OCR B Physics A-Level

PAG 5.2

Determining the speed of sound in air by formation of stationary waves in a resonance tube

Equipment

- Tuning fork
- Hammer for tuning fork
- Resonance tube (open at one end)
- Water reservoir

Method

1. Fill the resonance tube halfway with water.
2. Hit the tuning fork of a known frequency with a hammer and hold it above the tube then lower the water level until the intensity of sound is amplified, when resonance (loudest sound) is heard, mark the water level with a rubber band.
3. Then, lower the water further until the next point of resonance is heard and mark it, keep going in this manner as far as possible.
   Resonance occurs when the open tube length is $\lambda/4$, $3\lambda/4$ and $5\lambda/4$.

Calculations

- Using the length from the top of the tube to the rubber bands, find the wavelength, e.g. if the first maximum is 15cm down the tube, the wavelength is 15 x 4 = 60cm (0.6 m) repeat this step for each of the maxima and then calculate the mean wavelength.
- Multiply the mean wavelength (m) by the known frequency (Hz) to find the speed of the sound wave in m/s for the temperature of the room at that time.

Safety

- Don't let the tuning fork touch the resonance tube as the vibrations can break the tube.

Notes and Improvements

- The open end acts as an antinode, but the real antinode is about 0.6 r from the end (r is the tube radius). This correction can be added to get a more accurate value when only amplified sound (resonant point) can be measured.
- Using a resonance tube with a scale on it will help account for error when measuring the length of a curve tube with a ruler.