1. The first is a transverse wave, and the second is a longitudinal wave.

2. We know that \( y = 0.5 \cos (4x - 3t + \pi) = A \cos (kx - \omega t + \phi) \)

   So \( A = 0.5 \), \( k = 4 \), \( \omega = 3 \), and \( \phi = \pi \)

   So amplitude = \( A = 0.5 \)

   and wavelength = \( \lambda = \frac{2\pi}{k} = \frac{2\pi}{4} = \frac{\pi}{2} \approx 1.5708 \)

   and period = \( T = \frac{2\pi}{\omega} = \frac{2\pi}{3} \approx 2.0944 \)

   So wave speed = \( v = \frac{\lambda}{T} = \frac{3}{4} \cdot \frac{3}{2} = 0.75 \)

   Finally, phase = \( \phi = \pi \approx 3.1416 \)

3. We know that \( v = \sqrt{\frac{T}{\mu}} \). So \( \mu = \frac{T}{v^2} = \frac{\frac{4}{3}}{\left(\frac{3}{4}\right)^2} = \frac{64}{9} \approx 7.111 \frac{kN}{m^2} \)

   \( \rho v = \frac{1}{2} \sqrt{\frac{\rho}{\mu}} \cdot \omega^2 A^2 \)

   \[ = \frac{1}{2} \sqrt{\frac{\frac{8}{3} \cdot 4}{9} \cdot \left(\frac{3}{4}\right)^2} \]

   \[ = \frac{1}{2} \cdot \frac{8}{3} \cdot 2.9 \cdot \frac{1}{4} = 1.0 \]

4. To find amplitude: we know that maximum displacement is \( A \) and minimum displacement is \( -A \). So the distance between them is \( A - (-A) = 2A \). So we have \( 2A = 2m \Rightarrow A = 1m \)

   To find angular frequency: 10 oscillations in 20s means that in each second, \( \frac{10}{20} = \frac{1}{2} \) oscillations occur. So \( f = \frac{1}{2} \). But \( 2\pi \cdot \frac{1}{2} = \pi \). So \( \omega = 2\pi \cdot \frac{1}{2} = \pi \).

   To find wave number: the picture will look like:

   During one oscillation, displacement returns to zero twice, so it takes \( 2 \cdot 1.5m = 3m \) for an oscillation to occur.

   So \( \lambda = 3m \). But we know that \( k \lambda = 2\pi \Rightarrow k = \frac{2\pi}{\lambda} \Rightarrow k = \frac{2\pi}{3} \)

   To find phase: we know that \( y = A \cos(kx - \omega t + \phi) \) for a wave. But we also know that \( y(0,0) = 0 \). So \( 0 = A \cos(k \cdot 0 - \omega \cdot 0 + \phi) \)

   So \( \cos(\phi) = 0 \). Cosine is zero when \( \phi = \frac{\pi}{2} \) (or \( -\frac{\pi}{2} \), or \( \frac{3\pi}{2} \), etc.). Let's just choose \( \phi = \frac{\pi}{2} \).
5. Wave speed refers to the velocity of a disturbance as it travels. \( \frac{dy}{dt} \) refers to the velocity of each piece of the medium. For example, consider "the wave." This is where everyone in a stadium raises and lowers their bodies to create a wave. The wave speed \( v \) is how quickly the wave goes around the stadium, but \( \frac{dy}{dt} \) is the speed at which each individual person moves up and down.

6. Here's the trick: \( \cos(\theta + \pi) = -\cos(\theta) \). This is an old trig fact and it results from the periodicity of cosine. So by superposition, we add the two waves together:

\[
y_{\text{total}} = y_1 + y_2 = 2\cos(2x - 5t) + 2\cos(2x - 5t + \pi)
\]

\[
= 2\cos(2x - 5t) - 2\cos(2x - 5t)
\]

\[
= 0
\]

So at any time or location, the displacement is just zero; I won't bother drawing this.

7. Intensity is \( \frac{P}{A} \). When the signal has traveled a distance \( r \), it is spread over a sphere of radius \( r \), so \( A = 4\pi r^2 \). So

\[
I = \frac{P}{4\pi r^2}
\]

So for this case, \( \frac{100}{4\pi (5)^2} = \frac{1}{\pi} \approx 0.31831 \text{ W/m}^2 \)

So the intensity of the sound reaching your eardrum is 0.31831 W/m².

If its area is \( A = 0.5 \text{ cm}^2 = 0.00005 \text{ m}^2 \), the power is

\[
P = IA = 0.31831 \text{ W/m}^2 \cdot 0.00005 \text{ m}^2 \approx 1.5915 \times 10^{-5} \text{ W} \]