Name:

Temperature Measurements around the Lab

1. Alcohol Thermometer Resolution: ___________[ ]
   Precision: ±_________[ ]
2. If you are measuring room air temperature what would be a good way to position the thermometer? To hold the thermometer? Does the temperature reading change depending on how it is held or positioned?

Time [m:s]	Temp [°C]
Mean	

3. Based on the data from only your group's alcohol thermometer alone: Do you notice any trends in the data over time? Do any data points deviate significantly from the rest, or from the mean?
4. Do you think any of the things you noticed in #3 might be due to one or more sources of uncertainty? If so what do you think they might be?
5. Based on your data alone, would you say the room temperate is roughly constant?
6. Based on the alcohol thermometer data from everyone in the class: Did everyone get consistent results? Were any trends consistent across all lab groups? Did everyone read the thermometers the same way?
7. Might any of the things you noticed in #6 might be due to one or more sources of uncertainty? If so what do you think they might be? Did each lab group seem to have similar uncertainties of the same magnitude?

8. Based on the data from all the groups does it seem like the room temperature is roughly constant?

9. From the digital data recorded by the temperature probe determine what the minimum measurable step size is of the sensor (ie its resolution). While displaying data at unreasonably high decimal precision, you are looking for two very close values which repeat often that the probe seems to be "stepping" between.

Temperature Sensor Resolution

	Example	Your Temp [°C]
Higher	505.52482	
Lower	505.47482	
Min Step	0.05000	
Resolution	0.05	

We are rounding off for the resolution because even though the sensor claims it can read to many decimals it is highly unlikely that the sensor can actually differentiate between temperatures milliKelvins apart.

10. The manufacturer states that the stainless steel temperature probe has a resolution of 0.05°C. Do your measurements agree with this?

11. Based on your temperature probe data, would you say the room temperate is roughly constant? Explain how you could tell this from both the graph of temperature data, and from the standard deviation of the table data.

12. Which has the better **accuracy** the digital temperature probe or the analogue alcohol thermometer? How would you recommend determining this accuracy? Keep in mind the definition of accuracy.

13. Which has the better **precision** the digital temperature probe or the analogue alcohol thermometer?

Density of a Solid

Instrument	Resolution	Precision
Ruler		
Vernier caliper		
Triple-beam balance		

Object Height = _______ ± _____ [   ]

Object Diameter = _______ ± _____ [   ]

Object Radius = ________ ± ______ [   ]

Object Mass = _________ ± ______ [   ]

1. (a)Adjusting the triple-beam balance so that it read zero when empty, what type of error did this minimize?

   Systematic Measurement   Systematic Intrinsic

   Random Measurement   Random Intrinsic

   (b) Explain why this step is important.

2. Reading the mass from the triple-beam balance ruled scale and estimating the mass between marked rulings, what type of uncertainty is this an example of?

   Systematic Measurement   Systematic Intrinsic

   Random Measurement   Random Intrinsic

3. Using the density formula for your solid object compute the numerical value of the density and record it with the proper units and significant figures. <u>The formula should only contain variables that were measured</u>.

4. Derive an expression for the uncertainty in density. <u>The expression should only contain variables that were measured directly</u>. Show all steps, including differentiations.

5. Using the symbolic expression derived above, insert the measured data and compute the numerical value of the propagated uncertainty and present it along with the units. Make sure it is to the same decimal precision as your calculated density.

Period of a Pendulum

Period Time [s]

1. Compute the mean period $\bar{T}$, the standard deviation of your period measurements σ_T, and the standard deviation of the mean period $\sigma_{\bar{T}}$ based on your measured pendulum period times. Note the standard deviation of the mean, $\bar{x}$, is: $\sigma_{\bar{x}} = \frac{\sigma_x}{\sqrt{N}}$

2. Pendulum Length = __________ ± ____ [ ]

3. In theory, the period of a pendulum is given by $t = 2\pi\left(\frac{L}{g}\right)^{1/2}$ where *L* is the pendulum length in meters and *g* is the acceleration due to gravity (9.79264 m/s^2 in Daytona Beach). Compute the theoretical period.

4. Compute the percentage difference between the theoretical period and the mean measured period.

5. From above you found two independent results for the period of your pendulum. One way you directly measured the period, we normally call this an experimental value. The other method involved using a physical constant *g*, a measured length, and a general physics equation to computer a second result for pendulum period, we normally call this a theoretical value. The two are independent because they were determined in completely different ways and did not use the same information. Ideally the two will be the same, but in reality they will always be different, even if only slightly, because of sources of error. What possible sources of error do you think might be affecting your results? Think about equipment, governing theory, assumptions, and measurements. Try to think of as many as possible, but stay reasonable. Which do you think have the biggest/smallest affect?