


# Isotopes



## The Atom

### Atomic Number and Mass Number

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### Atomic Number on the Periodic Table

Atomic Number	→ 11	← Proton Number
Symbol	→ Na	← Sodium
	22.99	

Why is it a fraction?

ATOMIC MASS

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### ...Atoms have isotopes

**ISOTOPE:** Atoms with the same number of protons, but different numbers of neutrons.

- **Atoms** of the same element all have the same number of protons.
- **Isotopes** of the element have differing numbers of neutrons

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**new term : Mass Number**

**Mass Number**  
is  
the number of  
**protons and neutrons**  
in an atom

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**Writing Isotopes  
in the language of chemistry**

**ELEMENT  
OF SODIUM**

**11**  
**Na**  
**22.99**

**ISOTOPE  
OF SODIUM**

**23** ← mass number  
**Na**  
**11** ← atomic number

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**Writing isotopes  
in the language of chemistry**

**EXAMPLE** **Isotopes of chlorine**

$^{35}_{17}\text{Cl}$        $^{37}_{17}\text{Cl}$

**chlorine - 35**      **chlorine - 37**

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### Practice Isotopes

$^{16}_8\text{O}$	$^{31}_{15}\text{P}$	$^{65}_{30}\text{Zn}$
8 p+	15 p+	30 p+
8 n	16 n	35 n

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### Learning Check

Naturally occurring carbon consists of three isotopes,  $^{12}\text{C}$ ,  $^{13}\text{C}$ , and  $^{14}\text{C}$ .  
 State the number of protons, neutrons, and electrons in each of these carbon atoms.

	$^{12}\text{C}$	$^{13}\text{C}$	$^{14}\text{C}$
	6	6	6
#P	_____	_____	_____
#N	_____	_____	_____
#E	_____	_____	_____

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### Solution

	$^{12}\text{C}$	$^{13}\text{C}$	$^{14}\text{C}$
	6	6	6
#P	<u>6</u>	<u>6</u>	<u>6</u>
#N	<u>6</u>	<u>7</u>	<u>8</u>
#E	<u>6</u>	<u>6</u>	<u>6</u>

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An atom of zinc has a mass number of 65.

1. Number of protons in the zinc atom

- a) 30      b) 35      c) 65

2. Number of neutrons in the zinc atom

- a) 30      b) 35      c) 65

3. What is the mass number of a zinc isotope with 37 neutrons?

- a) 37      b) 65      c) 67

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## Learning Check

Write the atomic symbols for atoms with the following:

A. 8 p<sup>+</sup>, 8 n, 8 e<sup>-</sup> \_\_\_\_\_

B. 17p<sup>+</sup>, 20n, 17e<sup>-</sup> \_\_\_\_\_

C. 47p<sup>+</sup>, 60 n, 47 e<sup>-</sup> \_\_\_\_\_

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## Solution

A. 8 p<sup>+</sup>, 8 n, 8 e<sup>-</sup>       $^{16}_8\text{O}$

B. 17p<sup>+</sup>, 20n, 17e<sup>-</sup>       $^{37}_{17}\text{Cl}$

C. 47p<sup>+</sup>, 60 n, 47 e<sup>-</sup>       $^{107}_{47}\text{Ag}$

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## Learning Check

An atom has 14 protons and 20 neutrons.

1. Its atomic number is  
a) 14      b) 16      c) 34
2. Its mass number is  
a) 14      b) 16      c) 34
3. The element is  
a) Si      b) Ca      c) Se
4. Another isotope of this element is  
a)  ${}^{34}_{16}\text{X}$       b)  ${}^{34}_{14}\text{X}$       c)  ${}^{36}_{14}\text{X}$

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## Isotope Activity

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## Finding An Isotopic Mass

A sample of boron consists of  ${}^{10}\text{B}$  (mass 10.0 amu) and  ${}^{11}\text{B}$  (mass 11.0 amu)

If the average atomic mass of B is 10.8 amu, what is the % abundance of each boron isotope?

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Assign X and Y values:

$$X = \% \text{ } ^{10}\text{B} \quad Y = \% \text{ } ^{11}\text{B}$$

Determine Y in terms of X

$$X + Y = 100$$

$$Y = 100 - X$$

Solve for X:

$$\frac{X(10.0)}{100} + \frac{(100 - X)(11.0)}{100} = 10.8$$

Multiply through by 100

$$10.0X + 1100 - 11.0X = 1080$$

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Collect X terms

$$10.0X - 11.0X = 1080 - 1100$$

$$-1.0X = -20$$

$$X = \frac{-20}{-1.0} = 20 \% \text{ } ^{10}\text{B}$$

$$Y = 100 - X$$

$$\% \text{ } ^{11}\text{B} = 100 - 20\% = 80\% \text{ } ^{11}\text{B}$$

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## Learning Check 8

Copper has two isotopes  $^{63}\text{Cu}$  (62.9 amu) and  $^{65}\text{Cu}$  (64.9 amu). What is the % abundance of each isotope? (Hint: Check periodic table for atomic mass)

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**Solution 8**

2) 70%

**Solution**

$$62.9X + 6490 = 64.9X = 6350$$
$$-2.0 X = -140$$
$$X = 70\%$$

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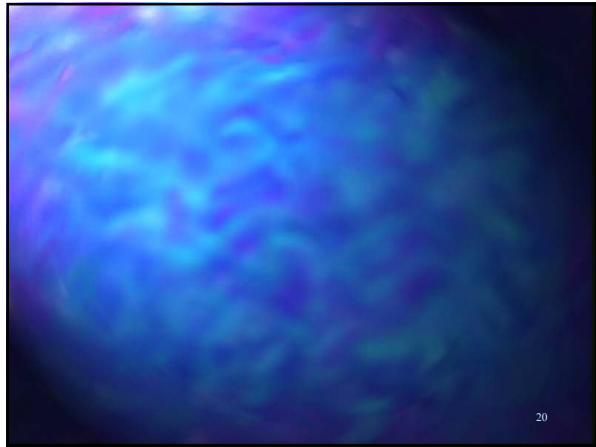
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