

## Waves in pipes and string

### Day 1: Organ pipes

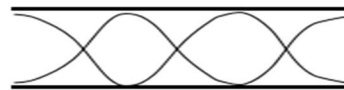
Date: .....

1. a. What is close organ pipe? Discuss various modes of vibration of the air column in close organ pipe and hence write the expression for the frequency of  $n^{th}$  mode. 3
  - b. What is tone and note in sound? 1
  - c. What is standing wave? How and what type of standing wave is formed in close organ pipe. 2
  - d. Determine the length of the pipe closed at one end in which the air column will vibrate with fundamental frequency of 160 Hz taking the speed of sound in air to be 340m/s. [0.53m] 2
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2. a. Explain briefly the phase reversal from the closed end and open end of an organ pipe. 2
  - b. What do you understand by 'harmonics' and 'overtone' in the case of organ pipe? 2
  - c. Draw the waveform for third harmonics in close organ pipe. If the fundamental frequency is  $f$ , what is the frequency of third overtone in close pipe? 2
  - d. A close pipe is 0.5m long. What is the fundamental frequency and third overtone if velocity of sound is 350 m/s? [175Hz, 1225Hz] 2

### Day 2: Organ pipes

Date: .....

3. Two open organ pipes of different lengths are resonated with two tuning forks of different frequencies. The waves patterns in the pipes are shown below:



Pipe A



Pipe B

- a. Find the harmonics and overtones in each of the given pipe A and B. 2
  - b. If pipe B resonates at a frequency of 288 Hz, what can be the resonating frequency in pipe A? [432Hz]
  - c. The sound produced by an open organ pipe is of higher quality than that by a closed organ pipe. Explain.
  - d. Discuss various modes of vibration of the air column in close organ pipe and hence write the expression for the frequency of  $n^{th}$  mode. 3
4. a. Fundamental frequency of oscillation of a close pipe is 400 Hz. What will be the fundamental frequency of oscillation of an open pipe of the same length? [800Hz] 2
  - b. Name two instruments based on the superposition of waves. 1
  - c. Why does sound travel faster in metals than in air? 2
  - d. For sound waves of frequency 2500Hz, it is found that two nodes are separated by 20cm, with three antinodes between them. Determine the wavelength and the speed in air. [0.133m, 330m/s] 2
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5. a. What is resonance? Suggest some examples. 2
  - b. The frequency of fundamental note of a closed organ pipe and that of open organ pipe are the same. What is the ratio of their length?
  - c. An open organ pipe of length 30cm sounding at third harmonics is in unison with a close organ pipe sounding at third overtone. Find the length of close pipe. [35cm] 2
  - d. Determine the shortest length of a closed pipe and an open pipe that will resonate in the air at  $0^\circ C$  with a frequency of 175vibrations per second.  
[Velocity of sound = 330m/s.] [0.47m, 0.94m] 2

### Day 3: Resonance apparatus/ End correction

Date: .....

6. a. What is end correction? How is end correction related to radius of pipe? 2