HIGH SCHOOL CHEMISTRY

CHAPTER 2

Set 3: Isotopes and Atomic Mass

Free Sample

Sample pages adapted from the full Isotopes and Atomic Mass study set. Try them, then get the whole set.

Try it, then get the whole set

7	5	11	★
files in the full set	sample sections	original diagrams	Honors kept separate

- Sample pages from the notes, revision sheets, traps, practice, flashcards and lab skills
- Answers included for every sample question
- Honors material clearly marked so Regular students can skip it

For high school chemistry, Regular and Honors. Chapter 2: Atoms and Isotopes, Set 3 of 3.

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FREE SAMPLE · SET 3 OF 3

Try the Isotopes and Atomic Mass set before you buy

This free sampler shows you sample pages adapted from six of the seven files in the full **Isotopes and Atomic Mass** study set: the notes, the revision sheets, the exam traps, the practice questions, the flashcards and the lab skills.

7	11	★	✓
files in the full set	original diagrams	Honors kept separate	answers for everything

What's in the full Isotopes and Atomic Mass set

File	What it does for you
1 · Complete Study Notes	Lessons on isotopes, notation and average atomic mass, every step shown.
2 · Quick Revision Sheets	The topic on a few pages: tables, flowcharts, memory tricks and a one-page cheat sheet.
3 · Exam Traps and Common Mistakes	The mistakes that cost points, and how to dodge each one.
4 · Practice Question Bank	Questions by lesson, easy to hard, with full worked answers.
5 · Quizzes and Unit Test	Three quizzes and a unit test, with an explained answer key.
6 · Glossary and Flashcards	Every key term defined, plus cut-out flashcards.
7 · Lab Skills for Tests	Model-element data sets, sources of error and lab questions, with answers.

NOTE | Regular or Honors?

Honors material sits in blue boxes marked ★ HONORS . Regular students can skip every one of them and still master the topic.

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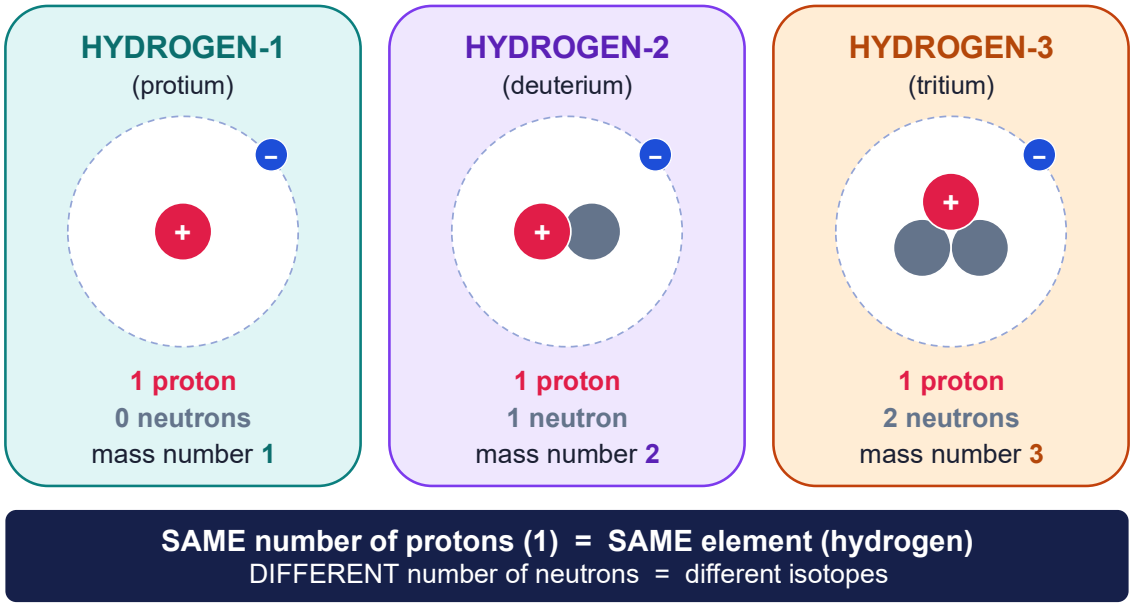
SAMPLE 1 From the Complete Study Notes

SAMPLE PAGE | FREE SAMPLE

This page is adapted from **Complete Study Notes**, one of the seven files in the full Isotopes and Atomic Mass set.

DEFINITION | Isotopes

Isotopes are atoms of the same element (same number of protons) that have different numbers of neutrons, and so different mass numbers.



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WORKED EXAMPLE | Average atomic mass of lithium

Lithium (Z = 3) has two natural isotopes. **Lithium-6** has a mass of 6.0151 amu and makes up 7.59% of lithium atoms. **Lithium-7** has a mass of 7.0160 amu and makes up 92.41%. Find the **average atomic mass** of lithium.

Step 1. Estimate. Almost all lithium is Li-7, so the answer should be just under 7.0 amu.

Step 2. Change each percent to a decimal (divide by 100).

$$7.59\% \div 100 = 0.0759$$

$$92.41\% \div 100 = 0.9241$$

Step 3. Multiply each mass by its decimal, then add.

$$\text{average} = (0.0759)(6.0151\ \text{amu}) + (0.9241)(7.0160\ \text{amu})$$

$$= 0.4565\ \text{amu} + 6.4835\ \text{amu}$$

$$= 6.9400\ \text{amu} \approx \mathbf{6.94\ amu}$$

Step 4. Check. 6.94 amu is between 6.0151 and 7.0160, and much closer to 7.0160. It matches the estimate.

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SAMPLE 2 From the Quick Revision Sheets

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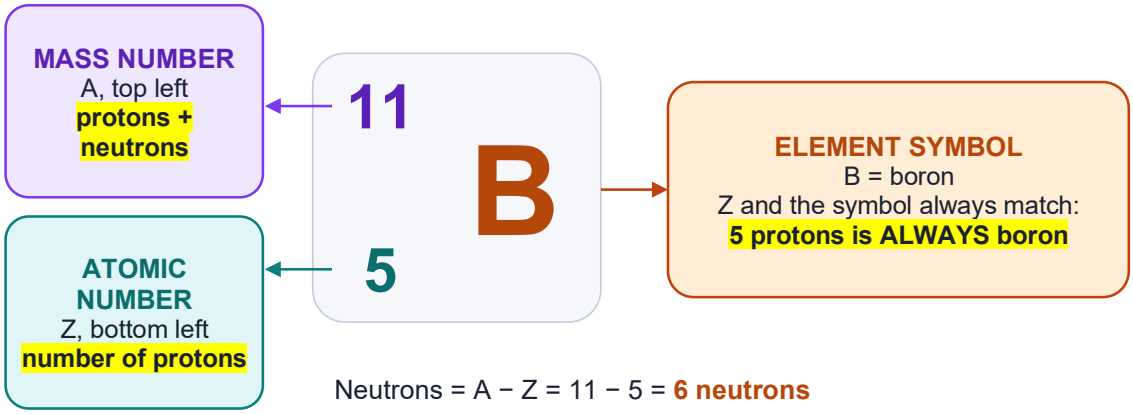
This page is adapted from **Quick Revision Sheets**, one of the seven files in the full Isotopes and Atomic Mass set.

Hyphen notation for the same isotope: **boron-11** or **B-11**



Neutrons = A − Z = 11 − 5 = **6 neutrons**

Counting chart

	Protons	Neutrons	Electrons
Rule	= Z	= A − Z	Z − charge
$^{7}_{3}\mathrm{Li}$	3	7 − 3 = 4	3
$^{32}_{16}\mathrm{S}^{2-}$	16	32 − 16 = 16	16 − (−2) = 18
$^{24}_{12}\mathrm{Mg}^{2+}$	12	24 − 12 = 12	12 − 2 = 10

MEMORY TRICK | Charge and electrons

Plus means electrons **lost**. **Minus** means electrons **gained**. A charge never changes the protons or the neutrons.

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SAMPLE 3 From Exam Traps and Common Mistakes

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This page is adapted from **Exam Traps and Common Mistakes**, one of the seven files in the full Isotopes and Atomic Mass set.

EXAM TRAP 17 | Taking a plain average

✗ WHAT STUDENTS WRITE	✓ WHAT EARNS THE POINTS
Rubidium (72.17% Rb-85 at 84.9118 amu, 27.83% Rb-87 at 86.9092 amu): $\frac{84.9118 + 86.9092}{2} = 85.91 \text{ amu}$	Weight each mass by its abundance: $(0.7217)(84.9118) + (0.2783)(86.9092)$ = **85.47 amu**

Why it's wrong: A plain average treats both isotopes as equally common. Rb-85 is almost three times as common, so the average sits much closer to 85.

MEMORY TRICK **Abundance picks the average.**

EXAM TRAP 9 | Swapping A and Z in the symbol

✗ WHAT STUDENTS WRITE	✓ WHAT EARNS THE POINTS
Writing oxygen-18 as ${}^{8}_{18}\text{O}$	${}^{18}_{8}\text{O}$ The **mass number goes on top**, the atomic number on the bottom.

Why it's wrong: A can never be smaller than Z, because A includes all the protons plus the neutrons. The bigger number is always on top.

MEMORY TRICK **Big number on top.**

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SAMPLE 4 From the Practice Question Bank

SAMPLE PAGE | FREE SAMPLE

This page is adapted from **Practice Question Bank**, one of the seven files in the full Isotopes and Atomic Mass set.

Q53 Boron is 19.90% boron-10 (10.0129 amu) and 80.10% boron-11 (11.0093 amu). Calculate its average atomic mass.

Q81 L3 ★ HONORS Bromine-79 has a mass of 78.9183 amu and bromine-81 has a mass of 80.9163 amu. The average atomic mass of bromine is 79.904 amu. Find the percent abundance of each isotope.

ANSWER KEY | Answers

Q53 **10.81 amu**

$$(0.1990)(10.0129) + (0.8010)(11.0093)$$
$$= 1.9926 + 8.8184 = 10.8110 \text{ amu} \approx \mathbf{10.81\ amu}$$

Check: 10.81 is between 10.01 and 11.01 and close to boron-11, the common isotope.

Q81 ★ HONORS **Bromine-79 = 50.67%, bromine-81 = 49.33%**

$$x = \frac{80.9163 - 79.904}{80.9163 - 78.9183} = \frac{1.0123}{1.9980} = 0.50666$$

Nearly 50/50, which matches an average almost exactly halfway between the masses.

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SAMPLE 5 Flashcards and Lab Skills

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This page is adapted from **Glossary and Flashcards**, one of the seven files in the full Isotopes and Atomic Mass set.

Front	Back
Isotope	Atoms of the same element (same number of protons) with different numbers of neutrons, so different mass numbers.
Mass number (A)	The total number of protons and neutrons in the nucleus of an atom. It is a count, so it has no unit.
Natural abundance	The percent of an element’s atoms, in a natural sample, that are one particular isotope. Also called percent abundance.
Average atomic mass	The weighted average of the masses of an element’s natural isotopes, based on how abundant each is. Unit: amu.

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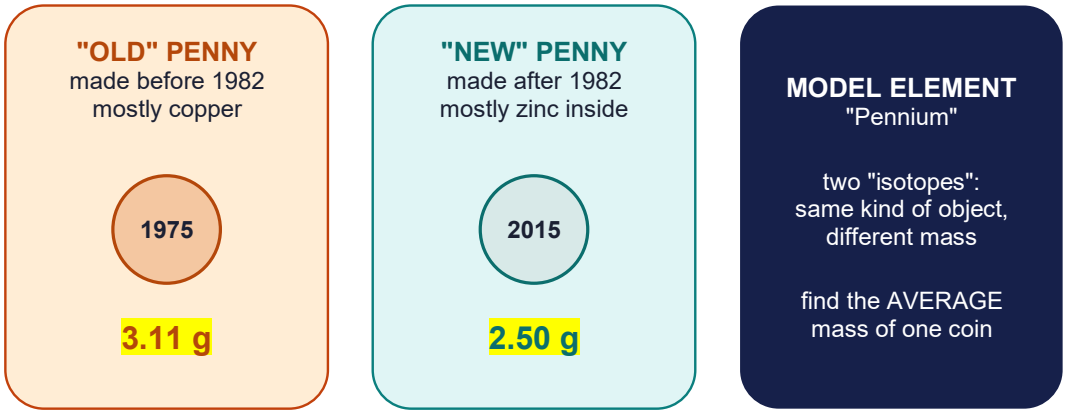
SAMPLE PAGE | FREE SAMPLE

This page is adapted from **Lab Skills for Tests**, one of the seven files in the full Isotopes and Atomic Mass set.

Data set: “pennium”, a two-isotope model

What the student did: A student used a bag of 40 pennies as a model element. Pennies made before 1982 are mostly copper and heavier; pennies made after 1982 are mostly zinc and lighter. The student sorted the pennies by date, counted each group, weighed 10 pennies of each kind together, and then weighed the whole bag of 40.



The two “isotopes” of pennium.

Measurement	Old pennies	New pennies
Number in the bag	14	26
Mass of 10 pennies (g)	31.10	25.00

Mass of all 40 pennies together: **108.54 g**

Questions

A1 Find the average mass of one old penny and one new penny.

A2 Find the percent abundance of each kind of penny in the bag.

A3 Calculate the weighted average mass of one penny in the bag. Show your work.

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ANSWER KEY | What the data show

A1 Old penny 3.11 g; new penny 2.50 g

$$\text{old} = \frac{31.10\ \text{g}}{10} = 3.11\ \text{g}$$

$$\text{new} = \frac{25.00\ \text{g}}{10} = 2.50\ \text{g}$$

A2 Old 35.0%; new 65.0%

$$\text{old} = \frac{14}{40} \times\ 100 = 35.0\%$$

$$\text{new} = \frac{26}{40} \times\ 100 = 65.0\%$$

Check: 35.0% + 65.0% = 100.0%.

A3 2.71 g

$$\text{average} = (0.350)(3.11\ \text{g}) + (0.650)(2.50\ \text{g})$$

$$\text{average} = 1.0885 + 1.6250 = 2.7135\ \approx\ 2.71\ \text{g}$$

The full file has three data sets like this one, plus lab safety, equipment, sources of error and test-style lab questions, all with answers.

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Get the Full Isotopes and Atomic Mass Set

You've seen a few pages. The full set covers **all of isotopes and atomic mass**, start to finish.

- ✓ **Complete Study Notes:** clear lessons, worked examples and quick checks.
- ✓ **Quick Revision Sheets:** tables, flowcharts, memory tricks and a one-page cheat sheet.
- ✓ **Exam Traps and Common Mistakes:** the mistakes that cost points, fixed.
- ✓ **Practice Question Bank:** questions by lesson with full worked answers.
- ✓ **Quizzes and Unit Test:** check you're ready, with an answer key.
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Also in this series: Set 1, Atomic Theory, and Set 2, Atomic Structure. Each set works on its own.

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