

During Class Invention
Measurement and Error

Name(s) with Lab section in Group



1. Bridges on the Kansas State Turnpike have the distance from the beginning of the turnpike to the bridge printed on the side of the bridge. The bridge in the picture has a mileage of 110.820 (miles) printed on the south (maybe the west) side of an overpass bridge crossing on the turnpike. The distance printed on the opposite side of the overpass bridge is also 110.820 miles. Assuming the Kansas Department of Transportation (KDOT) uses a global position system device accurate to within ± 1.5 meters;

a) Express the error in measuring accuracy of the GPS device used by KDOT in + or - terms in units of feet (show your work).

$$1.5 \text{ m} \left(\frac{100 \text{ cm}}{1 \text{ m}} \right) \left(\frac{1 \text{ in}}{2.54 \text{ cm}} \right) \left(\frac{1 \text{ foot}}{12 \text{ in}} \right) = 4.9 \text{ feet}$$

b) Express the error in measuring accuracy of the GPS device used by KDOT in + or - terms in units of miles (show your work).

$$1.5 \text{ m} \left(\frac{100 \text{ cm}}{1 \text{ m}} \right) \left(\frac{1 \text{ in}}{2.54 \text{ cm}} \right) \left(\frac{1 \text{ foot}}{12 \text{ in}} \right) \left(\frac{1 \text{ mile}}{5280 \text{ feet}} \right) = 0.00093 \text{ miles}$$

- c) Is the mileage number written on the bridge overpass reported to a reasonable number of significant figures? Explain.

0.00093 miles is very close to 0.001 miles, so the error in the measurement of 110.820 miles is in the last digit (to the right) which would be ± 0.001 miles. So it appears that the mileage value to three digits to the right of the decimal is reasonable.

2. Consider that the width of a four lane overpass for is 18 meters.
a) Is it reasonable to report the distance as the same number (110.820 miles) on opposite sides of this overpass? Explain.

$$18 \text{ m} \left(\frac{100 \text{ cm}}{1 \text{ m}} \right) \left(\frac{1 \text{ in}}{2.54 \text{ cm}} \right) \left(\frac{1 \text{ foot}}{12 \text{ in}} \right) \left(\frac{1 \text{ mile}}{5280 \text{ feet}} \right) = 0.0112 \text{ miles}$$

No it does not seem reasonable. If one side is 110.820 miles the other side would be ± 0.0112 miles, so either 110.809 miles or 110.831 miles.