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Solution: First, we need to calculate the volume of the sphere. The diameter is 10 nm so the radius is 5 nm.

$$V = \frac{4\pi r^3}{3} = \frac{4\pi(5\,x\,10^{-9}\,m)^3}{3} = 5.235\,x\,10^{-25}\,m^3$$

Then we use the density to determine the mass and the molar mass to determine the number of moles. Finally, use Avagadro's number of convert to a number of atoms.

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We can write out these steps in symbolic form. First, we calculate the mass

$$m = \rho V$$

and then the number of moles

$$n = \frac{\rho V}{M_m}$$

and then the number of molecules

$$N = \frac{N_A \rho V}{M_m}$$

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and then the number of molecules

$$N = \frac{N_A \rho V}{M_m}$$

We can plug in the values:

$$N = \frac{(6.022\ x\ 10^{23})(19000)(5.235\ x\ 10^{-25})(1000)}{79}$$

which gives N = 75,000.

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The unit analysis is:

$$N = \frac{\left(\frac{molecules}{mole}\right)\left(\frac{kg}{m^3}\right)(m^3)(1000\ \frac{gm}{kg})}{\frac{gm}{mol}}$$

The units are the only tricky part here. When using $M_m$ We often need to use the factor of 1000 to convert to kg in order to be compatible with MKS units.