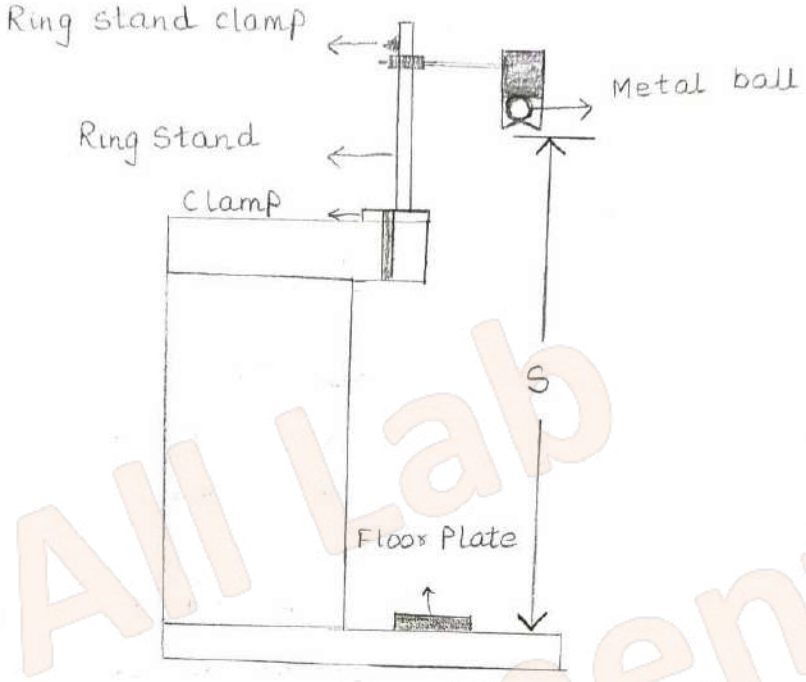
Aim :- To determine the value of the acceleration due to gravity, 'g' by free fall.

Diagram :-



Formula :-

$$g = \frac{2s}{t^2}$$

where, g = acceleration due to gravity
s = distance between the level of the metal ball and the floor plate
t = time taken for the ball to fall through the distance

Date 19/10/19

Expt. No. 6 Page No. 27

Experiment No. 6

Aim :- To determine the value of the acceleration due to gravity, 'g', by free fall.

Theory :- Any object, which is moving, and being acted upon only by the force of gravity is said to be in a state of "free fall". Freely-falling objects do not encounter air resistance. In the absence of air resistance, all objects in free fall near the surface of the earth experience the same uniform acceleration.

In this experiment, we will determine the acceleration due to gravity, g, by measuring the time of flight for a ball dropped from a known height. It is also verified that the acceleration due to gravity does not depend on the mass of the ball.

The Kinematics of constant acceleration tell us that :

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

which is Newton's second law of motion.

So as long as air resistance is not a factor, if you drop an object from rest from a height s,

$$s = \frac{1}{2} gt^2$$

where t is the time that the ball takes to fall through the distance s. Solving for g, we get :

$$g = \frac{2s}{t^2}$$

Teacher's Signature

Observation Table

S.No	l_1	l_2	$l_1 - l_2$	t	t_1	t_2	t^2 mean	2s
1	94	10	84	0.38	0.37	0.38	0.139	164
2	94	15	79	0.36	0.36	0.36	0.129	158
3	94	20	74	0.34	0.35	0.35	0.1156	148
4	94	25	69	0.33	0.33	0.33	0.1089	138
5	94	30	64	0.32	0.32	0.32	0.1024	128
6	94	35	59	0.30	0.30	0.30	0.09	118
7	94	40	54	0.29	0.29	0.29	0.0841	108
8	94	45	49	0.26	0.26	0.26	0.0676	98
9	94	50	44	0.25	0.25	0.25	0.0625	88
10	94	55	39	0.23	0.23	0.23	0.0529	78
11	94	60	34	0.20	0.20	0.20	0.04	68
12	94	65	29	0.18	0.18	0.18	0.0324	58
13	94	70	24	0.16	0.16	0.17	0.025	48
14	94	75	19	0.14	0.14	0.14	0.0196	38
15	94	80	14	0.11	0.11	0.11	0.0121	28
16	94	85	9	0.08	0.08	0.08	0.0064	18
17	94	90	4	0.05	0.04	0.04	0.0016	8

Calculations :-

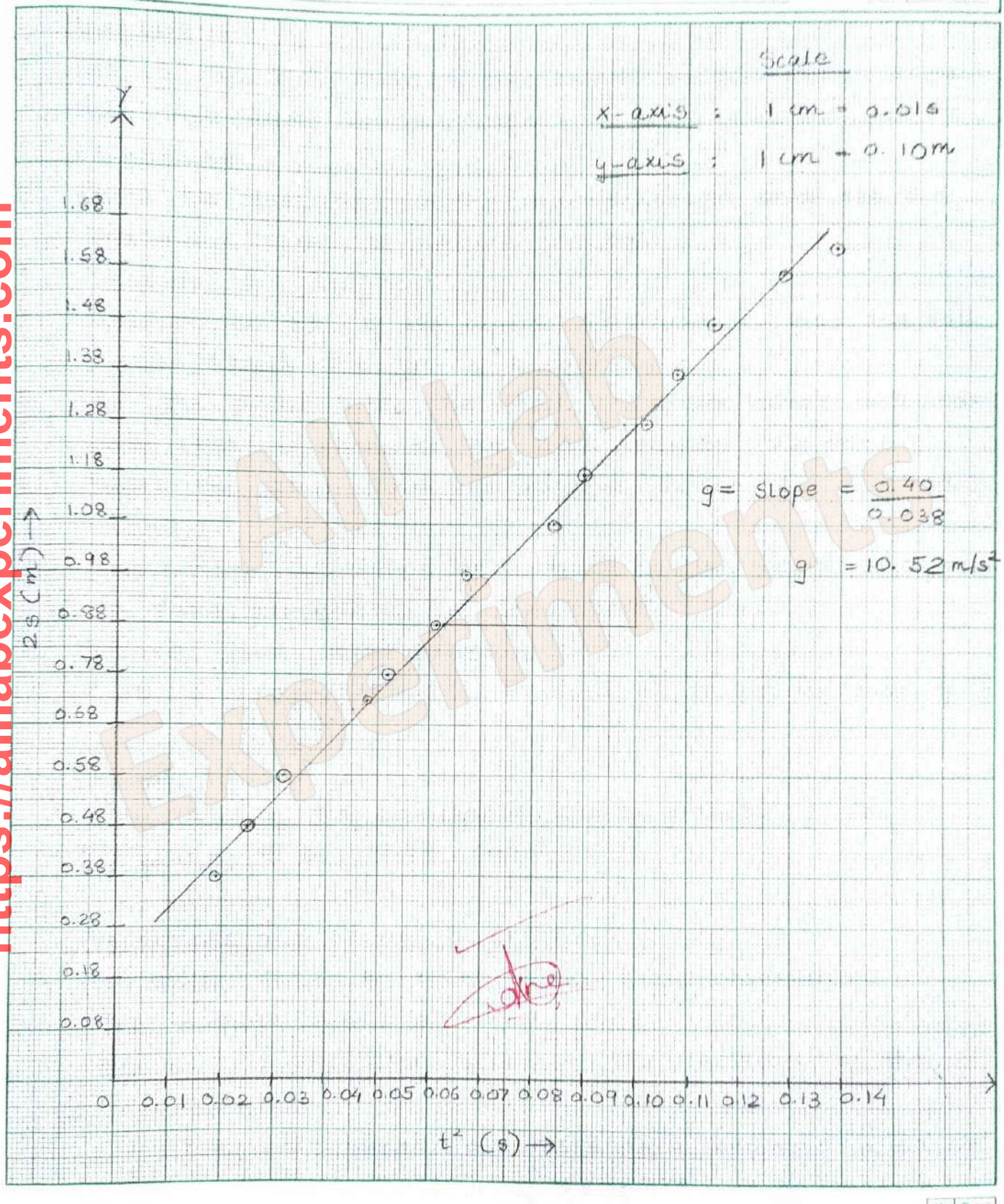
$$\text{Percentage error} = \left(\left| \frac{9.8 - 10.52}{9.8} \right| \right) \times 100\%$$

$$= +7.34\ \%$$

Date

Topic :

Date :



Axis

Procedure :-

1. Set up the ball-release mechanism on a vertical stand that will allow various heights to be considered for the experiment.
2. Place the steel ball in the cup-structure and set the tightening screw to secure the ball.
3. Measure the height.
4. Gently let go of the cupping structure so that the ball falls through the given height.
5. At the point when the ball falls, the timer will start and stop as soon as the ball touches the base.
6. Reset the timer and repeat this thrice for a given height.
7. Then, Keep adjusting and changing the height and follow the same procedure as given above.
8. Record your observations.
9. Plot a graph between 2s and t^2 to get the value of 'g'.

Result :-

The value of the acceleration due to gravity, g, is found to be 10.52 m/s^2.

($10.52 \pm 0.555\ m/s^2$)

Precautions and Sources of Error :-

1. The timer should be reset after every observation.
2. The screws should be tightly fixed.
3. Human reaction time destroys the precision of the measurement.
4. Over long distances, air resistance becomes a factor so that the acceleration of the object is no longer a constant.

Teacher's Signature _____

log error

$$g = \frac{2s}{t^2}$$

$$\log g = \log 2s + 2\log t$$

$$\frac{\Delta g}{g} = \frac{\Delta s}{s} - \frac{2\Delta t}{t}$$

For maximum log error,

$$\frac{\Delta g}{g} = \frac{\Delta s}{s} + \frac{2\Delta t}{t}$$

$$\frac{\Delta g}{g} = \frac{0.001}{8} + \frac{0.02}{0.38}$$

$$\frac{\Delta g}{g} = 0.000125 + 0.05263 = 0.052755$$

$$\Delta g = 10.52 \times 0.052755$$

$$\Delta g = 0.5549826$$

$$\therefore g = (10.52 \pm 0.5549826)\ m/s^2$$