

Problem 74

(a) If your speedometer has an uncertainty of 2.0 km/h at a speed of 90 km/h, what is the percent uncertainty? (b) If it has the same percent uncertainty when it reads 60 km/h, what is the range of speeds you could be going?

Solution

Part (a)

Use the formula for percent uncertainty and plug in the numbers.

$$\text{Percent Uncertainty} = \frac{\delta A}{A} \times 100\% = \frac{2.0 \frac{\text{km}}{\text{h}}}{90 \frac{\text{km}}{\text{h}}} \times 100\% \approx 2.2\%$$

Part (b)

Start with the same formula.

$$\text{Percent Uncertainty} = \frac{\delta A}{A} \times 100\%$$

Assume that the percent uncertainty is the same as in part (a) and that the speed is 60 km/h.

$$\frac{2.0 \frac{\text{km}}{\text{h}}}{90 \frac{\text{km}}{\text{h}}} \times 100\% = \frac{\delta A}{60 \frac{\text{km}}{\text{h}}} \times 100\%$$

Solve for δA , the uncertainty.

$$\frac{2.0}{90} = \frac{\delta A}{60 \frac{\text{km}}{\text{h}}}$$

Multiply both sides by 60 km/h.

$$\delta A = \frac{2.0(60)}{90} \frac{\text{km}}{\text{h}} = \frac{4}{3} \frac{\text{km}}{\text{h}} \approx 1.3 \frac{\text{km}}{\text{h}}$$

Consequently,

$$\text{Minimum Speed: } 60 \frac{\text{km}}{\text{h}} - \frac{4}{3} \frac{\text{km}}{\text{h}} \approx 58.7 \frac{\text{km}}{\text{h}}$$

$$\text{Maximum Speed: } 60 \frac{\text{km}}{\text{h}} + \frac{4}{3} \frac{\text{km}}{\text{h}} \approx 61.3 \frac{\text{km}}{\text{h}}.$$