Example Calculations Involving the Mole

A. Calculations Involving Atoms

- Eg: Calculate the mass, in grams, of 2.00 mol of calcium atoms.

  Given: $n_{Ca} = 2.00$ mol
  $M_{Ca} = 40.08$ g/mol

  Required: $m_{Ca} = ?$ g

  Analysis: $m = n \times M$

  Solution: $m_{Ca} = 2.00 \text{ mol} \times 40.08 \text{ g/mol}$
  $= 80.16$ g

  Paraphrase: The mass of 2.00 mol of calcium is 80.16g.

- Eg: How many atoms of sulphur are in a 230 g sample of pure sulfur?

  Given: $m_S = 230$ g
  $M_S = 32.06$ g/mol

  Required: 1. $n_s = ?$ mol
  2. $N_s = ?$ atoms

  Analysis: 1. $n_s = m_s/M_s$
  2. $N_s = n_s \times N_A$

  Solution: 1. $n_s = 230 \text{ g} / 32.06 \text{ g/mol}$
  $= 7.17$ mol
  2. $N_s = 7.17 \text{mol} \times 6.02 \times 10^{23} \text{atoms/mol}$
  $= 4.32 \times 10^{24}$ atoms

  Paraphrase: There are 4.32×10^{24} atoms of sulphur in a 230 g sample.

B. Calculations Involving Molecules and Compounds

- Eg: Calculate the mass of 2.00 mol of sodium fluoride.

Given: $n_{NaF} = 2.00$ mol
$M_{NaF} = 41.99$ g/mol

Required: $m_{NaF} = ?g$

Analysis: $m_{NaF} = M_{NaF} \times n_{NaF}$

Solution: $m_{NaF} = 41.99$ g/mol x 2.00 mol
$= 84.00$ g

Paraphrase: The mass of 2.00 mol of sodium fluoride is 84.00g.

- Eg: How many molecules of Fe_2O_3, are in a 77.2 g sample?

Given: $m_{Fe2O3} = 77.2$ g
$M_{Fe2O3} = 159.7$ g/mol

Required: 1. $n_{Fe2O3} = ?$ mol
2. $N_{Fe2O3} = ?$ molecules

Analysis: 1. $n_{Fe2O3} = m_{Fe2O3}/N_{Fe2O3}$
2. $N_{Fe2O3} = n_{Fe2O3} \times N_A$

Solution: 1. $n_{Fe2O3} = 77.2$ g / 159.7 g/mol
$= 0.483$ mol

2. $N_{Fe2O3} = 0.483$mol x 6.02×10^{23} molecule/mol
$= 2.91 \times 10^{23}$ molecules

Paraphrase: There are 2.91×10^{23} molecules of Fe_2O_3 in a 77.2g sample.