Lab Write Up # 12

Simple Harmonic Motion

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Lab section:

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1. Write down the Hook's law. Denote all the terms.

F = -kx
k is the spring constant
F is force
x is displacement

2. Derive the period of ocsillation in spring-mass system? Denote all the terms.

$F = -kx$

To find $T = ?$

$\omega = \frac{d\theta}{dt} = \frac{2\pi}{dt}$

$\omega = \frac{2\pi}{T}$

$\omega = \frac{2\pi}{\frac{1}{f}}$

$\omega = 2\pi f$

$f = \frac{1}{T}$

$T = \frac{1}{f}$

Here,

$F = -kx$

$ma = -kx$

$m\frac{d^2x}{dt^2} = -kx$

$\frac{d^2x}{dt^2} = \frac{-kx}{m}$

Simple harmonic eq.

$x = A\sin\omega t$

$\frac{dx}{dt} = A\frac{d\sin(\omega t)}{dt}$

$\frac{dx}{dt} = A\omega\cos(\omega t)$

$\frac{d^2x}{dt^2} = A\omega - \sin(\omega t)\,\omega$

$\frac{d^2x}{dt} = -A\omega^2\sin(\omega t)$

Now, $-A\omega^2\sin(\omega t) = \frac{-k}{m}(A\sin(\omega t))$

or, $\cancel{-}\cancel{A}\omega^2\cancel{\sin(\omega t)} = \cancel{-}\frac{k}{m}\cancel{A\sin(\omega t)}$

or, $\omega^2 = \frac{k}{m}$

or, $\omega = \sqrt{\frac{k}{m}}$

or, $2\pi f = \sqrt{\frac{k}{m}}$

Now, $f = \frac{1}{T}$

or, $2\pi\frac{1}{T} = \sqrt{\frac{k}{m}}$

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

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

Part A: Using Hooke's Law to Find the Spring Constant.

Follow the lab manual and complete the following table.

No of Observations	Hanging mass m(kg)	Force F(N)	Displacement x(m)	k
1	0.15	1.4715	0.2	7.3575
2	0.05	0.4905	0.065	7.54615385
3	0.1	0.981	0.13	7.54615385
4	0.2	1.962	0.27	7.26666667
5	0.22	2.1582	0.29	7.44206897

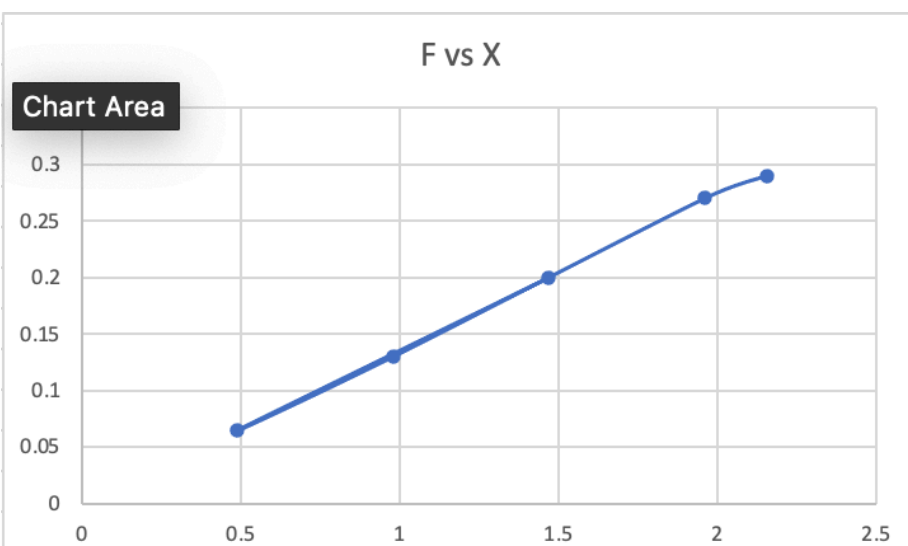
4. Plot **F vs x** graph and fit your data by using linear function. **Print** your graph with fit result on it. The slope of this plot is the spring constant in N/m. Put these values on the result sheet with uncertainty**.**

Measure the mass and predict the period

5. Select a weight and cart of total mass 0.472kg and measure the exact value. Using the following equation predict the period:

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

T = 1.58236



Part B: Period measurement

Follow the lab manual and complete the following table.

No of Observations	Time for 3 cycles (sec)	time for 1 cycle T(sec)	mean <T>	s.d σ
1	4.225	1.408333333	1.308333333	0.09279607
2	3.875	1.291666667	1.308333333	0.09279607
3	3.675	1.225	1.308333333	0.09279607

6. Make a correction of the predicted value by adding 1/3 of the mass of the spring to the value of the hanging mass.

No of Observations	Hanging mass m(kg)	Force F(N)	Displacement x(m)	k	K adjuste	T with adjusted K
1	0.15	1.4715	0.2	7.3575	10.3005	1.330674097
2	0.05	0.4905	0.065	7.54615385	16.6015385	0.927812001
3	0.1	0.981	0.13	7.54615385	12.0738462	1.16066171
4	0.2	1.962	0.27	7.26666667	9.44666667	1.462768344
5	0.22	2.1582	0.29	7.44206897	9.47172414	1.489090744
				Average adjusted T:		1.274201379

Result Sheet: Simple Harmonic Motion

1. What is the spring constant k of the spring you used? (Include units with answer)?

k = 7.422 ± ______________

2. Predicted period of mass/spring = T = 1.58236 ± ______________ s.

Instructor initial ______________

3. Measured period of mass/spring = T = 1.308333333 ± ______________ s.

4. Do they agree within experimental uncertainty?

No.

5. Does the making the correction for spring mass improve the agreement.

Yes it does

6. Does the period depend on the amplitude of the oscillation? Should it? Does the average depend on the amplitude?

No, it doesn't. And it shouldn't, it only depends on square root of m and square root of inverse K. Neither does Average.

7. How did the period of the oscillation change when the mass was increased?

As the mass increased so did the period with factor of square root of the value of mass over the spring constant.