Lab Report

Complete this report YOURSELF except DATA taking parts! This report will not be submitted (except the very last page), but you should carefully complete it as preparation for the applied exam.

Suggested Pre-Lab Question

Q1. Equation of motion for the system in this experiment is

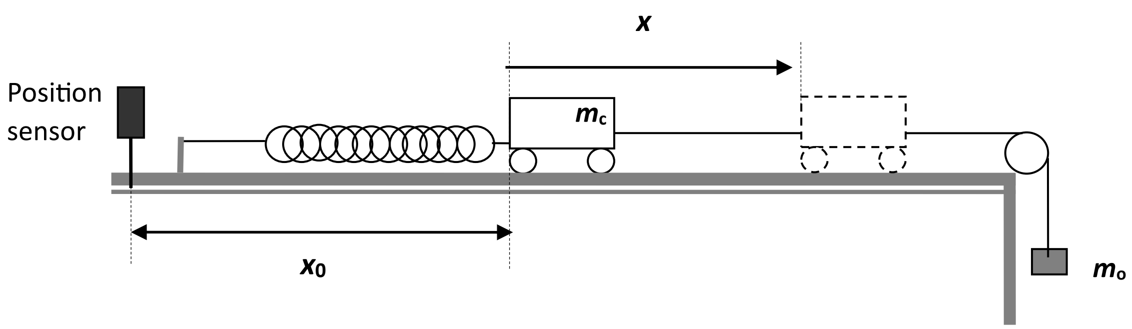
$\frac{d^2x}{dt^2} + \omega^2 x = \frac{m_0}{m_{tot}} g$ where $\omega^2 = \frac{k}{m_{tot}}$. Show that $x(t) = \frac{m_0 g}{k} - A\cos(\omega t + \delta)$ satisfies this equation. Derive the velocity v(t) and acceleration a(t) from x(t).

1

Experiment

OBJECTIVE : To investigate the resultant of two forces, one constant, the other depending on displacement from equilibrium (restoring force).

THEORY :



The system shown in the figure will be exhibiting a periodic motion due to the variable restoring force in the spring. If we write the equation of motion:

2

$$\frac{d^2x}{dt^2} + \omega^2 x = \frac{m_o}{m_{total}} g$$

$$m_{total} = m_c + m_o$$

then, the solution of this equation will be:

$$x(t) = \frac{m_o g}{k} - ACos(\omega t + \delta)$$

whose period of oscillation is given by

$$\omega^2 = \frac{k}{m_{total}}.$$

Derivative of the position with respect to time will yield the velocity as a function of time and the second derivative will give us the acceleration:

$$v(t) = A\omega Sin(\omega t + \delta)$$

$$a(t) = A\omega^2 Cos(\omega t + \delta)$$

Notice that when the magnitude of the velocity reaches its maximum the acceleration becomes zero and vice versa.

APPARATUS: Car and track system, position sensor, data logger, spring, hanger and mass set.

PROCEDURE :

1. Disconnect car from the spring and compensate for friction.
2. Fix the spring to the car; locate the point where no force is acting on the car, keeping the car stationary, and place mass ***m*** on the holder.
3. Place the position sensor at least 30 cm away from the car.
4. Download the mobile application SPARKVUE! Use the square codes in the Lab.
5. Using the mobile application SPARKVUE, connect to the data logger. (Consult to the manual on lab tables)
6. Start the data logger at the desired rate (suggested value is 10 per second) and let the car go. The car first accelerates ($mg > kx$), attains its maximum velocity where $mg = kx$, then decelerates ($mg < kx$) and finally stops coming back.
7. Using the data in the data logger's memory, calculate the average velocity for each interval.
8. **Plot** the **average velocity versus time** and **the total displacement versus time** curves.
9. From the velocity versus time graph, determine the maximum velocity which corresponds to zero acceleration and the corresponding time *t* and the period.
10. From the displacement versus time graph, determine the maximum displacement x_{eq}
11. Calculate other system parameters.

DATA

Description / Symbol	Value & Unit
Mass on the holder m=	. . . .
Initial distance of the Car x_0 =	. . . .
Number of the Cylinders in the Car =	. . . .
Data Taking Rate =	. . . .

DATA

Number of Intervals	t ( )	x ( )	Δx ( )	$v_{ave} = \Delta x / \Delta t$ ( )

Plot the **average velocity versus time** and **the total displacement versus time** curves on the next page.

READ FROM THE GRAPHS:

Description	Symbol	Value & Unit
Maximum velocity	v_{max} =	. . . .
Time Corresponding to to the max. Velocity	t =	. . . .
Equilibrium Displacement	$x_{eq.}$ =	. . . .

CALCULATIONS and RESULT:

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Description / Symbol	Calculations (show each step)	Result	Dimension
Spring Constant k =	. . . .	. . . .	. . . .
	. . . .		
Period of Oscillation T =	. . . .	. . . .	. . . .
	. . . .		
Frequency of Oscillation ω =	. . . .	. . . .	. . . .
	. . . .		

EXP.5: Simple Harmonic Motion

Description / Symbol		Calculations (Show each step)	Result	Dimension
System Parameter	A =	. . . .	. . . .	. . . .
		. . . .		
Maximum Displacement	x_{max} =	. . . .	. . . .	. . . .
		. . . .		
Maximum Acceleration	a_{max} =	. . . .	. . . .	. . . .
		. . . .		
Total Mass	m_{total} =	. . . .	. . . .	. . . .
		. . . .		
Mass of the Car	m_{car} =	. . . .	. . . .	. . . .
		. . . .		

Suggested Post-Lab Questions

Q1. What would be the amplitude of the simple harmonic motion be if the mass on the hanger were doubled?

Q2. Calculate the acceleration of the car at time t=T/4 where T is the period of the motion.

In the next experiment, which is an applied exam, you will have a different setup and a different experiment. You will observe and analyze angular harmonic motion.

Post-Lab Report

Aim of the experiment:

Suggestions for possible solutions to the problems experienced during the experiment:

Conclusion:

I have completed this experiment myself as specified in the lab sheet and as explained by the lab instructor.

Name & Surname:

Student ID:

Lab Section:

Table #:

Date:

Signature of the student

As the instructor of this Lab Section I confirm that the student has participated in and completed this experiment on time.

Stamp of the PHYS Labs and signature of the instructor

This page serves as proof of the fact that the student participated in and completed the experiment, only if it is submitted in time and accepted by the Lab instructor. The student and the instructor shall sign it along with the stamp of the Physics Laboratories.