AS Physics Name_____

Enrichment – Stationary Waves

You may build the apparatus in groups of 1-3. However all members must give their own written responses.

Introduction

In this assignment, you will analyze three different instances of stationary waves and construct and demonstrate one of them.

Instructions

1) Analyze the stationary wave found in a Kundt tube, as shown below.
   a) Mark on the diagram the location of the nodes (N) and anti-nodes (A).
   b) Explain the formation of stationary waves in this apparatus. Explain how that creates the larger Styrofoam peaks.
   c) Draw a diagram of the fundamental mode (aka 1st harmonic) and of the second harmonics and mark on the diagrams the location of the nodes (N) and anti-nodes (A).
   d) How could you change the shape of the fundamental mode of this scenario? (be specific!) What would the new fundamental mode look like?
   e) Given the length of the tube, L, write an expression for determining the frequency necessary to create the first 5 stationary waves. Give your answer in terms of the length of the tube, L, and the speed of sound (340 m/s).

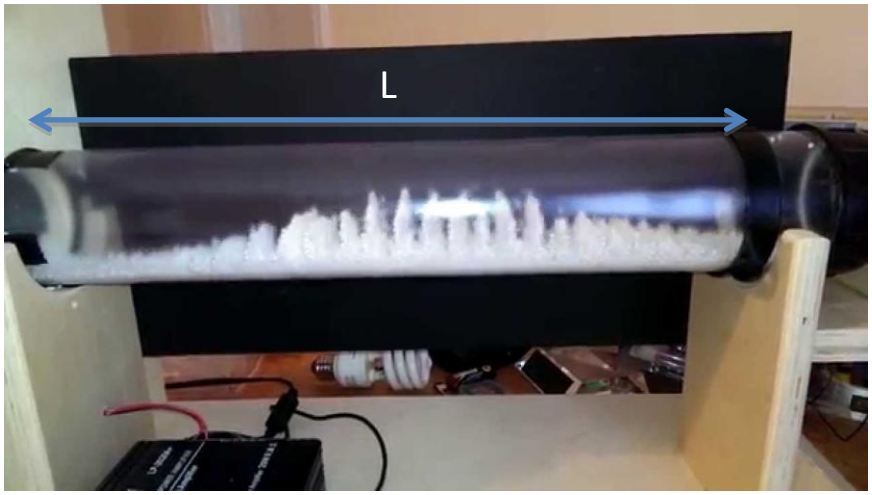

Fig. 1: Kundt Tube

2) Analyze the stationary wave found in a Chladni Plate, as shown below.
   a) Mark on the diagram the location of the nodes (N) and anti-nodes (A).
   b) Explain the formation of stationary waves in this apparatus. Explain how that creates the sand pattern.
   c) How could you change the shape of the fundamental mode of this scenario? (be specific!)
   d) Research how this phenomenon relates to guitars, violins and other string instruments. Give a 2-3-paragraph summary of your research. In your summary, include the importance of stationary waves in musical instruments (i.e. guitars).

Fig. 2: Chladni Plate

3) Analyze the stationary wave found in wind chimes, as shown below.
   a) Explain the formation of stationary waves in this apparatus. Explain how that creates the sound.
   b) Draw a diagram of the fundamental mode (aka 1st harmonic) and of the second harmonics and mark on the diagrams the location of the nodes (N) and anti-nodes (A).
   c) For the following notes, determine a) how long a tube would have to be to chime at that fundamental frequency and b) how long a tube would have to be to chime if that frequency was the second harmonic (give your answer in meters **and** in terms of a wavelength).
      i) A-440
      ii) C-523.25
      iii) E-659.25
      iv) A-880

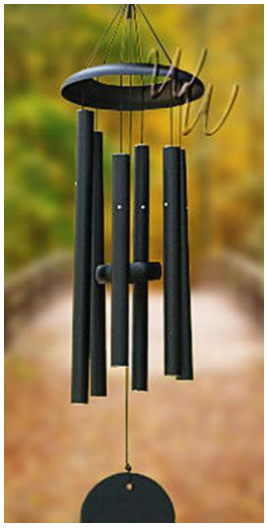

Fig. 3: Wind Chimes

4) Construct a device that creates stationary waves (such as one of the three above or via another medium ie. water, string, etc.) and demonstrate that it works properly. For the apparatus, state the 3 lowest frequencies for which you can achieve a stationary wave. Include a diagram for the stationary wave formed at each of those frequencies.