Physics 4C: Collected Homework 3

Solutions are not considered complete without the logical argument and/or full calculation.

1. Two waves with the same frequency travel along the same piece of string:

$$\begin{aligned} y_1(x,t) &= (4.35\text{ mm})\sin(2\pi x - 350\pi t) \\ y_2(x,t) &= (5.25\text{ mm})\sin(2\pi x - 350\pi t + 0.60\pi\text{ rad}). \end{aligned}$$

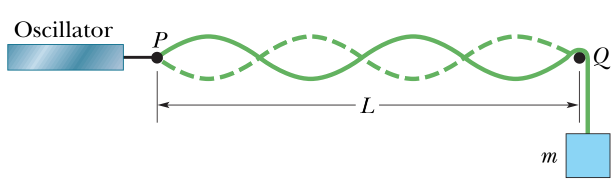
   (a) What is the amplitude of the resultant wave?

   (b) What is the phase angle (relative to wave 1) of the resultant wave?

   (c) If a third wave with the same wavelength as y_1 and y_2 and with amplitude 4.80 mm is also to be sent along the string in the same direction as the first two waves, what should be its phase angle in order to maximize the amplitude of the new resultant wave?

   (d) With the amplitude maximized as in part (c) what is the average power of this resultant wave? Assume that the wave number in the wave functions is given in units of m^{-1} and the angular frequency is given in s^{-1} and that $\mu = 5$ g/m is the string density.

2. A string, tied to a sinusoidal oscillator at point P and running over a support at Q, is stretched by a block of mass m. The separation between P and Q is $L = 1.20$ m, and the frequency f of the oscillator is fixed at 150 Hz. The amplitude of the motion at P is small enough for that point to be considered a node. A node also exists at Q. A standing wave appears when the mass of the hanging block is 117.0 g or 208.0 g, but not for any intermediate mass. What is the linear density of the string? (Assume that the distance that the block m hangs below Q is negligible.)



3. A string of length 120 cm carries a standing wave. Each of the points on the string at which the displacement amplitude is equal to 2.12 mm are separated by 20.0 cm. Find the maximum displacement amplitude. To which harmonic do these oscillations correspond?