Example

A metallic solid with an atomic radius of 0.139 nm crystalizes in an fcc unit cell and has a density of 21.45 g/cm^3. Calculate the atomic mass (g/mol) of the metal.

Step 1: Write an expression for the mass of the unit cell.

$4\ \text{atoms} \cdot \frac{1\ \text{mol}}{6.022\times10^{23}} \cdot \frac{\text{mm g}}{1\ \text{mol}} = \text{mass g}$

Step 2: Write an expression for the volume of the unit cell.

$V = e^3 = (2\sqrt{2}\,r)^3 = (2\sqrt{2} \cdot 0.139\times10^{-7})^3\ \text{cm}^3$

$f = 4r \quad f^2 = 2e^2$

$16r^2 = 2e^2 \quad e = 2\sqrt{2}\,r$

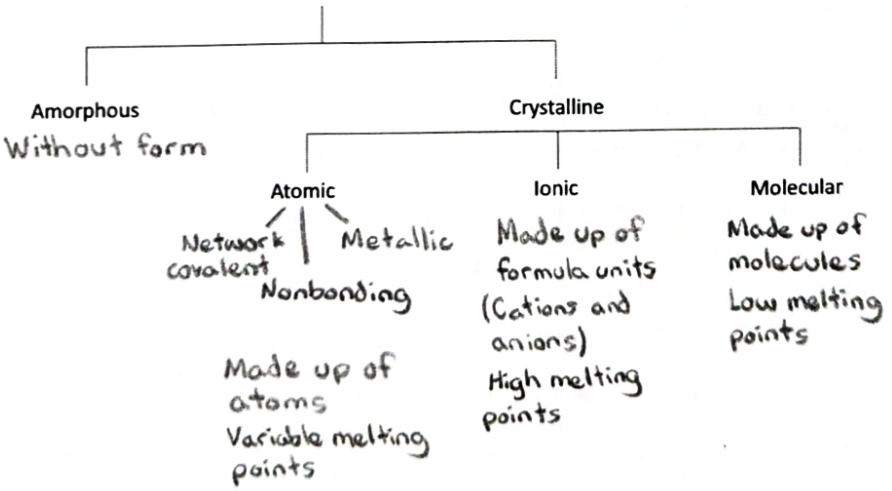
Step 3: Solve

$$\frac{\frac{4\cdot mm}{6.022\times10^{23}}}{(2\sqrt{2}\cdot0.139\times10^{-7})^3} = 21.45$$

$mm = 196\ \text{g/mol}$

pt

Solids



Atomic Solids

Nonbonding Xe (s)

Weak attractive forces
No chemical bonds
Low melting point

Metallic Cu (s)

Bonds between atoms
Nondirectional (sea of electrons)
Variable melting points

Network covalent C (s), Si (s)

Bonds between atoms - covalent
Highly directional
High melting point

Example

Identify each of the following solids as **Molecular**, **Ionic**, or **Atomic (nonbonding, metallic**, or **network covalent)**

a. Ar (s) Atomic nonbonding

b. H_2O (s) Molecular

c. K_2O (s) Ionic

d. Fe (s) Atomic metallic