Waves & Interference

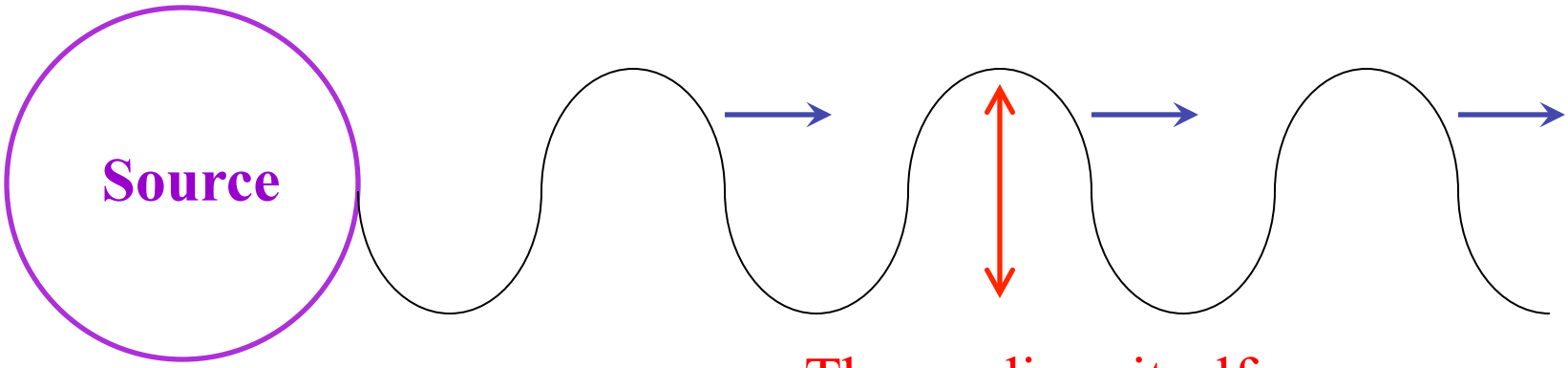
I. Definitions and Types
II. Parameters and Equations
III. Sound
IV. Graphs of Waves
V. Interference
   - superposition
   - standing waves

	The student will be able to:	HW:
1	Define, apply, and give examples of the following concepts: wave, pulse vs. continuous wave, source, medium, longitudinal wave, transverse wave, surface wave, crest, trough, compression, rarefaction.	1 – 11
2	Define, apply and give examples of the following wave parameters: speed, wavelength, frequency, period, and amplitude and state the influence of source and medium on each wave parameter.	
3	Identify the wave type, medium, and speed of mechanical waves and sound. State the relation between speed, wavelength, and frequency for a wave, and use this relation to solve related problems.	12 – 18
4	Solve problems analyzing graphs to determine a wave's parameters.	19 – 21
5	Define and apply the following concepts: superposition, constructive and destructive interference, phase, beat frequency and solve related problems.	22 – 24
6	Explain the requirements for the creation of a standing wave. Define and identify nodes and antinodes in standing wave patterns. Solve problems involving harmonics for strings or pipes.	25 – 38
7	Define resonance and identify and give examples of this phenomenon.	39 – 41

A **wave** is a disturbance propagating through a medium.

- Whatever it is that is being disturbed is called the **medium**.
- A **disturbance** is a change in the equilibrium state of the medium.
- **Propagation** implies that the wave is "self sustaining" and that the pattern of disturbance is reproduced at progressive points through the medium.
- All waves involve the transfer of energy and require a **source** that initiates the wave and supplies energy to the medium.

The disturbance travels *through* the medium.



The source supplies energy that is "transported" by the wave.

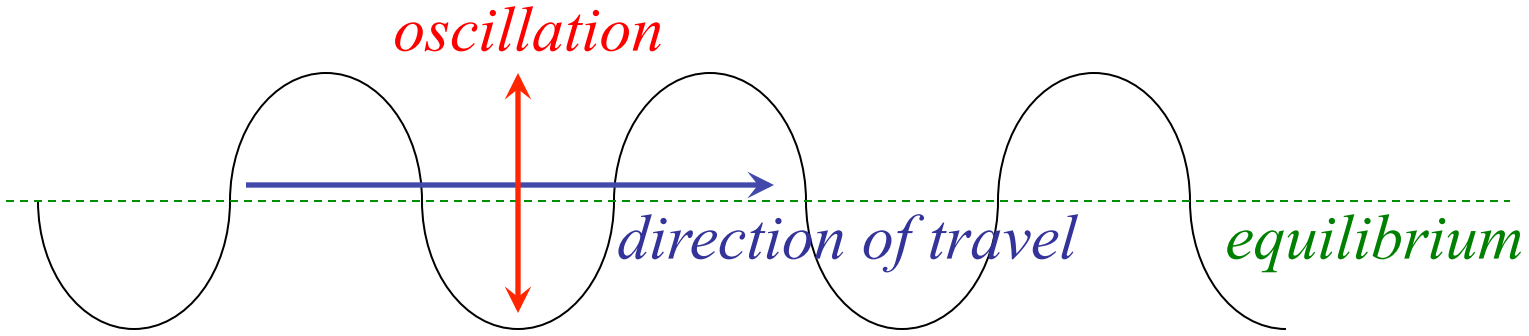
The medium itself oscillates about a fixed point.

Wave Types

- There are many different types of waves, characterized by the way in which the medium is disturbed from its equilibrium state.
- Three common types are: transverse waves, longitudinal waves, and surface waves.

Transverse Waves

In a **transverse wave** the oscillation of the medium is perpendicular to the direction the wave travels.

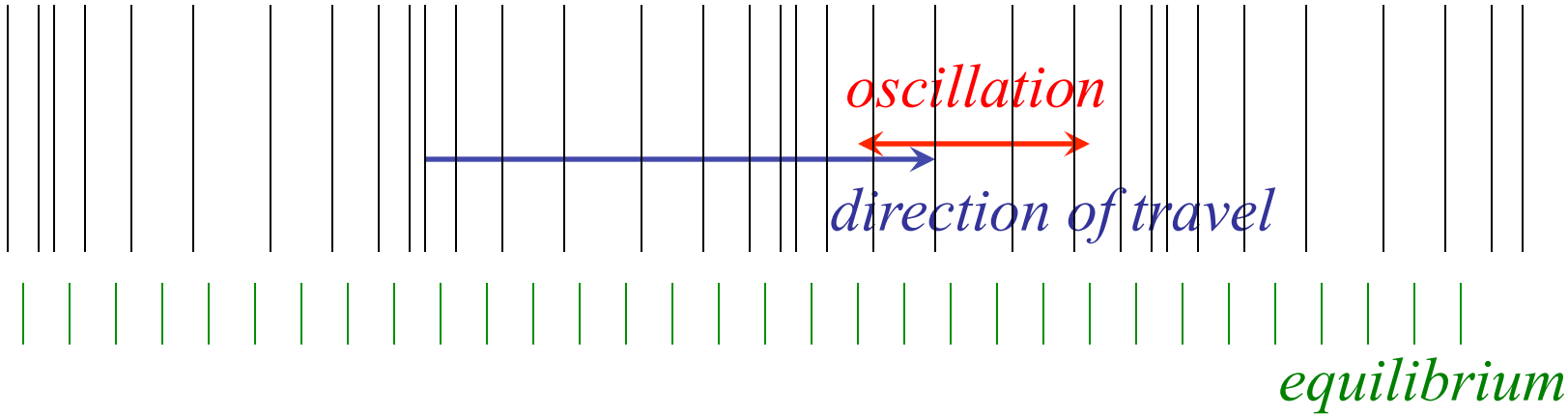


Crest = upward or positive displacement or change of the medium

Trough = downward or negative displacement or change of medium

Longitudinal Waves

In a **longitudinal wave** the oscillation of the medium is parallel to the direction the wave travels.

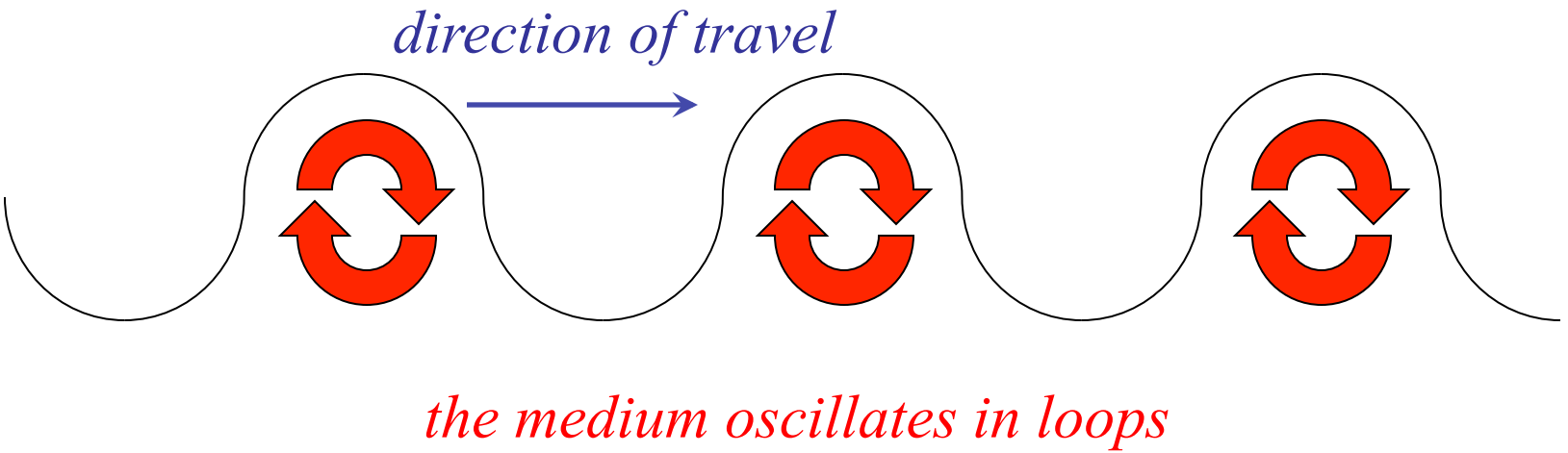


Compression = medium is more tightly spaced than normal

Rarefaction = medium is less tightly spaced than normal

Surface Waves

A **surface wave** occurs along a surface (boundary) between two different mediums and involves both transverse and longitudinal actions.



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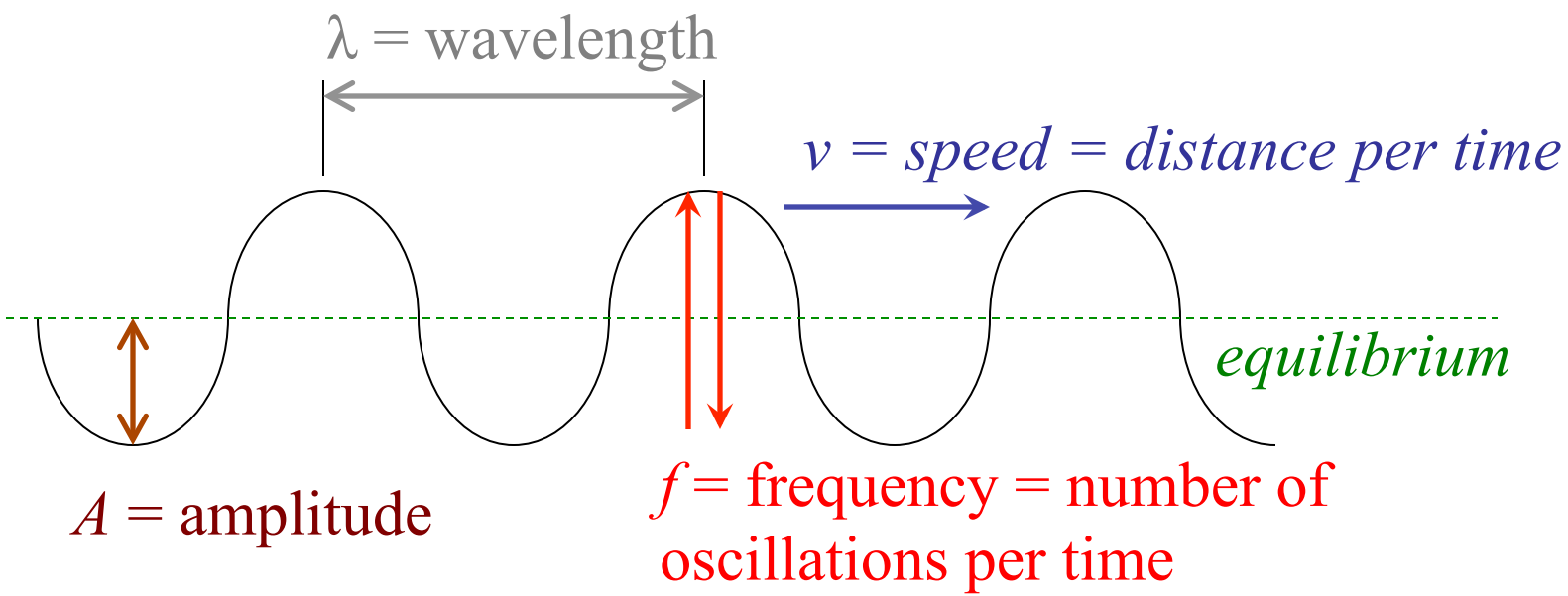
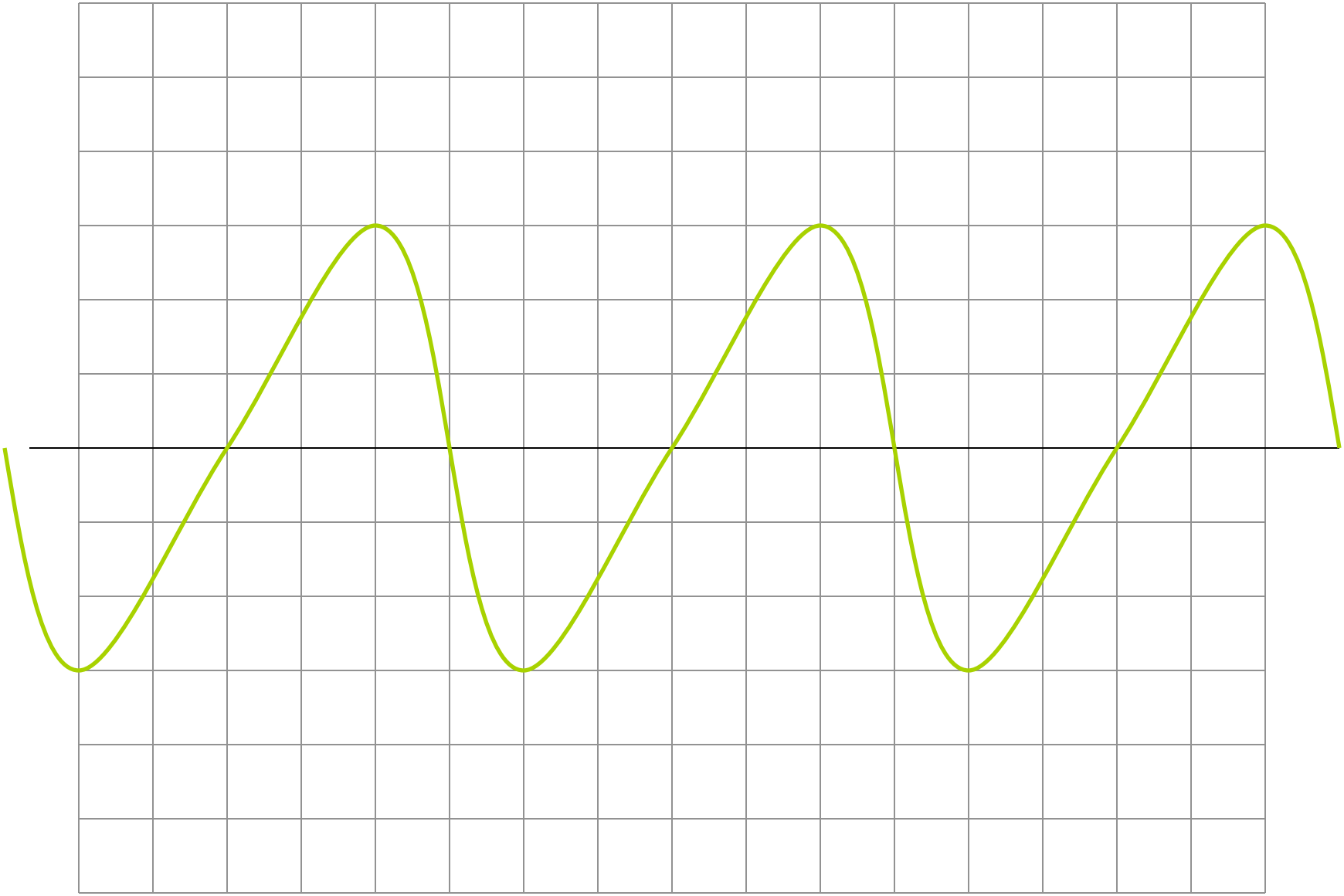
Wave Parameters

- The **speed** of a wave is the rate at which the disturbance travels through the medium.
- The **amplitude** is the maximum level of disturbance, measured from equilibrium.
- **Period** is the time for one complete cycle.
- **Frequency** is the number of cycles per unit time.
- **Wavelength** is the length of one complete cycle (measured along a line parallel to the direction of wave travel)



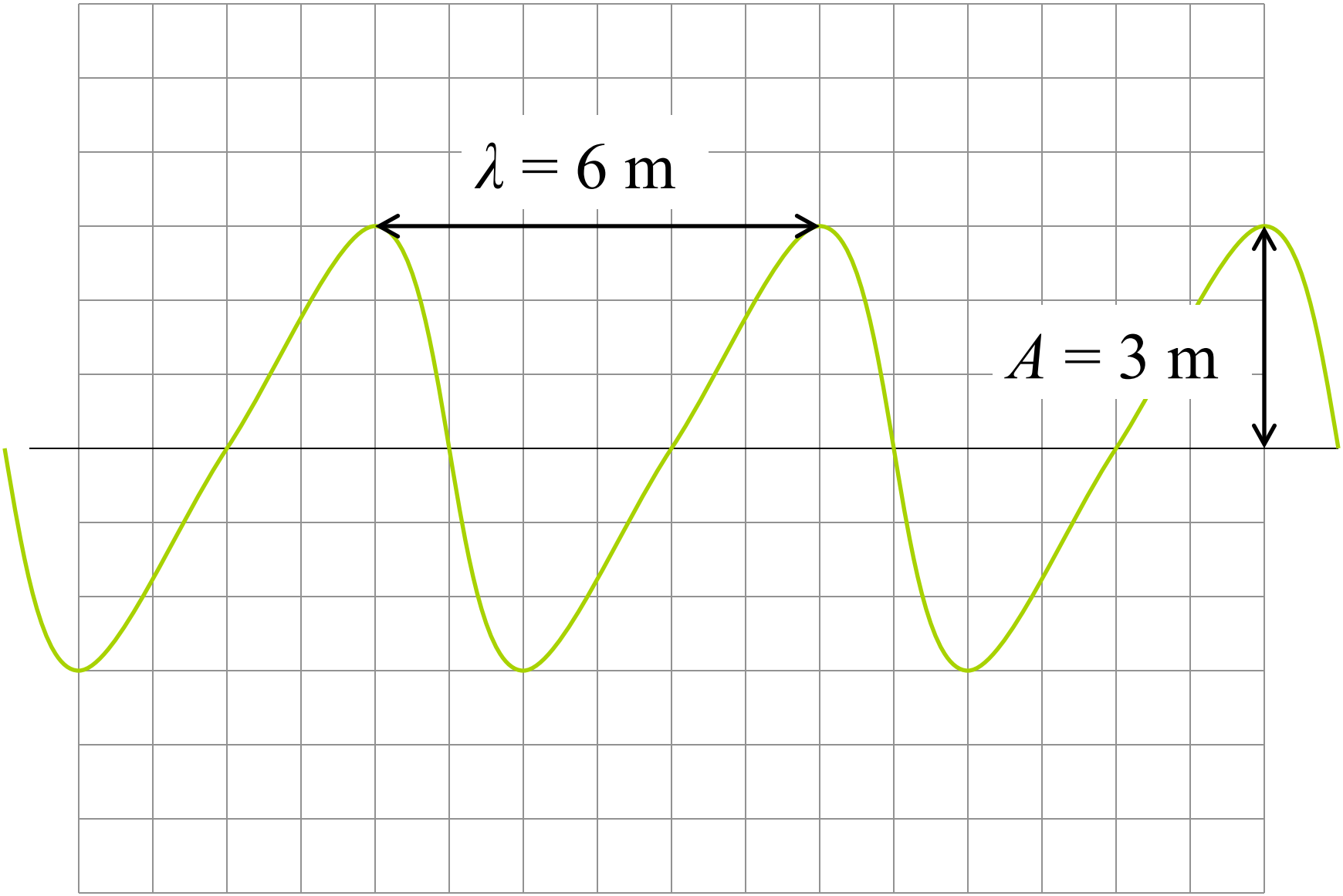
$$v = f \cdot \lambda$$

Find wavelength and amplitude.



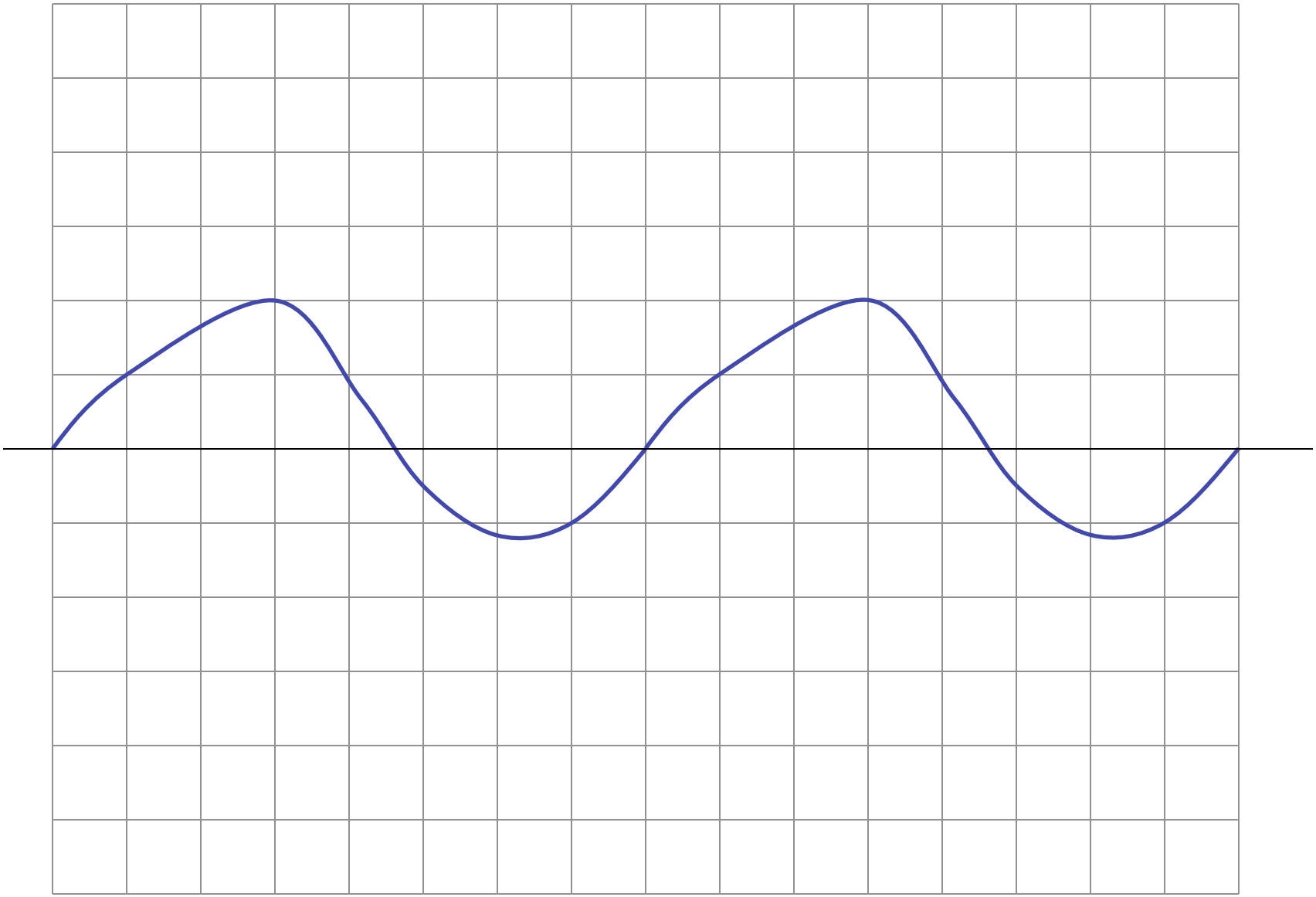
Scale: each square is 1 meter wide.

Find wavelength and amplitude.



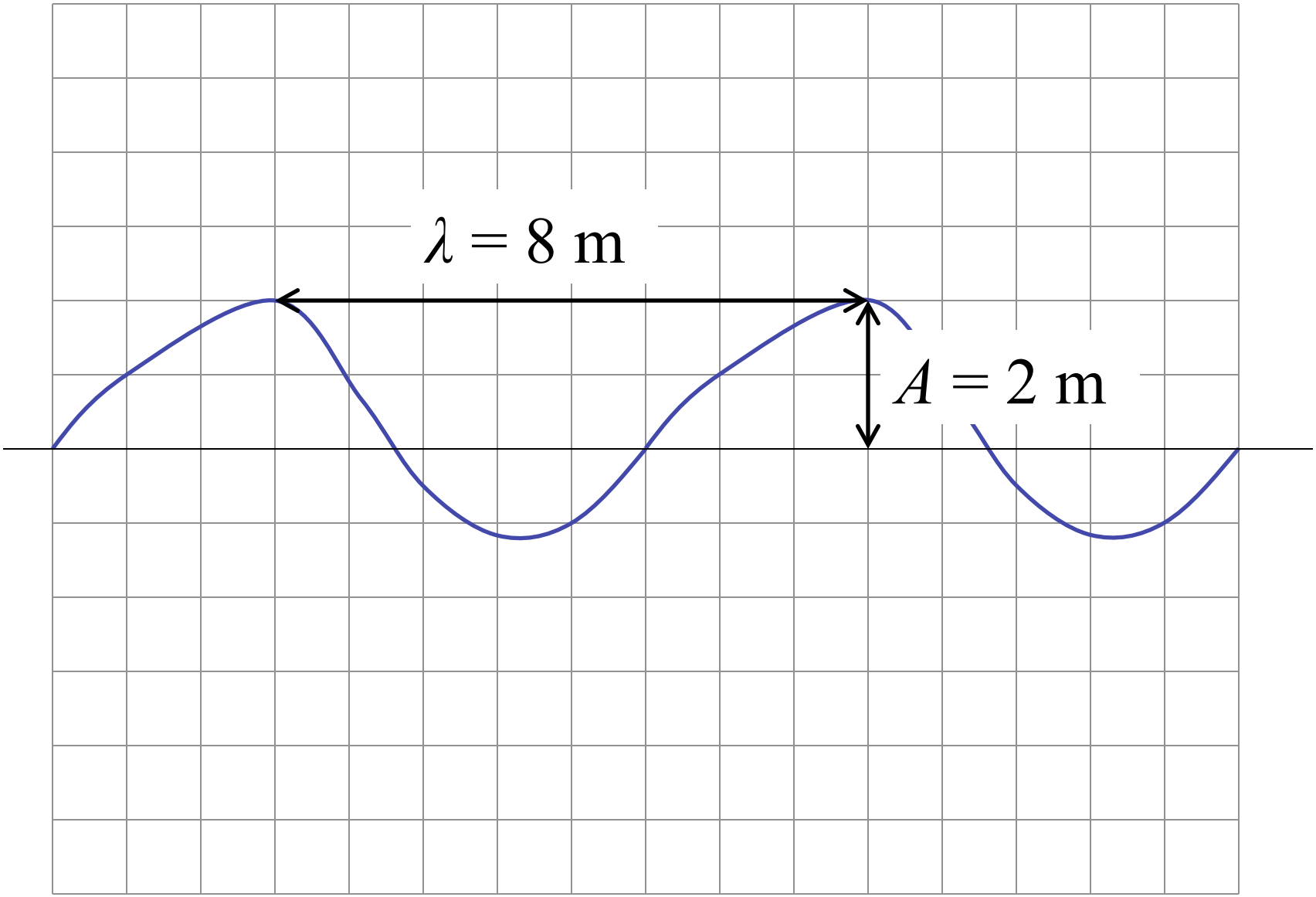
Scale: each square is 1 meter wide.

Find wavelength and amplitude.



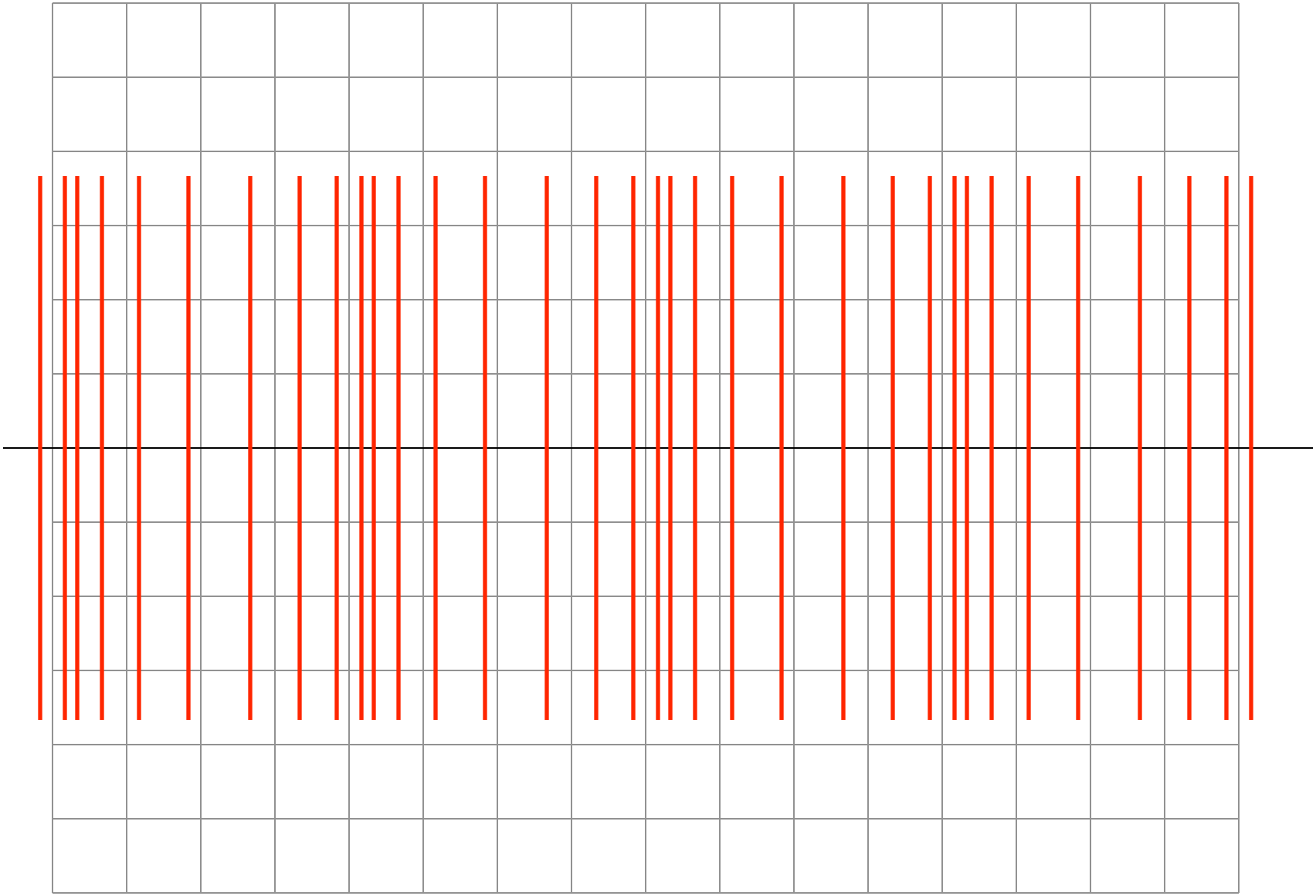
Scale: each square is 1 meter wide.

Find wavelength and amplitude.



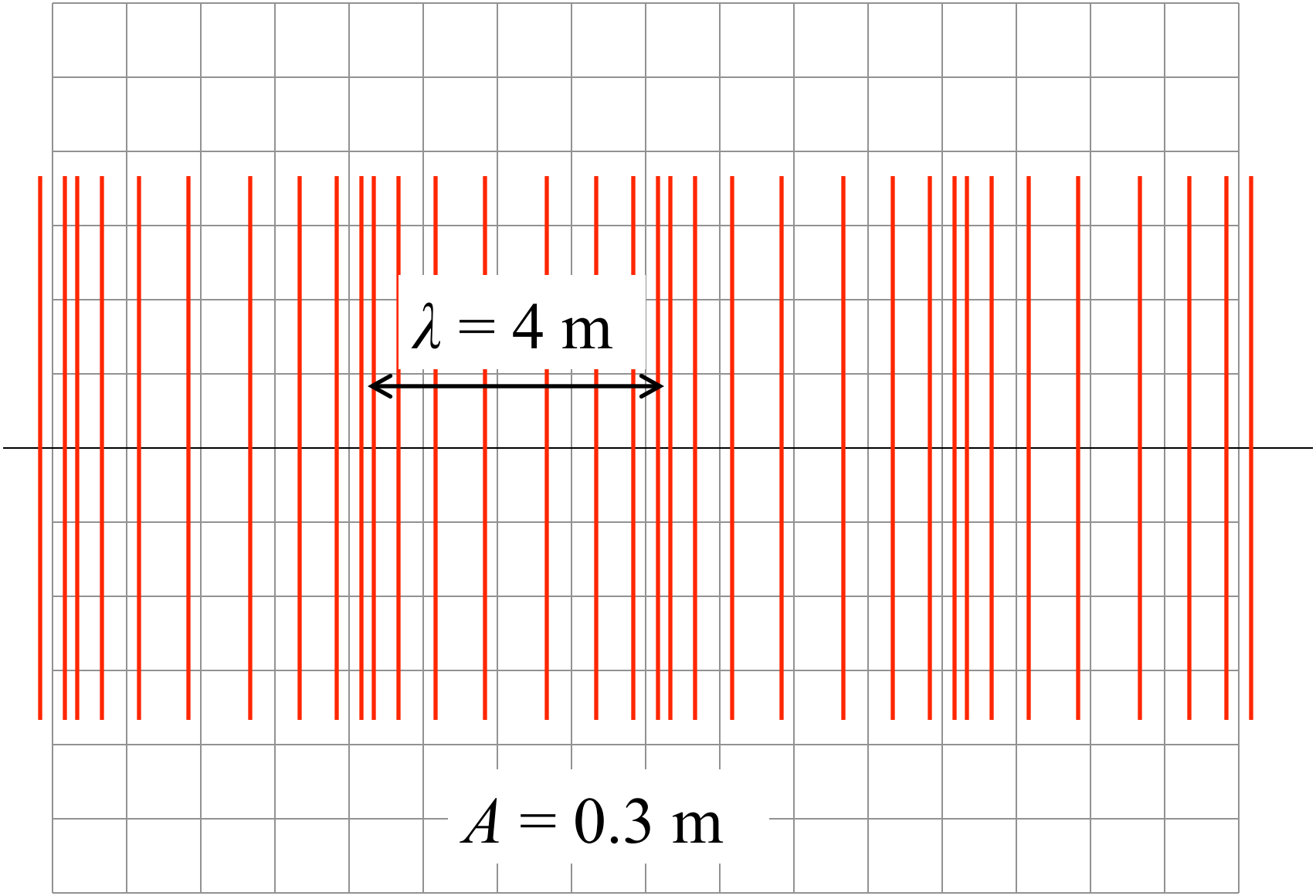
Scale: each square is 1 meter wide.

Find wavelength an amplitude.



Scale: each square is 1 meter wide.

Find wavelength and amplitude.



Scale: each square is 1 meter wide.

Source vs. Medium

- The source of a wave has no effect on the speed of the wave.
- The speed is determined by the properties of the medium.
- The medium of the wave has no effect on its frequency or period.
- The frequency and period of a wave are determined by (and equal) the frequency and period of the source.
- Wavelength is determined by speed (medium) and frequency (source) so that: $v = f\lambda$.