

Exercise 1: Measurements, means and standard deviations

1. Calculate the **percent by weight of water** in copper sulfate pentahydrate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$). Pay attention to significant figures.
2. If copper sulfate pentahydrate is heated, steam is seen rising from the substance. Write the **balanced equation** for this reaction.
3. Or is it a reaction? Examine the product that remains in the crucible. Make an **observation or two** that indicates whether a reaction has truly occurred.
4. A lab partnership makes the following measurements upon heating a substance that *looks like* copper sulfate pentahydrate:

Initial mass of hydrate (g)	Final mass of product (g)	Measured percent of water in hydrate
10.000	6.391	
20.000	12.783	
30.000	15.175	
40.000	25.566	
50.000	31.958	
60.000	38.350	

Calculate the **measured** percent by weight of water in each hydrate row. Pay attention to significant figures.

5. Calculate the **mean and standard deviation** (use σ_{n-1}) of the measured percent by weight of water in copper sulfate pentahydrate. Express the final value as "mean \pm standard deviation". Don't forget the units and pay attention to significant figures

6. Is the heated sample **consistent** with being copper sulfate pentahydrate, based on the measured percent by weight of water? Explain how the standard deviation helped you decide your conclusion.

7. Is your conclusion **robust**? In other words, do you have confidence in your conclusion? Explain how the size of the standard deviation helps you decide that. Hint: Estimate the **percentage** the standard deviation represents of the mean.

8. Was there an **outlier**? In other words, was there a measurement that was clearly different from the rest that influenced the mean and standard deviation unduly? If so, remove the outlier measurement and recalculate the mean and standard deviation. Express them in the standard format.

9. Is your answer to question 6 different with this new mean and standard deviation? Explain.

10. Is your answer to question 7 different with this new mean and standard deviation? Explain.