

Name: \_\_\_\_\_

Class Period: \_\_\_\_\_

## Physics: Sound Harmonics HW

### Conceptual Questions:

1. The formula for harmonics on stringed instruments is  $f_n = n \frac{v}{2L}$  the formula for harmonics in pipes is  $f_n = n \frac{v}{2L}$ . What are the differences between these two calculations if any?
2. Why does a saxophone sound different than a clarinet even if they are playing the same note at the same volume?
3. What is the limitation for pipes only open at one end? Why?
4. Use the space below to sketch the fifth harmonic for a....
  - A. Stringed instrument
  - B. A pipe open at both ends
  - C. A pipe open at one end

### Mathematical Questions

- For the questions below – first identify the category of instrument – whether it is considered a stringed instrument, pipe open at both ends, or a pipe open at one end.
  - Assume the velocity of sound in air to be 343 m/s unless stated otherwise
5. An organ pipe is 2.46 m long. If we assume the speed of sound in air to be 343 m/s, how many harmonics can be heard in the human hearing range (20 – 20,000 Hz)?

Instrument Category: \_\_\_\_\_

6. A flute produces a sound with a 4<sup>th</sup> harmonic that has a frequency of 1008 Hz.

*Instrument Category:* \_\_\_\_\_

Based on the information above, find the following.....

- A. The length of the flute
- B. The fundamental frequency

7. You find an open water bottle and blow across the top of it, producing a fundamental frequency of 472 Hz.

*Instrument Category:* \_\_\_\_\_

- A. What is the length needed for the column of air?
- B. What is the value of the next audible harmonic

8. What are the first three harmonics of a note produced on a violin string that is 31.0 cm long, has a mass of  $3.00 \times 10^{-3}$  kg, and is pulled with a tension of 726 N.

*Instrument Category:* \_\_\_\_\_

- A. What is the velocity of this string?
- B. What are the frequencies of the fundamental and the next two harmonics?