

1.2 Mass Spectra of Elements

Name: _____ Class: _____ Date: _____ **Total: 14 marks**

KEY WORDS mass spectrum 质谱图 • isotope 同位素 • relative abundance 相对丰度
• average atomic mass 平均原子质量

Objective

Build the skills to answer exam questions on **mass spectra of elements**.

You must be able to:

- describe **isotopes** 同位素 as atoms of one element with different numbers of neutrons
- read a **mass spectrum** 质谱图 (peak position = mass, peak height = relative abundance)
- calculate the **average atomic mass** 平均原子质量 as an abundance-weighted average
- convert percentage abundances to fractions before averaging

1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

■ Isotopes

Isotopes share protons but differ in neutrons, so they differ in mass. Chlorine occurs as chlorine-35 and chlorine-37.

■ Weighted average

Multiply each isotope mass by its fractional abundance and add:

$$\bar{m} = \sum (\text{fraction}) \times (\text{isotope mass}).$$

Chlorine (75% mass 35, 25% mass 37):

$$\bar{m} = 0.75(35) + 0.25(37) = 35.5 \text{ u.}$$

■ The average is pulled toward the common isotope

The more abundant isotope pulls the average toward its own mass.

2 Practice

Now apply the methods above.

2.1 State how two isotopes of the same element differ. [1]

2.2 An element is 60% mass 10 and 40% mass 11. Find its average atomic mass. [2]

2.3 On a mass spectrum, what does the height of a peak show? [1]

2.4 Two isotopes of mass 20 and 22 are each 50% abundant. Find the average mass. [2]

3 Exam-style questions

3.1 Isotopes of an element have the same number of [1]

A	B
C	D

- A neutrons
- B protons
- C total particles
- D nothing

3.2 An element is 90% mass 20 and 10% mass 22. Its average atomic mass is closest to [1]

A	B
C	D

- A 20.0
- B 20.2
- C 21.0
- D 22.0

3.3 Boron has two isotopes: boron-10 (20%) and boron-11 (80%).

(a) Find the average atomic mass. [2]

(b) State which isotope the average lies closer to, and why. [1]

3.4 A mass spectrum of an element shows two peaks: mass 63 (69%) and mass 65 (31%).

(a) Find the average atomic mass. [2]

(b) Identify the element (hint: this is its relative atomic mass). [1]