

Answer on Question#39740-Chemistry-Inorganic Chemistry

Question

An element has a body centred cubic (bcc) structure with a cell edge of 288 pm. The density of the element is 7.2 g/cm^3 . How many atoms are present in 208 g of the element?

Solution

Volume of given mass of the element:

$$V = \frac{m}{\rho} = \frac{208 \text{ g}}{7.2 \text{ g/cm}^3} = 29 \text{ cm}^3 = 2.9 \cdot 10^{-5} \text{ m}^3$$

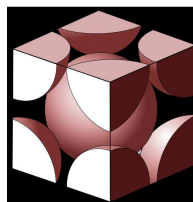
Volume of an elementary cell (a – cell edge):

$$V_{\text{cell}} = a^3 = (288 \text{ pm})^3 = (288 \cdot 10^{-12} \text{ m})^3 = 2.4 \cdot 10^{-29} \text{ m}^3$$

Number of the cells in given mass of the element:

$$n_{\text{cells}} = \frac{V}{V_{\text{cell}}} = \frac{2.9 \cdot 10^{-5} \text{ m}^3}{2.4 \cdot 10^{-29} \text{ m}^3} = 1.2 \cdot 10^{24} \text{ cells}$$

In case of body centred structure each elementary cell contains 2 atoms: one in the cell centre and 8 eighth parts ($1 + 8 \cdot 1/8 = 2$).



So, the number of atoms is two times greater than the number of cells:

$$n_{\text{atoms}} = 2 \cdot n_{\text{cells}} = 2 \cdot 1.2 \cdot 10^{24} \text{ cells} = 2.4 \cdot 10^{24} \text{ atoms}$$

Answer: $2.4 \cdot 10^{24}$ atoms