

## EXPERIENTIAL LEARNING ACTIVITY

**SUBJECT: PHYSICS**

**GRADE: XI**

| CHAPTER               | LAWS OF MOTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
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| TOPIC/CONCEPT         | FRICTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| NAME OF THE ACTIVITY  | To study the relationship between force of limiting friction and normal reaction and to find the coefficient of friction between a block and a horizontal surface                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| TYPE OF ACTIVITY      | Individual                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| LEARNING OUTCOME      | The students will be able to calculate the value of coefficient of friction between wood and glass.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| PROCEDURE/METHODOLOGY | <p><b>Diagram</b></p> <p style="text-align: center;"><b>Fig. Study for force of sliding friction.</b></p> <p><b>Procedure</b></p> <ol style="list-style-type: none"> <li>1. Check that the pulley is free of friction and also clean the table top.</li> <li>2. Before putting the block on the table top, weigh the block.</li> <li>3. Pass over the block on to the pulley by tying one end of the thread on the hook of the wooden block.</li> <li>4. Find the weight of the pan.</li> <li>5. The pan should be tied to the free end of the thread and left hanging vertically.</li> <li>6. Put some weights on the pan to pull the block easily.</li> <li>7. To make the block slide, start tapping the table top.</li> <li>8. Continue tapping by adding the weights little by little.</li> <li>9. Record the total weights in the pan in the observation table.</li> </ol> |

10. Repeat steps 8 and 9 by adding one 50g or 20g weight on the wooden block.
11. Every time the weight is increased by 50g or 20, repeat steps 8, 9 and 10 six times.
12. Record the observations as given below.

### Observations

Weight of wooden block,  $W = \dots\dots\text{g wt}$

Weight of pan,  $P = \dots\dots\text{g wt}$

Table for additional weights:

| Sl.no | Weights on wooden block (w) in g wt | Total weight being pulled (W+w)= Normal reaction in g wt | Weight on pan (p) in g wt | Total weight pulling the block and weights (P+p)=limiting friction (F) in g wt |
|-------|-------------------------------------|----------------------------------------------------------|---------------------------|--------------------------------------------------------------------------------|
| 1.    |                                     |                                                          |                           |                                                                                |
| 2.    |                                     |                                                          |                           |                                                                                |
| 3.    |                                     |                                                          |                           |                                                                                |
| 4.    |                                     |                                                          |                           |                                                                                |

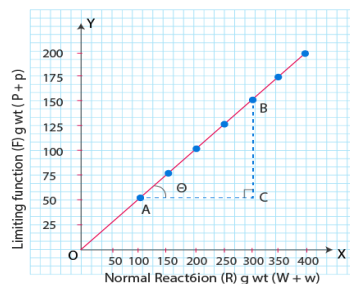
### Calculations

Total weight pulling the block and weights gives the value of the force of sliding friction.

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

Plot a graph between normal reaction  $R$  and limiting friction  $F$ , taking  $R$  along x-axis and  $F$  along the y-axis.

The graph comes to be a straight line as shown below:



Graph between R and F

## Result

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

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

The constant ratio of  $F/R$  is called the coefficient of friction ( $\mu$ ). It can be calculated by finding the slope of the graph.

In  $\triangle ABC$ ,

$$\text{Slope of straight line AB} = \tan \theta$$

$$= \frac{BC}{AC} = \frac{FR}{150-50} = \frac{100}{200} = 0.5$$

$$\tan \theta = \frac{FR}{100} = 0.5 \dots \dots \dots (1)$$

$$\text{But, } F = \mu R \dots \dots \dots (2)$$

$$FR = \mu R$$

From equation (1) and (2),

$$\mu = \tan \theta = 0.5 \quad \mu = 0.5$$

## Precautions

1. The table top should be horizontal.
2. The thread between block and pulley should be horizontal.
3. The pan should not oscillate or rotate and the weight should be added in small quantities.
4. The tapping of tabletop should be done gently.
5. The frictionless pulley should be used.

## Sources Of Error

1. The table top is not horizontal.
2. The thread between block and pulley may not be horizontal.
3. The frictionless pulley is not used.

## QUESTIONS &

Q1. Why thread part between block and pulley is kept

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
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| <p><b>SOLUTIONS/<br/>HINTS</b></p> | <p>horizontal?</p> <p>Ans: It is kept horizontal for the equal distribution of the total weight of pan and weights.</p> <p>Q2. Why has a frictionless pulley been used?</p> <p>Ans: By using a frictionless pulley the overall effective value can be reduced.</p> <p>Q3. Why do roads become slippery after rains?</p> <p>Ans: Friction between the feet and road reduces when there is a thin layer of rainwater between them. So the roads become slippery after rains.</p> <p>Q4. Why brake surfaces are kept flat?</p> <p>Ans: The surface of the brakes are flat because when the brake is pressed, it gets pushed from hydraulic pistons and the surface of the brake rotor. Since it is getting pushed from both the sides, friction is created and so the surface should be flat.</p> |
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