

Learning Guide 1E  
Protons, Neutrons and Electrons: Building Atoms from Scratch  
Chem 1010

Review:

What is the smallest and largest transition metal?

What is the smallest and largest inner transition metal?

What is the smallest and largest main group metal?

What is the smallest and largest nonmetal?

What is the smallest and largest alkali metal?

What is the smallest and largest halogen?

What is the smallest and largest noble gas?

What is the smallest and largest alkaline earth metal?

What is the smallest and largest element in the 5th period?

Which would you expect to have properties similar to sulfur?

phosphorus selenium chlorine oxygen

Which would you expect to have properties similar to strontium?

calcium rubidium yttrium barium

Give the atomic numbers and masses of the following elements:

antimony –

tellurium –

iodine –

xenon –

Which is better to use to organize the Periodic Table, mass or atomic number?

## Introduction

Today we will talk more about how atoms themselves are put together.

First we will look more closely at the three elementary particles that an atom is made up of.

Then we will show how the number of protons, neutrons, and electrons in an atom determines its atomic number, its charge, and its atomic mass.

We will see how to write the symbols for different ions and isotopes of an element.

Finally, we'll look at how the mass of a single atom of an element is different from a natural sample of atoms of that element.

## The Elementary Particles

What are the three elementary particles that make up an atom?

	location	charge	symbol	mass
proton				
neutron				
electron				

In order to talk about the mass of an atom, we need a new unit.

amu =

1 amu =

## Atomic Number, Charge, and Atomic Mass

Which of the elementary particles determines the atomic number of an atom?

Which of the elementary particles determines the charge on an atom?

Which of the elementary particles determines the mass of an atom?

If a proton were the size of a \_\_\_\_\_, an electron would be the size of a \_\_\_\_\_!

To illustrate how each of these works, we'll look at some models of atoms using beans.

Build the following atoms, using the key shown below.

proton = red bean  
neutron = white bean  
electron = black bean

Atom A	Atom B	Atom C	Atom D
2 protons 3 neutrons 3 electrons	3 protons 4 neutrons 2 electrons	6 protons 7 neutrons 6 electrons	9 protons 10 neutrons 8 electrons

### Atomic Number

What is the atomic number?

What does this tell you about the atom?

Where can you find the atomic number for an element if you didn't know it?

	Atom A	Atom B	Atom C	Atom D
protons				
neutrons				
electrons				
atomic number				
element symbol				

## Charge

What two elementary particles have a charge?

If an atom has the same number of protons and electrons, what is its charge?

Which of these particles is more likely to be lost or gained by an atom? Why?

If an atom loses an electron, what kind of charge will it have?

If an atom gains an electron, what kind of charge will it have?

	Atom A	Atom B	Atom C	Atom D
protons				
electrons				
charge				
symbol				

Charge is written to the \_\_\_\_\_ of the symbol for the atom.

(If the charge is +1 or -1, the "1" doesn't have to be written.)

Charged atoms are called \_\_\_\_\_. Positively charged atoms are called \_\_\_\_\_, while negatively charged atoms are called \_\_\_\_\_.

## Atomic Mass

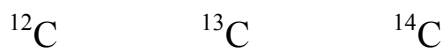
Which elementary particles contribute significantly to the mass of an atom?

	Atom A	Atom B	Atom C	Atom D
protons				
neutrons				
mass				
symbol				

The mass of an atom can be shown by writing it to the \_\_\_\_\_ of the symbol.

The mass of an atom can also be shown by writing out the name of the element, then a hyphen, and then the mass. This way of writing it doesn't give the charge.

Consider the following atoms:



What do the following atoms have in common?

How are they different?

Atoms of the same element with different masses are called:

## Atomic Mass and the Periodic Table

The mass of an individual atom is always:

However, we aren't usually dealing with only one atom. Instead, we have a large group of atoms.

When atoms occur in nature, they always have the \_\_\_\_\_ of each isotope of that element. This is called the \_\_\_\_\_.

For example, there are three naturally occurring isotopes of carbon:



What is the atomic mass of carbon on the Periodic Table?

Why?

The atomic mass given on the Periodic Table is a:

Most elements have one isotope that is more common than the others.

What is the most common isotope of vanadium?

What is the most common isotope of ruthenium?

Radioactive elements have their most stable mass shown in ( ).

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### Putting it all together

Let's sum up what we've talked about today:

atomic number =

charge =

mass of an atom =

complete symbol for an atom =

atomic mass on the Periodic Table of Elements =

How many protons, neutrons, and electrons would you need to make the following atoms?

	protons	neutrons	electrons
$^{10}\text{B}$			
$^{10}\text{B}^+$			
$^{10}\text{B}^{+2}$			
$^{10}\text{B}^-$			
$^{11}\text{B}^+$			
$^{11}\text{B}^{+2}$			

What element are the following atoms:

29 protons, 32 neutrons, 30 electrons

91 neutrons, 83 protons, 85 electrons

How many protons does a dysprosium atom have?

What is the atomic number of a krypton atom?

What charge do the following atoms have?

29 protons, 32 neutrons, 30 electrons

91 neutrons, 83 protons, 81 electrons

If an atom has a charge of +1, how many electrons has it gained or lost?

If an atom has a charge of -3, how many electrons has it gained or lost?

If an atom has 29 protons, 32 neutrons, and 30 electrons, what is its mass?

If an atom has 91 neutrons, 83 protons, and 85 electrons, what is its mass?

How many protons and neutrons does a  $^{75}\text{As}$  atom have?

What is the average mass of an atom in a naturally occurring sample of indium?

What is the most stable isotope of polonium?