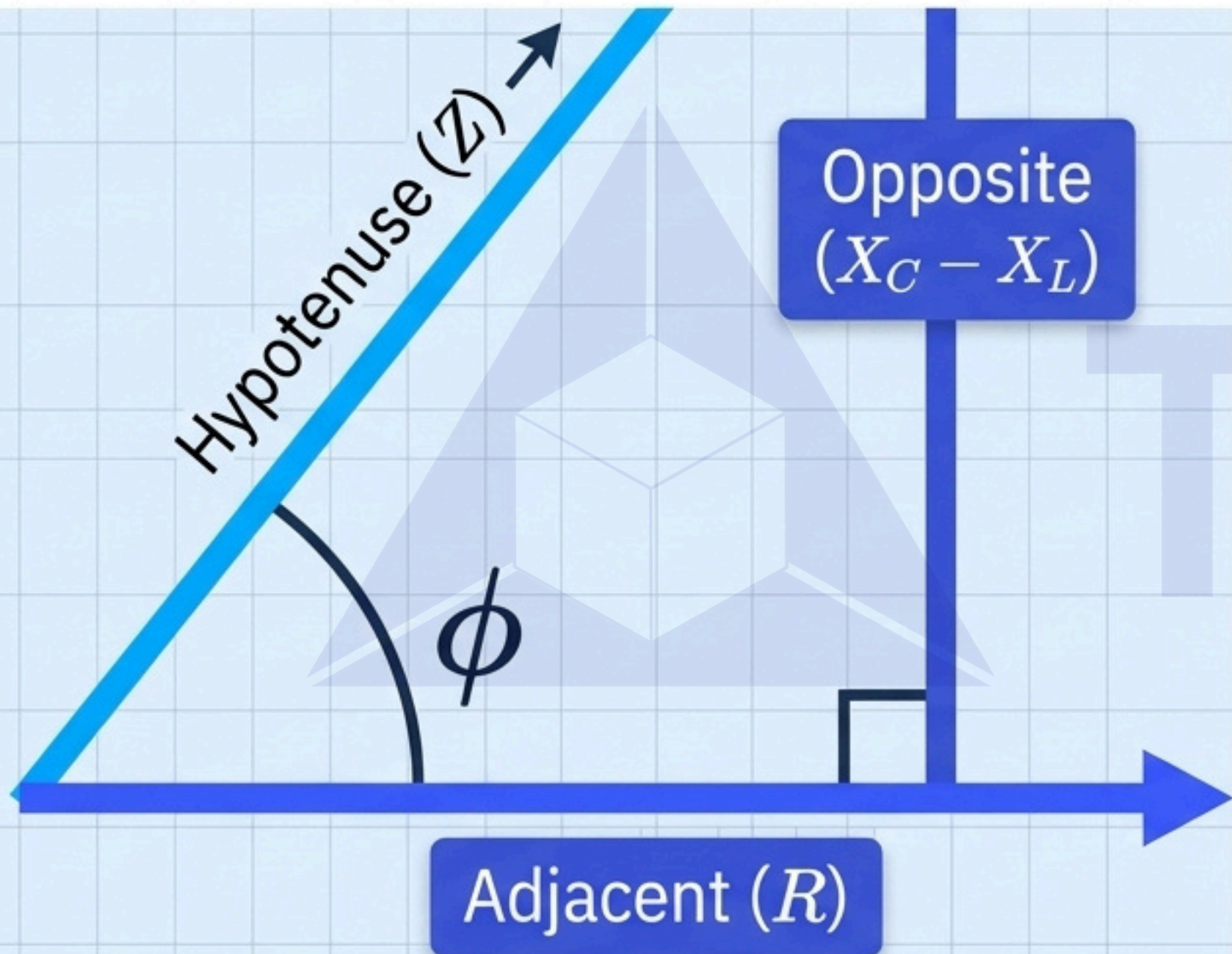
Divide every side of the voltage triangle by the current amplitude (i_m). This reveals the **Impedance Diagram**, representing the total opposition to alternating current.

Units: Ohms (Ω)



H1: Decoding the Phase Angle (ϕ)

H3: The relationship between source voltage and current



- The **angle** ϕ tells us how far the net current is shifted from the net voltage.
- Since Phasor I is always parallel to V_R (the base), ϕ is the angle between the base and the hypotenuse.

 **PHASE ANGLE**

$$\tan \phi = \frac{X_C - X_L}{R}$$

Note: This formula completely specifies the phase of the initial current equation: $i = i_m \sin(\omega t + \phi)$.

H1: Key Takeaways: The Sign Logic

H2: Predicting circuit behavior instantly

Column A	Column B
Capacitive Dominance	Inductive Dominance
<i>Condition: $X_C > X_L$</i>	<i>Condition: $X_C < X_L$</i>
<i>Phase Angle (ϕ): Positive</i>	<i>Phase Angle (ϕ): Negative</i>
<i>Result: Current leads the source voltage.</i>	<i>Result: Current lags the source voltage.</i>

EXAM TIP: If $X_C = X_L$, the circuit is purely resistive ($\phi = 0$). This is called Resonance!



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