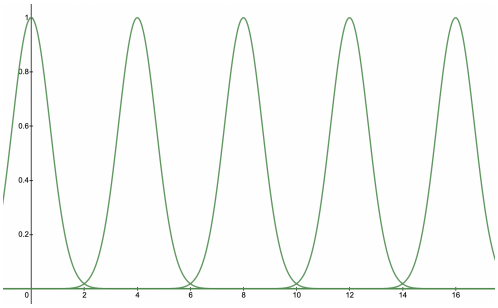
Practice problem

Consider an underwater[1] spherical wave that oscillates in time as shown below:



This "Gaussian comb" profile is defined over one period 4τ, where $\tau = 0.01$ is a dimensionless timescale, as

$$p = p_0 e^{-(t-4\tau)^2}$$

The pressure amplitude p_0 of the wave is 50 Pa when measured 1 m from the source.

1. Is this waveform *physical*? Defend your answer. Proceed with the problem even if your answer is "no."

2. Calculate the sound pressure level 200 m from the source. You may assume that
$$\int_{-2\tau}^{2\tau} e^{-Cx^2}\,\mathrm{d}x \simeq \int_{-\infty}^{\infty} e^{-Cx^2}\,\mathrm{d}x = \sqrt{\frac{\pi}{C}}$$

3. Calculate the particle velocity amplitude u_0 200 m from the source.

4. Suppose the source is Dr. Hamilton's pet hermit crab, Hammy, manically laughing at the world as it sits on the ocean floor at the edge of a continental shelf.[2] Calculate the sound power level.

[1] $\rho_0 = 1026$ kg/m^3, 1500 m/s, $\rho_0 c_0 = 1.54$ Mrayls

[2] That is, the sound propagates in only one quadrant of a sphere