

**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 $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ (g)	Final mass of product (g)
5.10	3.26
5.07	3.25
5.05	3.25
5.07	1.84
5.06	3.27
5.07	3.26

Calculate the **measured** percent by weight of water in each copper sulfate pentahydrate. Pay attention to significant figures.

5. Calculate the **mean and standard deviation** (use the n-1 version) of all 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 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.