Pre-Lab Report

Lab section:

Name & Surname:

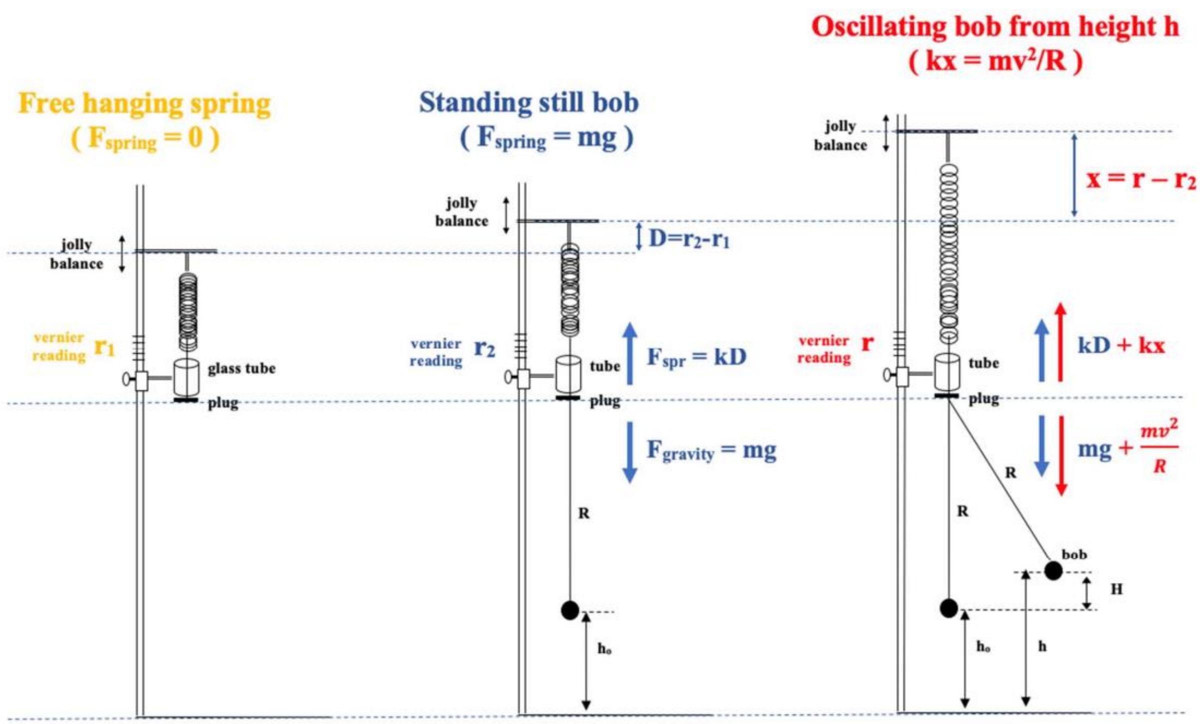
Table # :

***Before the Lab* complete this page YOURSELF! Hand it in *in the first 5 min*. of the session PERSONALLY!**

You MUST justify your answers and show all steps. NO COPYCAT answers, or NO credits!

Please read the relevant presentation on PHYS LAB Website.

Q1. The below figure taken from the presentation describes the setup for Centripetal Acceleration.



Calculate R for the given values below and write the answer into the box below with correct significant figures and units. **Show your calculations below explicitly or no credits!**

r_1 =2.79 cm

r_2 =9.11 cm

r=11.01 cm

h_0 =50.9 cm

h=68.2 cm

Spring 2024

BOĞAZİÇİ UNIVERSITY
Physics Department

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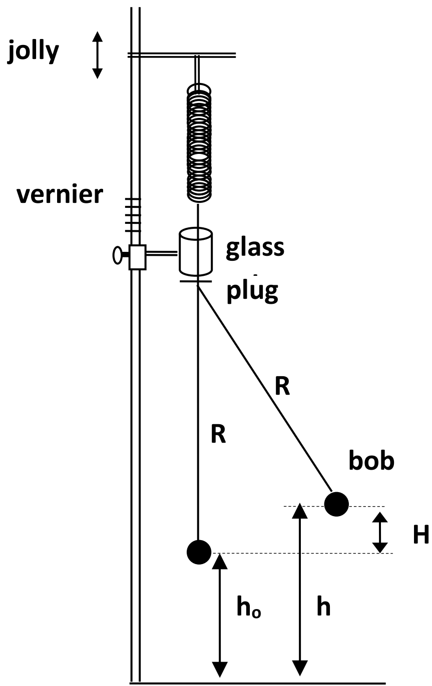
***Complete this report YOURSELF except DATA taking parts! Use a pencil for plots only and a pen for the rest!* Show your work clearly, NO COPYCAT analysis allowed, or NO credits!**

OBJECTIVE : To study the motion of a body moving in a circle and verify the centripetal force equation.

THEORY :



A mass swinging at the end of a string does a circular motion. The mass undergoing a uniform circular motion has the acceleration given by

$$a_{cent} = \frac{v^2}{R} \qquad (1)$$

where *R* is the length of the string. Since the velocity of the mass in a simple pendulum is not constant, the acceleration will be changing.

We will start the motion of the mass by releasing it from a height that we measure. When the ball passes through its lowest position, all the potential energy difference between the initial height and the lowest position will be converted into kinetic energy.

$$mgh = \frac{mv^2}{2} \qquad (2)$$

Using the speed calculated from this expression, we can determine the acceleration at this position. The centripetal acceleration is usually caused by the tension in the string if the pendulum is just a string hanging from the ceiling.

$$F_{cent} = ma_{cent} \qquad (3)$$

But we will hang the string from a spring to be able to measure the centripetal force. In this case the restoring force in the spring will be the centripetal force.

$$F_{rest} = kx = F_{cent} = \frac{mv^2}{R} \qquad (4)$$

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By combining Equations (2), (4), and the initial extension of the spring due to the mass of the bob:

$$mg = kD \qquad (5)$$

we can get

$$\frac{mg}{D}x = \frac{2mgh}{R} \qquad (6)$$

and

$$h = \frac{Rx}{2D}. \qquad (7)$$

This is a straight line with a slope of $R/2D$. Hence, recording the height from which we release the bob and the corresponding extension of the spring, we can determine the slope by plotting the data. Then, we can calculate the length of the pendulum R and compare it with the measured value.

APPARATUS : Centripetal force apparatus, meter stick.

PROCEDURE :

1. Place the bob on the table.
2. To read r_1, adjust the jolly balance until the glass tube barely touches the shoulder of the plug.
3. Let the bob hang freely, pulling the spring down and adjust the jolly balance again until the glass tube barely touches the shoulder of the plug. Read r_2.
4. For the first measurement, extend the spring by a distance of 1.90 cm.
5. Find the height ***h***, so that it will pull the plug out of the tube by a distance of Δx cm when the bob swings through its equilibrium position. Since the elongation due to the centripetal force is $\Delta x \sim 0.10$ cm, total spring extension, ***x*** will be 2.00 cm.
6. Increase the spring extension at 2.00 cm increments, measure the corresponding ***h*** as a function of the spring extension.

7. Plot your data and determine the slope of the straight line that fits the data best.

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DATA:

Description / Symbol			Value & Unit
Length of the pendulum	R_{TV}	=	....
Height from the floor to the center of the bob	h_o	=	....
Reading in vernier scale without the bob	r_1	=	....
Reading in vernier scale with the bob	r_2	=	....
Extension in the spring = $r_2 - r_1$ = due to bob	D	=	....

Reading in vernier ***r*** **( )**		**Total Extension in the spring** ***x*** **( )**	**Height of the bob from floor** ***h*** **( )**	$H = h - h_o$ **( )**

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CALCULATIONS & RESULTS

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A) From the graph, choose two SLOPE POINTS other than data points,

SP_1 : (;)

SP_2 : (;)

B) Calculate:

Symbol		Calculation (show each step)	Result	Dimension
Slope	=	. . . .	. . . .	. . . .
		. . . .		
R / 2D	=	. . . .	. . . .	. . . .
		. . . .		
R_{EV}	=	. . . .	. . . .	. . . .
		. . . .		

% Error for the Length of the Pendulum, *R*: . . . .

Consult to the resources for this experiment from PHYS LAB Website:

PHYL101 Intro

Presentation #5

PHYL101 Lab Book