

October 3

## Quiz

### A Place Where Everyone Knows Your Name Block

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$$M = 36.6 \text{ g}$$

$$V = 13.6 \text{ cm}^3$$

$$\rho = \frac{m}{V} = \frac{36.6 \text{ g}}{13.6 \text{ cm}^3} = 2.7 \text{ g/cm}^3$$

One mole of Al mass 26.98 g

How many moles in name block?

$$\frac{36.6 \text{ g}}{27.0 \text{ g/mol}} = 1.36 \text{ mol}$$

How many atoms?

Multiply by  $N_A$

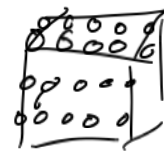
$$1.36 \text{ mol} \times 6.02 \times 10^{23} \frac{\text{atoms}}{\text{mol}}$$

$$= 8.2 \times 10^{23} \text{ atoms}$$

$4.1 \times 10^{23}$  atoms in ~~1~~  
half

How many atoms  
across side?

$74 \times 10^6$  atoms per side



1.9 cm

$74 \times 74 \times 150$  million atoms

$$\sqrt[3]{4.1 \times 10^{23} \text{ atoms}} = 7.4 \times 10^7 \text{ atoms per side}$$

How far apart are the atoms?

$$d_{\text{atom}} = \frac{1.9 \times 10^{-2} \text{ m}}{7.4 \times 10^7 \text{ atom}} = 2.6 \times 10^{-10} \text{ m/atom} = 2.6 \text{ \AA}$$

What is mass of single Al atom?

$$M_{\text{atom}} = \frac{36.6 \text{ g}}{8.27 \times 10^{23} \text{ atoms}} = 4.5 \times 10^{-23} \text{ g/atom} = 0.45 \times 10^{-25} \frac{\text{kg}}{\text{atom}}$$

$$m_{\text{atom}} = \frac{27 \frac{\text{g}}{\text{mole}}}{6 \times 10^{23} \frac{\text{atoms}}{\text{mole}}} = \frac{M}{N_{\text{Avogadro}}} = 4.5 \times 10^{-23} \frac{\text{g}}{\text{atom}} = 0.45 \times 10^{-25} \frac{\text{kg}}{\text{atom}}$$

$$\rho_{\text{micro}} = \frac{m_{\text{atom}}}{V_{\text{atom}}} = \frac{m_{\text{atom}}}{d_{\text{atom}}^3} = \frac{N_{\text{atoms}} m_{\text{atom}}}{N_{\text{atoms}} d_{\text{atom}}^3} = \rho_{\text{macro}}$$

$$d_{\text{atom}} = \sqrt[3]{\frac{m_{\text{atom}}}{\rho_{\text{macro}}}} = \sqrt[3]{\frac{M}{N_{\text{Avogadro}} \rho_{\text{macro}}}}$$

$$d_{\text{atom}} = \sqrt[3]{\frac{4.5 \times 10^{-26} \frac{\text{kg}}{\text{atom}}}{2.7 \times 10^3 \frac{\text{kg}}{\text{m}^3}}} \qquad \rho_{\text{macro}} = \left(2.7 \frac{\text{g}}{\text{cm}^3}\right) \left(\frac{1 \text{ kg}}{1000 \text{ g}}\right) \left(\frac{100 \text{ cm}}{1 \text{ m}}\right)^3 = 2.7 \times 10^3 \frac{\text{kg}}{\text{m}^3}$$

$$d_{\text{atom}} = 2.6 \times 10^{-10} \text{ m}$$

Odd mass & diameter of gold atom

For ————— ~~but~~  
lead atom

$\rho$

$$M_{Au} = 3.3 \times 10^{-25} \text{ kg/atom}, d = 2.6 \times 10^{-10} \text{ m}$$

$$M_{Pb} = 3.5 \times 10^{-25} \text{ kg/atom}, d = 3.1 \times 10^{-10} \text{ m}$$

### The "Standard" Solid

$$a_{\text{atom}} \approx 1 \text{ \AA} = 10^{-10} \text{ m}$$

$$m_{\text{atom}} \approx 10^{-25} \text{ kg}$$

$$r_{\text{nucleus}} \approx 10^{-14} \text{ m}$$

### Young's Modulus