Name ____________________ Class ____________ Date ________

1.3 Reporting with Precision and Accuracy

Essential Question: How do you use significant digits when reporting the results of calculations involving measurement?

Resource Locker

Explore Comparing Precision of Measurements.

Numbers are values without units. They can be used to compute or to describe measurements. Quantities are real-word values that represent specific amounts. For instance, 15 is a number, but 15 grams is a quantity.

Precision is the level of detail of a measurement, determined by the smallest unit or fraction of a unit that can be reasonably measured.

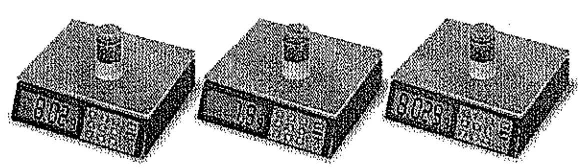
Accuracy is the closeness of a given measurement or value to the actual measurement or value. Suppose you know the actual measure of a quantity, and someone else measures it. You can find the accuracy of the measurement by finding the absolute value of the difference of the two.

(A) Complete the table to choose the more precise measurement.

Measurement 1	Measurement 2	Smaller Unit	More Precise Measurement
4 g	4.3 g	0.1g	4.3g
5.71 oz	5.7 oz	0.01 oz	5.71oz
4.2 m	422 cm	1cm	422cm
7 ft 2 in.	7.2 in.	0.1 in.	7.2in

(B) Eric is a lab technician. Every week, he needs to test the scales in the lab to make sure that they are accurate. He uses a standard mass that is exactly 8.000 grams and gets the following results.

Scale	Mass
Scale 1	8.02 g
Scale 2	7.9 g
Scale 3	8.029 g



Scale 1 Scale 2 Scale 3

Complete each statement:

The measurement for Scale ___3___ is the most precise

because it measures to the nearest ___0.001g___, which is smaller than the smallest unit measured on the other two scales.

(C) Find the accuracy of each of the measurements in Step B.

Scale 1: Accuracy = | 8.000 – 8.02 | = 0.02

Scale 2: Accuracy = | 8.000 – 7.9 | = 0.1

Scale 3: Accuracy = | 8.000 – 8.029 | = 0.029

Complete each statement: the measurement for Scale 1, which is 8.02 grams, is the most accurate because .02 < .029 < .1.

Reflect

1. **Discussion** Given two measurements of the same quantity, is it possible that the more precise measurement is not the more accurate? Why do you think that is so?

Yes. If the instrument used to measure is not correct, the measure will be precise but not accurate

Explain 1 Determining Precision of Calculated Measurements

As you have seen, measurements are reported to a certain precision. The reported value does not necessarily represent the actual value of the measurement. When you measure to the nearest unit, the actual length can be 0.5 unit less than the measured length or less than 0.5 unit greater than the measured length. So, a length reported as 4.5 centimeters could actually be anywhere between 4.45 centimeters and 4.55 centimeters, but not including 4.55 centimeters. It cannot include 4.55 centimeters because 4.55 centimeters reported to the nearest tenth would round *up* to 4.6 centimeters.

Example 1 **Calculate the minimum and maximum possible areas. Round your answers to the nearest square centimeter.**

(A) The length and width of a book cover are 28.3 centimeters and 21 centimeters, respectively.

Find the range of values for the actual length and width of the book cover.

Minimum length = (28.3 – 0.05) cm and maximum length = (28.3 + 0.05) cm, so 28.25 cm $\leq$ length < 28.35 cm.

Minimum width = (21 – 0.5) cm and maximum width = (21 + 0.5) cm, so 20.5 cm $\leq$ width < 21.5 cm.

Find the minimum and maximum areas.

Minimum area = minimum length · minimum width

$= 28.25 \text{ cm} \cdot 20.5 \text{ cm} \approx 579 \text{ cm}^2$

Maximum area = maximum length · maximum width

$= 28.35 \text{ cm} \cdot 21.5 \text{ cm} \approx 610 \text{ cm}^2$

So $579 \text{ cm}^2 \leq \text{area} < 610 \text{ cm}^2$.

B. The length and width of a rectangle are 15.5 centimeters and 10 centimeters, respectively.

Find the range of values for the actual length and width of the rectangle.

Minimum length = (15.5 − 0.05) cm and maximum length = (15.5 + 0.05) cm,

so 15.45 ≤ length ≤ 15.55.

Minimum width = (10 − 0.5) cm and maximum width = (10 + 0.5) cm,

so 9.5 width < 10.5.

Find the minimum and maximum areas.

Minimum area = minimum length · minimum width

= 15.45 cm · 9.5 cm ≈ 147 cm^2

Maximum area = maximum length · maximum width

= 15.55 cm · 10.5 cm ≈ 163 cm^2

So 147 cm^2 ≤ area < 163 cm^2.

Reflect

2. How do the ranges of the lengths and widths of the books compare to the range of the areas? What does that mean in terms of the uncertainty of the dimensions?

The range of the areas is larger. When uncertain lengths are multiplied the uncertainty becomes even larger

Your Turn

Calculate the minimum and maximum possible areas. Round your answers to the nearest square whole unit.

3. Sara wants to paint a wall. The length and width of the wall are 2 meters and 1.4 meters, respectively.

Min length: 1.5

Max length: 2.5

Min width: 1.35

Max width: 1.45

Min area = 1.35 × 1.5 ≈ 2m^2

Max area = 1.45 × 2.5 ≈ 4m^2

4. A rectangular garden plot measures 15 feet by 22.7 feet.

Min length: 14.5

Max length: 15.5

Min width: 22.65

Max width: 22.75

Min area = 14.5 × 22.65 = 328ft^2

Max area = 15.5 × 22.75 = 353ft^2