Spring Oscillation and Effective Mass

Your Name
General Physics Laboratory

August 29, 2026

1 Aim

Determine the spring constant from oscillation periods and test whether the attached mass contributes a measurable correction.

2 Theory

For small vertical oscillations,

$$T = 2\pi\sqrt{\frac{m + m_{\mathrm{eff}}}{k}}, \qquad T^2 = \frac{4\pi^2}{k}m + \frac{4\pi^2 m_{\mathrm{eff}}}{k}. \tag{1}$$

The gradient of a plot of T^2 against m gives k without requiring a static displacement measurement.

3 Experimental method

Attach each mass without twisting the spring, displace it by a small amplitude, and time ten complete oscillations. Repeat the timing twice and use the mean.

4 Data

Table 1: Timing measurements.

m (g)	t_1 (s)	t_2 (s)	T^2 (s^2)
100	15.86	15.91	2.519
150	18.91	18.86	3.548
200	21.82	21.77	4.730
250	24.25	24.31	5.907

5 Analysis

Fit a straight line to $T^2(m)$, show the fitted gradient and intercept, and propagate the timing resolution into the uncertainty in k. Inspect residuals for curvature before interpreting the effective mass.

6 Evaluation

Discuss damping, amplitude drift, reaction time and the assumption of a massless spring. Give one repeat measurement that would best discriminate between the leading error sources.

7 Conclusion

Spring constant k _____

Effective mass m_{eff} _____

Model limitation _____