Sound Velocity Worksheet

Your Name: Trevor N. Signature: Trvr N.

Lab partner(s): Katherine

Course & Section: PHYS 121-118 Station # 4 Date: 24/04/2024

Distance d with uncertainty and units: $d =$ 153.3 ± 0.1 cm

What is the uncertainty in your measurements of time? 0.0001s

$V = \frac{2d}{s}$

Trial	Time (s)	Velocity (m/s)
1	0.0089 s	344.49
2	0.0087	~~3...~~ 352.41
3	0.0088.	348.41
4	0.0088	348.41
5	0.0088	348.41
6	0.0088	348.41
7	0.0089	344.49
8	0.0089	344.49
9	0.0087	352.41
10	0.0087	352.41

Mean velocity = 348. Standard dev. = 3.24 St.error of mean = 1.

Calculated uncertainty in velocity for one typical run. δ_v = 27.7 ≈ 28.
Show your work on the back of this page.

How does this uncertainty compare to your results for Standard Deviation and St. error of the mean for your multiple trials? Do your results make sense?

It is significantly more than that of the whole set. This is expected as std. err takes into account the number of samples, and our errors were also estimated on the safe side.

$B =$ (1.5 ± 0.2)x10⁵ Show your work on the back of this page.
Attach a printout of one of your *Logger Pro* plots.

GRADE:_______ (out of 15 points) **GRADED BY** ________ (TA's initials)

Show your work for the calculation of the uncertainty in velocity for one typical run and for your calculation of the bulk modulus of air and its uncertainty:

$$v = \frac{2d}{s}$$

$$\delta_v = v\sqrt{\left(\frac{\delta d}{d}\right)^2 + \left(\frac{\delta s}{s}\right)^2}$$

$$= 27.7 \text{ m/s}$$

$$v = \sqrt{B/\rho}$$

$$B = v^2 \rho$$

$$\rho = 1.204 \frac{\text{kg}}{\text{m}^3}$$

$$\delta_B = B \frac{2\delta v}{v}$$

$$B = (1.5 \pm 0.2) \times 10^5 \frac{\text{kg}}{\text{s}^2\text{m}}$$

Standing Waves on a String Worksheet

Your Name: Trevor N. **Signature:** TrevN.

Lab partner(s): Katherine

Course & Section: 121-118 PHYS **Station #** 14 **Date:** 24/04/2024

String mass M_{string} = 8.3 ± 0.1 g

String length L = 205.5 ± 0.5 cm

Discussion of reasoning for appropriate length for finding μ and measurement techniques:

$\mu = \frac{m}{L}$ we weighed and measured the stretched string above, and can now calculate the mass density with $\frac{m}{L}$.

$\sigma_\mu = \mu\sqrt{\left(\frac{\sigma_m}{m}\right)^2 + \left(\frac{\sigma_L}{L}\right)^2}$

Linear density μ = 0.00404 ± 0.00005 kg/m

Mass of hanging mass M_{mass}= 0.2 kg (we can assume negligible uncertainty)

Enter into the table on the reverse side of this worksheet the frequencies, periods and wavelengths of each arrangement of standing waves that you observe. Include uncertainties.

Measured velocity of wave propagation V_M = 23.7 ± 0.1 m/s

Predicted value V_P = 22. ± 1. m/s $V_P = \sqrt{\frac{gM}{\mu}}$ $\sigma_{V_P} = V_P\sqrt{\cancel{\left(\frac{\sigma_M}{M}\right)^2} + \left(\frac{\sigma_\mu}{2\mu}\right)^2}$

Compare your measured and predicted values of the wave velocity. Comment on their consistency. Justify your conclusions.

They are very close, error propagation from our estimated value is fairly conservative. additional error could be due to inconsistencies in the human measurement and estimation of Hz.

Attach a printout of your *Origin* graph and linear fit, with fit parameters.

Number of Loops n	Frequency f (Hz)	Period T(s)	Length D of n loops	Wavelength λ (m)
1	9	0.111	1.32 m	2.64
2	18	0.056	1.27 m	1.27
3	27	0.037	1.275 m	0.85
4	36.5	0.027	1.25 m	0.625
5	45.22	0.022	1.25 m	0.5
6	54.1	0.018	1.25 m	0.417
7	63.5	0.016	1.24 m	0.354
8	73.5	0.014	1.24 m	0.310
9	82.6	0.012	1.23 m	0.273
10	91.8	0.011	1.24 m	0.248
11	101.	0.010	1.23 m	0.224
12	111.4	0.009	1.22 m	0.203
13	121.5	0.008	1.23 m	0.189
14	129.6	0.008	1.23 m	0.176

GRADE:_______
(out of 15 points)

GRADED BY _________
(TA's initials)