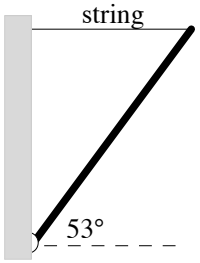
1 (28 points) A light horizontal string 2.0m long holds a uniform beam at an angle of 53° with the horizontal. The beam's weight is 100N and its lower end is supported by a frictionless pivot. A wind causes the string to vibrate at its fundamental frequency of 34.5Hz. What is the string's mass? (b) If the amplitude of this fundamental standing wave is 1.0mm, what is the maximum speed of a short segment of the string 0.5m from either end?



2 (18 points) Two identical piano strings, of the same length and mass density, are fixed at both ends and play exactly the same fundamental frequency. Suddenly, on one of the strings, the peg designed to maintain the tension slips, reducing the tension to 96% of what it had been before, and a beat frequency of 5.3Hz is heard as a result. (The string's mass density is unchanged.) What was the original frequency played by the two strings?

3 (20 points) You're standing on the side of a desert highway as a police car whizzes by at constant speed, siren blaring. As it approaches, you hear 1200Hz, and after it passes, you hear 900Hz. How fast was it traveling? (Assume the speed of sound is 344m/s.)

4 (18 points) On a day when the speed of sound is 330m/s, two speakers emit coherent sound waves in phase with each other, of 88Hz frequency. The waves spread uniformly in all directions from each, and dissipative energy loss is negligible. Your ear is at a point P that is 5.50m from Speaker 1 and 4.25m from Speaker 2. When either speaker is played *independently* (i.e. the other speaker disconnected), you hear the *same* intensity I_P. (a) What is the ratio of the power emitted by Speaker 2 to that emitted by Speaker 1? (b) What intensity will you hear with both speakers on?

5 (16 points) A film of oil of refractive index 1.45 floats on a body of water, of refractive index 1.33. Of wavelengths in the accepted visible range, we see very strong reflection of only 450nm and 630nm. What is the film's thickness?