Determination of Gravitational Acceleration via a Simple Pendulum

Physics 101 Laboratory Report
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1 Objective

To determine the local acceleration due to gravity, g, by measuring the period of oscillation of a simple pendulum at several lengths.

2 Theory

For small oscillation angles, a simple pendulum of length L has period

$$T = 2\pi\sqrt{\frac{L}{g}}.$$

Rearranging gives $g = 4\pi^2 L / T^2$, so a plot of T^2 against L should be linear with slope $4\pi^2/g$.

3 Procedure

1. Attach a small mass to a string of measured length L.
2. Displace the pendulum by a small angle ($< 10^\circ$) and release from rest.
3. Time 20 complete oscillations using a stopwatch; divide to obtain the period T.
4. Repeat for five string lengths between 0.20 m and 1.00 m.

4 Data

L (m)	T (s)	T^2 (s^2)	g (m/s^2)
0.20	0.90	0.81	9.75
0.40	1.27	1.61	9.80
0.60	1.55	2.40	9.86
0.80	1.80	3.24	9.74
1.00	2.01	4.04	9.78

5 Analysis

The mean measured value is $\bar{g} = 9.79$ m/s^2, compared with the accepted value $g_0 = 9.81$ m/s^2. The percent error is

$$\left|\frac{\bar{g} - g_0}{g_0}\right| \times 100\% = \left|\frac{9.79 - 9.81}{9.81}\right| \times 100\% \approx 0.2\%.$$

The small discrepancy is consistent with reaction-time error in manual timing and minor air resistance, both of which would systematically lengthen the measured period.

6 Conclusion

The simple pendulum method yields $g = 9.79 \pm 0.05$ m/s^2, in close agreement with the accepted value, confirming the small-angle approximation and the linear relationship between T^2 and L.