

Lab 11

Massing an Unknown Massive Object

OBJECTIVES

1. To think “out of the box” and design your own experiment in a group setting.
2. Design two experiments to measure the mass of an unknown mass m_x .
3. Compare two different sets of data and state whether they measure the same unknown mass m_x .

EQUIPMENT

Stockroom

PROCEDURE

- a. The procedure for this experiment is
 - Given a set of reference masses (10, 20, 50 and 100 grams), **design two experiments** that are **independent** of each other that measure the mass of a given unknown mass m_x . One can use the concepts of kinematics, Newton’s Laws, energy, momentum, or rotational motion.
 - Before proceeding, your **proposed experiments must be approved** by either the Instructor (Carlos) or LIA (John). They should include how the experiment will be performed, how the data will be analyzed, and how error uncertainties are calculated.
 - Mass scales will **not** be available.
- b. The error uncertainties for each type of experiment must include the following criteria:
 - If the proposed experiment has multiple measurement runs, calculate an average unknown mass \bar{m}_x , the standard error σ_m , and the confidence interval ($\bar{m}_x \pm 2\sigma_m$).
 - If the proposed experiment is performed where only one measurement is made, calculate the unknown mass m_x , the “estimated uncertainty δm_x ”, and the confidence interval ($\bar{m}_x \pm 2\delta m$).
 - Estimate the total uncertainty δm_x for the whole experiment and justify how the uncertainty was arrived at.
- c. Summarize the two unknown masses $(\bar{m}_x)_1$ and $(\bar{m}_x)_2$, percent standard errors $\% \sigma_m$ or percent estimated uncertainties $\% \delta m$, and the confidence intervals into a single table. Using this table, **plot both confidence intervals onto one plot**.
- d. By looking at this table, compare these results and answer the following questions:
 - Which is most precise? Does this mean that it is the most accurate?
 - Which has the most significant figures? Does this mean that it is the most accurate?
 - Which of these masses is most reliable? Does your “gut feeling” agree with your answer?
 - Do both of these unknown mass measurements measure the same unknown mass m_x ?

Formal Lab Report Format

The formal lab report (written in the third person) will be based on the Massing an Unknown Massive Object. The report should be

- 4 – 10 pages in length
- No wide open spaces larger than 4 carriage returns
- typed in the font style Arial or Times New Roman and font size point 12

The report **must** include the following sections in the following order:

1. Abstract (summarize the key points in the report in 100 words or less).
2. Introduction (creates interest, gives background information, an application of the topic, and states their theory).
3. Materials and Methods (describe equipment and procedures).
4. Data and data results (with calculations) presented in tables and graphs, error analysis, and predicted and experimental comparison.
5. Discussion (recaps key points and interprets the results).

Hint: The Peer Review Sheet is a good check to see if you have included all of the required elements of the report.

Key Dates:

Massing an Unknown Massive Object Experiment	11/18 – Wednesday
Final Lab Report due	120/8 – Tuesday

Peer Review Guide Sheet

1. Abstract and Introduction

- Is the abstract complete – including results?
- Does it draw interest? Is the interest topic connected to the actual experiment?
- Was an application of the topic included?
- How does the application relate to the laboratory experiment?
- Does it include theory and purpose?

2. Materials and Methods

- Is it sufficiently complete even for a stranger?
- The explanations should not be in “recipe form.” Are they?
- Are the descriptions and illustrations clear?

3. Results

- Are the derivations and sample calculations clear?
- Are calculations explained with words also?
- Are there clear presentations of data tables, graphs, and illustrations?
- Is there a clear comparison between theory and experiment?
- Explain what being consistent or not consistent with a 1σ - and 2σ -intervals.
- Is there a clear estimated experimental uncertainty?
- Are there too many repeated calculations?
- Are all of the above in sequential order?

4. Discussion of Results

- Is there a clear summary of key results?
- Are significant discrepancies identified and discussed?
- Does it show thoughtful/insightful discussion of results?
- Is the discussion quantitative/specific rather than vague/general?
- Is there too much opinion?