Evaluating Laboratory Reports for Communication

- **Writing Across the Curriculum**
- **Defining "Good" & "Bad" Writing**
  - ***Homew#6:k #: Initial evaluation of example laboratory reports from 2 students***
- **Expanding Our Vocabulary for Evaluating Writing – Writing Factors**
- **Redefining Quality of Writing: moving away from "Good" & "Bad"**
- **Ways that Writing Factors Apply to Physics Laboratory Reports**
  - ***Act 17b: 16: Evaluating sample laboratory report from laboratory manual***
  - ***Act 18a: 17a: How to grade student laboratory reports***
  - ***Act 18b: 17b: Grading of example laboratory reports from 2 students***
- **Campus Resources for Writing Support**
- **Formal Requirements for Writing-Intensive Course Work**

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Writing Across the Curriculum

The national movement called "Writing Across the Curriculum," or WAC, advocates the instruction of writing *across* & *within* disciplines, as it holds the belief that writing is important to all subject areas & can be effectively instructed in specific disciplinary contexts.

WAC

Some basic assumptions:

- **Writing is a learning activity that involves problem solving & communication skills**
- **Writing is a social activity, shaped by contextual factors such as a community of peers**
- **Writing is not separable from content**
- **Forms of writing vary from context to context**
- **Certain factors of writing are central to all writing acts, such as audience, purpose, context, organization, support, design, & expression**

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Teaching with Writing

At the University of Minnesota, instructors from across the disciplines are *incorporating writing* into their courses. Doing so has *affirmed the enhancing role* that writing activities can play in *student learning*. It has also allowed faculty & students alike to *recognize* that *language use* & *text production* take place *within disciplinary language communities*

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Mission of the Writing Requirements

- Learning to write is a *life-long task* … *refined* through an individual's personal, social, & professional *experiences*
- Principal means by which all scholars … *make inquiries* & *communicate* their learning
- Learning to write effectively can be one of the most *intellectually empowering* components of an university education
- University regards the teaching of writing as a *responsibility shared by all departments*

Writing-Intensive (W-I) Courses

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WAC: *complementary objectives*

Good writers:

- **practice on a continuing basis, so one of the goals of W-I courses is to offer *ongoing writing practice***
- **are able to write for a variety of audiences; they understand that effective writing depends on context. For this reason, students should *write in many different kinds of courses, to audiences ranging from their peers to senior scholars & scientists***
- **are able to produce a range of different kinds of writing. So the *nature of the writing* done in W-I courses should *vary considerably***
- **Because no one course can meet all these goals, the *collective goal* of all these W-I courses is to *prepare students to communicate effectively in a variety of situations* at the University, in their future employment, & in their roles as citizens**

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W-I Courses

Address the idea that *writing is important to learning technical content*. It is important to acknowledge that writing involves more than simply mastering grammar, spelling, & mechanics

W-I courses in Physics provide students the *opportunity to learn about physics* through written assignments *(laboratory reports)* that involve problem solving, language use, & organizational skills

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W-I Courses: *requirements*

1) Course grade is directly tied to the quality of the student's writing as well as to knowledge of the subject matter, so that *students cannot pass the course who do not meet minimal standards* of writing competence
2) Courses requiring a significant amount of writing – *minimally 10 to 15 finished pages* beyond informal writing & any in-class examinations. Note that the page guidelines may be met with an assortment of short assignments that add up to the total
3) Courses in which *students are given instruction on the writing aspect of the assignments*
4) Courses in which *assignments include at least one for which students are required to revise a draft & resubmit* after receiving feedback from the course instructor or graduate teaching assistant. Otherwise, writing assignments may be of various kinds & have various purposes, as appropriate to the discipline

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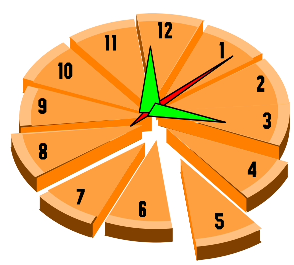
Defining "Good" & "Bad"

Your task:

- Take 5 minutes to compare the characteristics that you came up with for Homework with your nearest neighbor
- Take 5 minutes to discuss your grading of the 2 examples for Homework with your nearest neighbor



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Defining "Good" & "Bad" Writing

What words or characteristics come to mind when trying to define "good" writing?

What words or characteristics come to mind when trying to define "bad" writing?

Discussion of Homework: ***Initial Evaluating of 2 Examples***

Example #1	***Example #2***
Good:	**Good:**
Bad:	**Bad:**

Expanding Our Vocabulary for Evaluating Writing - Writing Factors

Although different situations require that writing take different forms (i.e., resume versus laboratory report), certain factors are important to ALL writing situations. These factors, while general, can be adapted or explained in terms that are specific to each writing situation. Below is a list of eight communication factors that apply to writing situations. I encourage you to begin using this vocabulary to describe writing.

Expanding Vocabulary: *Writing Factors*

Content: Has the student included technical or scientific *Content* accurately & thoroughly? Does the student address accurate information such as definitions, formulas, theorems, explanations, or data?

Context: Has the student communicated in a way appropriate for the situation or *Context* in which the document / presentation / visual will be received? Have the requirements of the assignment been met?

Audience: Has the student addressed the *Audience* with appropriate language & technical content, vocabulary, level of knowledge, & register (informal or formal)?

Purpose: Has the student identified the *Purpose* of their communication, such as to inform, persuade, instruct, or demonstrate?

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Expanding Vocabulary: *Writing Factors*

Support: Has the student included appropriate *Support* in the form of documentation, facts, statistics, formulas, illustration, or evidence?

Design: Does the student use effective *Design*, both for page design & for the integration of verbal explanation & visual illustration? Does the student display neatness & cross-references at appropriate points?

Organization:
Has the student *Organized* the communication into logical sections, paragraphs, topic sentences, & headings?

Expression:
Has the student *Expressed* written work clearly, efficiently, & effectively? Has the student used correct grammar & mechanics?

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Redefining Quality of Writing:

Moving away from "good" & "bad"

Content	Satisfactory	Adequate	Poor
Addresses *content* accurately and thoroughly	Accurate and complete technical information, including formulas, explanations, theory, and data.	Accurate technical information, but has missed some important information.	Does not include accurate or complete information.

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Redefining Quality of Writing:

Moving away from "good" & "bad"

Context	Satisfactory	Adequate	Poor
Writes to the appropriate *context* or situation of assignment – format suitable for a short technical document	Meets the requirements of the assignment; includes proper format & sections that assignment requires.	Adequately meets requirements of the assignment; does not always display proper format.	Does not meet the requirements of the assignment as specified.

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Redefining Quality of Writing:

Moving away from "good" & "bad"

Audience	Satisfactory	Adequate	Poor
Addresses *audience* appropriately – can be understood by classmates in this physics class	Writes appropriately for classmates, including proper terms, explanations of concepts, formal register.	Does not always include proper terms, concepts, or register (perhaps is too informal).	Does not include proper terms, concepts, or register to effectively address audience.

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Redefining Quality of Writing:

Moving away from "good" & "bad"

Purpose	Satisfactory	Adequate	Poor
Indicates clear *purpose* for writing	Indicates purpose of the report (to solve a problem, to instruct, to explain, to demonstrate, etc.) in the beginning of the report.	Purpose of the report is not clearly indicated by the writer, or is indicated incorrectly.	Purpose of the report is not indicated at all. No effort has been made to indicate purpose of writing.

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Redefining Quality of Writing:

Moving away from "good" & "bad"

Organization	Satisfactory	Adequate	Poor
Paper is logically *organized*	Has complete, concise, paragraphs; includes strong topic sentences that indicate focus of paragraph; includes strong forecasting statements; includes appropriate headings & subheadings; demonstrates coherence throughout report.	Adequate overall format; does not display concise paragraph or topic sentences; does not have all appropriate headings; paragraphs are not clearly coherent.	Does not use appropriate headings or subheading; paragraphs do not logically connect nor are they concise; topic sentences are not effective.

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Redefining Quality of Writing:

Moving away from "good" & "bad"

Support	Satisfactory	Adequate	Poor
Includes adequate *support* (documentation & illustrations)	Has necessary illustrations or figures. Refers to appropriate readings, theories, & relevant background information; includes relevant graphs & tables; with proper labeling & cross-references figures, tables, & graphs.	Has appropriate readings & background information, but does not use clear logic; has tables & graphs but they are not always labeled or cross-referenced.	Does not include necessary support in the form of logic, background information, tables, or graphs. No labeling, & cross-references.

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Redefining Quality of Writing:

Moving away from "good" & "bad"

Design	Satisfactory	Adequate	Poor
Applies an appealing *design*	Report & figures are clear & legible. Visuals are balanced on the page with appropriate verbal explanation nearby. Report is neat; headings & titles have similar font & style to indicate hierarchy of information. Easy to read.	Report & figures are legible, but some areas are difficult to read. Figures & illustrations are not as neat as they could be. Do not demonstrate hierarchy of information.	Reports & figures are messy & difficult to read. Visuals & explanations are not convenient to read.

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Redefining Quality of Writing:

Moving away from "good" & "bad"

Expression	Satisfactory	Adequate	Poor
Uses clear *expression*	Uses complete sentences & proper subject-verb construction. No spelling errors. Uses commas, periods, & other punctuations correctly. Uses correct abbreviations & capitalization. Uses appropriate vocabulary & writes in a tone that clearly conveys ideas or concepts. Uses consistent voice.	Uses readable tone, but is not clear all the time. Includes occasional spelling errors. May occasionally misuse punctuation. Does not include consistent voice.	Includes multiple spelling, grammar, or punctuation errors. Is difficult to read due to misuses of language.

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Ways that Writing Factors Apply to Physics Laboratory Reports

Although evaluating sheets for laboratory reports may not exclusively address the eight factors mentioned in pervious pages, many are implicitly included. For example, the grading rubric used by Physics to assess laboratory reports includes words such as “clear and readable,” “stated correctly,” “section headings provided,” “correct grammar and spelling,” and “use of labels on graphs.” I would consider each of these criteria that address communication.

(See sample grading rubric on the next page)

SAMPLE COVER SHEET

PHYSICS ____ LABORATORY REPORT
LABORATORY I

Name and ID#: ____

Date performed: _____________ Day/Time section meets: ____________

Lab Partners' Names: ____

____

____

Problem # and Title: ____

Lab Instructor Initials: __________

Writing Factors

Grading Checklist	Points
LABORATORY JOURNAL:	
PREDICTIONS (individual predictions completed in journal before each lab session)	
LAB PROCEDURES (measurement plan recorded in journal, tables and graphs made in journal as data is collected, observations written in journal)	
PROBLEM REPORT:	
ORGANIZATION (clear and readable; correct grammar and spelling; section headings provided; physics stated correctly)	
DATA AND DATA TABLES (clear and readable; units and assigned uncertainties clearly stated)	
RESULTS (results clearly indicated; correct, logical, and well-organized calculations with uncertainties indicated; scales, labels and uncertainties on graphs; physics stated correctly)	
CONCLUSIONS (comparison to prediction & theory discussed with physics stated correctly ; possible sources of uncertainties identified; attention called to experimental problems)	
TOTAL (incorrect or missing statement of physics will result in a maximum of 60% of the total points achieved; incorrect grammar or spelling will result in a maximum of 70% of the total points achieved)	
BONUS POINTS FOR TEAMWORK (as specified by course policy)	

Expression
Expressi
Organization
Content
Expression & design
Support
Support
Content

* An "R" in the points column means to <u>rewrite that section only</u> and return it to your lab instructor within two days of the return of the report to you.

Evaluating Sample Laboratory Report from Laboratory Manual

We've redefined the quality of writing based on the general writing factors, and how these factors relate to the rubric used to grade physics laboratory reports. The laboratory manual for the students includes, at the beginning, information about what is to be expected of their laboratory reports. There is also a sample report that further model what is expected. In this activity you will evaluate this sample laboratory report for its quality based on the grading rubric, all the while keeping in mind the qualities as described and defined by the general writing factors.

Individual Tasks:

1. *Individually* read through the sample laboratory report (the double-barred sections are descriptions and explanations on what is expected in each section of the report).

2. *Individually* evaluate the sample laboratory report – mark down any and all comments about the quality of the paper, both good and bad.

Whole Group Discussion:

Follow along with the overhead presentation as it points out certain segments that related to the writing factors. Participate in discussing various aspects of the quality of the sample laboratory report.

Time: 45 minutes.

SAMPLE COVER SHEET

PHYSICS ____ LABORATORY REPORT
LABORATORY I

Name and ID#: ____

Date performed: ____________ Day/Time section meets: ____________

Lab Partners' Names: ____

____

____

Problem # and Title: ____

Lab Instructor Initials: __________

Grading Checklist	Points
LABORATORY JOURNAL:	
PREDICTIONS (individual predictions completed in journal before each lab session)	
LAB PROCEDURES (measurement plan recorded in journal, tables and graphs made in journal as data is collected, observations written in journal)	
PROBLEM REPORT:	
ORGANIZATION (clear and readable; correct grammar and spelling; section headings provided; physics stated correctly)	
DATA AND DATA TABLES (clear and readable; units and assigned uncertainties clearly stated)	
RESULTS (results clearly indicated; correct, logical, and well-organized calculations with uncertainties indicated; scales, labels and uncertainties on graphs; physics stated correctly)	
CONCLUSIONS (comparison to prediction & theory discussed with physics stated correctly ; possible sources of uncertainties identified; attention called to experimental problems)	
TOTAL (incorrect or missing statement of physics will result in a maximum of 60% of the total points achieved; incorrect grammar or spelling will result in a maximum of 70% of the total points achieved)	
BONUS POINTS FOR TEAMWORK (as specified by course policy)	

* An "R" in the points column means to rewrite that section only and return it to your lab instructor within two days of the return of the report to you.

Appendix E: Sample Laboratory Report

There is no set length for a problem report but experience shows the good reports are typically three pages long. Graphs and photocopies of your lab journal make up additional pages. Complete reports will include the terminology and the mathematics relevant to the problem at hand. Your report should be a clear, concise, logical, and honest interpretation of your experience. You will be graded based on how well you demonstrate your understanding of the physics. Because technical communication is so important, neatness, and correct grammar and spelling are required and will be reflected on your grade.

Note: As with Problem 1 of Lab 1, the double vertical bars indicate an explanation of that part of the report. These comments are not part of the actual report.

Statement of the problem

In a complete sentence or two, state the problem you are trying to solve. List the equipment you will use and the reasons for selecting such equipment.

The problem was to determine the dependence of the time of flight of a projectile on its initial horizontal velocity. We rolled an aluminum ball down a ramp and off the edge of a table starting from rest at two different positions along the ramp. Starting from the greater height up the ramp meant the ball had a larger horizontal velocity when it rolled along the table. Since the table was horizontal, that was the horizontal velocity when it entered the air. See Figure 1 from my lab journal for a picture of the set-up.

We made two movies with the video equipment provided, one for a fast rolling ball and one for a slower one. These movies were analyzed with LabVIEW™ to study the projectile's motion in the horizontal and vertical directions.

Prediction

Next comes your prediction. Notice that the physical reason for choosing the prediction is given. In this case there is a theoretical relationship between Δt and v_o. There is a reference to real life experience: the example of the bullets. Also, **note that this prediction is wrong**. That is all right. The prediction does not need to be correct, it needs to be what you really thought before doing the lab; that is why it is called a prediction. The prediction is supposed to be a complete and reasonable attempt by your group to determine the outcome of the problem.

Our group predicted that the time the ball took to hit the ground once it left the table would be greater if the horizontal velocity were greater. We have observed that the faster a projectile goes initially, the longer its trajectory. Since the gravitational acceleration is constant, we reasoned that the ball would take more time to travel a larger distance.

Mathematically, we start from the definition of acceleration:

$$a = \frac{d}{dt}\left(\frac{dy}{dt}\right)$$

and integrate twice with respect to time to see how a change in time might be related to initial velocity. We found that:

$$y - y_o = v_o\Delta t + 0.5a\Delta t^2 \qquad (1)$$

With the y-axis vertical and the positive direction up, we know the acceleration is -g. We also know that v_o is the initial velocity, and $y_o - y$ is h, the height of the table. Solving for Δt one finds:

$$\Delta t = \frac{vo \pm \sqrt{(vo^2 + 2hg)}}{g} \qquad (2)$$

Faced with a choice in sign, our group chose the solution with the positive sign, deciding that a possible negative value for elapsed time does not correspond with our physical situation. From equation (2), we deduced that if v_o increased, then the time of fall also increases. This coincided with our prediction that a projectile with fastest horizontal velocity would take the most time to fall to the ground. For a graph of our predicted time of flight versus initial horizontal velocity, see Graph A from the lab journal.

LabVIEW™ generated graphs of x and y positions as functions of time. Our prediction for the vertical direction was equation (1). Since the ball only has one acceleration, we predicted that equation (1) would also be true for the horizontal motion:

$$x - x_o = v_o\Delta t + 0.5a\Delta t^2$$

The dotted lines on the printed graphs represent these predictions.

The Example of Two Bullets

Our TA asked us to compare a bullet fired horizontally from a gun to a bullet dropped vertically. Our group decided the bullet that is fired horizontally will take longer to hit the ground than the one that is simply dropped from the same height.

Data and results

This section describes your experimental method, the data that you collected, any problems in gathering the data, and any crucial decisions you made. Your actual results should show you if your prediction was correct or not.

To ensure the ball's velocity was completely horizontal, we attached a flat plank at the end of the ramp. The ball rolls down the ramp and then goes onto the horizontal plank. After going a distance (75 cm) along the plank, the ball leaves the edge of the table and enters projectile motion.

We measured the time of flight by simply counting the number of video frames that the ball was in the air. The time between frames is 1/30 of a second since this is the rate a video camera takes data. This also corresponds to the time scale on the LabVIEW™ graphs. We decided to compare the times of flight between a ball with a fast initial velocity and one with a slow initial velocity. To get a fast velocity we started the ball at the top of the ramp. A slower velocity was achieved by starting the ball almost at the bottom of the ramp.

During the time the ball was in the air, the horizontal velocity was a constant, as shown by the velocity in the x-direction graphs for slow and fast rolling balls. From these graphs, the slowest velocity we used was 1.30 m/s, and the fastest was 2.51 m/s.

After making four measurements of the time of flight for these two situations, we could not see any correspondence between time of flight and initial horizontal velocity (see table 1 from lab journal). As a final check, we measured the time of flight for a ball that was started approximately halfway up the ramp and found it was similar to the times of flight for both the fast and the slow horizontal velocities (see table 2 from lab journal).

A discussion of uncertainty should follow all measurements. No measurement is exact. Uncertainty must be included to indicate the reliability of your data.

Most of the uncertainty in recording time of flight came from deciding the time for the first data point when the ball is in the air and the last data point before it hit the ground. We estimated that we could be off by one frame, which is 1/30 of a second. To get a better estimate of this uncertainty, we repeated each measurement four times. The average deviation served as our experimental uncertainty (see Table 1 from lab journal). This uncertainty matched our estimate of how well we could determine the first and the last frame of the projectile trajectory.

Conclusions

This section summarizes your results. In the most concise manner possible, it answers the original question of the lab.

Our graph indicates that the time of flight is independent of the ball's initial horizontal velocity (see lab journal, Graph A). We conclude that there is no relationship between these two quantities.

A good conclusion will always compare actual results with the predictions. If your prediction was incorrect, then you must discuss where your reasoning went wrong. If your prediction was correct, then you should review your reasoning and discuss how this lab served to confirm your knowledge of the basic physical concepts.

Our prediction is contradicted by the apparent independence of the time of flight and initial horizontal velocity. We thought that the ball would take longer to fall to the floor if it had a greater initial horizontal velocity. After some discussion, we determined the error in our prediction. We did not understand that the vertical motion is completely independent of the horizontal motion. Thus, in the vertical direction the equation

$$y - y_o = v_o\Delta t + 0.5a\Delta t^2$$

means that the v_o is the only the y-component of initial velocity. Since the ball rolls horizontally at the start of its flight, v_o in this equation always equals zero.

The correct equation for the time of flight, with no initial vertical component of velocity, is actually:

$$y - y_o = 0.5a\Delta t^2$$

In this equation, there is no relationship between time of flight and initial horizontal velocity.

Furthermore, the graphs we generated with LabVIEW™ showed us that velocity in the y-direction did not change when the initial horizontal velocity changed. Velocity in the y-direction is always approximately zero at the beginning of the trajectory. It is not exactly zero because of the difficulty our camera had determining the position when the projectile motion begins. We observed that the y-velocity changed at the same rate (slope of v_y plots, graphs 1 and 2) regardless of the horizontal velocity. In other words, the acceleration in the y-direction is constant, a fact that confirms the independence of vertical and horizontal motion.

After you have compared your predictions to your measured results, it is helpful to use an alternative measurement to check your theory with the actual data. This should be a short exercise demonstrating to yourself and to your TA that you understand the basic physics behind the problem. Most of the problems in lab are written to include alternative measurements. In this case, using the time of fall and the gravitational constant, you can calculate the height of the table.

The correct equation for the horizontal motion is

$$x - x_o = v_o\Delta t$$

The horizontal acceleration is always zero, but the horizontal distance that the ball covers before striking the ground does depend on initial velocity.

** Alternative Analysis**

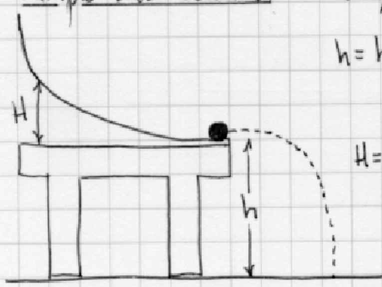
Since $y_o - y = h$ and $a = -g$ we can check to see if our measured time of flight gives us the height of the table. From our graph, we see that the data overlaps in a region of about 0.41 sec. With this as our time of flight, the height of the table is calculated to be 82.3 cm. Using a meter stick, we found the height of the table to be 80.25 cm. This helped convince us that our final reasoning was correct.

The example of the two bullets discussed in the Prediction section was interpreted incorrectly by our group. Actually, both bullets hit the ground at the same time. One bullet travels at a greater speed, but both have the same time of flight. Although this seems to violate "common sense" it is an example of the independence of the horizontal and vertical components of motion.

APPENDIX E: SAMPLE LAB REPORT

The following are pages photocopied from my lab journal:

Sample Lab Journal July 13th, 1998



h = height of table

H = ball's starting height

Equipment: ramp, aluminum ball, video camera, computer, meterstick

Purpose: Determine if Time of flight depends on initial horizontal velocity

Method: One person releases ball, another operates video camera. Count frames with ball in the air to find time of flight.

Exploration: Larger H results in larger horizontal $\vec{v}$.

E - 6

Table 1

Fast Ball, $H \simeq 35$ cm, $v_0 = 2.51$ m/s

Trial	Frames with ball in air	Deviation from ave.
1	13	0.25
2	13	0.25
3	12	0.75
4	13	0.25
Average	12.75	0.4

Time of flight:
$12.75 \text{ frames} \times \frac{1}{30} \frac{\text{sec}}{\text{frame}} =$

0.42 sec

Uncertainty:
$\pm 0.4 \text{ frames} \times \frac{1}{30} \frac{\text{sec}}{\text{frame}} =$

$\pm$ 0.014 sec

Slow Ball, $H \simeq 10$ cm, $v_0 = 1.3$ m/s

1	12	0.5
2	13	0.5
3	13	0.5
4	12	0.5
Average	12.5	0.5

Time of flight:
$12.5 \text{ frames} \times \frac{1}{30} \frac{\text{sec}}{\text{frame}} =$

0.41 sec

Uncertainty
$\pm 0.5 \times \frac{1}{30} \frac{\text{sec}}{\text{frame}} =$

$\pm$ 0.018 sec

Table 2

Medium Ball, $H \simeq 20$, $v_0 = 1.8$ m/s

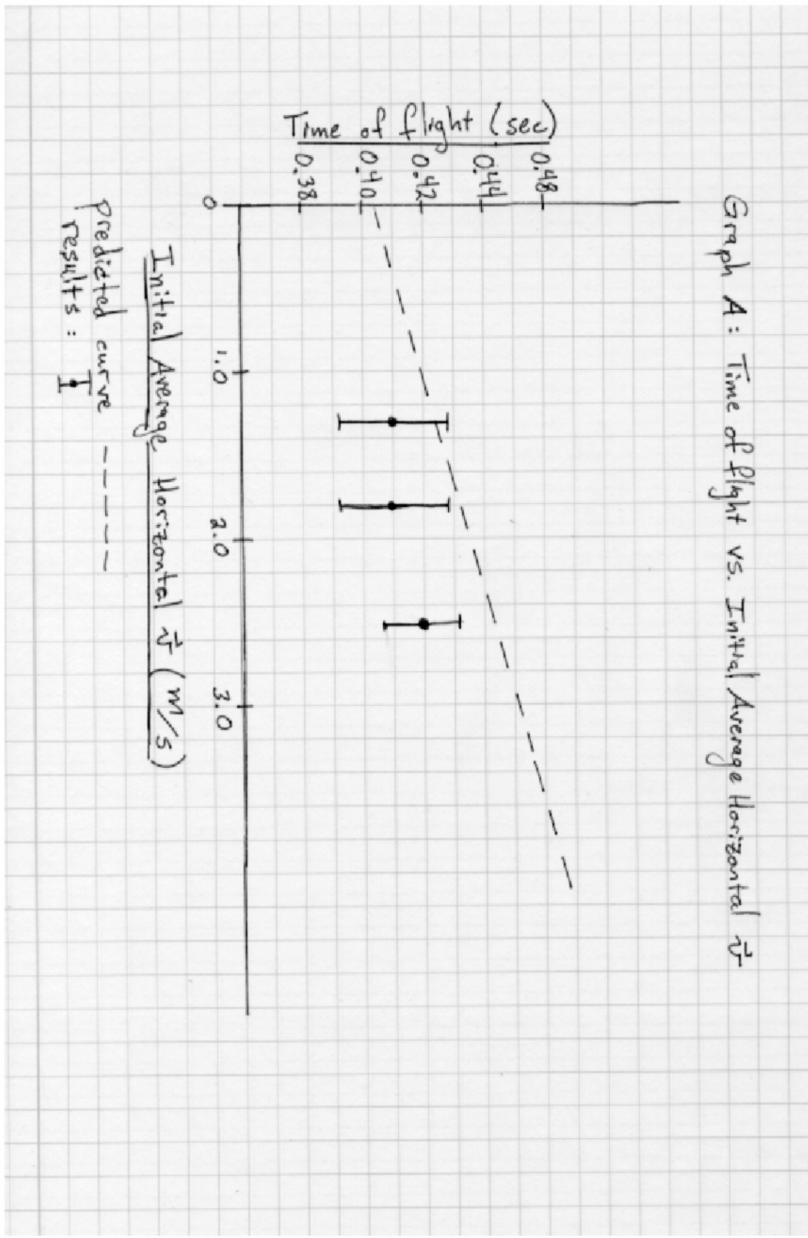
Trial	# frames	Deviation
1	12	0.5
2	12	0.5
3	13	0.5
4	13	0.5
Average	12.5	0.5

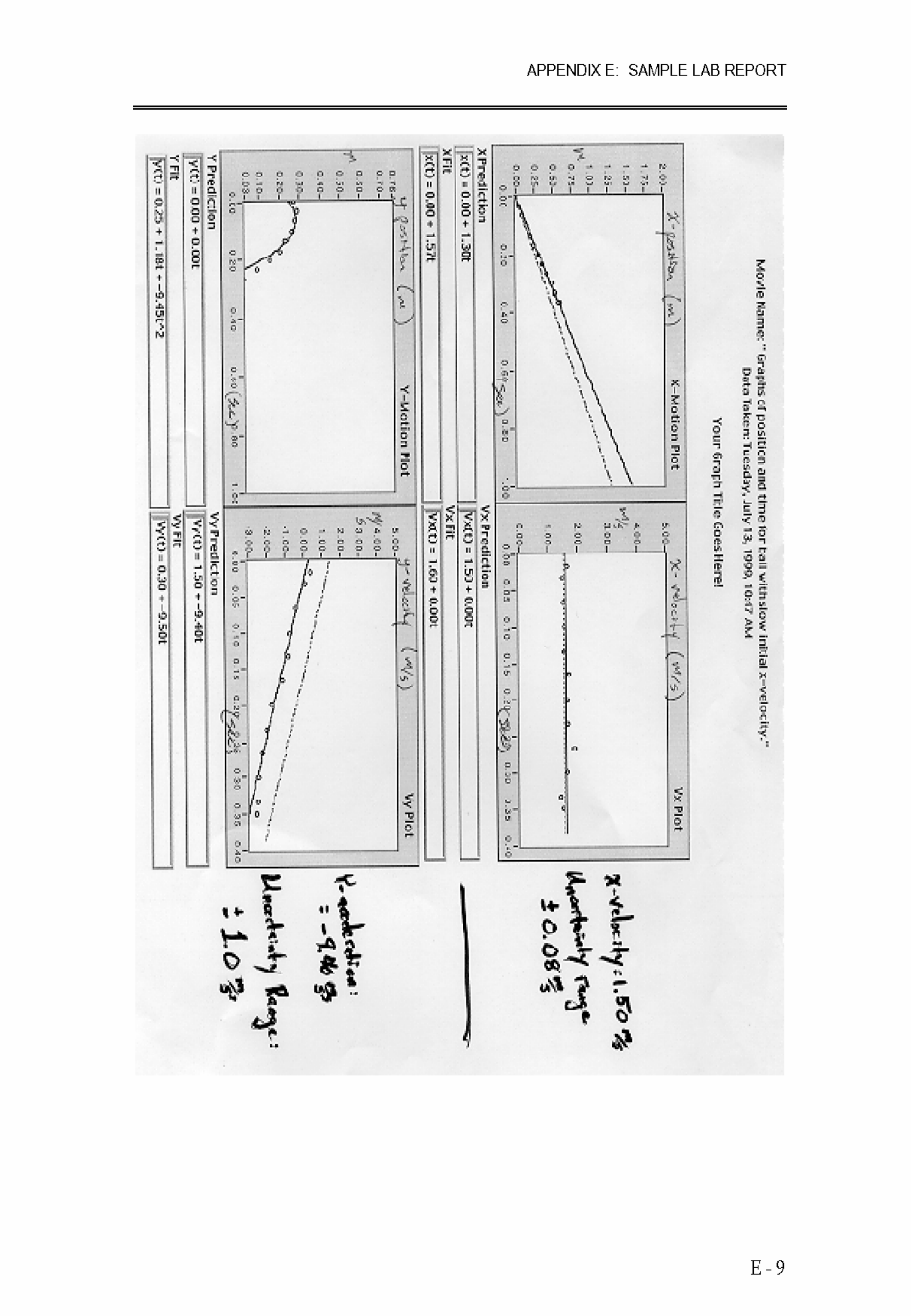
Time of flight:
$12.5 \text{ frames} \times \frac{1}{30} \frac{\text{sec}}{\text{frames}} =$

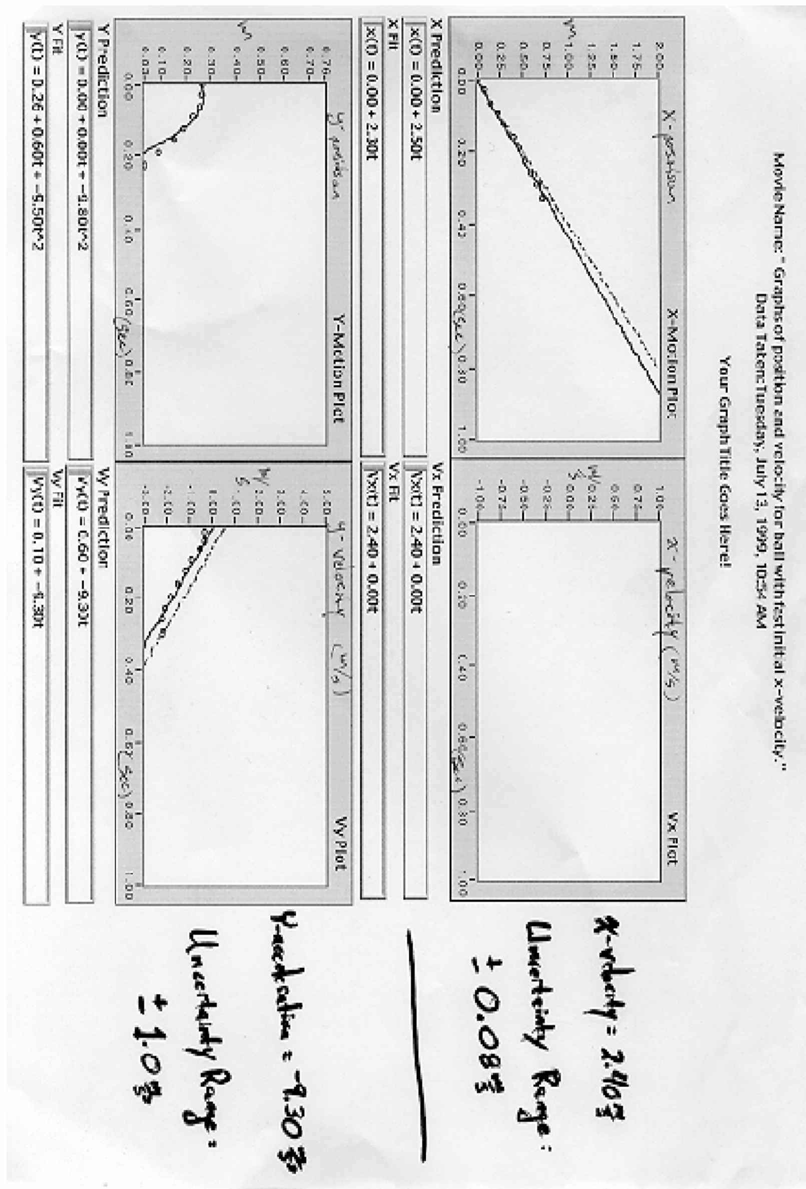
0.41 sec

Uncertainty: $\pm 0.5 \times \frac{1}{30} \frac{\text{sec}}{\text{frame}} =$

$\pm$ 0.018 sec


Graph A: Time of flight vs. Initial Average Horizontal v
Time of flight (sec)
0.38
0.40
0.42
0.44
0.48
0
1.0
2.0
3.0
Initial Average Horizontal v (m/s)
Predicted curve
results :


APPENDIX E: SAMPLE LAB REPORT
Movie Name: "Graphs of position and time for ball with slow initial x-velocity."
Data Taken: Tuesday, July 13, 1999, 10:47 AM
Your Graph Title Goes Here!
X-Motion Plot
Vx Plot
Y-Motion Plot
Vy Plot
X Prediction
x(t) = 0.00 + 1.30t
X Fit
x(t) = 0.00 + 1.57t
Vx Prediction
Vx(t) = 1.50 + 0.00t
Vx Fit
Vx(t) = 1.60 + 0.00t
Y Prediction
y(t) = 0.00 + 0.00t
Y Fit
y(t) = 0.25 + 1.18t + -9.45t^2
Vy Prediction
Vy(t) = 1.50 + -9.40t
Vy Fit
Vy(t) = 0.30 + -9.50t
x-velocity: 1.50 m/s
Uncertainty range ± 0.08 m/s
y-acceleration: = -9.46 m/s²
Uncertainty Range: ± 1.0 m/s²


Movie Name: "Graphs of position and velocity for ball with fast initial x-velocity."
Data Taken: Tuesday, July 13, 1999, 10:54 AM
Your Graph Title Goes Here!
X-Motion Plot
Vx Plot
Y-Motion Plot
Vy Plot
X Prediction
x(t) = 0.00 + 2.50t
X Fit
x(t) = 0.00 + 2.30t
Vx Prediction
Vx(t) = 2.40 + 0.00t
Vx Fit
Vx(t) = 2.40 + 0.00t
Y Prediction
y(t) = 0.00 + 0.00t + -9.80t^2
Y Fit
y(t) = 0.26 + 0.60t + -5.50t^2
Vy Prediction
Vy(t) = 0.60 + -9.30t
Vy Fit
Vy(t) = 0.10 + -9.30t
x-velocity = 2.40 m/s
Uncertainty Range: ± 0.08 m/s
Y-acceleration = -9.30 m/s²
Uncertainty Range: ± 1.0 m/s²

Discussion of Sample Laboratory Report with Annotations Regarding Communication – Writing Factors

What characteristics of writing does the report display well?

What characteristics are not displayed well?