

**EXPERIMENT 2: FREE FALL MOTION****Course Learning Outcome:**

Solve problems related to Physics of motion, force and energy, waves, matter and thermodynamics  
(C4, PLO 4, CTPS 3, MQF LOD 6)

**Learning Outcomes:**

At the end of this lesson, students will be able to describe experiment to determine acceleration due to gravity using free fall motion.

**Student Learning Time:**

| Face-to-face | Non face-to-face |
|--------------|------------------|
| 1 hour       | 1 hour           |

**Instruction:** Read over the lab manual and then answer the following questions.

**Introduction**

1. What is meant by free fall motion? [select all correct answers]

The motion of an object is totally under the influence of gravitational force

Acceleration of the object is the same as the gravitational acceleration

Acted upon only by gravity alone

Velocity of the object in free fall is decreasing due to air resistance

2. Under free fall motion the acceleration of an object is also known as gravitational acceleration or acceleration due to gravity. What is the symbol and SI unit of this type of acceleration?

**Symbol :**

SI unit : ☐  $kg\ m\ s^{-2}$

☐  $m\ s^{-2}$

☐  $kg\ m\ s^{-1}$

3. What is the value of acceleration due to gravity at the surface of Earth?

☐  $9.81\ m\ s^{-2}$

☐  $10.0\ m\ s^{-2}$

☐  $9.81\ m\ s^{-1}$

4. State the characteristics of free fall motion. **[select all correct answers]**

Free fall motion is solely under the influence of the gravitational force

When the object is dropped, the initial velocity of the object is zero.

The velocity of the object is zero when it hits the ground

Free fall motion is one dimensional motion

Free falling object does have horizontal displacement

The object gains velocity as it falls down to the ground.

5. State the law applied in these experiment

### Experiment

6. How do we release the object to form free fall motion?

7. Select the measuring apparatus involved. (e.g. type / name of equipment) for the experiment.

- ☐ Acoustic stopwatch (Phyphox App)
- ☐ Measuring tape/meter ruler
- ☐ Stopwatch
- ☐ Pen
- ☐ Trap door

8. State the related variables that need to be recorded in this experiment?

| Types of variable                           | Free fall motion |
|---------------------------------------------|------------------|
| Manipulated variable<br>(change on purpose) |                  |
| Responding variable<br>(what is measured)   |                  |

9. Construct the table to record the related values for free fall motion experiment.  
[ complete the table below]

| Falling<br>distance, h<br><br>(± cm) | Falling time, t<br>(± s) |                |                |         | t <sup>2</sup><br>( s <sup>2</sup> ) |
|--------------------------------------|--------------------------|----------------|----------------|---------|--------------------------------------|
|                                      | t <sub>1</sub>           | t <sub>2</sub> | t <sub>3</sub> | Average |                                      |
| 1.                                   |                          |                |                |         |                                      |
| 2.                                   |                          |                |                |         |                                      |
| •<br>•<br>•                          | •<br>•<br>•              |                |                |         |                                      |
| 6.                                   |                          |                |                |         |                                      |

10. What sensor of the phone the application utilizes to detect the sound upon impact?

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### Data Analysis

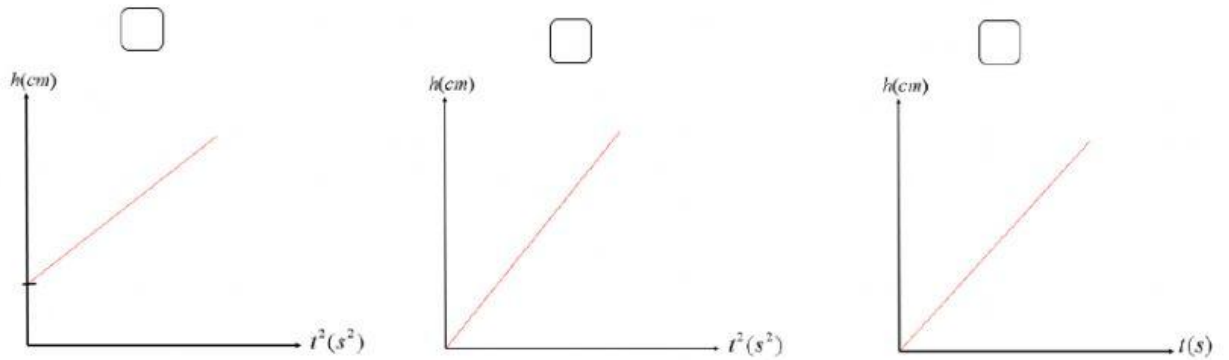
11. a) Write the equation related to the experiment in order to determine the acceleration due to gravity, g. [select from the options below]

☐  $v_y^2 = u_y^2 - 2gh$

☐  $s = \frac{1}{2}gt^2$

☐  $s = -\frac{1}{2}gt^2$

b) Sketch a suitable graph for free fall motion. [select from the options below]



c) How the acceleration due to gravity,  $g$  can be determined from the graph free fall motion?  
[arrange the options in correct order]

Step 1

Step 2

Step 3

Step 4

Thus,  $g$  is equal to :

$$g = 2m$$

Refer to the equation

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

Equation of gradient of graph

$$m = \frac{1}{2}g$$

Compare with Straight-Line equation

$$Y = mX + c$$

- d) How to compare the acceleration due to gravity,  $g$  obtained in experiment with standard value?  
[select all applicable answers]

Calculate the percentage of error

☐  $\% \text{ error} = \frac{|g_{\text{Experiment}} - g_{\text{standard}}|}{g_{\text{standard}}} \times 100\%$

Calculate the percentage of uncertainty

☐  $\% \text{ uncertainty} = \frac{\Delta x}{x} \times 100\%$

☐ Compare the experimental value to the standard value.

☐ Using the percentage of error to determine the accuracy of the experiment

12. State **THREE** precautions of this experiment

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