PHYS 1312 EOC - Homework Assignment No. 1

Chapter 23, Aug. 18, 2022

Due: Aug. 30, 2022

Problem 1. A sinusoidal wave travels along a stretched string. A particle on the string has a maximum speed of 2.0 m/s and a maximum acceleration of 200 m/s^2. What are the frequency and amplitude of the wave? (answer: 16 Hz , 2.0 cm)

Problem 2. The displacement of a wave traveling in the positive x-direction is $y(x,t) = (3.5\text{ cm})\sin(2.7x - 124t)$, where x is in m and t is in s. What are the (a) frequency, (b) wavelength, and (c) speed of this wave? (answer: 20 Hz, 2.3 m, 46 m/s)

Problem 3. A friend of yours is loudly singing a single note at 400 Hz while racing toward you at 25.0 m/s on a day when the speed of sound in air is 340 m/s. (a) What frequency do you hear? (b) What frequency does your friend hear if you suddenly start singing at 400 Hz? (answer: 432 Hz, 429 Hz)

Problem 4. We can make a simple model of the human vocal tract as a tube extending from the opening of the mouth to the diaphragm. What kind of model tube should you use? What is the length of this tube if its fundamental frequency equals a typical speech frequency of 250 Hz? The speed of sound in the warm air of your throat is 350 m/s. (answer: 35 cm)

Problem 5. Two in-phase loudspeakers, which emit sound in all directions, are sitting side by side. One of them is moved sideways by 3.0 m, then forward by 4.0 m. Afterward, constructive interference is observed $\frac{1}{4}$ and $\frac{3}{4}$ of the distance between the speakers along the line that joins them. What is the maximum possible wavelengths of the sound waves? (answer: 5.0 m)

Problem 6. Two microwave signals of nearly equal wavelengths can generate a beat frequency if both are directed onto the same microwave detector. In an experiment, the beat frequency is 100 MHz. One microwave generator is set to emit microwaves with a wavelength of 1.250 cm. If the second generator emits the longer wavelength, what is that wavelength? (answer: 1.255 cm)

Problem 7. Scientists are testing a transparent material whose index of refraction for visible light varies with wavelength as $n = (30.0\text{ nm}^{1/2})/\lambda^{1/2}$, where λ is in nm. If a 295-nm-thick coating is placed on glass ($n = 1.50$), for what visible wavelengths will the reflected light have maximum constructive interference? (answer: 679 nm, 428 nm)