Quiz 12.4 – Solids and Crystal Structure

Name: __Key__

Question 1

Classify the following solids in as many ways as you can:

Quartz Crystal	Naphthalene	Aluminum Foil	Glass	Iron(III) Oxide
Crystalline	Crystalline	Crystalline	Amorphous	Crystalline
Covalent Network	Molecular	Metallic		Ionic

Question 2

At room temperature, iron has a body-centered cubic structure. Iron atoms have a radius of 126 pm

- Give the coordination number of the iron atoms 8

- Find the length of the edge of a unit cell $\ell = \frac{4}{\sqrt{3}} r = 291.0 \ pm = 2.910 \cdot 10^{-10} m = 2.910 \cdot 10^{-8} cm$

- Estimate the density of iron metal. $\left(\text{The observed value is } 7.87 \ \frac{g}{cm^3}\right)$

$$d = \frac{m}{V} = \frac{2 \cdot 55.845 \ \text{g/mol} \left(\frac{1 mol}{6.022 \cdot 10^{23}}\right)}{\left(2.910 \cdot 10^{-8} cm\right)^3} = 7.53 \ \text{g/cm}^3$$

(I've solved this several times, and I can't explain why this doesn't match the observed value)

Question 3

Lead has a face-centered cubic structure, and a density of 11.34 $\frac{g}{cm^3}$

- Give the coordination number of the lead atoms 12

- Find the length of the edge of a unit cell $\ell = \sqrt{8} \cdot r$

- Estimate lead's atomic radius. (The observed value is 175 pm)

$$d = \frac{m}{V} \rightarrow 11.34 \frac{g}{cm^3} = \frac{4 \cdot 207.2 \ \text{g/mol} \left(\frac{1 mol}{6.022 \cdot 10^{23}}\right)}{\ell^3} \rightarrow \ell^3 = 1.214 \cdot 10^{-22} cm^3$$

$$\ell = 4.951 \cdot 10^{-8} cm \rightarrow \ell = 4.951 \cdot 10^{-10} m \rightarrow \ell = 495.1 pm$$

$$495.1 pm = \sqrt{8} \cdot r \rightarrow r = 175 pm$$