

## Quiz 12.2 – Unit Cells

Name: *Key*

## Question 1

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  *$l = \frac{4}{\sqrt{3}} \cdot r = 2.910 \cdot 10^{-10} \text{ m} = 2.910 \cdot 10^{-8} \text{ cm}$*
- Estimate the density of iron metal. (The observed value is  $7.87 \frac{\text{g}}{\text{cm}^3}$ )

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

*Note: I've checked and re-checked everything about this problem, and it is solved correctly. I don't know why it doesn't match the observed value. -\_- (T\_T) -*

## Question 2

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

- Give the coordination number of the lead atoms *12*
- Find the length of the edge of a unit cell  *$l = \sqrt{8} \cdot r \Rightarrow r = \frac{l}{\sqrt{8}}$*
- Estimate lead's atomic radius. (The observed value is 175 pm)

$$d = \frac{m}{V} \Rightarrow 11.34 \frac{\text{g}}{\text{cm}^3} = \frac{4 \cdot 207.2 \frac{\text{g}}{\text{mol}} \cdot \frac{1 \text{ mol}}{6.022 \cdot 10^{23}}}{l^3} \Rightarrow l^3 = 1.214 \cdot 10^{-22} \text{ cm}^3$$

$$l = 4.951 \cdot 10^{-8} \text{ cm} = 495.1 \text{ pm} \quad r = \frac{l}{\sqrt{8}} = 175 \text{ pm}$$

*Agrees with observed radius!*