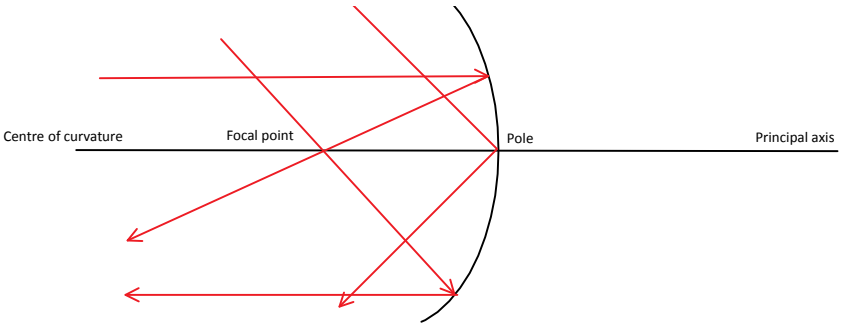
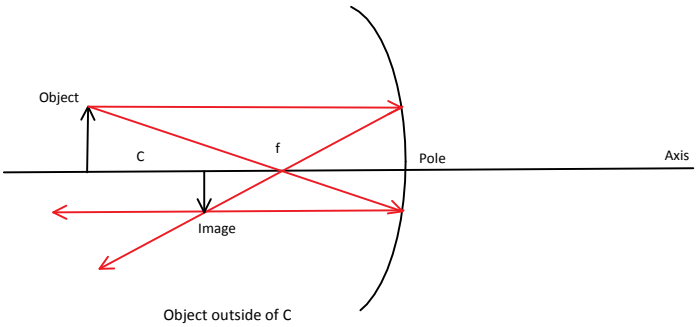
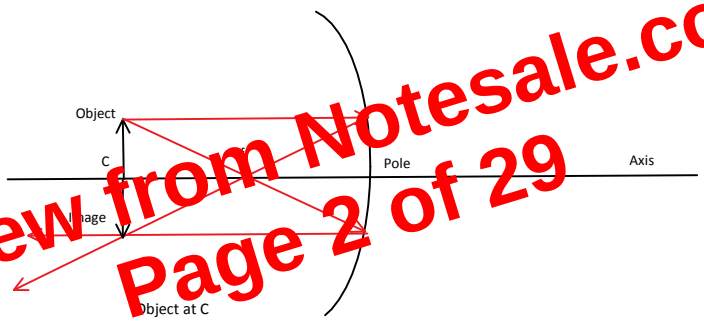


- Centre of curvature
  - Centre of mirror
- Focal point
  - Half way between mirror and centre
- Image formation



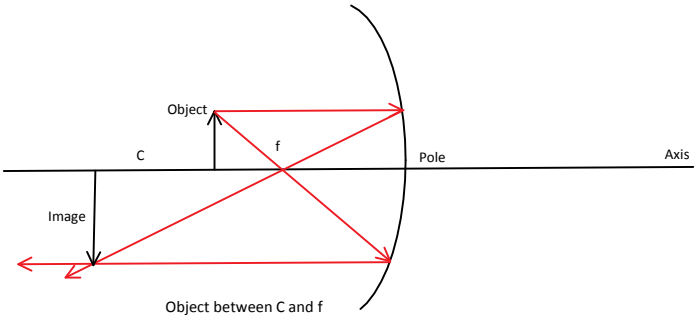
Object outside of C

- Image
  - Real
  - Inverted
  - Diminished



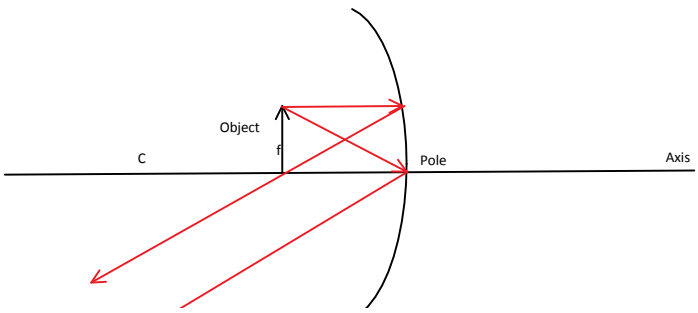
Object at C

- Image
  - Real
  - Inverted
  - Same size

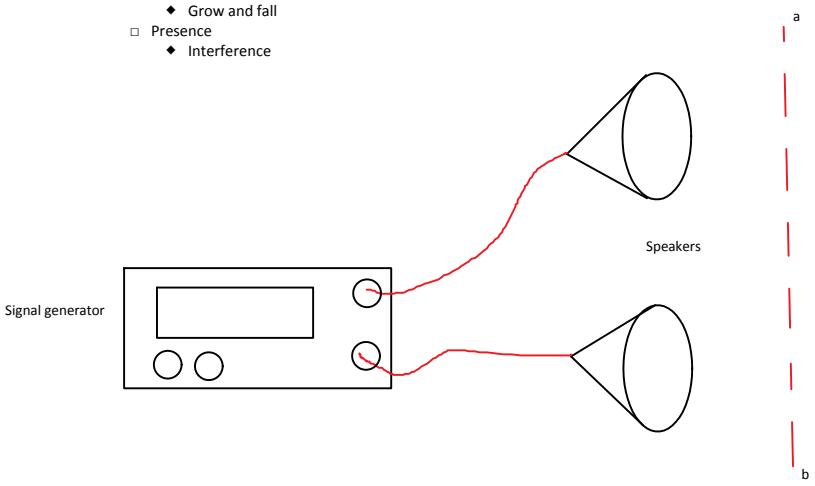


Object between C and f

- Image
  - Real
  - Inverted
  - Magnified



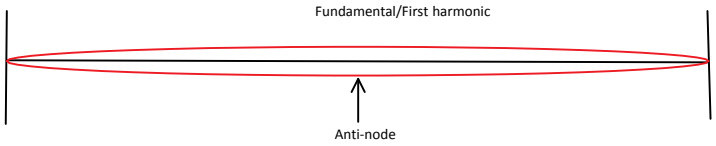
- Sound
  - Hear repetitively
    - Grow and fall
  - Presence
    - Interference



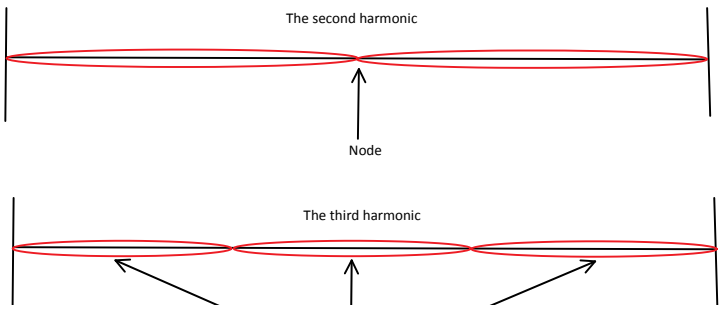
- Sound waves
  - Reflected
    - Echo
  - Refracted
    - Travels slower in cold air
    - Cold night
      - Cold air near surface
      - Sound wave
        - Rising
        - Hits
          - Warmer air
          - Refracted downward
      - Hear better at night
  - Longitudinal
    - Demonstration
      - Slinky
    - Created
      - Vibrating object
  - Needs medium
    - Different medium
      - Different speeds
    - Air
      - 330m/s
    - Water
      - Higher
    - Solids
      - Even higher

Harmonics

- Bodies
  - Natural frequencies vibrations
- Standing waves
  - Node fixed
  - Anti-node moves



- Factors
  - Control frequency
    - Length
    - Tension
    - Mass per unit length
    - Formula
      - $f = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$
- Second harmonic
  - Node
    - Either end
    - Middle



Resonance

- Resonance is the transfer of energy between two bodies of the same natural frequency
- Body
  - Particular natural frequency
  - Contact
    - Another body
      - Same natural frequency
    - Energy transfer
- Experiments
  - Stretched string
  - Tuning fork
    - Same frequency as string
      - String vibrates

Speed of sound

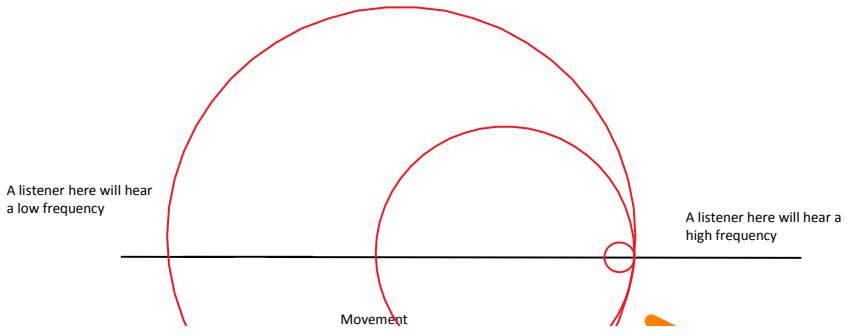
- Air
  - 330m/s
- Faster liquids
- Fastest in solids
- Waves
  - Speed related to frequency and wavelength
  - Expression
    - Compare
      - Wavelength
      - Frequency
      - Speed
      - Between medium
- Equipment
  - Sound
    - Different speed in different media
    - Reflected off surfaces
    - Helps
      - Sonar
      - Ultrasounds
        - Used when x-rays dangerous

Sound intensity

- Measured
  - Wm^{-2}
- Sound intensity level
  - Measured
    - Decibels
  - Calculated
    - Log scale
    - Number of dBs
      - Corresponds
        - Volume of sound
  - Double sound intensity
    - Increases sound intensity level
      - 3 dB
- Frequency limits of audibility
  - Highest and lowest sound detectable by [illegible] average human ear
  - Lower limit
    - 20 Hz
  - Upper limit
    - 0 Hz

Doppler effect

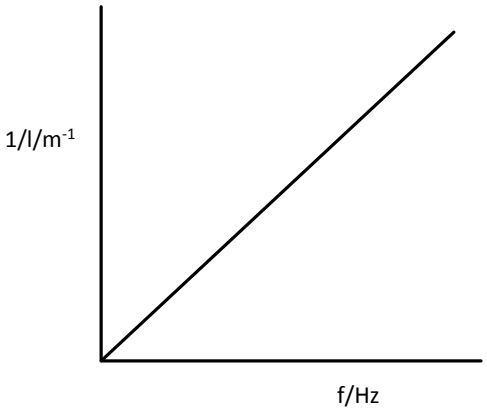
- Sound approaching
  - Pitch/ frequency
    - Higher
- Away
  - Pitch/ frequency
    - Lower
- Applies
  - All waves
- Waves spread out
  - Stationary object
    - Circle around stationary point
      - Moves constantly from that point
  - Moving source
    - Circles emitted in lines
    - Constantly growing
    - Each circle
      - Different centre
    - Waves
      - Bunch
        - Front
        - Pass quicker
          - Higher frequency/pitch
      - Spread
        - Behind
        - Pass slower
          - Lower frequency



3. Start with a small for l and slow increase it, until the paper rider moves, indicating that the string is vibrating.
4. Record l and f.
5. Repeat for various tuning forks, and record the measurements in a table.
6. Plot a graph of frequency f against the inverse length: 1/l.

Conclusion

A straight line graph through the origin will verify that frequency f is proportional to 1/l.

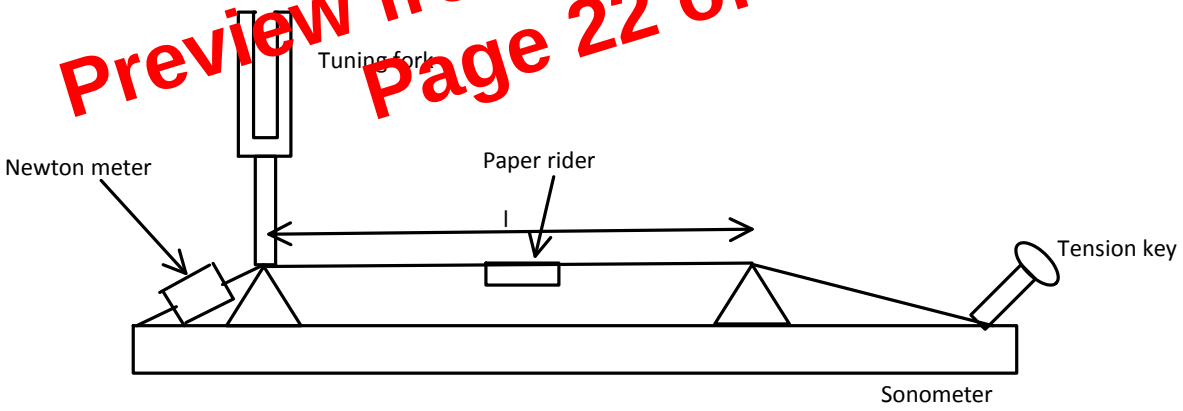


Accuracy

- It is difficult to determine when the strings vibrations are at their greatest, the paper rider helps with this.
- Tuning forks are easily damaged and may not vibrate at the labelled frequency.

Investigation of the variation of the fundamental frequency of a stretched string with tension.

Apparatus



Method

1. Set up the apparatus as shown in the diagram.
2. Select a wire length l (e.g. 30cm) by suitable placement of the bridges. Keep this length fixed throughout the experiment.
3. Striker a tuning fork and place it on the sonometer. Start at low tension and slow begin to increase it until the string begins to vibrate. Record f and T.
4. Repeat the procedure several times with different tunign forks.
5. Plot a graph of frequency f against the square root of tension: $\sqrt{T}$.

Conclusion

A straight line through the origin verifies that f is proportional to $\sqrt{T}$.