Chapter 17 Problem 40

$f = 100\ kHz$

$v = 343\ m/s$ $\quad\quad \Delta p = 1.30\ Pa$

a) What is the wave function of the sound wave?

The general form is

$$p(x,t) = \Delta p \sin(kx - \omega t)$$

(Details will be filled in after part b.)

b) What are the period & wavelength of the sound wave

$$T = \frac{1}{f} = \frac{1}{100 \times 10^3\ Hz} = 1.0 \times 10^{-5}\ s = \boxed{10\ \mu s}$$

$$v = f \cdot \lambda \rightarrow \lambda = \frac{v}{f} = \frac{343\ m/s}{100 \times 10^3\ Hz} = 3.43 \times 10^{-3}\ m$$

$\boxed{3.43\ mm}$

Now let's move on to wave number

$$k = \frac{2\pi}{\lambda} = \frac{2\pi}{3.43 \times 10^{-3}\ m} = 1832\ \frac{rad}{m}$$

and angular frequency

$$\omega = 2\pi f = 2\pi (100 \times 10^3\ Hz) = 6.28 \times 10^5\ \frac{rad}{s}$$

So the function is

$$\boxed{p(x,t) = (1.30\ Pa) \sin\left(1832\ \frac{rad}{m} \cdot x - 6.28 \times 10^5\ \frac{rad}{s} \cdot t\right)}$$