# 10-108 Trajectory Apparatus

**Purpose:**
To plot the two dimensional trajectory of a freely falling steel ball.

**Contents:**

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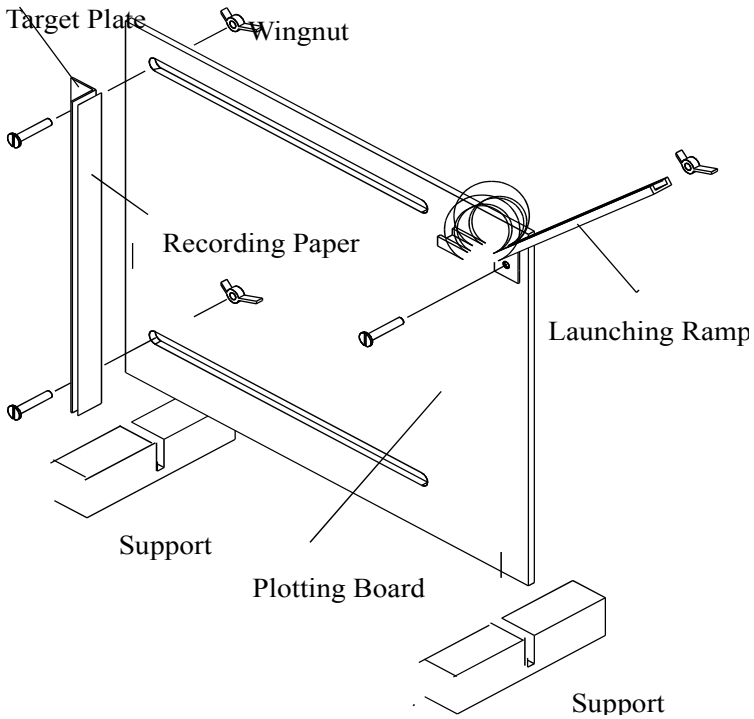
|---|---|
| One (1) | Plotting Board, slotted |
| Two (2) | Supports for plotting board |
| One (1) | Curved launching ramp |
| One (1) | Target Plate |
| | Recording Paper |
| | Hardware Package, |

**Containing:**
2 thumbscrews
3 wingnuts
1 screw 8-32 x ½
1 steel ball
1 slotted tube

**Required Accessories:**
Bubble Level
Note Card
Graph Paper

**Assembly:**

Refer as necessary to the assembly diagram for the proper positioning of the enclosed parts. Position the bottom slots of the plotting board into the slots of the wooden supports. Push together firmly. A layer of tape around the board edge or wood glue will make this permanent. Using two knurled head thumb screws and two wing nuts, attach the target plate to the plotting board as shown. Using the remaining machine screw and wingnut, fasten the launching ramp to the upper right hand corner of the plotting board.




**Experimental Procedure:**

Level the apparatus by placing a small bubble level on the top edge of the plotting board and shimming under the wooden supports if necessary. Adjust the angle of the launch ramp so the short section is horizontal. Leveling the launching ramp can be done with the bubble level or by placing the steel ball on this section of the ramp and adjusting the angle until the ball rests in one place.

The graph paper should first be trimmed to fit between the slots of the apparatus. The steel ball will trace a path across the paper beginning somewhere at the upper right corner of the grid. This means that the right hand side of the grid must be even with the end of the launch ramp. Later, make a mark on this edge even with the center of the ball when it is on the end of the track. Tape this upper right corner of the paper to the plotter board. Make sure the horizontal lines on the paper are parallel to the top edge of the plotting board. When you are satisfied that the paper is

properly aligned, tape the remaining three corners to the plotting board. Make sure the paper is taped tightly and smoothly to the board.
Position the target plate so that its front edge is lined up with the left most vertical line on the graph paper and fasten in place. Release the ball from various locations on the ramp until a position is found where the ball strikes the target plate at the lowest horizontal line of the graph paper. Mark this point on the launching ramp with the aluminum stop (slotted tube). This can be done by pressing the end of the slotted tube into the ramp channel at the desired location. For each trial in the experiment, the ball should be held against this stop and then released.

Tape a strip of the pressure sensitive recording paper to the surface of the target plate. The paper should be tight and smooth. This will record the locations where the ball impacts the target plate. Position the target plate with the recording paper taped to its surface 2 or 3 centimeters from the end of the launching ramp. The target plate should also be aligned vertically with the graph paper grid.

Release the ball several times from the stop on the ramp and transfer marks to graph paper by holding a note card against the target plate at the level of the impact mark and squarely against the plotting board. Make a small dot on the graph paper where the corner of the note card and the graph paper come together.

Repeat this procedure for several different locations of the target plate. When you have finished collecting your data, draw a smooth curve through the data points on the graph paper. What is the shape of this curve?

You may wish to repeat this experiment using different positions for the aluminum stop or different angles for the launching ramp. This latter will introduce an initial vertical component of velocity to the ball as it leaves the ramp. How will this affect the shape of your plotted curve? How would these observations apply to objects in everyday life, such as thrown base balls and basketballs?

**Time Allocation:**

To prepare this product for an experimental trial should take less than ten minutes. Actual experiments will vary with needs of students and the method of instruction, but several trials are each easily concluded within one class period.

**Feedback:**

If you have a question, a comment, or a suggestion that would improve this product, you may call our toll free number.