1.14. With a wooden ruler, you measure the length of a rectangular piece of sheet metal to be 12 mm. With micrometer calipers, you measure the width of the rectangle to be 5.98 mm. Use the correct number of significant figures: What is (a) the area of the rectangle; (b) the ratio of the rectangle's width to its length; (c) the perimeter of the rectangle; (d) the difference between the length and the width; and (e) the ratio of the length to the width?

Solution:

(a)

$$A = 12\,\text{mm} \times 5.98\,\text{mm} \approx 72\,\text{mm}^2 \tag{1}$$

(b)

$$5.98\,\text{mm}/12\,\text{mm} \approx 0.50\,\text{mm} \tag{2}$$

(c)

$$P = 24\,\text{mm} + 11.96\,\text{mm} \approx 36\,\text{mm} \tag{3}$$

(d)

$$12\,\text{mm} - 5.98\,\text{mm} \approx 6.0\,\text{mm} \tag{4}$$

(e)

$$12\,\text{mm}/5.98\,\text{mm} \approx 2.0\,\text{mm} \tag{5}$$

1.15. A useful and easy-to-remember approximate value for number of seconds in a year is $\pi \times 10^7$. Determine the percent error in this approximate value. (There are 365.24 days in one year.)

Solution:

$$365.24\,\text{days}\left(\frac{24\,\text{hrs}}{1\,\text{day}}\right)\left(\frac{60\,\text{mins}}{1\,\text{hr}}\right)\left(\frac{60\,\text{s}}{1\,\text{min}}\right) = 3.1556736 \times 10^7 \tag{6}$$

$$3.1556736 \times 10^7 - \pi \times 10^7 = 140,809.46410206705 \tag{7}$$

$$\frac{140,809.46410206705}{3.1556736 \times 10^7} = 0.004462104829284849 \tag{8}$$

$$\approx 0.45\% \tag{9}$$

1.16. Express each approximation of π to six significant figures: (a) 22/7 and (b) 355/113. (c) Are these approximations accurate to that precision?

Solution:

(a)

$$22/7 \approx 3.14286 \tag{10}$$

(b)

$$355/113 \approx 3.14159 \tag{11}$$

(c)

$$\text{These approximations are accurate to that precision.} \tag{12}$$