Experimental No. (5)

Uniform Acceleration Motion

Objective:

To study the motion of freely falling bodies.

To evaluate the acceleration due to the gravity.

Apparatus:

Free falling apparatus with electronic timer and meter stick.

Theory:

When objects of different masses are allowed to fall freely from rest, the objects are observed to fall identical distances in identical times. The average velocities and the final velocities of the masses are also identical. Hence the accelerations of the objects are equal. So, all objects accelerate at the same rate under the influence of gravity. We can derive an equation for the distance an object falls in a time t.

If you let the mass (m) falls freely from rest then the distance made:

$$y = \frac{1}{2}gt^2 \tag{31}$$

From the last equation we see that: if we plot a graph of y versus t^2 we

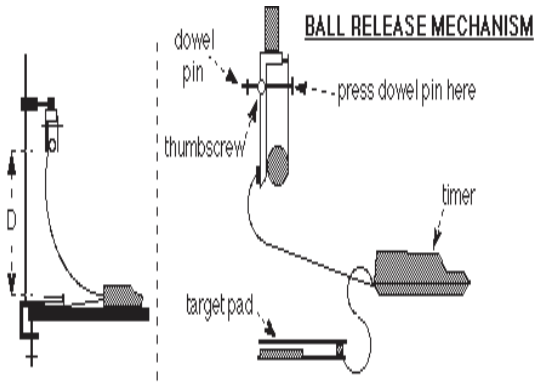

Figure 13:

get a straight line whose slope is equal to $S = \frac{1}{2}g$. So by measuring the distance and time we can experimentally determine the acceleration due to gravity.

Procedure:

A- Use a free fall distance of about 0.80 m, make three measurements of the free fall for two steel ball and for the big copper ball.

Note you can use any three different masses.

B-

1. **Turn the timer switch.**
2. **Put the small ball in the ball release mechanism.**
3. **Measure and record the distance from the bottom of the steel ball to the target pad on the ball receptor.**
4. **Release the ball and record the time.**
5. **Obtain three values of the fall time for each release and find the average time.**
6. **Plot y versus t^2, draw smooth curve through the points.**
7. **Find g from the graph and calculate the error, using the following law:**

$$error\% = \frac{g_{theoritical} - g_{experimental}}{g_{theoritical}} X100 \tag{32}$$

Name: **Grade:**

Students No.: **Date:**

The density of the steel is $7.9gm/cm^3$**, copper 8.23**gm/cm^3

distance	Mass of the ball	t_1	t_2	t_3	$\overline{t}$
0.80m					
0.80m					
0.80m					

Trial number	Mass of the ball	t_1	t_2	t_3	$\overline{t}$	t^2	y (m)
1							
2							
3							
4							
5							

from the graph of y versus t^2 **find the slope.**

S=....., **g=.....**

calculate the error in g.

Questions:

1. **Prove that covered distance in the gravity of the earth does not depend on the mass of the falling object.**

2. **Derive equation no.1.**

Experimental No. (6)

Atwood's Machine

Objective:

The purpose of this laboratory activity is to study the relationship between force, mass, and acceleration using an Atwood's Machine.

Apparatus:

Pulley, loads with electronic timer and meter stick.

Theory:

The acceleration of an object depends on the net applied force, and the mass. In an Atwood's Machine, the difference in weight between two hanging masses determines the net force acting on the system of both masses. This net force accelerates both of the hanging masses; the heavier mass is accelerated downward, and the lighter mass is accelerated upward.

In the free body diagram of the Atwood's machine, T is the tension in the string, M_1 is the lighter mass, M_1 is the heavier mass, and g is the acceleration due to gravity. Assuming that the pulley has no mass, the string has no mass and doesn't stretch, and that there is no friction, the net force on M1 is the difference between the tension and $M_1 g$ $(T > M_1 g)$. The net force on M_2 is the difference between the tension and $M_2 g$ $(T < M_2 g)$.

Solve for "a", the acceleration of the system of both masses. The theoretical acceleration is "g" times the difference in mass divided by the total mass.

$$a = g\frac{M_2 - M_1}{M_2 + M_1} \tag{33}$$

From the analysis of the force equation we see that: if we plot a graph of y versus t^2 we get a straight line whose slope is equal to $S = \frac{1}{2}a$. So