How many grams of copper are required to make a hollow spherical shell having an inner radius of 5.70 cm and an outer radius of 5.75 cm? The density of copper being 8.92g/cm³.

Solution:
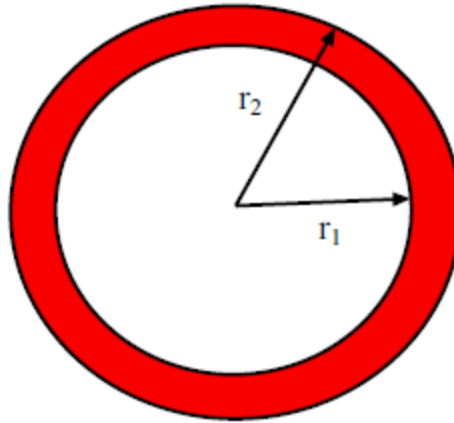
A cross–section of the copper sphere is shown in Figure above. The outer and inner radii are noted as r_2 and r_1, respectively. We must find the volume of space occupied by the copper metal ; this volume is the difference in the volumes of the two spherical surfaces:

$$V_{shell} = V_2 - V_1 = \frac{4}{3}\pi r_2^3 - \frac{4}{3}\pi r_1^3 = \frac{4}{3}\pi(r_2^3 - r_1^3)$$

With the given values of the radii, we find:

$$V_{shell} = \frac{4}{3}\pi(5.75^3 - 5.70^3) = 20.59 \ cm^3$$

Now use the definition of density to find the mass of the copper contained in the shell:

$$\rho = \frac{m}{V_{shell}}$$

So,

$$m = \rho V_{shell} = (8.92)(20.59) = 183.7 \ g$$

Answer: $183.7 \ g$

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