# T.C.

# GEBZE TECHNICAL UNIVERSITY

# PHYSICS DEPARTMENT

## PHYSICS LABORATORY I

## EXPERIMENT REPORT

**THE NAME OF THE EXPERIMENT**

Projectile Motion



**PREPARED BY**

**NAME AND SURNAME:**

**STUDENT NUMBER :**

**DEPARTMENT :**

Signature:

## Experimental Procedure:

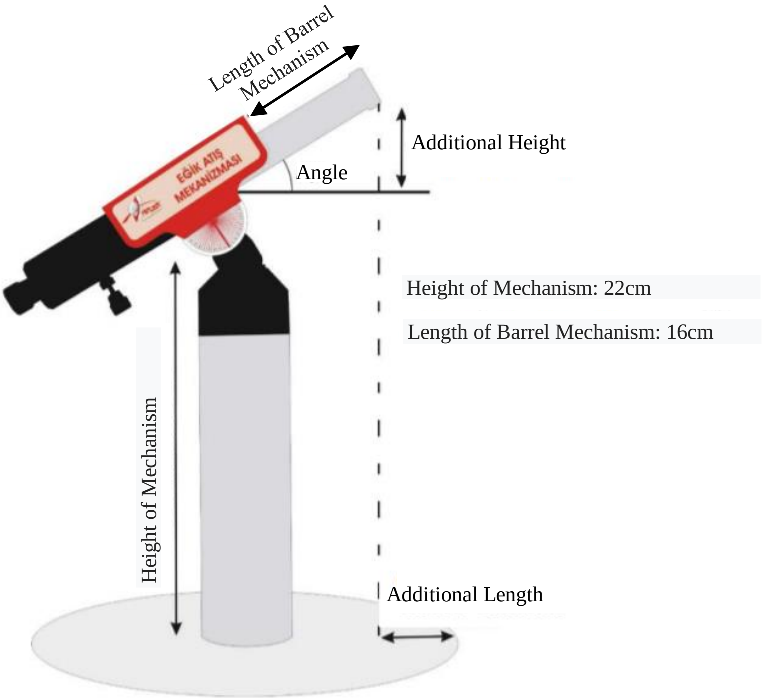


**Figure 2.2.** Experiment setup of Projectile Motion

A sensor at the tip of the mechanism (photogate) available. When the laser coming out from one tip of the sensor is not read by the other end of the sensor (in case of an object), the process starts and stops the process as soon as it receives the signal, giving the time as $t_1$ on the indicator on the timer. The second sensor starts to read time after the first sensor is switched off and continues to read time until a contact is applied to the pressure sensor plane sensor (force plate). This time appears on the timer as $t_2$ and gives the time of the ball it takes to stay in the air.

**IMPORTANT!! Do not change the position of the projectile launcher and the force plate while performing the experiment!!**

### I. When θ = 0°

**1)** Make sure the angle on the projectile mechanism is “0”.

**2)** Set the speed to the first level.

**3)** Place the object in the mechanism and turn on the timer, press the ‘start’ button on the timer, then throw the object to shoot the test.

**4)** Determine where the object falls on the pressure sensor plane sensor, as a blind eye, place a sheet of white paper and a carbon sheet on top of it.

**5)** Press the ’reset’ button on the pressure sensor.

**6)** Where the object strikes the carbon paper, it will leave a mark on the white paper. The distance between these tracks and the mechanism will be measured in meters and range values will be found.

**7)** Measure the $t_1$, $t_2$ times and the range 5 times separately and write them down in Table 2.1 below. (After each shot, do not forget to press ‘reset’ on the pressure sensor and ‘start experiment’ on the timer before placing the object into the mechanism before the next shot.)

**Table 2.1** θ = 0° Level 1 measurements

| | 1. measure. | 2. measure. | 3. measure. | 4. measure. | 5. measure. | Average |
|---|---|---|---|---|---|---|
| **$t_1$ (s)** | | | | | | |
| **$t_2$ (s)** | | | | | | |
| **Range (cm)** | | | | | | |

**8.** Take the arithmetic mean of $t_1$, $t_2$ and range values you have measured and write them in the relevant places in Table 2.1. (Show the process in detail.)

**9.** Measure the distance between the tip of the mechanism and the surface of the table and determine the 'vertical distance'. Write it down in Table 2.2. (The distance (vertical distance) between the tip of the table and the table surface is 50 cm).

**10.** Using equation 2.6, calculate the object flight time ($t_2$) using the measured vertical distance. Write it down in Table 2.2. (Show the process in detail, $g$ = 980 cm/s$^2$)

**11.** Using the average range value in Table 2.1 and the object flight time ($t_2$) you found in step 9, find the initial velocity of the object $V_0^{experimental,1}$. Write it down in Table 2.2. (Show the process in detail.)

**12.** Divide the diameter ($R$ = 1.60 cm) of the object by $t_1$ of the sensor, determine the initial velocity of the object $V_0^{Theoretical,1}$. Write it down in Table 2.2. (Show the process in detail.)

**13.** Compare the initial velocity of the object calculated in step 11 with the velocity measured by the sensor in step 10. Find the error percentage. Write it down in Table 2.2. (Show the process in detail.)

**Table 2.2** θ = 0° 1st step data table

| | |
|---|---|
| Vertical distance (cm) | |
| The object flight time ($t_2$) | |
| Initial velocity of object ($V_0^{experimental,1}$) | |
| Initial velocity of object ($V_0^{Theoretical,1}$) | |
| Error percentage | |

**14.** Repeat the same procedure with setting the speed to the second level.
**15.** Show the all calculations in steps 7, 9, 10, 11 and 12 for second level in detail in the space below and fill in the relevant tables. (The time $t_2$ will not be measured because it will remain the same.)

**Table 2.3** θ = 0° Level 1 measurements

| | 1. measure. | 2. measure. | 3. measure. | 4. measure. | 5. measure. | Average |
|---|---|---|---|---|---|---|
| **$t_1$ (s)** | | | | | | |
| **Range (cm)** | | | | | | |

**Table 2.4** θ = 0° 2nd step data table

| | |
|---|---|
| Vertical distance (cm) | |
| The object flight time ($t_2$) | |
| Initial velocity of object ($V_0^{\text{experimental,2}}$) | |
| Initial velocity of object ($V_0^{\text{Theoretical,2}}$) | |
| Error percentage | |

### II. When θ = 30°

**1.** Make sure the angle on the projectile mechanism is "30".
**2.** Calculate the vertical distance. Write it down in Table 2.5.
(Vertical distance = Height of the mechanism + Length of the barrel of the mechanism × sinθ) (Height of the mechanism: 22 cm, Length of the barrel of the mechanism: 16 cm)
**3.** Find the object flight time $t_2^{\text{Theoretical,2}}$ by using angle (30°), measured vertical distance and initial velocity of the object which is calculated in the second level in case $\theta$=0. Write it down in Table 2.5. (Show the process in detail by using Eq. 2.6.)

**Table 2.5.** θ = 30°Level 2 measurements

| | 1. measure. | 2. measure. | 3. measure. | 4. measure. | 5. measure. | Average |
|---|---|---|---|---|---|---|
| $t_2^{Experiment}$ **(s)** | | | | | | |
| ***Range*** **(cm)** | | | | | | |

**4.** Set the speed to the second level.

**5.** Determine where the object falls on the pressure sensor plane sensor, as a blind eye, place a sheet of white paper and a carbon sheet on top of it.

**6.** Place the object in the mechanism and turn on the timer, press the ‘start’ button on the timer, then throw the object to shoot the test. Press the ’reset’ button on the pressure sensor.

**7.** Where the object strikes the carbon paper, it will leave a mark on the white paper. The distance between these tracks and the mechanism will be measured in meters and range values will be found.

**8.** Measure the $t_2$ time and the range 5 times separately and write them down in Table 2.5 below. (After each shot, do not forget to press ‘reset’ on the pressure sensor and ‘start experiment’ on the timer before placing the object into the mechanism before the next shot.)

**9.** Take the arithmetic mean of $t_2$ and range values you have measured and write them in the relevant places in Table 2.5. (Show the process in detail.)

**10.** Compare the flight time of the object $t_2^{\text{Theoretical}}$ calculated in step 3, with the average flight time $t_2^{\text{Experiment}}$ measured by the sensor in Table 2.5. Find the error percentage.

**11.** Determine the range of the object by using initial velocity $V_0^{Theoretical,2}$ of the previous case (when $\theta$=0), object flight time $t_2$ from Table 2.5 and projectile angle.

**12.** Compare the calculated range and measured average range from Table 2.5 and find the error percentage.

## Conclusion, Comment and Discussion:

**(Tips:** Give detail explanation about what you've learned in the experiment and also explain the possible errors and their reasons.)

Signature:

## Questions:

**1. a)** Is it possible to fall at the same spot of two identical object launched by the same speeds at different angles? Why?

**b)** Compare the flight time of the objects?

**2)** Compare the flight time, the maximum height and range of identical objects launched with the same angle and speed in mediums with different gravitational acceleration?