- 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

- Object
- sound
  - Hear repetitively
    - Grow and fall
    - Presence
      - Interference

- Interference
  - Presence

- Sound
  - Echo
  - Reflected
    - Travels slower in cold air
      - Cold night
        - Cold air near surface
        - Sound wave
          - Rising
          - Hits
            - Warmer air
            - Refracted downward

  - 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
      - 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
  - Wm²
- 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 average human ear
    - Lower limit
      - 20 Hz
    - Upper limit
      - 20 kHz
- Doppler effect
- Sound approaching
  - Pitch/frequency
    - Higher
- Away
  - Pitch/frequency
    - Lower
- Applies
  - All waves
- Waves spread out
  - Stationary object
    - Circle around stationary 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

A listener here will hear a low frequency
A listener here will hear a high frequency
3. Start with a small force on the string and slowly increase it, until the paper rider moves, indicating that the string is vibrating.
4. Record the force and frequency.
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 $1/l$.

![Graph of $1/l$ against $f$]

**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**
- Tuning fork
- Sonometer
- Newton meter
- Paper rider
- Tension key

**Method**
1. Set up the apparatus as shown in the diagram.
2. Select a wire length $l$ (e.g., 30 cm) by suitable placement of the bridges. Keep this length fixed throughout the experiment.
3. Strike a tuning fork and place it on the sonometer. Start at low tension and slowly begin to increase it until the string begins to vibrate. Record $f$ and $T$.
4. Repeat the procedure several times with different tuning 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 $\sqrt{T}$.