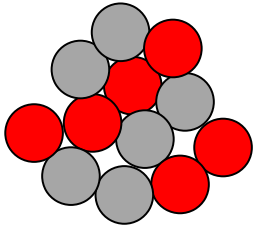
Mass Spectra of Elements

Essential Question

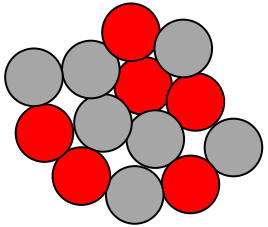
How can a graph tell us about an element's isotopes?

Isotopes

- Same element = same number of protons
- Different numbers of neutrons
- So isotopes have different masses



Carbon-12
6 p^+, 6 n^0



Carbon-13
6 p^+, 7 n^0

proton

neutron

Isotope Notation

Mass number
protons + neutrons

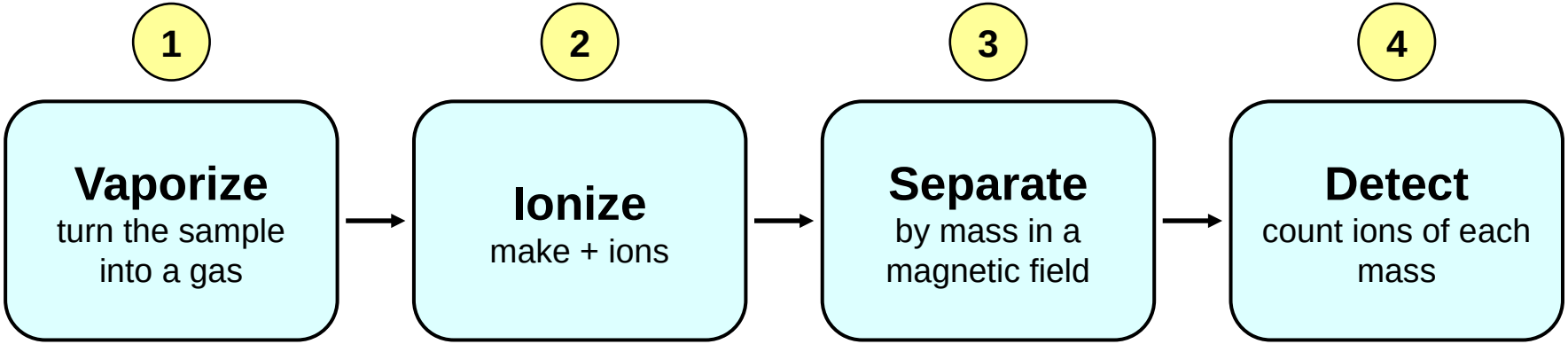
Atomic number
protons

$$^{35}_{17}Cl$$

Neutrons
= 35 − 17 = 18

Also written:
chlorine-35 or Cl-35

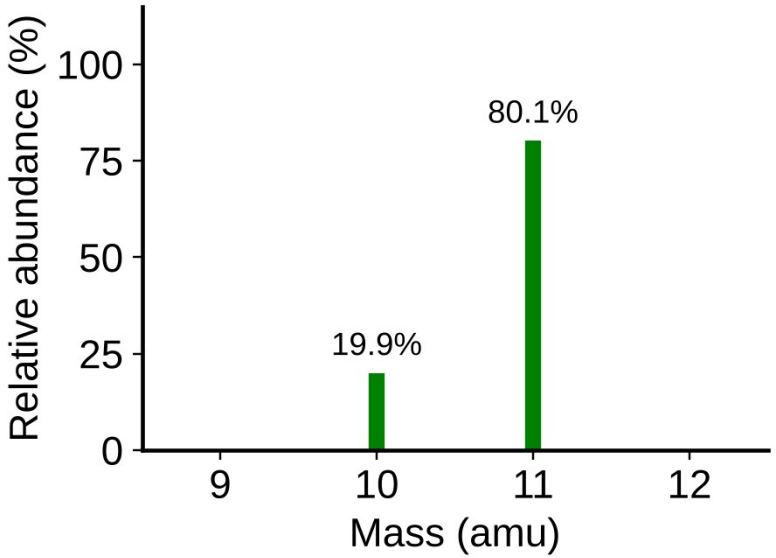
How a Mass Spectrometer Works



- Lighter ions bend more than heavier ions
- The detector gives us a mass spectrum

Reading a Mass Spectrum

- Each peak = one isotope
- Position = isotope mass
- Height = relative abundance



Mass spectrum of boron

Average Atomic Mass

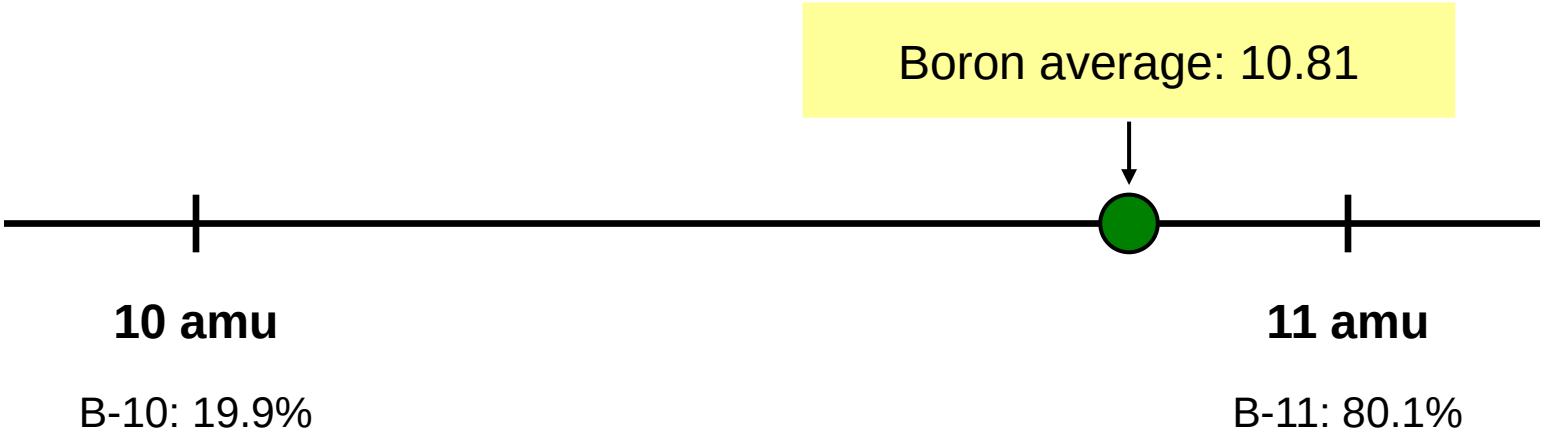
- A weighted average of all the isotopes
- Change percent to a decimal first: 80.1% → 0.801

$$\text{Average} = (\text{mass}_1 \times \text{abundance}_1) + (\text{mass}_2 \times \text{abundance}_2) + \ldots$$

Use every isotope that has a peak

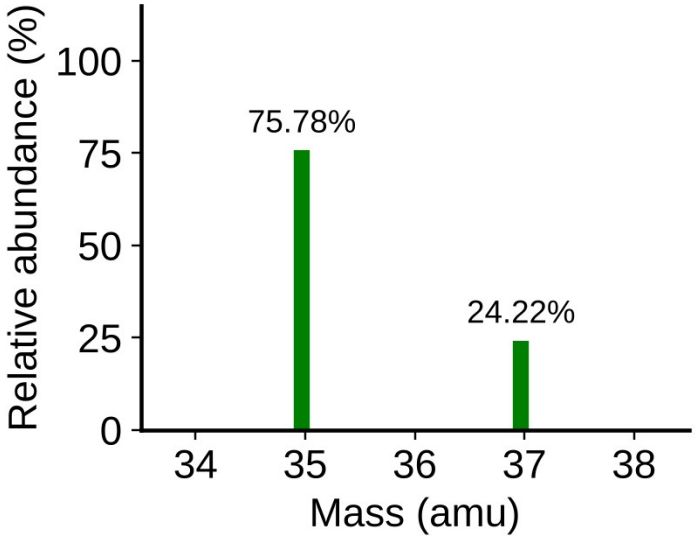
The Weighted Average Idea

- The average lands closer to the most common isotope



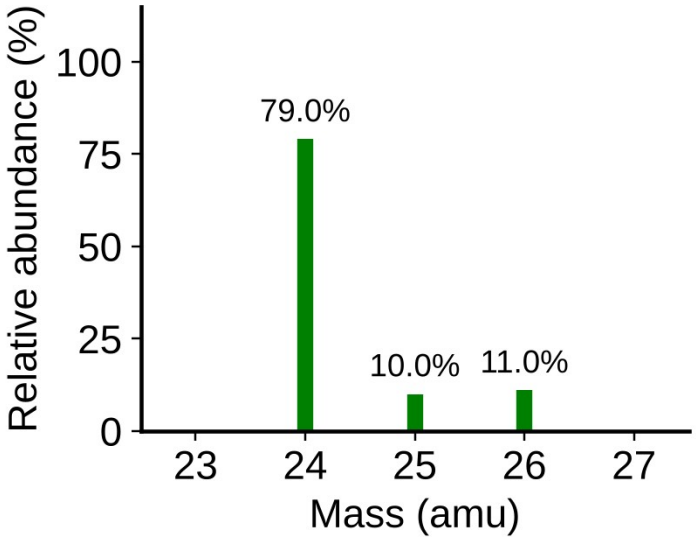
Example: Average Atomic Mass

Use the mass spectrum of chlorine to calculate its average atomic mass. The isotope masses are 34.97 amu and 36.97 amu.



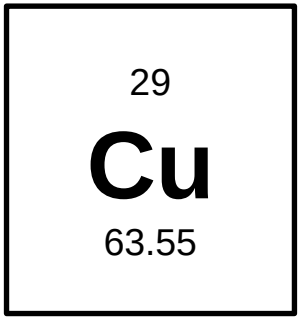
Example: Identifying an Element

The mass spectrum of an element is shown. Identify the element.



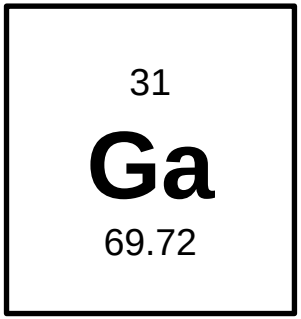
Example: Finding Percent Abundance

Copper has two isotopes: Cu-63 (62.93 amu) and Cu-65 (64.93 amu). The average atomic mass of copper is 63.55 amu. What is the percent abundance of Cu-63?



Example: Predicting Abundance

Gallium has two isotopes, Ga-69 and Ga-71. Its average atomic mass is 69.72 amu. Which isotope is more abundant? Justify your answer.



Mass Spectra of Elements

Big Ideas

- Isotopes: same protons, different neutrons
- Peak position = mass, height = abundance
- Average atomic mass is a weighted average
- The average is closest to the most common isotope

