Graphs of Waves

Revealing the Shape of the Wave

Light: Interference and Optics

I. Light as a Wave
- wave basics review
- electromagnetic radiation

II. Diffraction and Interference
- diffraction, Huygen’s principle
- superposition, interference
- standing waves, slits & gratings

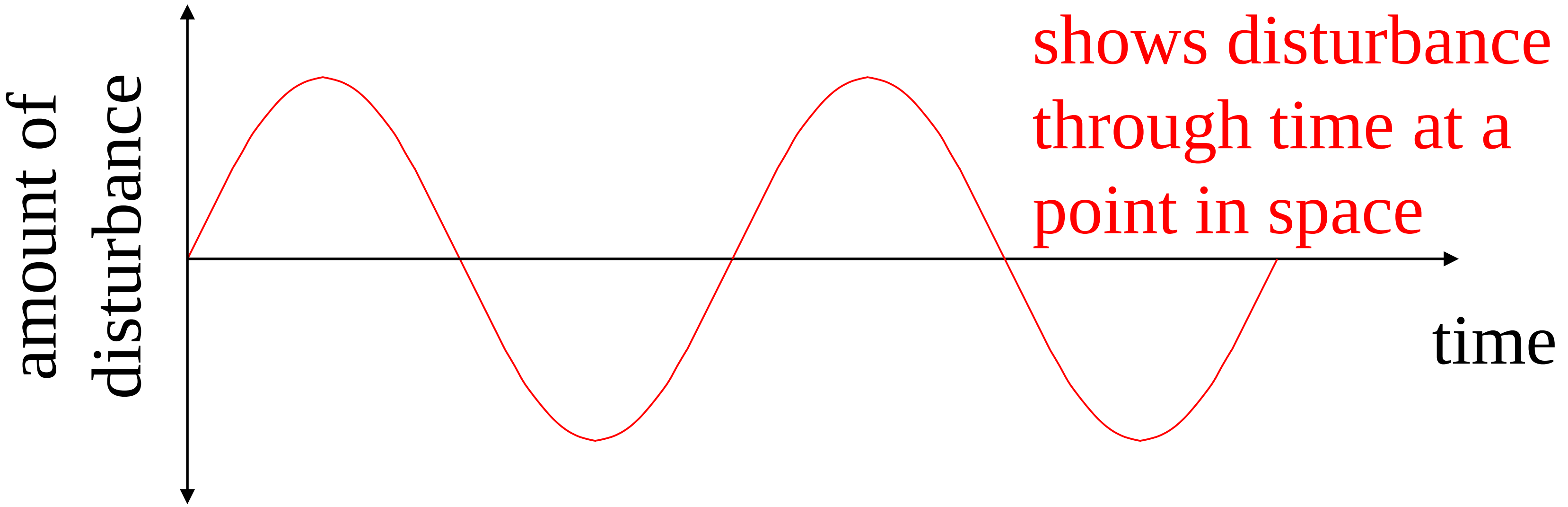
III. Geometric Optics
- reflection, refraction, Snell’s Law
- images, lenses, and mirrors

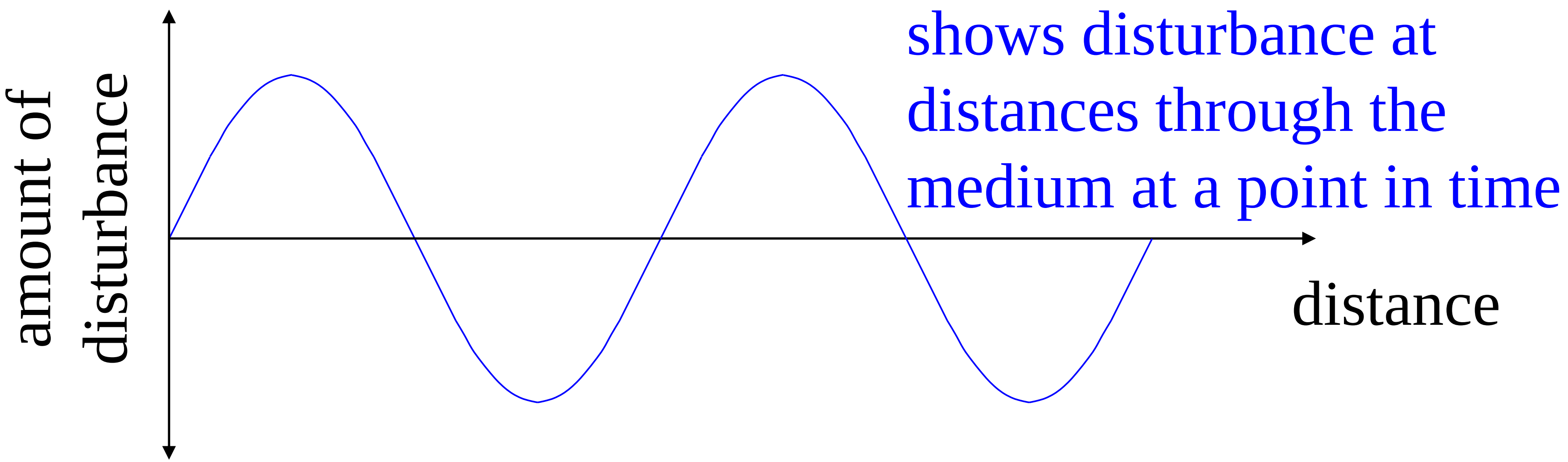
	The student will be able to:	HW:
1	Model light and other types of electromagnetic radiation as a transverse wave of electric and magnetic fields and analyze graphs and/or functions to solve related problems and explain related phenomena such as polarization, absorption, production, intensity, etc.	1 – 5
2	Model diffraction and interference of light involving slits or gratings by Huygen's principle and analyze and solve problems relating geometry of openings to patterns of interference.	6 – 18
3	State and apply laws of reflection and refraction, Snell's Law, and solve related problems and/or describe qualitatively the phenomena of absorption, transmission, and reflection of light undergoing a change in medium.	19 – 25
4	Apply the ray model of light to explain and analyze formation of real and virtual images by plane, concave, and convex mirrors and solve related problems involving object and image distance, magnification, focal length and/or radius of curvature.	26 – 31
5	Apply the ray model of light to explain and analyze formation of real and virtual images by converging or diverging thin lenses and solve related problems involving object and image distance, magnification, focal length and/or radius of curvature.	32 – 36

Wave Graphs

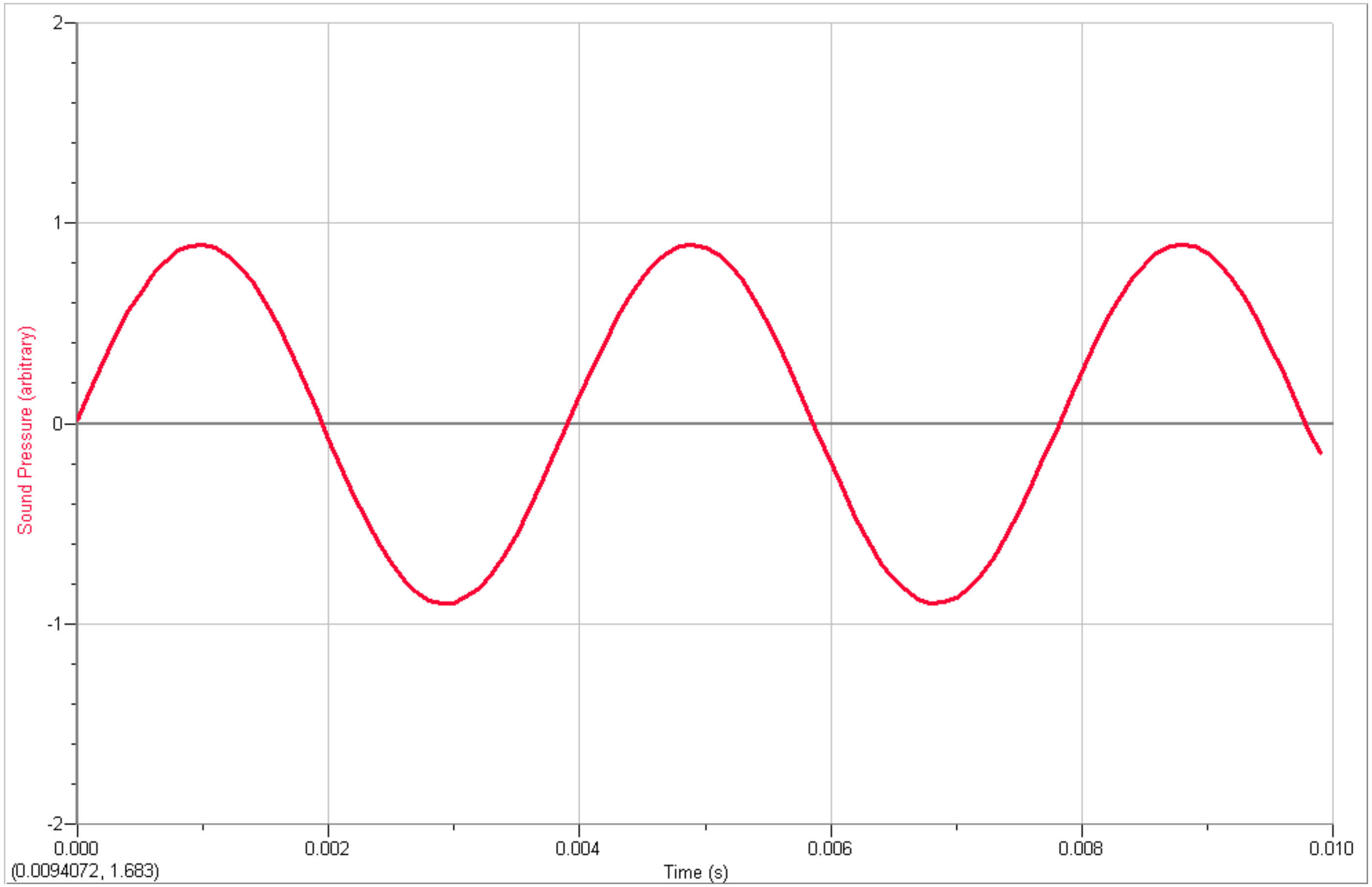
- Aside from wavelength, frequency, speed, and amplitude a wave can be unique in its shape or form.
- The shape or form of the wave is the pattern of disturbance.
- A common type of pattern is a sinusoidal wave (or more simply a "sine wave"). This is a wave pattern that has the same curved shape as the graph of the sine function.

Two Types of Wave Graphs



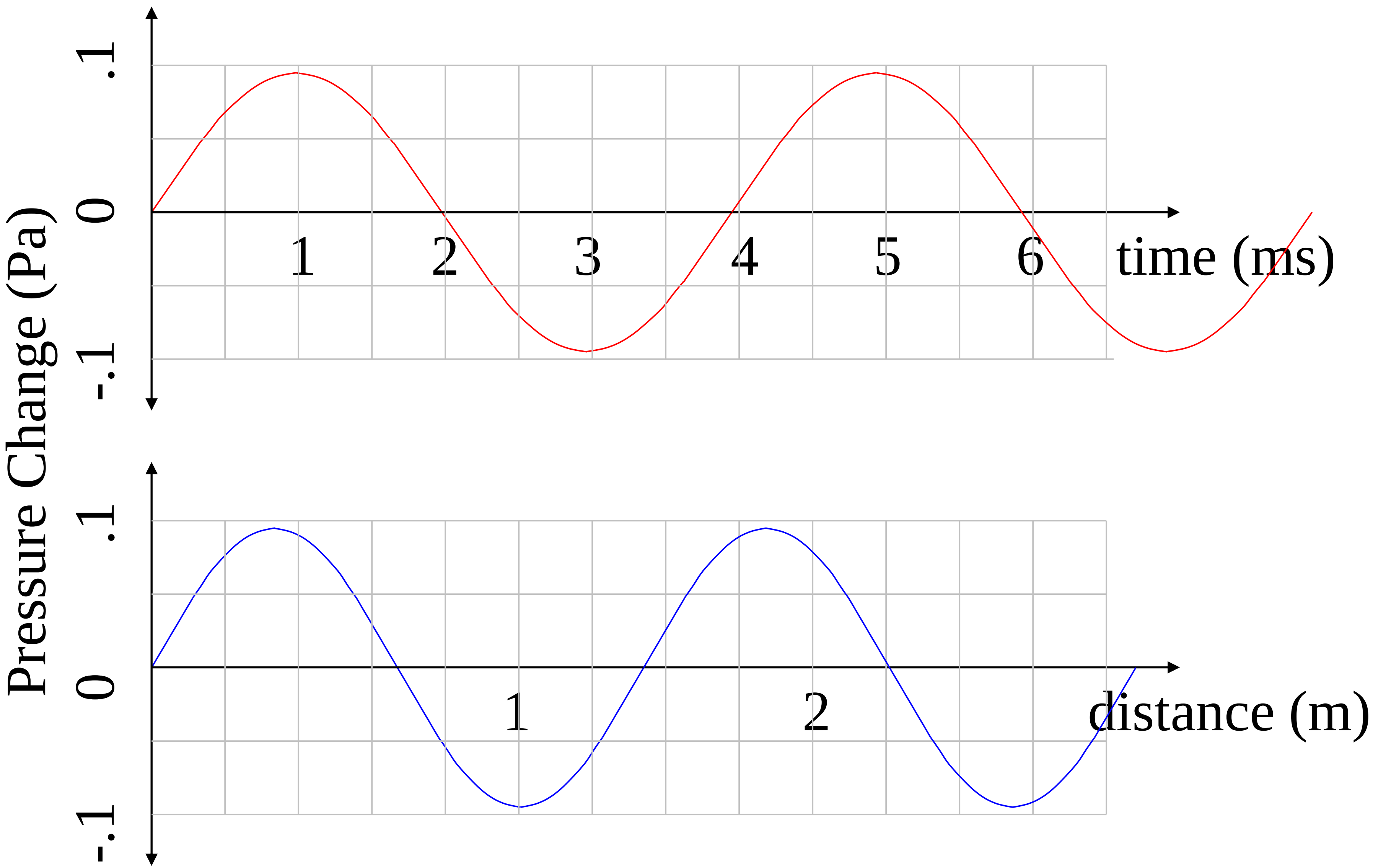


Graph of Sound Wave Made by Tuning Fork:

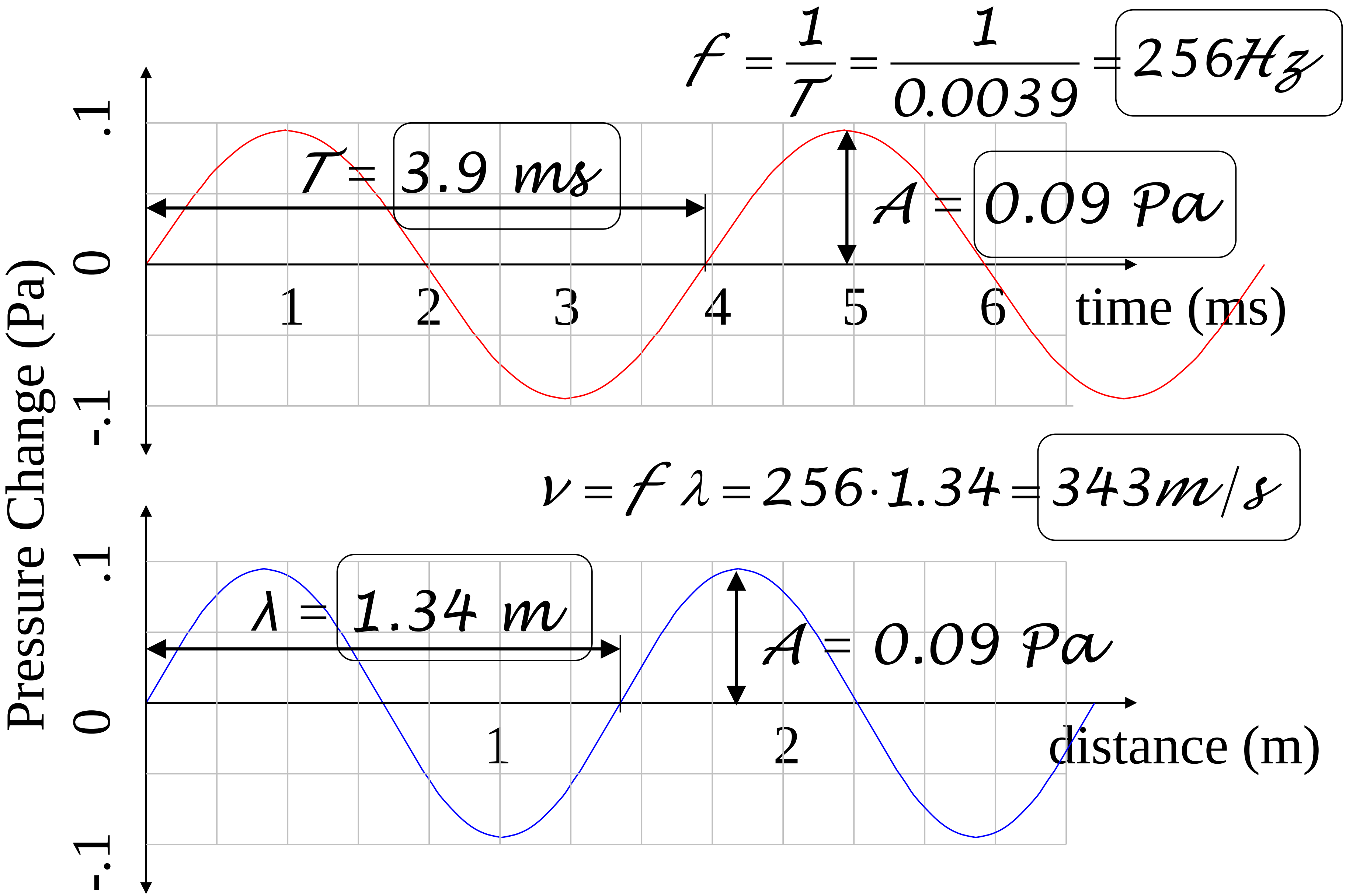


This is the output of an **oscilloscope**. An oscilloscope displays voltage vs. time – in this case the voltage output of a microphone.

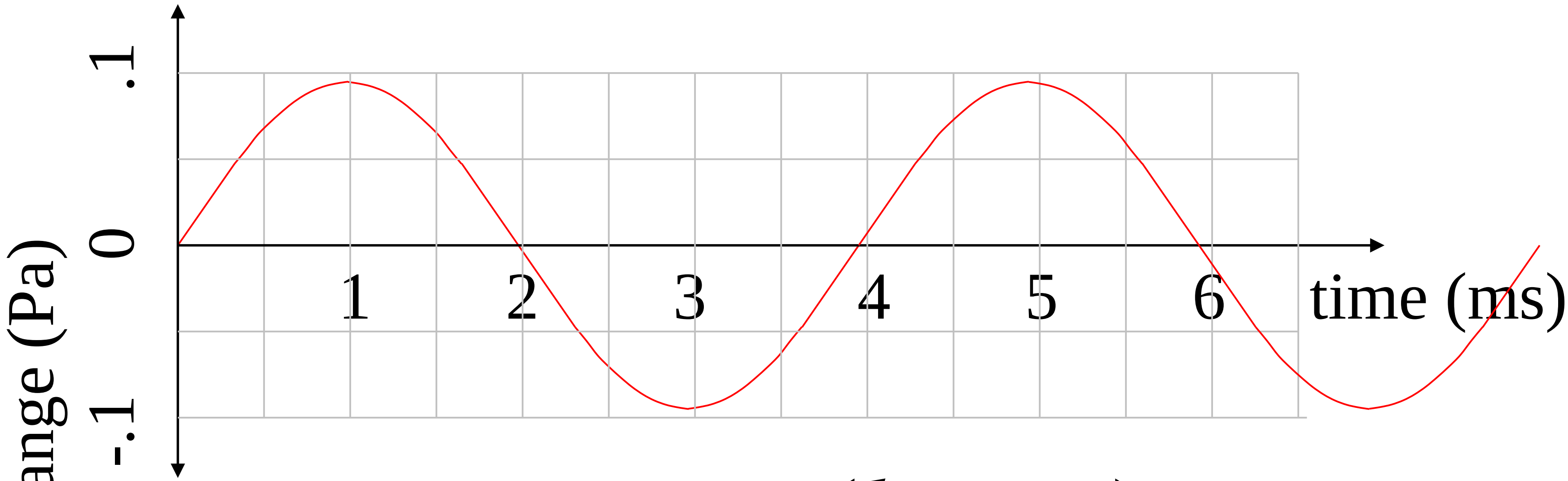
Example – Find the Parameters *A*, *f*, *T*, *λ*, *v*



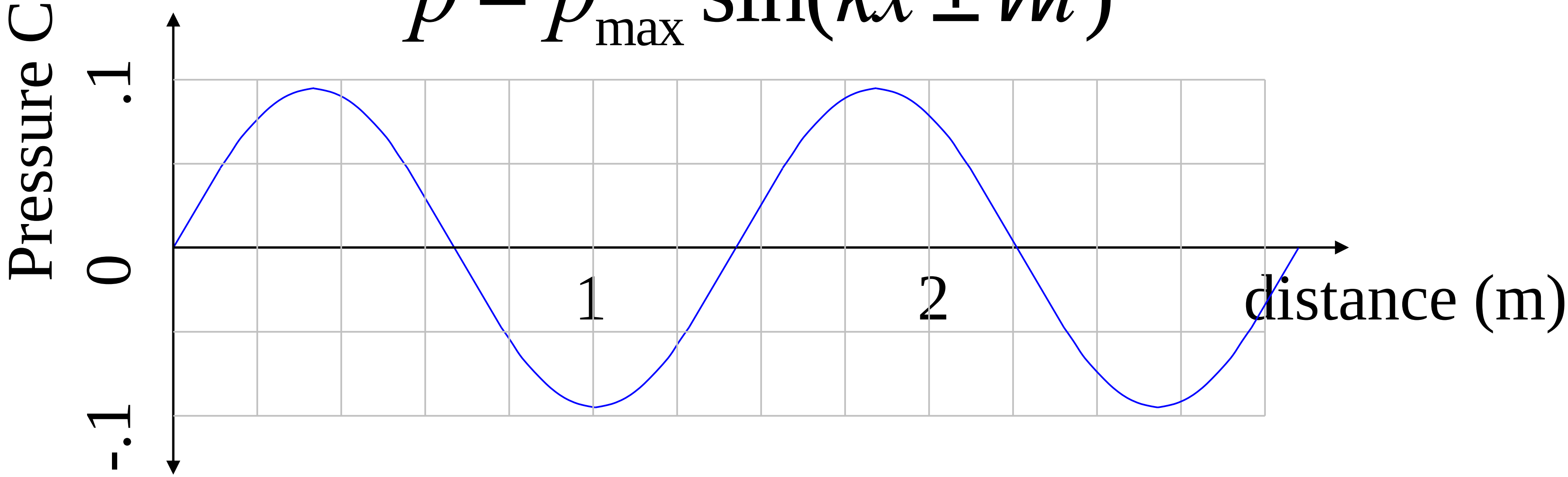
Find the Parameters A, f, T, λ, v:



Example – Find the Parameters *A*, *f*, *T*, *λ*, *v*



$$p = p_{max}\sin(kx \pm \omega t)$$



Example tuning fork sound wave:

f = 256 Hz, λ = 1.34 m, A = 0.09 Pa, v = 343 m/s

$$k = \frac{2p}{l} = \frac{2p}{1.34\,\text{m}}$$

wave number: $$k = 4.69\,\tfrac{1}{\text{m}}$$

$$w = \frac{2p}{T} = 2pf = 2p \times 256\,\tfrac{1}{\text{s}}$$

angular frequency: $$w = 1608\,\tfrac{1}{\text{s}} = 1.61\,\tfrac{1}{\text{ms}}$$

pressure deviation: $$p = 0.09 \times \sin(4.69x - 1.61t)$$

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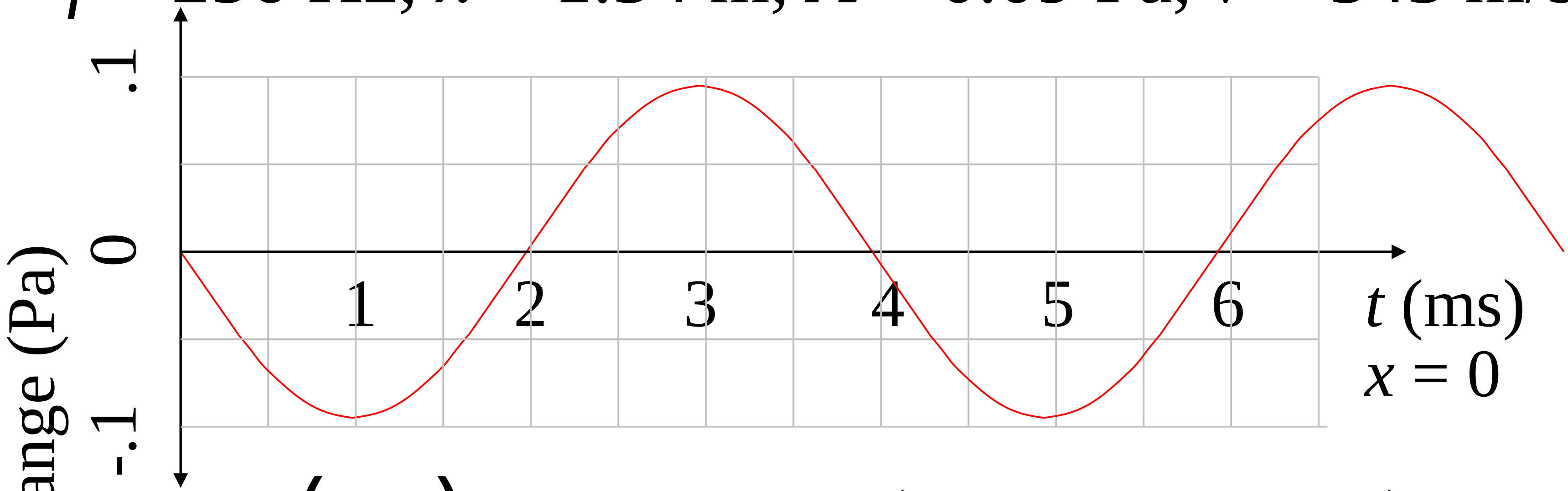

$$p(x,t) = 0.09 \times \sin(4.69x - 1.61t)$$