

Exercise 1.14

With a wooden ruler you measure the length of a rectangular piece of sheet metal to be 12 mm. You use micrometer calipers to measure the width of the rectangle and obtain the value 5.98 mm. Give your answers to the following questions to the correct number of significant figures. (a) What is the area of the rectangle? (b) What is the ratio of the rectangle's width to its length? (c) What is the perimeter of the rectangle? (d) What is the difference between the length and width? (e) What is the ratio of the length to the width?

Solution

Part (a)

The area is the product of the length and the width.

$$A = lw = (12 \text{ mm})(5.98 \text{ mm}) = 71.76 \text{ mm}^2 \approx 72 \text{ mm}^2$$

Since "12" has fewer significant digits than "5.98," use only two significant figures in the final answer. This rule applies for multiplication.

Part (b)

The ratio of the width to the length is

$$\frac{w}{l} = \frac{5.98 \text{ mm}}{12 \text{ mm}} \approx 0.50.$$

Since "12" has fewer significant digits than "5.98," use only two significant figures in the final answer. This rule also applies for division.

Part (c)

The perimeter of the rectangle is the sum of all its sides.

$$P = l + w + l + w = 2l + 2w = 2(l + w) = 2(12 + 5.98) = 35.96 \approx 36$$

The uncertainty of "12" is the ones place, whereas the uncertainty for "5.98" is the hundredths place. The final answer will therefore have uncertainty in the ones place. This rule applies for addition.

Part (d)

The difference between length and width is

$$l - w = 12 - 5.98 = 6.02 \approx 6.$$

The uncertainty of "12" is the ones place, whereas the uncertainty for "5.98" is the hundredths place. The final answer will therefore have uncertainty in the ones place. This rule also applies for subtraction.

Part (e)

The ratio of the length to the width is

$$\frac{l}{w} = \frac{12}{5.98} \approx 2.0.$$

Since “12” has fewer significant digits than “5.98,” use only two significant figures in the final answer. This rule applies for division.