2. HORIZONTAL PROJECTILE MOTION (ROLLING A STEEL BALL DOWN AN INCLINED TRACK)

I. Objectives:

 To predict where a steel ball will land when released from a certain height on an inclined ramp.

 To calculate the horizontal range of a steel ball rolled down from an inclined ramp (track).

II. Hypothesis:

 The equation of the motion predicts that when a projectile is launched at greater height the distance it travels forward increase

III. Apparatus / Materials:

 Inclined ramp(track)

 Meter stick

 Steel bob

 Carbon paper

 Sheets of white paper

 Table

 Stopwatch

IV. Theory

The first thing we do on the experiment is we throw the bob from a certain height the bob will roll over the ramp and a curved motion will appear. In this case there are two kind of motion. The vertical direction have a uniformly accelerated motion whereas the motion in the horizontal direction is a uniform motion.

$x = vo \times t$ ……horizontal

$y = \frac{1}{2}gt^2$……. vertical displacement of the projectile and

t is the time of flight.

From the above equation we can get t , $t = \sqrt{\frac{2y}{g}}$ ----------*

When the projectiles rolls without friction the gravitational potential energy at the top of the inclined ramp will be equal to the kinetic energy at the bottom.

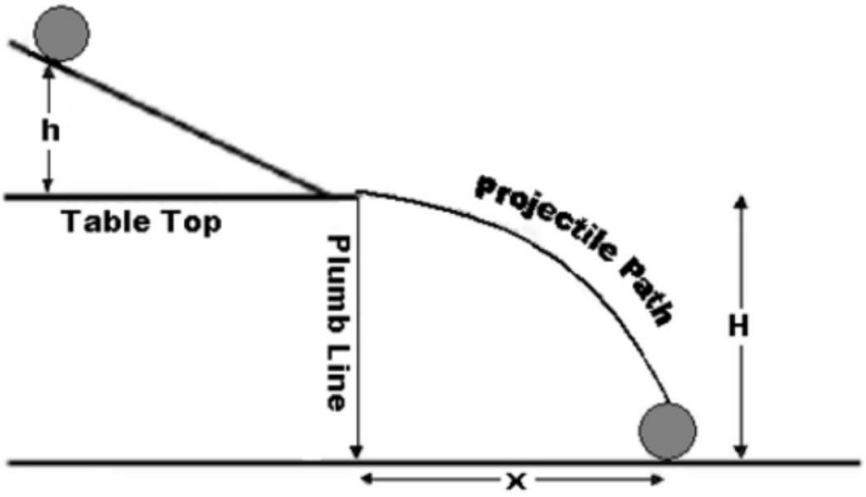
$$mgh = \frac{1}{2}mv^2$$

$$Vo = \sqrt{2gh}$$ ----------**

From * and ** $x = \sqrt{2gh} \times \sqrt{\frac{2y}{g}}$

$$X_y = 2\sqrt{hy}$$

V. Procedure



1. We Placed the inclined ramp as shown in the figure above. We marked the location at which we released the steel ball. These ensure us that the steel ball achieves the same velocity with each trial.

2. We created a plumb line by attaching a monofilament line and we hold the string to the edge of the table and marked the spot at which the plumb line touches the ground.

3. We put carbon and white papers on the ground to see where the ball landed. When the steel ball hits the carbon paper, the force transfers some of the It's ink

to the underlay white paper and allowed us to pinpoint where the contact was first made.

4. We started the experiment by releasing the steel ball at the marked point on the ramp.

5. We took horizontal distance travelled from the plumb line to the first mark made and we recorded the value in the data table.

6. Finally we repeated the above 2 steps for different release heights and recorded our values in the data table.

VI. Data

The table shown below shows the raw data collected which includes the following parameters.

Height of the table (Y) (cm)=76

No of trail	Release height (cm)	Actual Horizontal traveled by the steel (x) in (cm)
1	10	46.75
2	20	64
3	30	73

VII. Data analysis

The table shown below shows the raw data collected which includes the following parameters

Height of the table (Y)(cm)= 76

No of trial	Release height (cm)	Actual horizontal traveled by the steel (x) in (m)	Predicted horizontal distance travelled (Xp)(m)	Percentage error (%)
1	10	0.46	0.55	-19.5
2	20	0.64	0.77	-20.3
3	30	0.73	0.95	-30.1

Note :-

When you are analyzing the collected raw data we used the following basic expressions

1. Predicted horizontal distance travelled by the steel ball($x_p = 2\sqrt{hy}$)

2. Percentage error ($\frac{actual\ range - predicted\ range}{actual\ range} \times 100\%$)

VIII. Result and Discussions:

1. Discuss what the possible source of errors could have produced the deviation above?

The sources of errors in a horizontal projectile motion are the following:-

 Systematic error person measuring the length using a meter stick. This error can be minimized by repeating the experiment many times.

 The friction between the bob and the inclined plane decrease the horizontal speed of the bob. This can be reduced by using friction less ramp.

 The roughness in the transition from the inclined to the table make the horizontal speed less and make the projectile to go at an angle.

 In measuring horizontal distance from the table up to the carbon paper where the bob lands.

 The air resistance on the bob

2. If air resistance were not present, would the steel ball land farther or closer to the table? Explain why?

The bob will land farther from the table because air that applied on the bob is absent. The air resistance decrease the bob speed.

IX. Conclusion

From this experiment we can conclude that as height of the inclined plane increases the distance it travels forward increases.

X. Reference

Griffith W. Thomas, "The Physics of Everyday Phenomena: A Conceptual Introduction to Physics," New York: McGraw-Hill Higher Education, vol. 4, 2001. 1
Serway, R. A. and Vuille, C., 2018, College Physics, 11th ed., Cengage Learning, Boston, USA edition.