Experiment zero (Lab intro)
PHYS221 Introduction to measurement & error analysis data sheet

NAME_____ Section_____ Date_____

In this lab you will measure various quantities using either an analog device (which does not have a digital display, e.g., a ruler or triple beam balance) or a device with a digital display (e.g., a digital balance).

The readability (or precision) of any type of device is defined as the smallest quantity that can be read from (i.e., measured by) that device.

The uncertainty of an analog device is generally **(but not always)** defined as **½ of the readability** of the scale.

The uncertainty of a digital device is generally defined as **the readability** of the digital display.

Part one- Readability and uncertainty of a measuring instrument

Instrument	**Readability (include units)**	**Uncertainty (include units)**
ruler		+/-
protractor		+/-
triple beam balance		+/-
electronic (digital) balance		+/-
Vernier caliper		*Use readability* +/-

Part two-Measurement of dimensions of metal block.

Please note that dimensions (lengths) of the sides of the blocks are denoted as **long**, **medium** and **short.**

All measurements must have units when applicable and all uncertainties should be written using one significant figure. For example (51.5 +/- 0.5) cm. *This can also be written as 51.5 +/- 0.5 cm*

Length ±Absolute uncertainty of length

Dimension (length) measured	**Ruler (include units)**	**Caliper (include units)**
long ±δlong		
medium ±δmedium		
short ±δshort		**25.40 +/- mm**

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How to calculate fractional of percent error.

Say you are given a measurement with an absolute uncertainty of (51.5 +/- 0.5) cm. To convert to fractional (percent) uncertainty you would do the following calculation:

$$(51.5 \pm 0.5)\,cm \rightarrow 51.5\,cm \pm \frac{0.5\,cm \times 100}{51.5\,cm} \rightarrow 51.5\,cm \pm 0.9709\,\%.$$

Since all uncertainties (in a lab of this type) should be written with one significant figure, we write

$$51.5\,cm \pm 1\,\%.$$

Note that the fraction (i.e., the percent term) has no units since the cm canceled.

Length $\pm$ Per cent (fractional) uncertainty of length.
Show all work (i.e., fractional uncertainties calculations) on the back of the page.

Dimension (length) measured	Ruler	Caliper
long $\pm\delta_{\%}$long		
medium $\pm\delta_{\%}$medium		
short $\pm\delta_{\%}$ short		

Part 3- Measurement of mass (of a coin). Give measurements with both absolute and percent uncertainties.

Mass of coin using triple beam balance. Mass of coin using digital balance.

Part 4-Mass and weight of a cell phone. Measure the mass of your cell phone using the triple beam balance and then determine its weight. Weight = mass times acceleration of gravity (use $9.800\,m/s^2$)

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Post Lab questions

1. Do you think a digital measuring device is inherently better than an analog device of the same type? Explain your answer. (Don't spend too much time on this one).

2. Are both masses of the coin in part 3 the same when (absolute) uncertainty is considered? Explain your answer.

3. Google "the weight of an apple". How many apples would it take to equal the weight of your cell phone. Show all work.

4. What is the readability and uncertainty of the imperial scale on the ruler?