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⑥ Motion Under Gravity & Acceleration due to Gravity

EXPERIMENT 7

AIM: Using a simple pendulum, plot its $L-T^2$ graph and use it to find effective length of second's pendulum.

APPARATUS

A clamp with stand, a split cork, thread, bob, stopclock / watch, metre scale and a piece of chalk.

THEORY

1. **Simple Pendulum** – An ideal simple pendulum consists of a heavy point mass (bob) tied to one end of perfectly inextensible, flexible & weightless string. There is no ideal simple pendulum.

2. **Length of Simple Pendulum** – The distance b/w point of suspension of pendulum and its C.G. (which is C.G. of bob) is called the length of simple pendulum. It is

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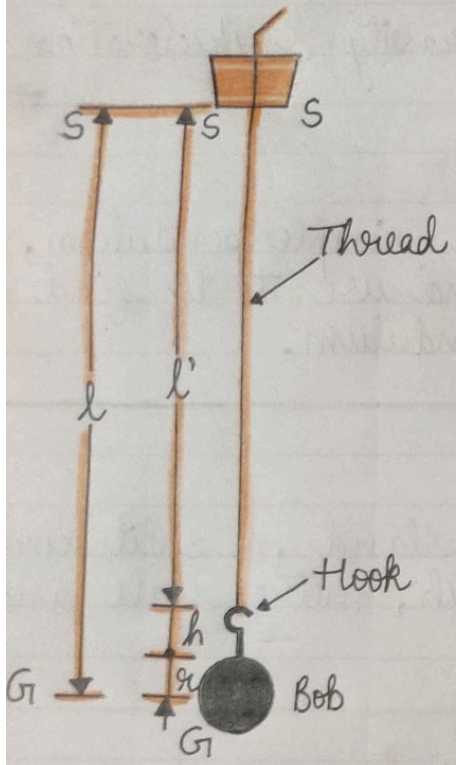

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represented by the symbol (l).

length of simple pendulum = length of thread + length of hook of bob + mean radius of the spherical bob.

i.e.,

$$l = l' + h + r$$

3. Time Period of Simple Pendulum - Time taken by the bob of simple pendulum to make one complete vibration is called time period of simple pendulum. It is represented by the symbol (T).

The time period is given by formula,

$$T = 2\pi\sqrt{\frac{l}{g}}$$

$$T^2 = \frac{4\pi^2 l}{g}$$

$$l = \frac{gT^2}{4\pi^2}$$

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Table for length (l) and Time (T)

S. No. of Obs.	length of Thread Pendulum		Time for 20 vibrations		Time period $T = \frac{t}{20}$ (s)	T^2 $(s)^2$
	l' (cm)	l (cm)	t_1 (s)	Mean t (s)		
1.						
2.						
3.						
4.						
5.						
6.						

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OBSERVATIONS

Observed diameter of the bob :

(i) ____ cm, (ii) ____ cm, (iii) ____ cm

Mean observed diameter, d_0 = ____ cm

Mean ~~ir~~radius of the bob, $r = \frac{d}{2}$ = ____ cm

length of hook of the bob, h = ____ cm

Standard value of g = 980 cms^{-2}.

CALCULATIONS

For each length, write mean time for 20 vibrations,

$$t = \frac{t_1 + t_2 + t_3}{3}$$

RESULT

Experimental length = ~~100 cm~~

Actual length = ~~x~~

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GRAPH

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PRECAUTIONS

1. Thread should be strong, weightless & inextensible
2. Amplitude should be small to have $\sin\theta = \theta$. [when $\theta \leq 18°$]
3. The bob should move along a straight line.

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EXPERIMENT 8

AIM : To study variation of time period of a simple pendulum of a given length by taking bobs of same size but different masses and interpret the result.

APPARATUS

A clamp with stand, a split cork, thread, stopclock / watch, metre scale and pendulum bobs of different masses.

THEORY

The time period is given by formula,

$$T = 2\pi\sqrt{\frac{l}{g}}$$

or

$$T^2 = \frac{4\pi^2 l}{g}$$

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Table to check the effect of bobs of different masses on time period

S. No.	Bob No.	Radius of Bob	Effective length of simple pendulum (L)	Time taken for 20 t(s) oscillations		Period of oscillation $T = \frac{t}{20}$ (s)
				t_1 (s)	Average t (s)	
1.	First bob with mass m_1 =	r_1 =				
2.	Second bob with mass m_2 =	r_2 =	100.00			
3.	Third bob with mass m_3 =	r_3 =				

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CALCULATIONS

Average time for 20 vibrations,

$$t = \frac{t_1 + t_2 + t_3}{3}$$

Then, time period,

$$T = \frac{t}{20} \text{ second}$$

RESULT

It is clear from the table, for same effective length of simple pendulum, the time period is same for bobs of different masses i.e., time period is independent of mass of bob.

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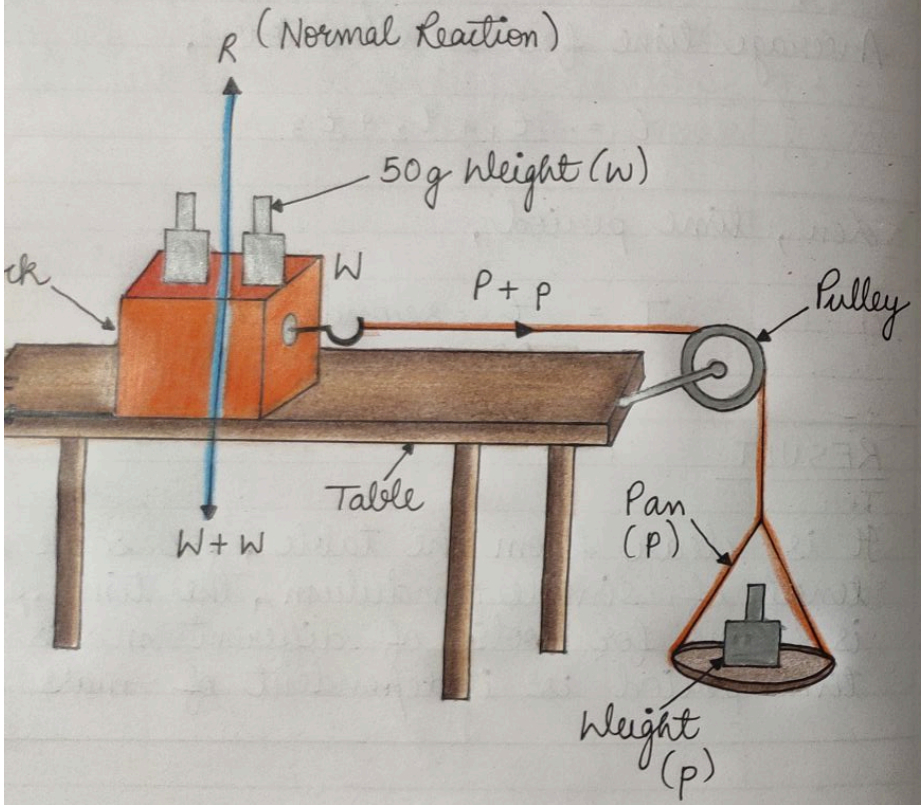
RAM



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⑦ Friction

EXPERIMENT 9

AIM : To study the relationship between force of limiting friction and normal reaction & to find the co-efficient of friction between a block and a horizontal surface.

APPARATUS

Wooden block (with a hook on one side), 50g or 20g weights, horizontal plane (table top) fitted with a frictionless pulley at one end, pan, spring balance, thread, spirit level.

THEORY

Sliding friction - It is the friction between two surfaces of the bodies in sliding motion.

Force of sliding friction - It is the least force required to make a body start sliding over a surface.

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Table for additional weights

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Force of friction,

$$F \propto R$$
$$F = \mu R \quad \text{——} (1)$$

where μ = co-efficient of friction,
R is normal reaction.

At equilibrium,

$$F = P + p \quad \text{——} (2)$$
$$R = W + w \quad \text{——} (3)$$

OBSERVATIONS

Weight of wooden block, W = ____ gwt

Weight of pan, P = ____ gwt.

CALCULATIONS

Total weight (force) pulling the block & weights gives the value of force of sliding friction.

On horizontal surface, total weights being pulled, give normal reaction (R). Total weight (force) pulling these weights gives dynamic friction (F).

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RESULT

It is found that as the total weight pulled increases, force of limiting friction also increases. The increase is in direct proportion.

The graph shows that limiting friction F is directly proportional to normal reaction R. It is an agreement with law of limiting friction.

The constant ratio $\frac{F}{R}$ is called co-efficient of friction (μ).
It can be calculated by finding slope of the graph.

PRECAUTIONS

1. The surface (table top) should be horizontal.
2. The part of thread bhw block and pulley should be horizontal.
3. Pulley should be frictionless.

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