Calculate acceleration due to gravity

Introduction

We know from Newton's second law of motion,

The acceleration of an object produced by an external net force is directly proportional to net force and inversely proportional to the mass of an object.

Mathematically,

$$a \propto F \tag{1}$$

$$a \propto \frac{1}{m} \tag{2}$$

where a is an acceleration of an object, F is the net force acting on an object, and m is the mass of an object.

from equation (1) and (2), we get,

$$a = \frac{F}{m}$$

$$F = ma \tag{3}$$

If an object is pulled to the ground due to earth's gravitational force then the acceleration "a" is replace by acceleration due to gravity "g".

$$F = mg \tag{4}$$

where g is an acceleration due to gravity.

If we know the acceleration due to gravity, the force on an object of m resting on a floor can be calculated.

Find the value of "g" using a drop tower.

Follow the instruction to Build Mindstroms EV3 Lego.

https://education.lego.com/v3/assets/blt293eea581807678a/bltf1b9dd6cd3d4f034/5ec63f9dd6d1293eb9efbfd7/acceleration-of-gravity-bi.pdf

Theory

When an object is dropped from a height h at rest, the average velocity is given by,

$$\text{Average Velocity} = \frac{\text{Total Displacement}}{\text{Total Time}}$$

$$v_{avg} = \frac{h}{t} \tag{5}$$

where t is the time taken by an object to travel a distance h.

Also, from definition of Average Velocity,

$$\text{Average Velocity} = \frac{\text{Initial Velocity} + \text{Final Velocity}}{2}$$

$$v_{avg} = \frac{v_i + v_f}{2} \tag{6}$$

where v_i is the initial velocity of an object (velocity at starting point) and v_f is the final velocity just before hitting the ground.

In this experiment, the object is dropped from height "h" initially at rest i.e. $v_i = 0$, so

$$v_{avg} = \frac{v_f}{2} \tag{7}$$

$$v_f = 2 \times v_{avg} \tag{8}$$

From definition of acceleration,

$$\text{Acceleration} = \frac{\text{Change in Velocity}}{\text{Total Time}}$$

$$a = \frac{v_f - v_i}{t} \tag{9}$$

here $v_i = 0$, since object is dropped from rest at height h.

$$a = \frac{v_f}{t} \tag{10}$$

From Equation (8) putting the value of v_f in Equation (10), we get

$$a = \frac{2 \times v_{avg}}{t} \tag{11}$$

In this experiment we are calculating acceleration due to gravity "g" hence,

$$g = \frac{2 \times v_{avg}}{t} \tag{12}$$

Observation

SN#	mass (kg)	height (m)	time (s)	average velocity v_{avg} (m/s)	acceleration due to gravity, $g = \frac{2 \times v_{avg}}{t}$ (m/s^2)	average acceleration due to gravity, g (m/s^2)
1						
2						
3						
4						
5						
1						

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2						
3						
4						
5						

Average acceleration, g = _____ (m/s^2)

Standard deviation, σ = _____ (m/s^2)

What does standard deviation mean?

_____

_____

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_____

Result and Conclusion

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