

Collaboration (10 pts):

- Header includes Author names, Date, Lab # (5pts).
- The text is edited: same font, paragraphs are blended, not patched, no bullets/lists (10pts).

Abstract (45 pts):

(1) *What was done?* (5pts) The objective of the lab was to construct a container that will precisely fit a given amount of either rice or beans. Using ***past passive tense***, generally outline what was done to achieve the objective:

Four samples ***were collected*** (state the difference in manner of collection/subject) → Physical properties of each sample such as mass and volume ***was measured*** → The measured properties ***were used to calculate*** the density of each type of the grains → The uncertainties of calculated density values ***were compared to determine the most reliable*** → The most reliable calculated value of the density was used to calculate the volume of the given amount of the grains → Dimensions of the container ***were decided*** based of the result of the calculation of the overall volume → The ***grains were poured*** into constructed container.

(2) *Why was it done?* (10pts) Refer to the relationship between the mass, volume, and density to state why the value of density was necessary to calculate the volume (do not limit your reference to just formula, explain the relationship verbally); explain the need of samples (why volume was not measured directly?); note that mass was measured by the same device but there were two different devices for the volume measurements (how the scale of each device was different?); state how the absolute uncertainty of each device were determined and discuss why the calculation of % uncertainty was necessary.

(3) *How was it done?* (10pts) Elaborate on the outlined steps without copying the Instructions but rather, consulting the notes collected during the experiment. For example, describe ***your logic*** behind the estimation of the absolute uncertainty in the volume of the beans/rice sample in the beaker collection and in the graduated cylinder collection. How did you calculate density and absolute uncertainty of density? Provide equations for absolute uncertainty, %uncertainty, and density (do NOT explain calculations in words). How did density precision affect your choice when calculating volume for your container? Describe ***your logic*** for deciding on the length of your container's sides based on the calculations of the grains volume using density. Provide relevant equations if calculations were done.

(4) *What was observed and why?* (10pts) Which grain density was most precise? Which number did you look at to decide this? Hint: the grain density that has the smallest absolute uncertainty associated with it has the smallest range in which the true measurement could fall. Another way of saying this is if you have less uncertainty (smaller range of possible values around your measurement), you are more certain of the measurement itself. Was it a consequence of the device for volume measurements? (Which measuring device was more precise? beaker or graduated cylinder? How can you tell?) When the volume of the full amount of the grains were calculated, did any rounding take place? Why?

(5) *So what?* (10pts) Was the constructed container perfect for the grains or was it too small/too large? What could contribute to that?

Data (45 pts): 5 points deduction per item for captions copied from the Instructions.

- Table 1 captioned and labeled (15 pts).
- Table 2 captioned and labeled (15 pts).
- Figure 1 captioned and labeled (container with grains in it) (15 pts).