1. \( m_{\text{sphere}} = (540.00 \pm 0.05) g \)

\[ r_{\text{sphere}} = \frac{d_{\text{sphere}}}{2} = \frac{(5.070 \pm 0.005) cm}{2} = (2.5350 \pm 0.0025) cm \]

\[ V_{\text{sphere}} = \frac{4}{3} \pi r^3 \]

\[ \rho_{\text{sphere}} = \frac{m_{\text{sphere}}}{V_{\text{sphere}}} = \frac{m}{\frac{4}{3} \pi r^3} \]

\[ \rho_{\text{sphere}} = \frac{540.00 g}{\frac{4}{3}(2.5350 cm)^3} = 7.913 g/cm^3 \]

\[ \frac{\Delta V}{V} = 3 \frac{\Delta r}{r} \]

\[ \frac{\Delta \rho}{\rho} = \frac{\Delta m}{m} + \frac{\Delta V}{V} = \frac{\Delta m}{m} + 3 \frac{\Delta r}{r} \]

Therefore,

\[ \Delta \rho = \rho \left( \frac{\Delta m}{m} + 3 \frac{\Delta r}{r} \right) \]

\[ = 7.913 g/cm^3 \left( \frac{0.05 g}{540.00 g} + 3 \frac{0.0025 cm}{2.5350 cm} \right) = 0.024 g/cm^3 \]

\[ \rho = (7.91 \pm 0.02) g/cm^3 \]

The published density is 7.87 g/cm\(^3\), and so the measured value is not in agreement with this value within experimental uncertainty.

2. For gaussian error distributions, the fractional errors add in quadrature, according to:

\[ (\frac{\Delta V}{V})^2 = (3 \frac{\Delta r}{r})^2 \]

\[ (\frac{\Delta \rho}{\rho})^2 = (\frac{\Delta m}{m})^2 + (\frac{\Delta V}{V})^2 = (\frac{\Delta m}{m})^2 + (3 \frac{\Delta r}{r})^2 \]
Therefore,

\[
\Delta \rho = \rho \sqrt{\left( \frac{\Delta m}{m} \right)^2 + \left( \frac{3 \Delta r}{r} \right)^2} = 7.913 \text{g/cm}^3 \sqrt{\left( \frac{0.05g}{540.00g} \right)^2 + 9\left( \frac{0.0025\text{cm}}{2.5350\text{cm}} \right)^2}
\]

\[= 0.023 \text{g/cm}^3\]

\[
\rho = (7.913 \pm 0.023) \text{g/cm}^3
\]

Note that this error is only slightly smaller than in the case of a uniform distribution. The error in the mass is basically negligible, compared to the error in the radius.