MEMORIAL UNIVERSITY

MUN PHYSICS

Physics 1051

Lab Introduction

Department of Physics and Physical Oceanography

Computer Login & Attendance

Username = ***maclab??***

refers to the maclab numbers of your computer found on a piece of paper taped to the top of your computer monitor.

Password = ***raptors***

Do attendance… both you and your partner…

Lab Attendance Stormtrooper

Rules & Regulations

1. No food or drink.
2. Cell phones off/silent.
3. Attendance is taken.
4. Absent:
   a. Must contact by email within 48 hrs. (MUN 6.7.5c2)
   b. justin.pittman@mun.ca
5. Pass labs to pass the course.
6. Be on time; 15 min late rule.
7. Prelab checked at door.

To begin…

Username: maclab##

(see number on top of your screen)

Password: raptors

Fill out attendance:

- **Everyone** enter attendance data
- Lab Number: *Introduction*

Resources

This info available at:

www.mun.ca/physics/

Go to: »Undergraduate Laboratories

» 1051 Manual

» Lab Introduction

Physics Help Center:

Help Center C-3071

Mon-Fri 10am-4pm

Uncertainty

- Expected that you know this from Phys 1050.
  - Linked on website for reference.

Addition/Subtraction Rule

Example 1: $z = x - y,$
$\delta z = \delta x + \delta y$

Example 2: $z = x + y,$
$\delta z = \delta x + \delta y$

Multiplication/Division Rule

Example 1: $z = \frac{x}{y}$

$$\frac{\delta z}{z} = \frac{\delta x}{x} + \frac{\delta y}{y}$$

$z = xy$

Example 2: $\frac{\delta z}{z} = \frac{\delta x}{x} + \frac{\delta y}{y}$

Power Rule

$$z = x^n$$

$$\frac{\delta z}{z} = n\frac{\delta x}{x}$$

Combination of Rules

$a = bc^2/d,$

$$\frac{\delta a}{a} = \frac{\delta b}{b} + 2\frac{\delta c}{c} + \frac{\delta d}{d}$$

A little different…

- No lab workbook
- Required to write your own report
- Be prepared!
- Prelabs checked at door
  - *Objective*, *Theory*, *Apparatus* sections complete
  - 15-20% of report grade
- These labs are *very* independent
- Two Parts:
  - **Experimental Report** & **In-Lab Assignment**
  - Submit report before leaving
- Lab Skills Test at end of semester

Lab Report Format

- All reports should follow this general structure:
  - Title
  - Objective
  - Theory
  - Apparatus & Methods
  - Analysis & Result
    - Numbered questions to answer.
  - Conclusions

Prelab Write-Up

- Copy/Paste is NOT appropriate.
  - Reports should be your own work
  - Handwritten or typed is acceptable
- Duotang folder; No binders.

In-lab Assignments

- Each lab has assignment questions associated:
  - Exam-type questions.
  - Graded as part of the lab.
  - About 30% of the laboratory session.

- Submit report, complete In-Lab questions.
  - Lab reports are submitted at **1hr 20 mins**.
  - Once lab report is submitted, then you complete In-Lab assignment questions.
  - Bring paper to complete questions on.

Prelab Sections

- Objective:
  - Statement of purpose of the experiment.
  - Sentence or two.
- Theory:
  - All necessary theory to be utilized.
  - Equations with explanations of terms.
  - In most cases, a paragraph or two.
- Apparatus:
  - Description of equipment to be used
  - Basic explanation of how to use it.

15-20%

NO Signature; NO marks awarded for these sections

Plotting and Graphing

Example

- We collect data to determine physical parameters
- Compare data with physics equations
- Let's say we have 4 objects dimensions and mass.
  - Find Density, ρ.

Cylinder	Volume (cm^3)	Mass (g)
1	8.314	22.50
2	34.110	91.95
3	22.700	61.30
4	13.300	36.10

Example

- What to plot?
- What's their relationship?
- What are we trying to find?
  - Density, ρ
- M vs. V or V vs. M?

Cylinder	Volume (cm^3)	Mass (g)
1	8.314	22.50
2	34.110	91.95
3	22.700	61.30
4	13.300	36.10

Example

$$\rho = M/V$$

density = mass/volume

Linear relationship:

$$y = \{slope\}x + b$$

$$M = \rho V + 0$$

What happens if V on y-axis?

Example

$$\rho = M/V$$

density = mass/volume

Linear relationship:

$$y = \{slope\}x + b$$

$$V = (1/\rho)\, M + 0$$

What happens to the uncertainty?

Example #2

Have velocity and time of a falling object.

Find acceleration.

What do we do?

Where do we start?

Velocity (m/s)	Time (s)
0.699	0.00
1.202	0.0523
1.574	0.0883
1.866	0.1180
2.091	0.1430
2.336	0.1660
2.512	0.1860
2.718	0.2050

Example #2

- What do we have {data}?
- What equation relates these?
- Compare data with equation.
  - What variables represent your data?
- Plot appropriate data relationship.
- Write graph equation;

  Solve for y-variable.
- Draw conclusions/meaning.

Velocity (m/s)	Time (s)
0.699	0.00
1.202	0.0523
1.574	0.0883
1.866	0.1180
2.091	0.1430
2.336	0.1660
2.512	0.1860
2.718	0.2050

Kinematics Equations

$$v_x = v_{x0} + a_x t$$

$$v_x^2 = v_{x0}^2 + 2a_x(x - x_0)$$

$$x = x_0 + v_{0x}t + \frac{1}{2}a_x t^2$$

Velocity (m/s)	Time (s)
0.699	0.00
1.202	0.0523
1.574	0.0883
1.866	0.1180
2.091	0.1430
2.336	0.1660
2.512	0.1860
2.718	0.2050

General Approach

- What data do you have?
- What equation relates these?
- Compare data with equation.
  - What variables represented in your data?
- Write graph equation; Solve for y-variable.
- Plot appropriate data relationship.
- Draw conclusions/meaning.

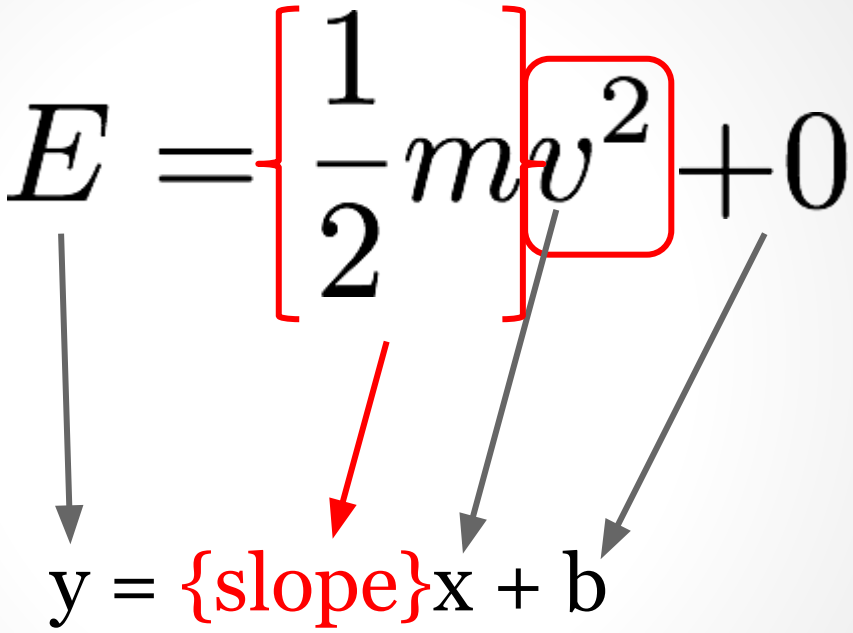
Example #3

For something a little different.

- Given
  - Energy (Joules)
  - Speed (meters/sec)
  - Find the mass of the object (kilograms)
- How do we proceed?

Energy (J)	Speed (m/s)
4.56	1.91
8.29	2.58
11.36	3.02
14.32	3.38
16.32	3.61
19.36	3.94
21.38	4.14
24.13	4.39

Graphing…



Slope is equivalent to more than one term.
Intercept should be zero.

Your turn… Write a Report!

You have collected position and time data for an object starting from rest.

Write a report and determine the **acceleration (m/s²)** and **initial position (m)**.

Report should include *name, student number, objective, theory, analysis, and conclusion*. Include your plot!

Position (m)	Time (s)
16.24	0.81
14.01	1.10
12.14	1.27
10.17	1.39
8.42	1.55
6.30	1.67
4.92	1.76
2.72	1.89

$$v_x = v_{x0} + a_x t$$

$$v_x^2 = v_{x0}^2 + 2a_x(x - x_0)$$

$$x = x_0 + v_{0x}t + \frac{1}{2}a_x t^2$$

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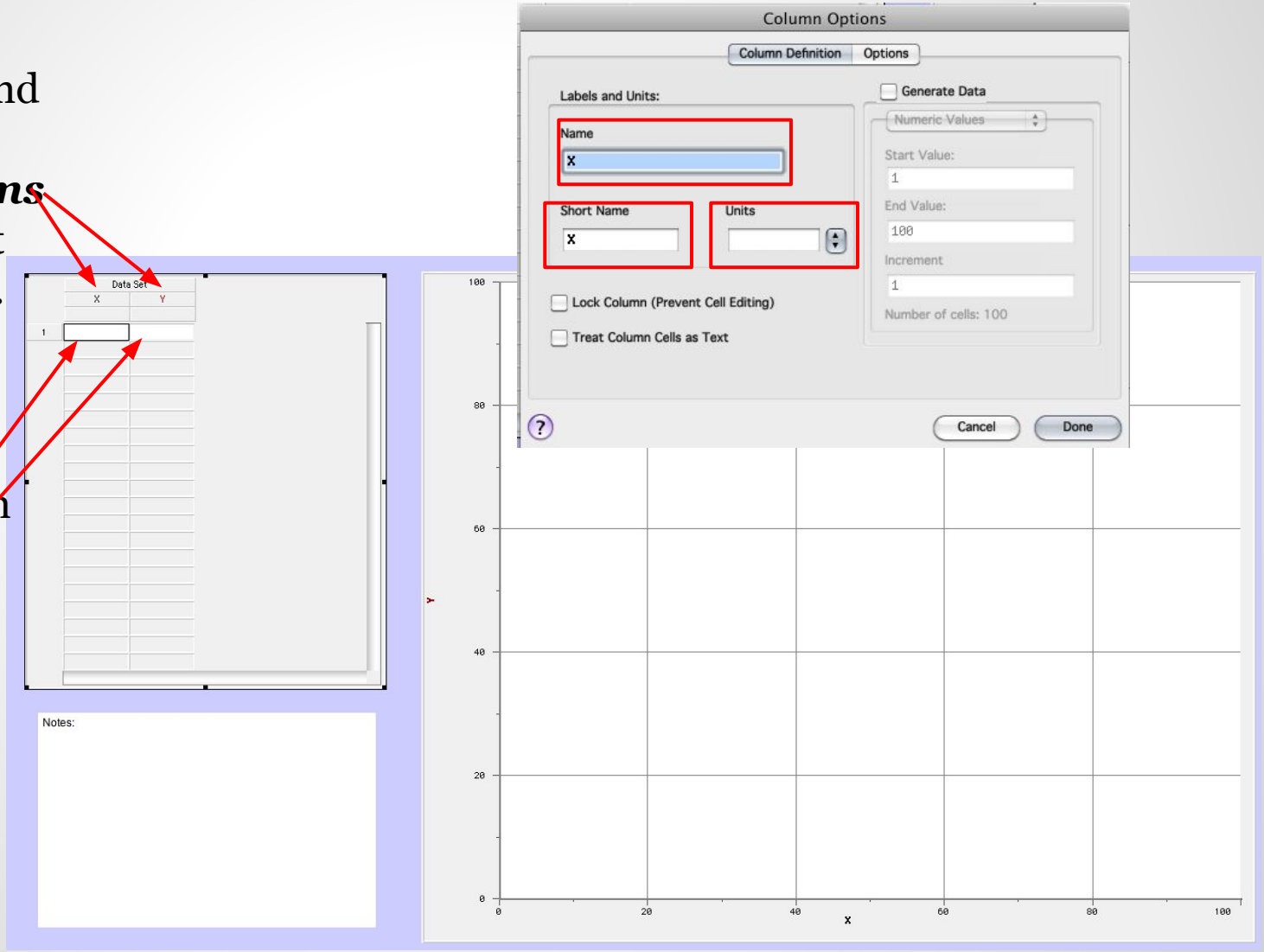
Appendix A

Using Graphical Analysis 3

Appendix A:
Graphical Analysis - Data Entry

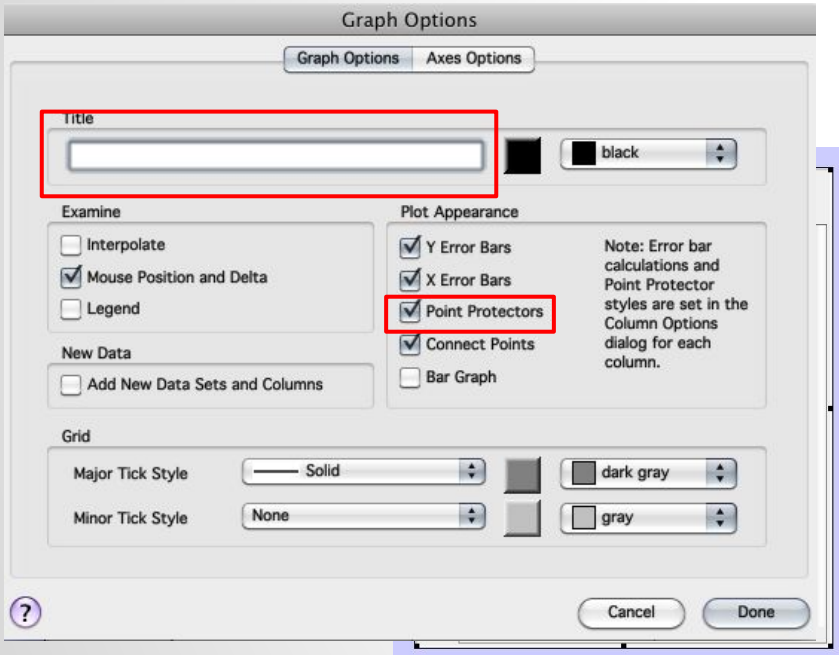
Double click X and Y to access ***Column Options*** add Name, Short Name and Units.

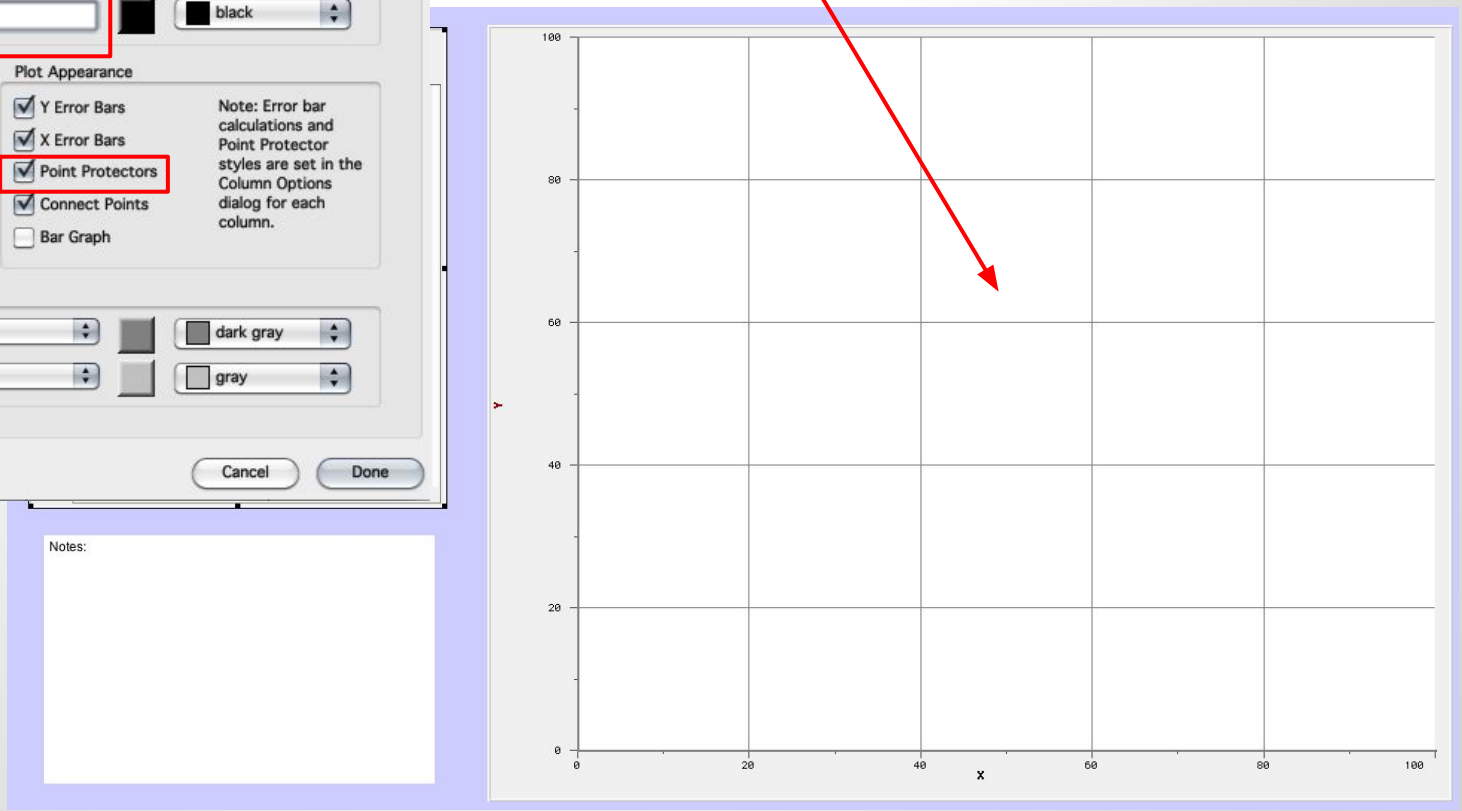
Enter ***Data Set*** in cells of column X and Y



Appendix A:
Graphical Analysis - Graph Options

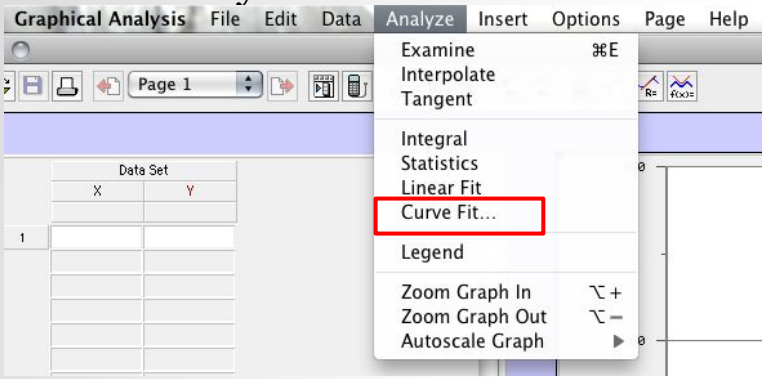
Double click blank space on graph to access ***Graph Options*** to add Title and remove Point Protectors



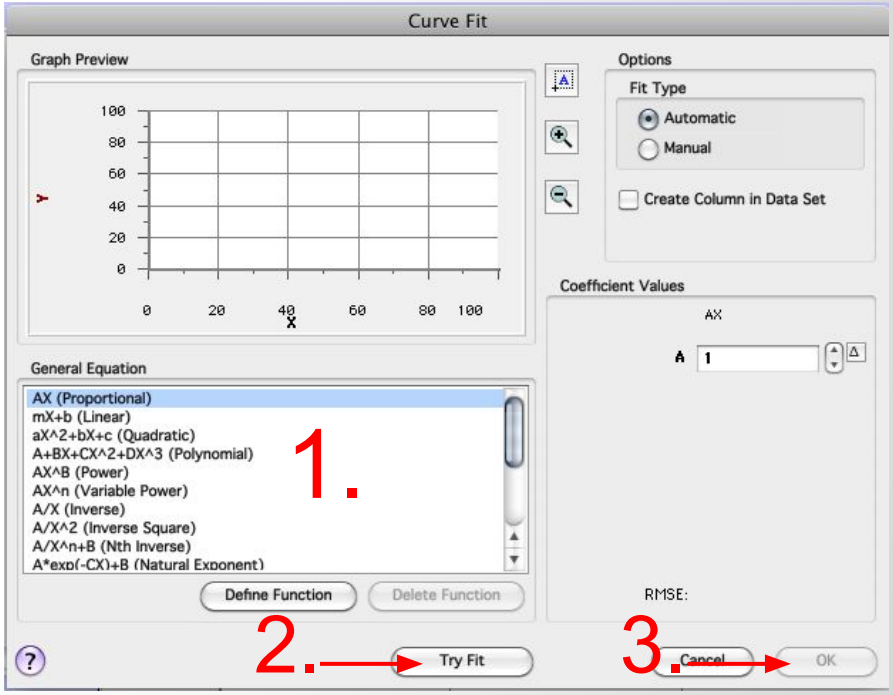


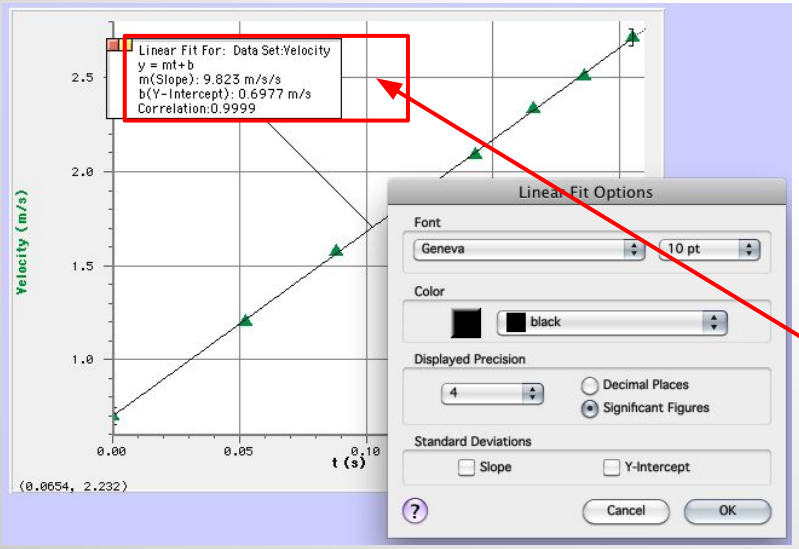
Appendix A:
Graphical Analysis - Fitting

Click on Analyze to access ***Curve Fit***



Select General Equation and Try Fit.





If a linear fit, double click the Fit Box to access ***Linear Fit Options*** to <u>display uncertainties</u> by checking Slope and Y-intercept under *Standard Deviations*

Appendix B

Uncertainties

Appendix B:
Using Uncertainties Rules

1. Find an expression for calculating quantity.
2. Based on step 1, decide the uncertainty rule.

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Multiplication/Division Rule

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Note: *These rules can be found in the online laboratory guidelines document.*

Appendix C

Writing a Quantity with its Uncertainty

Appendix C:
Writing Quantities with Uncertainties

1. Calculate the value of the quantity you wish to determine (Ignore uncertainty at this point).

2. Use uncertainty rules to find the uncertainty.

3. Round the uncertainty to 1 significant figure.

4. Round the value of your quantity to the same number of places of your uncertainty.

Note: *This information can be found in online laboratory guidelines document.*