

Solutions

Original-task allocations: B1 = one point, M1 = one method mark, A1 = one accuracy mark.

2.1 Independent: tension, varied through hanging mass. Dependent: fundamental frequency. Keep vibrating length or string linear density fixed.

2.2 Small current limits heating and changing resistivity. The zero check allows a known diameter offset to be corrected. Secure contacts reduce variable contact resistance or intermittent readings.

2.3 The drift indicates changing cell conditions, rather than only random variation. Reduce current/use a larger load resistance. Open the switch between readings and allow conditions to stabilise.

3.1 Keep lamp–cell distance fixed using a measured constant radius. Keep lamp output fixed using the same supply setting. Keep background light steady with shielding/darkened room, or keep cell load/temperature steady with a stated method. First sample a broad range to find the peak region, then add more closely spaced angle settings around the peak while maintaining controls.

3.2 Place each beam across supports with the same separation. Add measured masses at the same loading position, converting total supported mass to force using $F = mg$ or reading a suitable force sensor. Increase in small steps near failure and record the highest supported load plus the next failing load as a bracket. Keep dimensions, support arrangement and other preparation conditions fixed. Use several comparable beams per composition because failure destroys a specimen; compare spread/mean rather than reusing a broken beam. Use a shield/eye protection and a tray to catch fragments or falling masses, naming the relevant risk.

3.3 Use a vibration generator driven by a signal generator and measure the length between end nodes. Tune to the fundamental at each of several lengths; approach resonance from both sides/repeat. Keep tension and linear density fixed. Plot f against $1/L$; the model predicts a straight line through the origin with gradient $\frac{1}{2}\sqrt{T/\mu}$. Secure the stand/masses or protect against a named falling-mass hazard.