Lab 9: Simple Harmonic Motion (SHM)

Name: **Your Name**
Class: **PHYS 2125 (15921)**
Date: **2025-03-21**

Objective

To determine the spring constant.

Equipment

- (1) small A-base
- (1) long metal rod
- (1) clamp
- (1) short rod
- (1) spring set
  - (3) spring with unknown k value
  - (1) 5g hook
- (1) set of weights of known mass
- (1) stopwatch

Theory

$$T = 2\pi\sqrt{\frac{m}{k}}$$

$$T^2 = 4\pi^2(\frac{m}{k})$$

$$T^2 = (\frac{4\pi^2}{k}) \cdot m$$

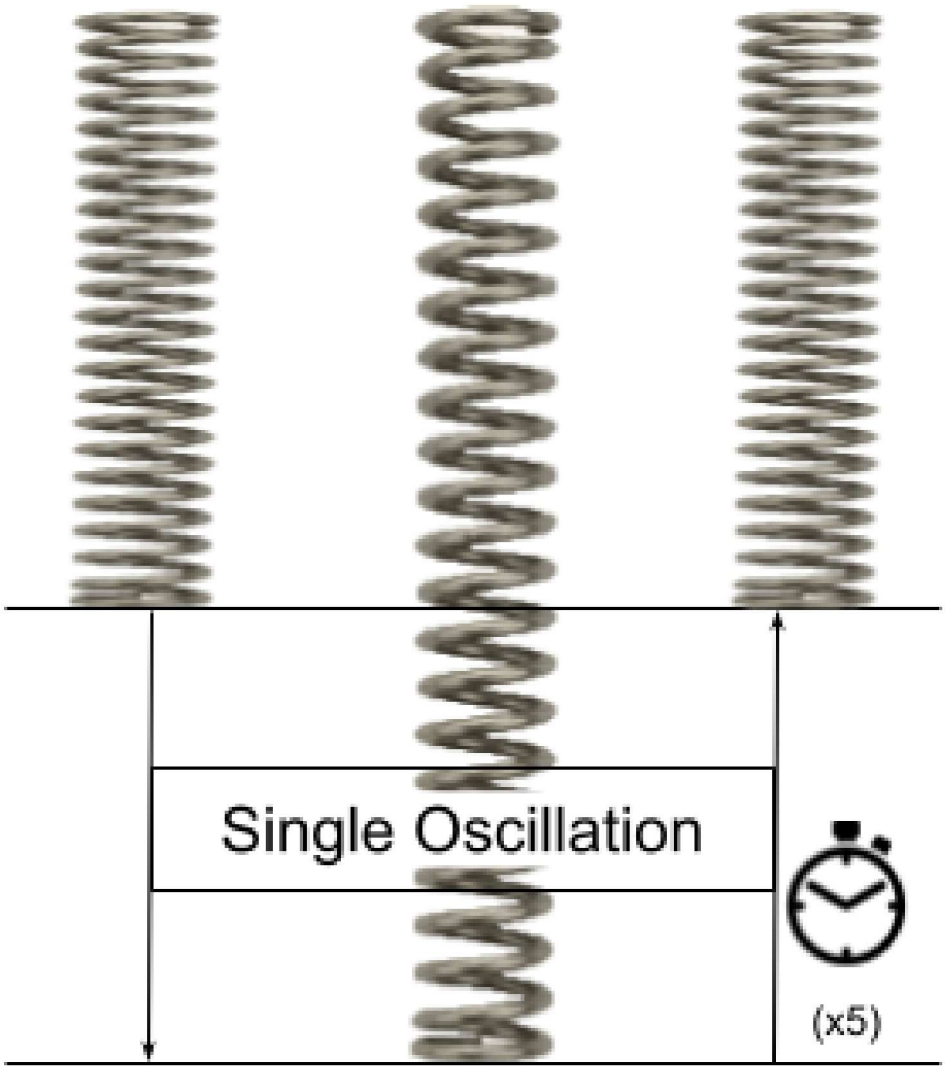
$$k = 4\pi^2(\frac{m}{T^2})$$

where

T is the period of oscillation,

M is the hanging mass, and

k is the spring constant.


Single Oscillation
(x5)

Procedure

The following procedure was followed.

Initial Setup

The pendulum was constructed as follows.

1. A small cast iron A-base was placed on the table.
2. A 45cm steel rod was secured into the A-frame, raised up as much as possible to maximize the height.
3. The vertical mounting side of a steel clamp was secured at the very top of the rod.
4. A 15cm rod was attached to the horizontal side of the same steel clamp, to the far end of the smaller rod.
5. A spring with unknown spring constant k was hung near the middle of the smaller rod.

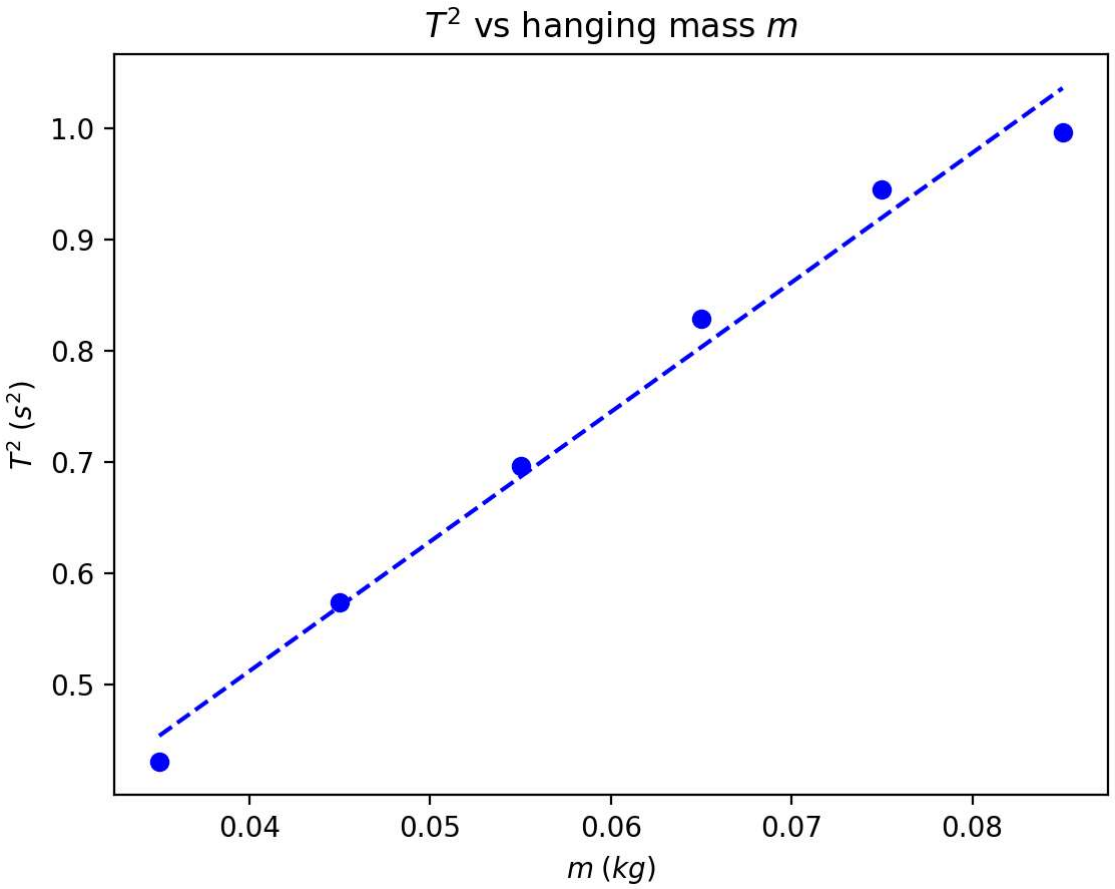
Trial (completed for each m_a)

1. A mass m_a was attached to the hook.
2. The mass was made to oscillate by pulling down on the weight with light-to-moderate force.
3. Twice a measurement was taken of the the time required to complete five (5) oscillations.
4. These values were recorded as $5T_1$ and $5T_2$.

Data

m (kg)	m_a (kg)	m_{hook} (kg)	$5T_1$ (s)	$5T_2$ (s)	T_1 (s)	T_2 (s)	T (s)	T^2 (s²)	k (N/m)
0.035	0.03	0.005	3.24	3.32	0.648	0.664	0.656	0.430336	3.210851
0.045	0.04	0.005	3.77	3.8	0.754	0.76	0.757	0.573049	3.100134
0.055	0.05	0.005	4.2	4.14	0.84	0.828	0.834	0.695556	3.121694
0.065	0.06	0.005	4.57	4.53	0.914	0.906	0.91	0.8281	3.098777
0.075	0.07	0.005	4.8	4.92	0.96	0.984	0.972	0.944784	3.133924
0.085	0.08	0.005	4.99	4.99	0.998	0.998	0.998	0.996004	3.369129
Average									3.172418
StdDev									0.120283

Calculations



Using the least squares method a trend line is fit to the data with *slope* 11.646 and y-*intercept* 0.046, resulting in the equation $y = 11.646x + 0.046$.

Results

The average value of k was calculated as 3.172 ± 0.120.

Using a least squares method k was calculated as 3.390.

These two values differ by 0.066%.

Discussion

Discussion

Questions

What is your name? (5 pts)

Question 1 Answer

What is your quest? (5 pts)

Question 2 Answer