

Conversions with Avogadro's Number

Figure 3-11 shows that Avogadro's number can be used to find the number of atoms of an element from the amount in moles or to find the amount of an element in moles from the number of atoms. While these types of problems are less common in chemistry than converting between amount in moles and mass in grams, they are useful in demonstrating the meaning of Avogadro's number. Note that in these calculations, Avogadro's number is expressed in units of atoms per mole.

SAMPLE PROBLEM 3-4

How many moles of silver, Ag, are in 3.01×10^{23} atoms of silver?

SOLUTION

ANALYZE

Given: 3.01×10^{23} atoms of Ag

Unknown: amount of Ag in moles

PLAN

number of atoms of Ag \longrightarrow amount of Ag in moles

From Figure 3-11, we know that number of atoms is converted to amount in moles by dividing by Avogadro's number. This is equivalent to multiplying numbers of atoms by the reciprocal of Avogadro's number.

$$\text{Ag atoms} \times \frac{\text{moles Ag}}{\text{Avogadro's number of Ag atoms}} = \text{moles Ag}$$

COMPUTE

$$3.01 \times 10^{23} \text{ Ag atoms} \times \frac{\text{mol Ag}}{6.022 \times 10^{23} \text{ Ag atoms}} = 0.500 \text{ mol Ag}$$

EVALUATE

The answer is correct—units cancel correctly and the number of atoms is exactly one-half of Avogadro's number.

PRACTICE

1. How many moles of lead, Pb, are in 1.50×10^{12} atoms of lead?

Answer

2.49×10^{-12} mol Pb

2. How many moles of tin, Sn, are in 2500 atoms of tin?

Answer

4.2×10^{-21} mol Sn

3. How many atoms of aluminum, Al, are in 2.75 mol of aluminum?

Answer

1.66×10^{24} atoms Al

SAMPLE PROBLEM 3-5

What is the mass in grams of 1.20×10^8 atoms of copper, Cu?

SOLUTION

ANALYZE

Given: 1.20×10^8 atoms of Cu

Unknown: mass of Cu in grams