

Exercise 1.69

Two students determine the percentage of lead in a sample as a laboratory exercise. The true percentage is 22.52%. The students' results for three determinations are as follows:

(1) 22.52, 22.48, 22.54

(2) 22.64, 22.58, 22.62

(a) Calculate the average percentage for each set of data and state which set is the more accurate based on the average. (b) Precision can be judged by examining the average of the deviations from the average value for that data set. (Calculate the average value for each data set; then calculate the average value of the absolute deviations of each measurement from the average.) Which set is more precise?

Solution

Part (a)

Calculate the average of the data for each student.

$$\text{Student 1:} \quad \text{Average} = \frac{22.52 + 22.48 + 22.54}{3} \approx 22.51$$

$$\text{Student 2:} \quad \text{Average} = \frac{22.64 + 22.58 + 22.62}{3} \approx 22.61$$

Student 1's set is more accurate because the average is closer to 22.52, the true value.

Part (b)

Calculate the average of the absolute deviation of each measurement from the average for each student.

$$\text{Student 1: Average Deviation} = \frac{\left|22.52 - \frac{22.52+22.48+22.54}{3}\right| + \left|22.48 - \frac{22.52+22.48+22.54}{3}\right| + \left|22.54 - \frac{22.52+22.48+22.54}{3}\right|}{3} \approx 0.02222$$

$$\text{Student 1: Average Deviation} = \frac{\left|22.64 - \frac{22.64+22.58+22.62}{3}\right| + \left|22.58 - \frac{22.64+22.58+22.62}{3}\right| + \left|22.62 - \frac{22.64+22.58+22.62}{3}\right|}{3} \approx 0.02222$$

The average deviations are the same, so both sets of data are equally precise.