Pre-Lab Questions 2

Topic: Motion in One Dimension

Objective: 1. To enable the students to relate one dimensional motion of two masses connected by a massless string to acceleration due to gravity.
2. Identify the independent, fixed and dependant variables in an equation used in an experiment.

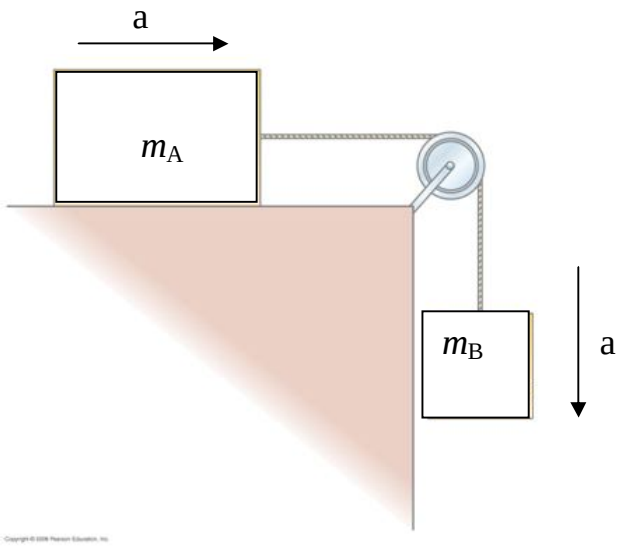
After answering these questions, the students will be able to

1. Use Newton's 2nd law to derive $a = \frac{m_B}{(m_A+m_B)}\ g$.
2. Determine the independent, fixed and dependent variables in this experiment.
3. Plan how to determine the acceleration of the masses by using a linear air tract, and photo gate timer.
4. Identify the graph that will give g as its gradient.

PRE-LAB QUESTIONS 2

Answer the following questions and submit your group answer to the instructor.

1. Assume two masses (m_A and m_B) are connected by a string, as in Fig. 1, and m_A is sliding on a frictionless surface.



By applying Newton's 2nd Law to the system in Fig 1, derive the following equation.

$$a = \frac{m_B}{(m_A+m_B)}\ g \quad \ldots\ldots\ldots\ldots(1)$$

a = acceleration of m_A and m_B
g = acceleration due to gravity

You may refer to Example 5.10 Acceleration of Two Objects Connected by a Cord (Serway & Jewett, Physics for Scientists and Engineers with Modern Physics, 8th Edition, p.121). Note: Referring to Fig. 5.15 (a) p.121, for the system in Fig. 1, $\theta = 0^o$, therefore $\sin \theta = 0$.

2. If g is to be determined from equation 1, state the quantities that you need to
   i) vary (independent variable)
   ii) fix (fixed variable)
   iii) measure. (dependent variable).

3. The acceleration of m_A in Fig. 1 can be determined by applying a kinematic equation $v^2 = u^2 + 2as$. Describe how the acceleration can be determined if m_A is on a linear air-tract, passing through a photo gate timer, while a slotted mass represents m_B. You may refer Experiment 4 (Motion in One Dimesion) in the Old Lab Manual for PHY430.

4. State the graph that you need to plot so that *g* can be determined from its gradient.

Experiment 2

Topic: Motion in One Dimension

Objective: To determine the value of g

Learning Outcomes of Experiment 1

After doing the experiment, the students will be able to

1. determine g from the given system moving in one dimension.
2. plot and analyze an appropriate graph to determine g and its uncertainty.
3. write a report on the experiment.
4. state the appropriate and reasonable sources of error or factors that contributed to the uncertainties in the results.

Introduction

In a system containing multiple masses, the basic equation F = ma becomes F = m'a where m' is the "active mass". For the system in Fig 1, the active mass is $\frac{m_B}{m_B+m_A}$.
In order to determine the acceleration of m_A and m_B, it is adequate to estimate the horizontal acceleration of m_A only. Starting m_A from initial velocity zero to certain velocity v after traveling distance s, would enable the acceleration of m_A to be determined from kinematic equation $v^2 = 2as$, where u = 0.

Instructions

1. Discuss the following items with your lab group before taking the reading.

    a. Discuss the quantity to be measured, how they are going to be measured and the appropriate apparatus (linear air tract, glider with flag, photo gate timer, pulley and slotted masses) to determine the acceleration of m_A.

    b. Decide the number of measurements to be made

    c. Decide how you are going to analyse the data in order to determine g.

2. Make your measurements, tabulate the data appropriately and calculate the value g from an appropriate graph with its uncertainty. State your final results in SI units.

3. Hand in your group report at the end of the lab period.

4. All groups will be scheduled to present and defend their procedures, data and results of certain experiments in class.

Format of the Laboratory Report

1. *Objective* : State the objective of the experiment.
2. *Apparatus* : State the instruments used.
3. *Theory* : State the formula that you use to determine the value of *g*
4. *Procedures* : Describe the steps that you take to perform the experiment.
5. *Data* : Present the data appropriately. Organize the data in tables if possible. Use a correct and consistent significant figures. State the units and uncertainties of each quantity.
6. *Results* : Show the calculations the value *g* and its uncertainty.
7. *Conclusions* : Indicate what is measured, the uncertainties and the sources of uncertainties.

Post Laboratory Questions

1. State an example of a systematic and a random error involved in this experiment?

2. What source of error do you believe, affected the measurement of *g* most?

3. What would the graph of v versus s look like? Why didn't we use this graph to find a?