

Appendix X. Sample Lab Notebook pages

revised October 24, 2003

The following pages contain laboratory notebook pages from an experiment with a simple pendulum to determine the acceleration due to gravity.

Name: Daniel B Scholtz

Date: 21 Oct 03

05

Experiment: Simple Pendulum

Partner: None

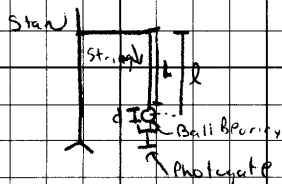
Course: PHYS 121

Section: 09A

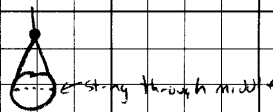
Lab Station: 20

TA: None

Apparatus:



Side view of ball-bearing



Calibration of photogate timer:

Started Logger Pro, hit "collect," blocked gate, blocked gate and started stopwatch, blocked gate and stopped stopwatch
Stopwatch timing: 29.000 ± 0.100 sec Logger pro timing 1757.088

Used callipers to measure diameter of ball bearing. Limiting factor: resolution of callipers

$$d = (2.58 \pm 0.01) \text{ cm}$$

Procedure:

Measure L w/ Z-meter stick

(Take off stand, tape ends so that top notch is at 10-cm mark, pull tight, measure other end, subtract 10cm.)

Start pendulum swinging

Start Logger Pro recording data

Let swing for 20-25 swings

Stop Logger Pro

Save data

Shorten string

Repeat

→ Actually easier to measure L after doing run w/ Logger Pro

δL : Resolution of stick + stretching + straight + shift of knots
⇒ $\delta L \approx 2 \text{ mm}$

(T seems to decrease as time goes on, use small amplitude oscillations)

Important: Place card under blue copy.

Name: the B lll Daniel B Schultz

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06

Experiment: Simple pendulum

All Logger Pro files will be saved to
L:\SimplePendulum\name.mbl

L(m)	File Name	T(s)	σ (s)	N	δT (s)
(to .002 m)					
1.128	Run 01	2.14254	3.386×10^{-4}	21	0.00007
1.067	Run 02	2.08401	3.192×10^{-4}	20	0.00007
0.986	Run 03	2.00979	2.709×10^{-4}	25	0.00005
0.912	Run 04	1.92741	2.761×10^{-4}	25	0.00005
0.835	Run 05	1.84822	4.870×10^{-4}	36	0.00008
0.769	Run 06	1.77008	3.068×10^{-4}	25	0.00006
0.688	Run 07	1.67733	3.703×10^{-4}	25	0.00007
0.620	Run 08	1.58358	1.823×10^{-4}	19	0.00004
0.548	Run 09	1.47666	9.466×10^{-4}	25	0.00019
0.477	Run 10	1.39619	3.914×10^{-4}	25	0.00008
0.477	Run 11	1.37302	8.031×10^{-4}	25	0.00017
0.403	Run 12	1.29207	8.513×10^{-4}	25	0.00017
0.335	Run 13	1.17055	0.00327	21	0.0007
0.262	Run 14	1.04757	6.898×10^{-4}	24	0.00014

Measured mass of bearing w/ balance. Resolution of balance limiting factor
 $m = (23.7 \pm 0.1)g$

Note: Runs 8, 13, 14, last few oscillations didn't properly pass through photogates, have $T \sim 2x$ others and excluded from analysis.

$$\delta T = \sigma / \sqrt{N}$$

$$T_{\text{actual}} = T_{\text{measured}} \left(\frac{t_{\text{stopwatch}}}{t_{\text{distribution}}} \right) = T_{\text{measured}} \left(\frac{1749.9}{1757.088} \right)$$

Do these calculations in Origin

$$\delta T_{\text{actual}} = T_{\text{actual}} \sqrt{\left(\frac{\delta T}{T_{\text{meas}}} \right)^2 + \left(\frac{\delta t_{\text{stop}}}{t_{\text{stop}}} \right)^2}$$

Use Run 05 for "typical" run histogram
 Histogram saved as L:\SimplePendulum\Hist.005

Important: Place card under blue copy.

Name: Pan. Pi B Schultze *Phil B. M.* Date: 21 Oct 03

07

Experiment: Simple Pendulum

~~Use~~ From Theory: $T = 2\pi\sqrt{\frac{L}{g}}$

$\Rightarrow L = \frac{g}{4\pi^2} T^2$
 $y = m x + b$

$\Rightarrow g = 4\pi^2 m$ $\delta g = 4\pi^2 \delta m$

$L = L + \frac{d}{2}$ $\delta d \ll \delta L \Rightarrow \delta L \approx \delta L$

$\delta_{T^2} = \left| \frac{d}{dT} T^2 \right| \delta T = 2T \delta T$

Save Origin file as L:\Simple Pendulum\Results.op5

Slope = $(0.2485 \pm 0.0005) \text{ m/s}^2$

$\Rightarrow g = 4\pi^2 (0.2485) = 9.81039$

$\delta g = 4\pi^2 (0.0005) = 0.02$

$\Rightarrow g = (9.81 \pm 0.02) \text{ m/s}^2$

Conclusions

Good agreement w/ accepted value ($\approx 9.8 \text{ m/s}^2$)

Poss. sources of systematic error:

- Air Drag
- Small angle approximation

Rel. uncertainty $\approx 0.2\%$, not bad

Hard to get > 3 sig. figs on g

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