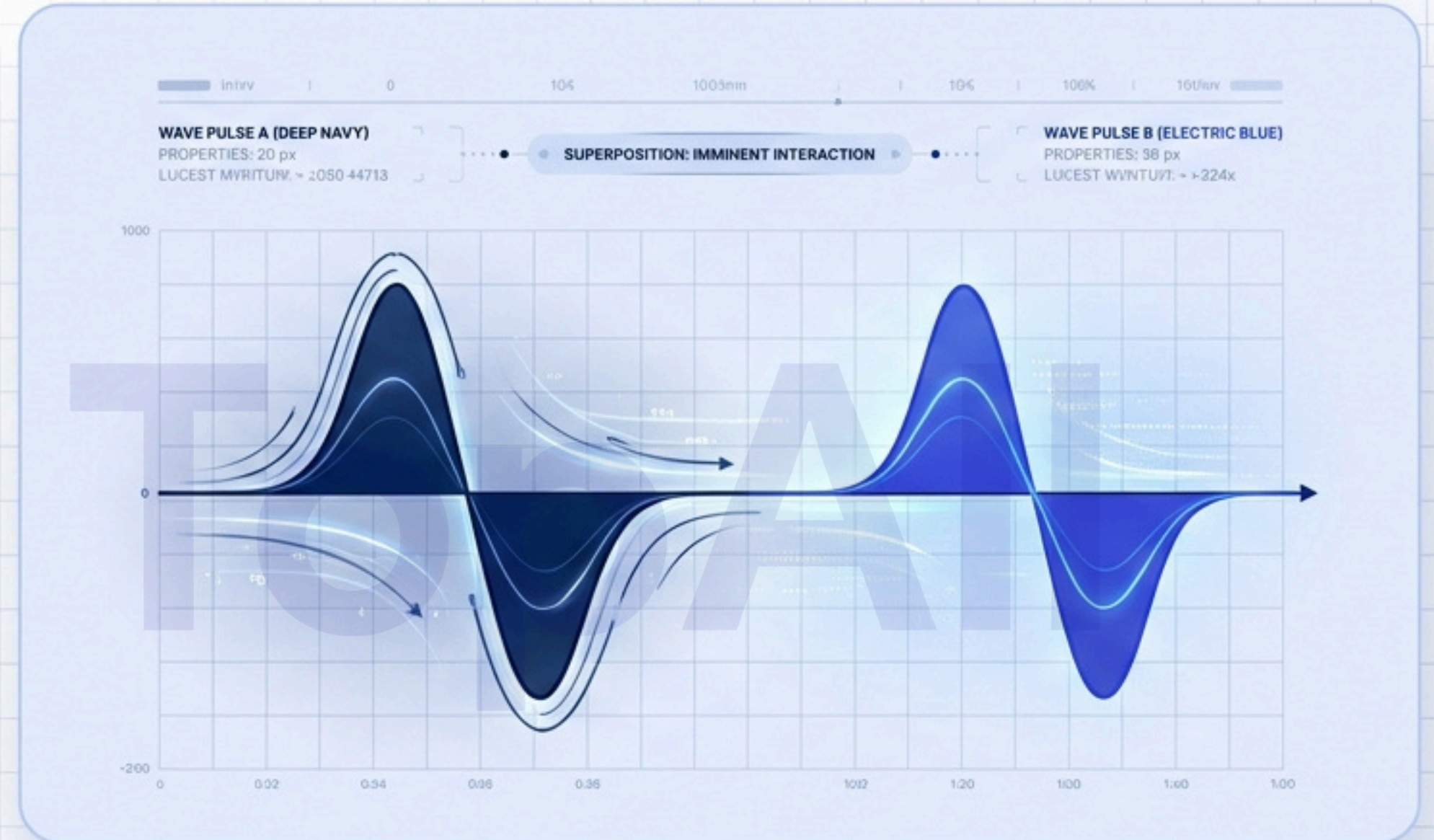


CLASS 11 PHYSICS • CHAPTER 14

The Principle Of Superposition Of Waves

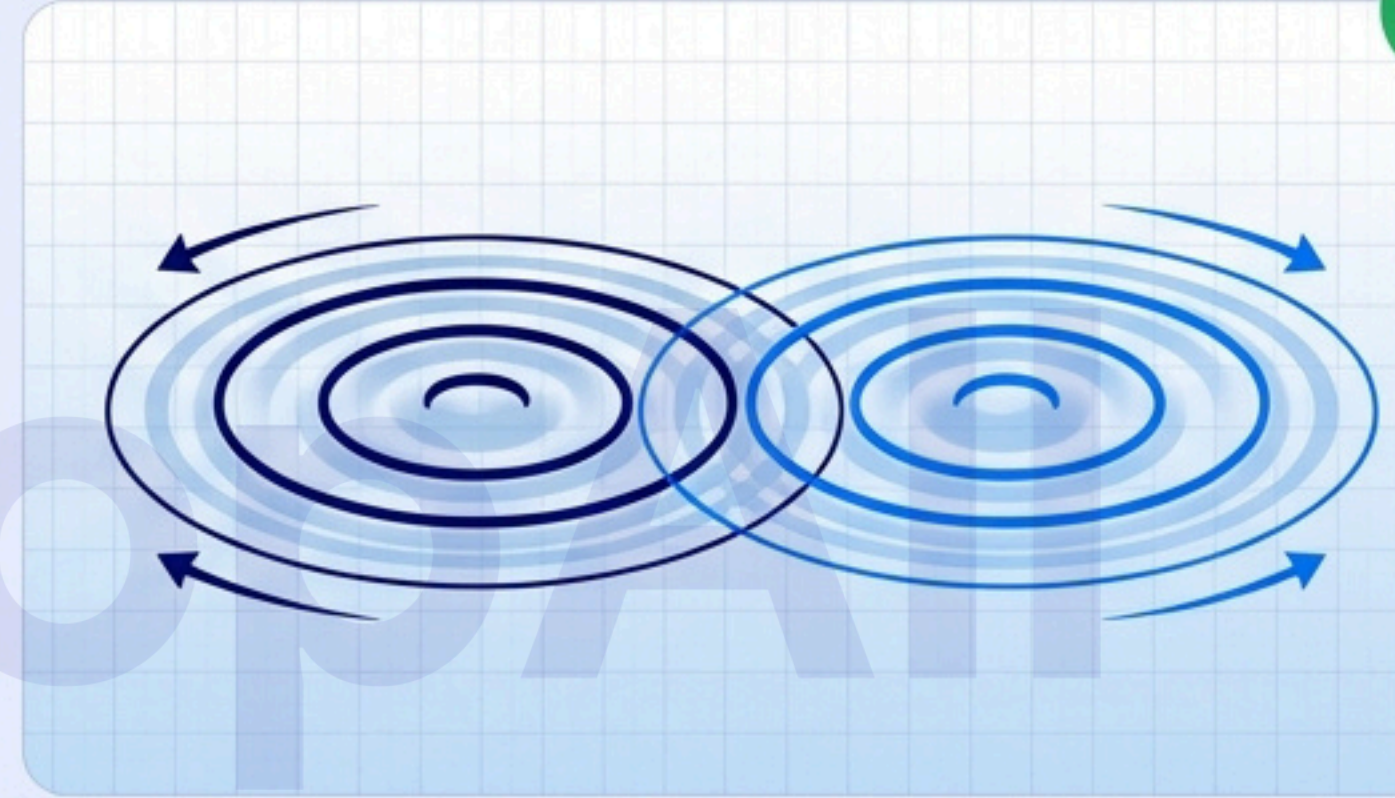
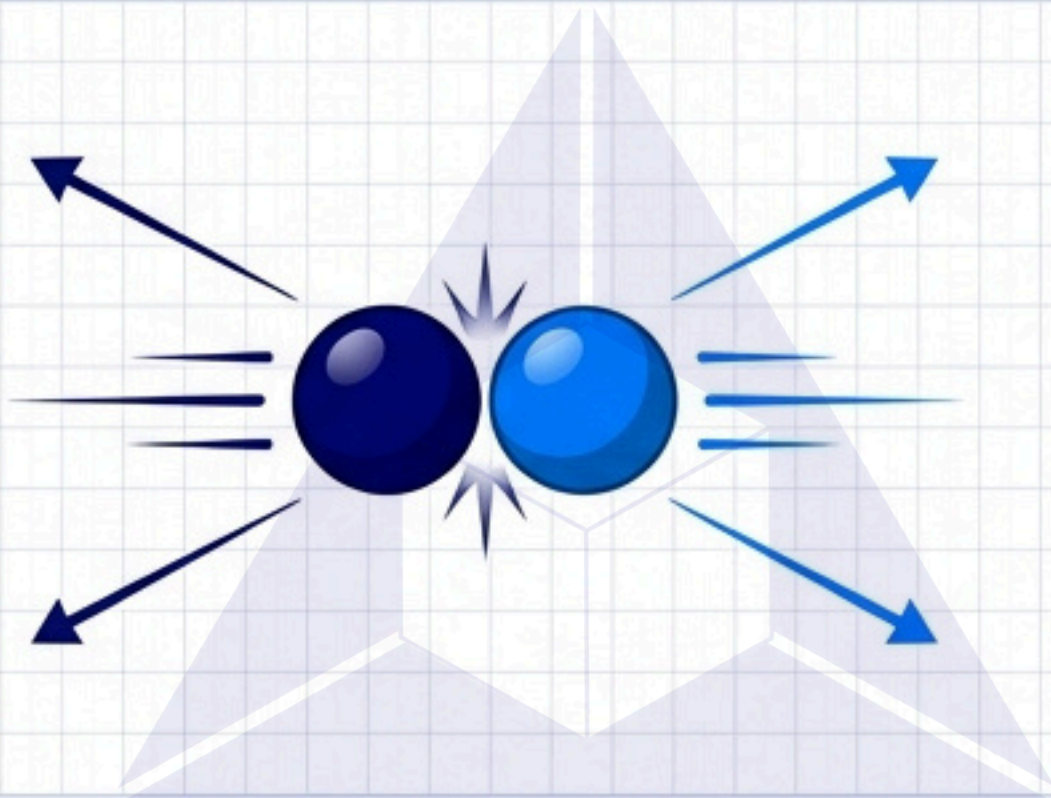
Understanding How Waves Interact in the Same Medium

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Waves Do Not Collide Like Matter

When two wave pulses travel in opposite directions and cross, they do not bounce off one another.



- Waves are disturbances of energy, not physical objects.
- The medium can handle multiple disturbances simultaneously.
- Waves continue to retain their exact individual identities after crossing.

CONCEPTUAL KEY: Waves transfer energy, not matter.

The Law Of Wave Addition

During the time waves overlap, the net displacement of the medium is the simple algebraic sum of the individual displacements.

CORE EQUATION

$$y(x, t) = y_1(x, t) + y_2(x, t)$$

- $y(x, t)$ = Resultant net displacement
- y_1, y_2 = Individual wave displacements
- Crucial rule: Displacements can be positive (crests) or negative (troughs), meaning they can add to or subtract from each other.



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

$$E=mc^2$$



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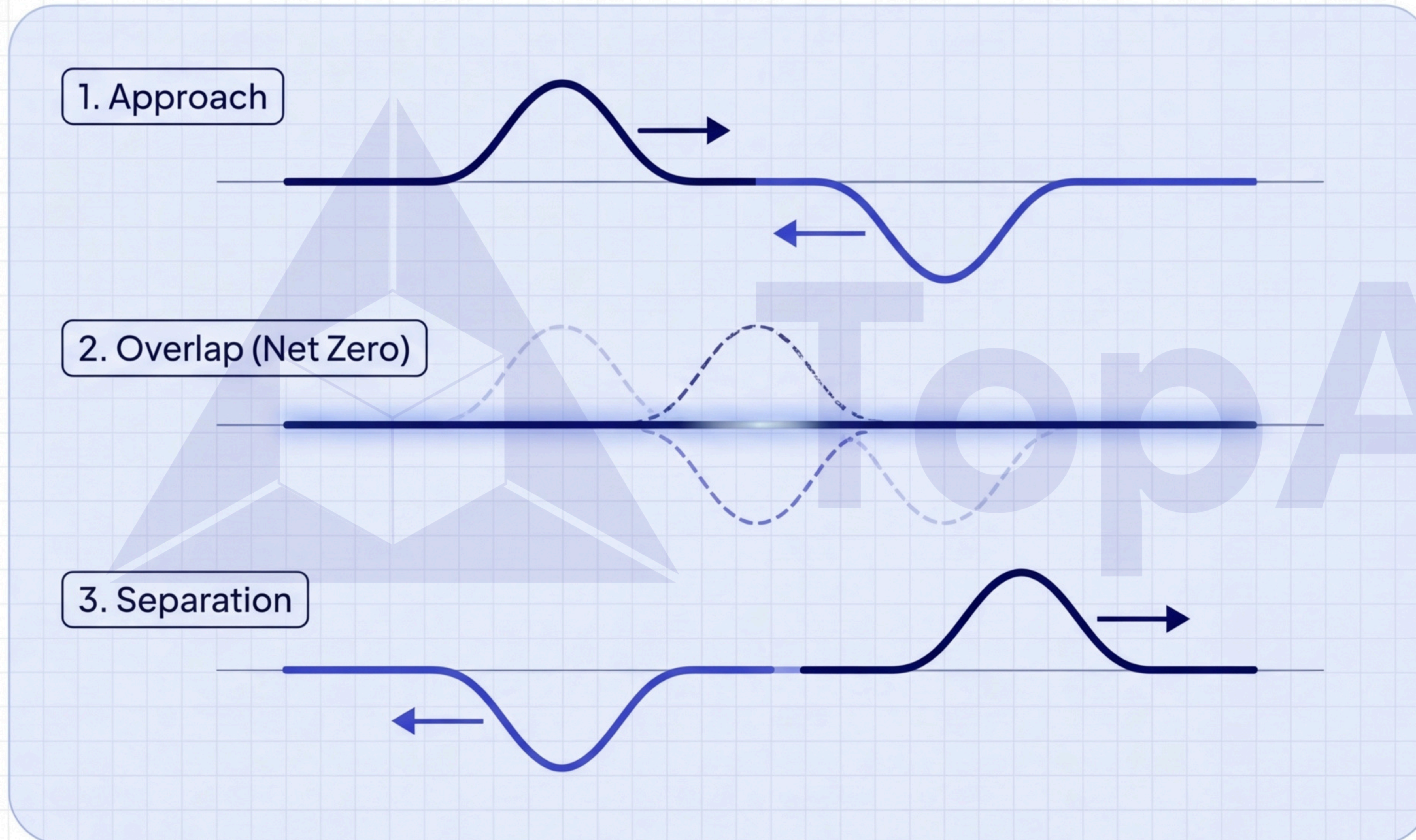
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- » Climb the Leaderboard Among Fellow Aspirants
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Watch The Displacements Cancel



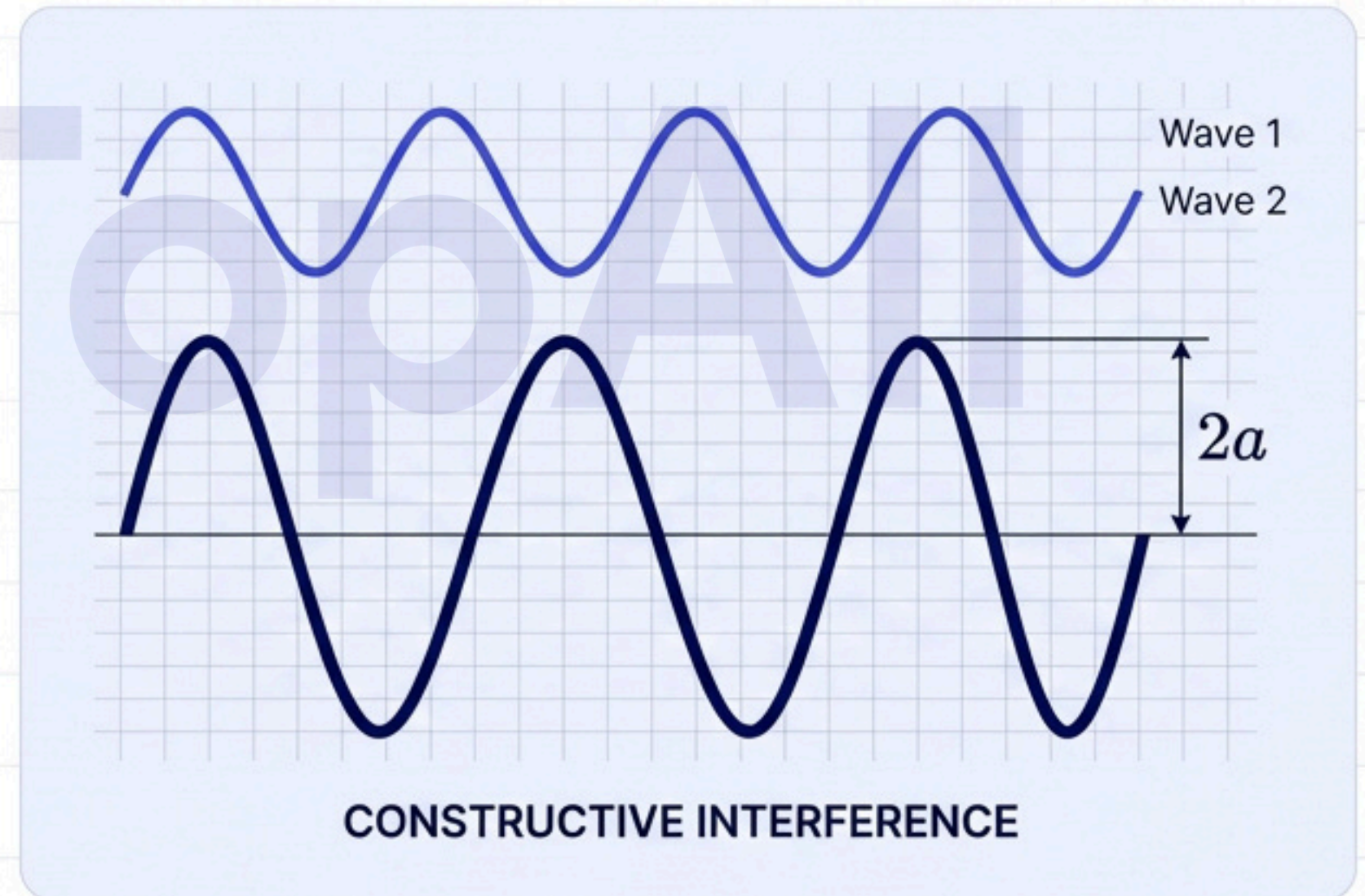
- Each pulse moves as if the other is not present.
- The medium's particles suffer displacements due to both pulses simultaneously.
- Once separated, the pulses look exactly as they did before meeting.

IN-PHASE ADDITION ($\phi = 0$)

When Waves Work Together

Interference occurs when two harmonic waves of the same frequency and amplitude travel in the same direction.

- Phase difference $\phi = 0$ (Waves are perfectly in phase).
- Crests align with crests; troughs align with troughs.
- Resultant amplitude is maximized:
 $A = 2a$.

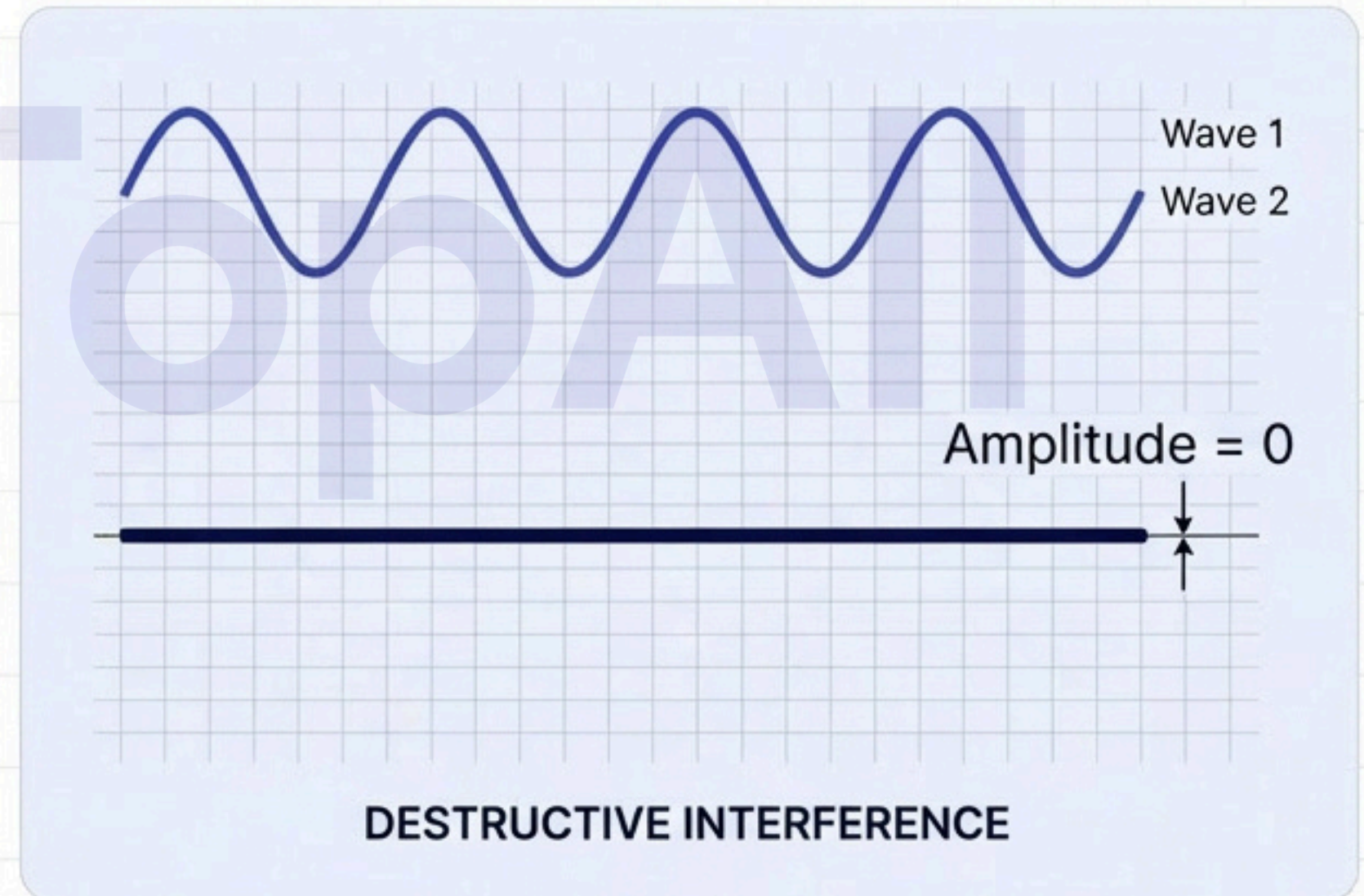


OUT-OF-PHASE CANCELLATION ($\phi = \pi$)

When Waves Cancel Out

If the exact same harmonic waves are shifted so they are completely out of sync, they destroy each other's displacement.

- Phase difference $\phi = \pi$ or 180° (Waves are out of phase).
- Crests perfectly align with troughs.
- Resultant amplitude is zero everywhere: $A = 0$.



EXAM CHECKLIST

“Core Concepts Conquered” in Plus Jakarta Sans

- ✓ **Independence:** Waves pass through each other and retain their exact original identity.
- ✓ **The Math:** Net displacement is the simple algebraic sum of individual displacements: $y = y_1 + y_2$.
- ✓ **Interference:** Superposition of identical waves creates Constructive ($A = 2a$ at $\phi = 0$) or Destructive ($A = 0$ at $\phi = \pi$) interference based on phase difference.

→ Try Chapter 14 MCQs Next



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