Yanbu University College

General Physics I (PHYS 101)

Lab. Exercise No. .....

Free Fall

Name : _____ **ID No.** _____

PERFORMANCE OBJECTIVES

Upon completion of this laboratory exercise the student will be able to:

1. Investigate the free fall of an object in an earth's gravitational field.
2. Investigate height-time relationship during the free fall.
3. Plot graph of height vs time^2 and determine precisely the acceleration due to gravity.

MATERIALS AND EQUIPMENT

The falling sphere apparatus having, release unit, impact switch, digital counter, support base, right angle clamp, plate holder, cursors -1 pair, meter scale, and connecting cords.

THEORETICAL CONCEPTS

If an object is allowed to fall from the state of rest ($u = 0$) under the influence of constant gravitational field, it will perform a linear movement, i.e., it will fall downward. The equation of distance covered by mass is given by

$$s = ut + \frac{1}{2}at^2$$

In this case we can replace with h ($s = h$), where h is the height from which the object is falling and a is replaced by g ($a = g$), we get,

$$h = ut + \frac{1}{2}gt^2$$

Applying the initial conditions, initial velocity $u = 0$, we can write

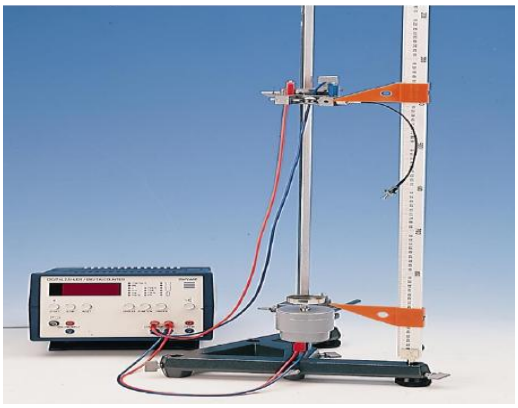
$$h = \frac{1}{2}gt^2 .$$

This is the equation of straight line. If we plot a graph between *h* and t^2 and determine the slope of the line *m*. Then $\frac{1}{2}$ of the slope of h *vs* t^2 graph gives us the value of g.

We can determine g from the following relation.

$$m = \frac{1}{2}g \qquad \text{or} \qquad g = 2m$$

SETTING-UP THE APPARATUS



1. Arrange the apparatus as shown in Figure 1.
2. An electrically conducting sphere is gripped in the release mechanism which closes the start circuit.
3. Carry out some releasing tests for different increasing heights of fall. If the ball does not hit the pan roughly in its centre for each height of fall, then the support rod might be slightly inclined. You may have to adjust it each time by hand after each fall.
4. For correct determination of height of fall, the radius of the sphere must be taken into consideration.

EXPERIMENTAL PROCEDURE

1. Release the steel ball from 10 cm and note the time at which ball hits the pan.
2. Repeat the procedure for various heights starting from 10 cm up to 100 cm and note the time for each height.
3. Do not forget to adjust the pan under the arrest switch each time by hand after each position.
4. Record the height measured and its corresponding time (t) in the Table 1.
5. Calculate corresponding t^2 and write in the Table 1.
6. Use the data obtained in the Table 1 to plot height-time and height-time^2 graphs in the graphs provided in Figures 2 and 3.

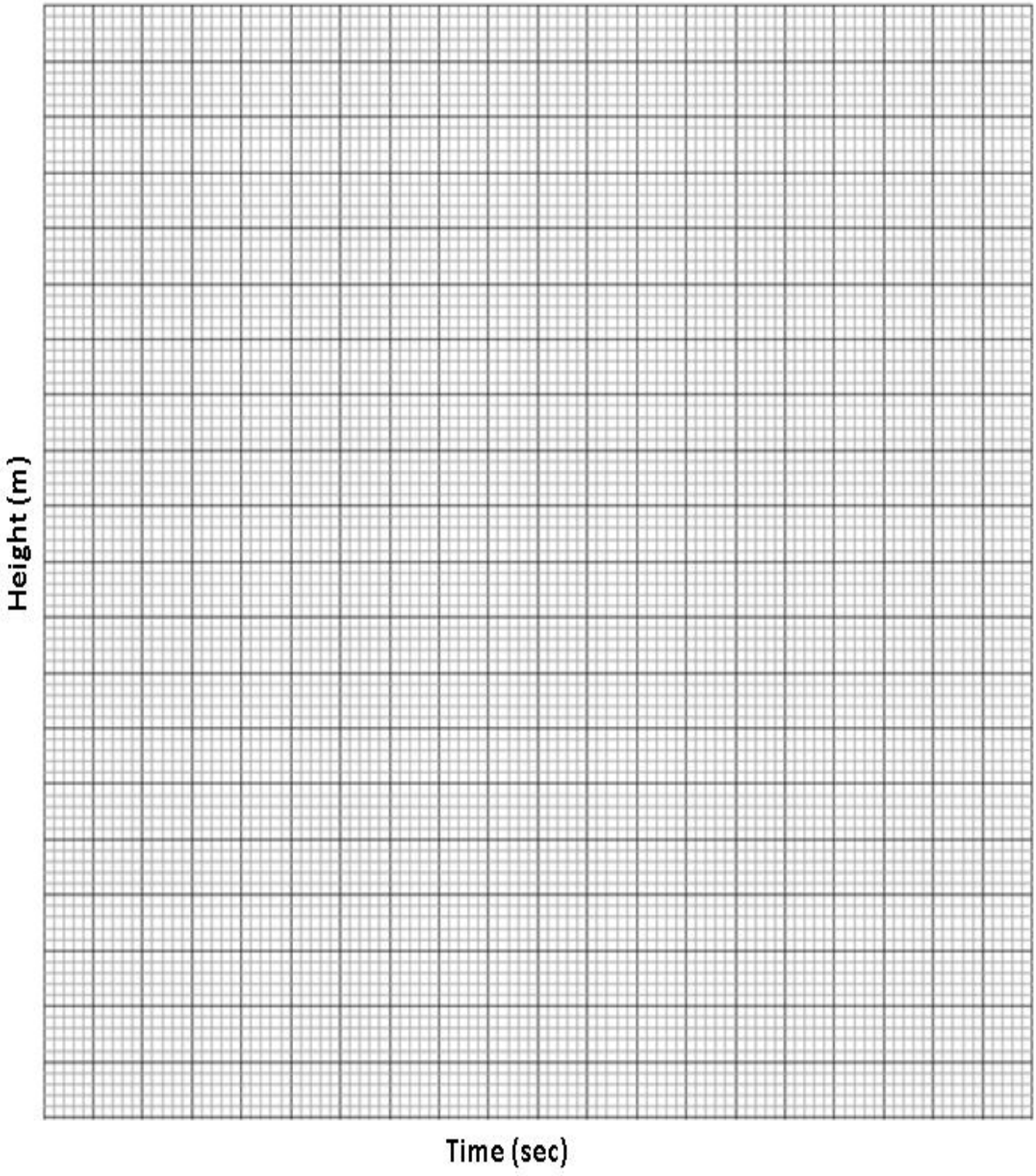
[03 Marks]

Table 1

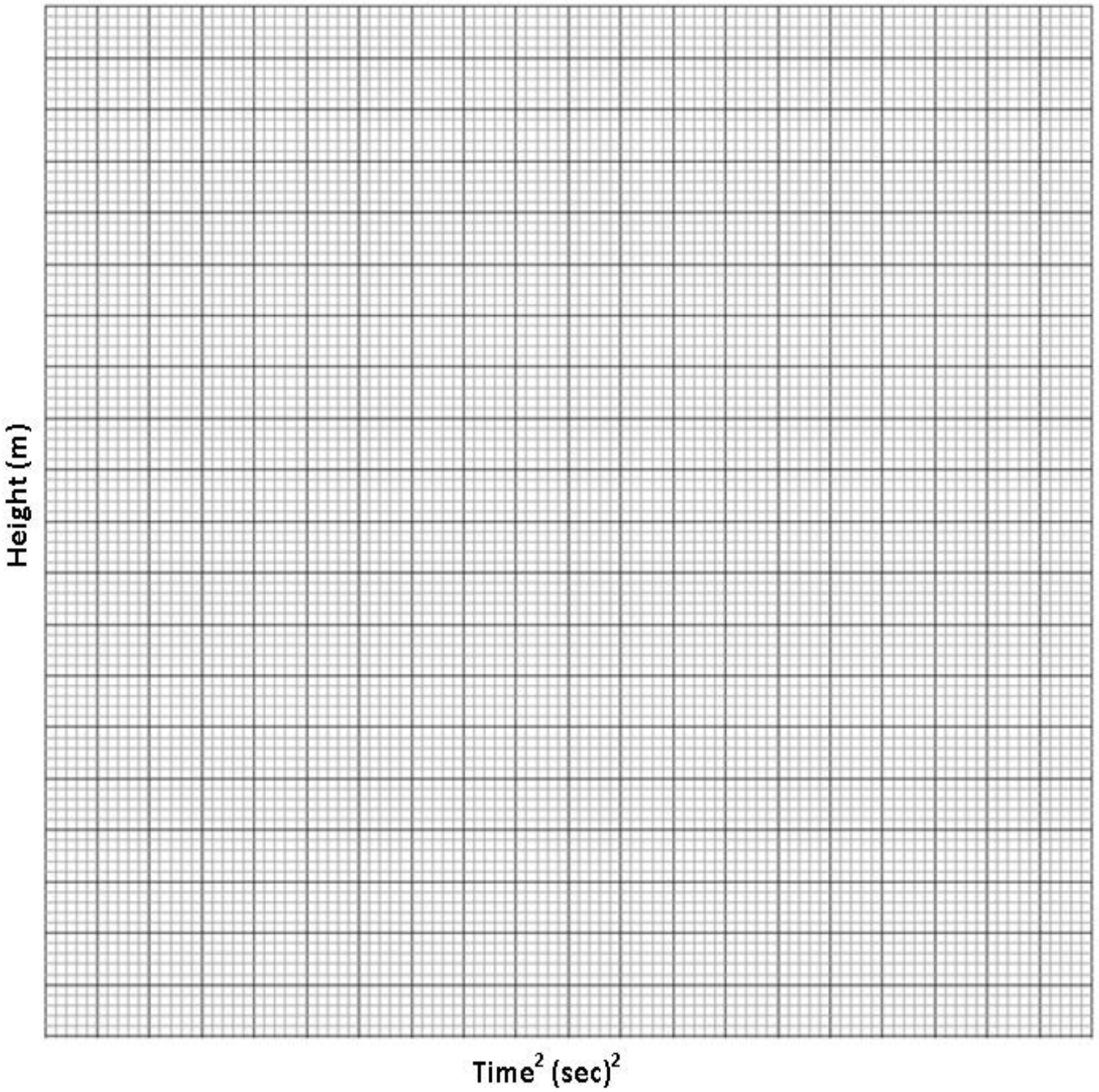
Obs. No.	Height (h) (cm)	Time (t) (s)	Time-Square(t^2) (s^2)
1	10		
2	20		
3	30		
4	40		
5	50		
6	60		
7	70		
8	80		
9	90		
10	100		

(Note: Remember we have ignored the air drag in this experiment).

Plot graph between height *(h)* and time *(t)* **[02 Marks]**



Plot graph between height *(h)* and time square *(t^2)* **[02 Marks]**



Calculation: **[02 Marks]**

1. Find the slope of the graph sketched in Figure 3. (Use $m = \Delta h / \Delta t^2$)

2. Calculate the acceleration due to gravity using the relation $g = 2m$

3. Compare the value obtained with the value of acceleration due to gravity

End of lab exercise