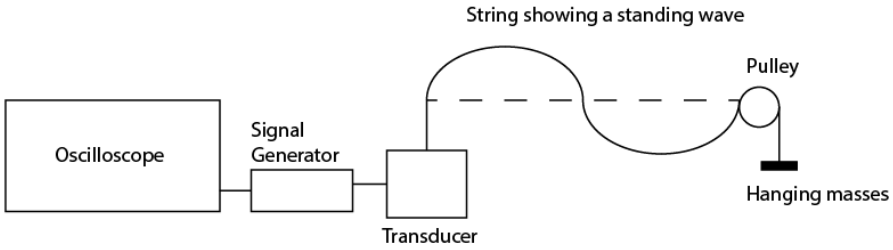
Edexcel Physics A Level

Core Practical 7

Factors affecting the Frequency of a Vibrating String



Method 1: Effect of Tension on Frequency

- Attach 10g of mass to the end of the pulley and calculated tension as followed:

$$Tension = mass\ added \times g$$

- Switch on transducer and increase frequency until first harmonic is formed
- First harmonic is observed when there is a standing wave on the string with 2 nodes and 1 antinode (wavelength = twice the length of the string)

- Using timebase on oscilloscope, find frequency of first harmonic $\left(\frac{1}{T}\right)$ – record the frequency
- Increase the amount of mass up to 100g in 10g increments, finding the first harmonic, frequency and tension each time
- Plot frequency against tension and frequency against square root tension to investigate the relationship between the two variables

Method 2: Effect of μ on Frequency

- Measure the mass and length of the string between transducer and pulley using a metre ruler and a mass balance
- Calculate the mass per unit length, μ;

$$\mu = \frac{mass\ of\ string}{length\ of\ string}$$

- Keep 10g of mass on the end of the pulley (keep tension constant) and the length of the string constant
- Change the string's mass per unit length by using a thicker string or different material
- Plot frequency against μ and draw line of best fit to determine the relationship between the two variables

Method 3: Effect of Length on Frequency

- Measure the length of the string between transducer and pulley using a metre ruler
- Keep 10g of mass on the end of the pulley (keep tension constant)
- Change length of string between pulley and transducer (use same string to keep μ constant)

- Record and plot fundamental frequency against length to find the effect of length on fundamental frequency

Safety

- No major hazards – string is elastic so won't snap easily, low masses used, pulley firmly attached to bench

Evaluation

- Using oscilloscope overcomes uncertainty in signal generator
- To measure one variable (Tension, Length, Mass/length) keep the other two constants
- Don't use heavier masses, in order to keep low frequencies required to form the first harmonic
- Set timebase on oscilloscope so one wavelength is on the display, to reduce uncertainty in measuring the distance across timebase
- Uncertainty at nodes measuring wavelength due to blur
- For graphs, the following relationship applies:

$$v = f\lambda = \sqrt{\frac{T}{\mu}}$$

where λ = 2 x length of string, T is tension and f is the fundamental frequency