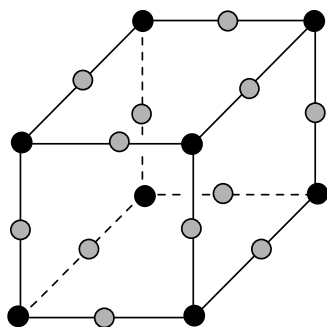


- The diagram below shows the structure of an oxide of rhenium. The unit cell is cubic with rhenium at each of the corners and oxygen in the centre of each of the edges.

Marks
5



What is the chemical formula of this oxide?

There are 8 Re atoms on the corners, each contributing 1/8 to the unit cell: total number of Re atoms = $8 \times 1/8 = 1$.

There are 12 O atoms on the edges, each contributing 1/4 to the unit cell: total number of O atoms = $12 \times 1/4 = 3$.

The formula is thus ReO_3 .

Answer: **ReO_3**

What are the coordination numbers of rhenium and oxygen in this compound?

Re: **6 (octahedral)**

O: **2 (linear)**

There is a large hole at the centre of the cell that in some compounds is occupied by a cation. What is the coordination number of a cation occupying this site?

12 coordinate.

Given that the density of this oxide is 7.1 g cm^{-3} , calculate the length of the cell edge. (The structure is cubic.)

The unit cell contains one formula unit of ReO_3 .

The formula mass of ReO_3 is $(186.2 (\text{Re}) + 3 \times 16.00 (\text{O})) = 234.2 \text{ g mol}^{-1}$.

This is the mass of 1 mol. The mass of 1 formula unit is therefore:

$$\text{mass} = 234.2 \text{ g mol}^{-1} / 6.022 \times 10^{23} \text{ mol}^{-1} = 3.889 \times 10^{-22} \text{ g}$$

ANSWER CONTINUES ON THE NEXT PAGE

As density = mass / volume,

$$\text{volume} = \text{mass} / \text{density} = (3.889 \times 10^{-32} \text{ g}) / (7.1 \text{ g cm}^{-3}) = 5.48 \times 10^{-23} \text{ cm}^3$$

As the cell is cubic, if the side length is a , the volume is a^3 and,

$$a = (5.48 \times 10^{-23} \text{ cm}^3)^{1/3} = 3.8 \times 10^{-8} \text{ cm} = 3.8 \times 10^{-10} \text{ m or } 380 \text{ pm}.$$

Answer: 380 pm