Answer on Question #80969, Physics / Other

A brass sphere has radius (3.0+_0.1) mm and mass (1.000+_0.001)g .Calculate the density of the material of the ball. Include the uncertainty in the density.

Solution:

For a spherical object:

$$\rho = \frac{Mass}{4/3\pi r^3} = \frac{1.000\ g}{4/3\ \times \pi \times (0.30\ cm)^3} = 8.84\ g/cm^3$$

For the mass, we have a percentage uncertainty of $\frac{0.001}{1} \times 100\% = 0.1\%$. For the volume, however, the radius is cubed. The radius has a percentage uncertainty of $\frac{0.1}{3} \times 100\% = 3.333\%$, so the effective percentage error in the volume of the sphere is 10%.

Total percentage error = 0.1%(mass) + 10%(volume) = 10.1%.
So,

$$\Delta\rho = 10.1 \times \frac{8.84}{100} = 0.89\ g/cm^3$$

Answer: $8.84 \pm 0.89\ g/cm^3$.