

PHYSICS
CLASS

$$E = m \cdot c^2$$

$$P = \frac{F}{A}$$

$$V = a \cdot t$$

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$



PHYSICS - The Nuclear Atom

LEARNING OBJECTIVES

Core

- Describe the structure of an atom in terms of a positive nucleus and negative electrons

- Describe the composition of the nucleus in terms of protons and neutrons
- State the charges of protons and neutrons
- Use the term proton number Z
- Use the term nucleon number A
- Use the term nuclide and use the nuclide notation ${}^A_Z\text{X}$
- Use and explain the term isotope

Supplement

- Describe how the scattering of α -particles by thin metal foils provides evidence for the nuclear atom
- State the meaning of nuclear fission and nuclear fusion
- Balance equations involving nuclide notation

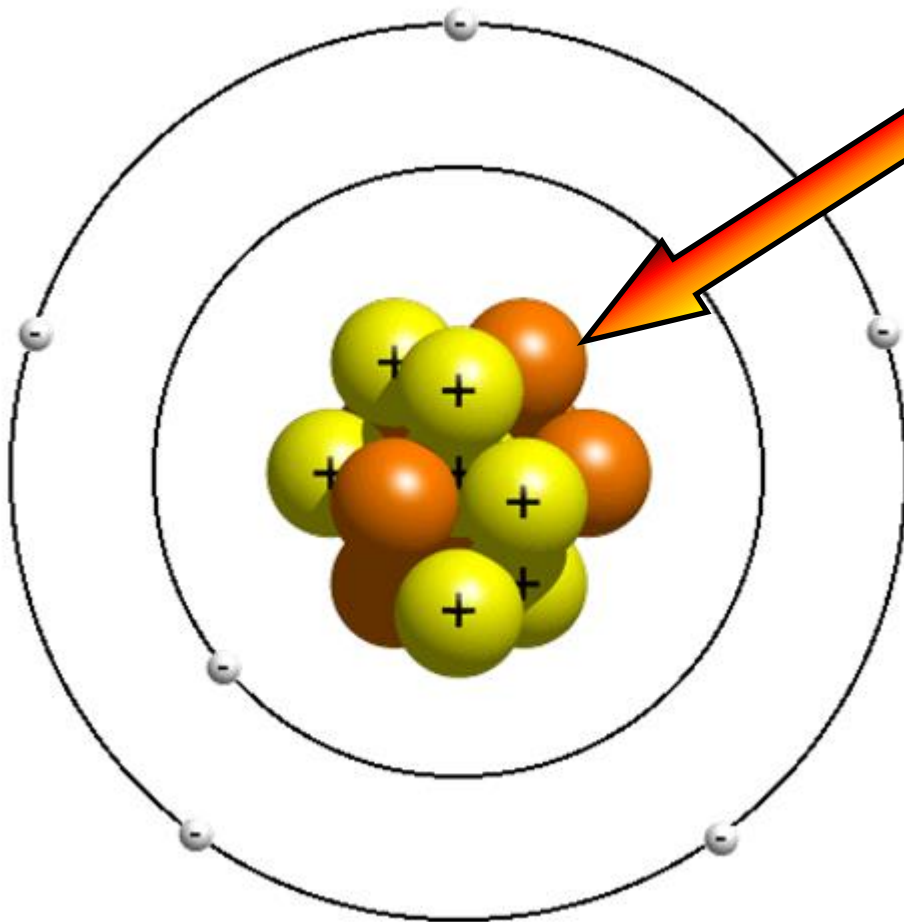
Atoms

Atomic structure

Atoms

Atomic structure

The Nucleus

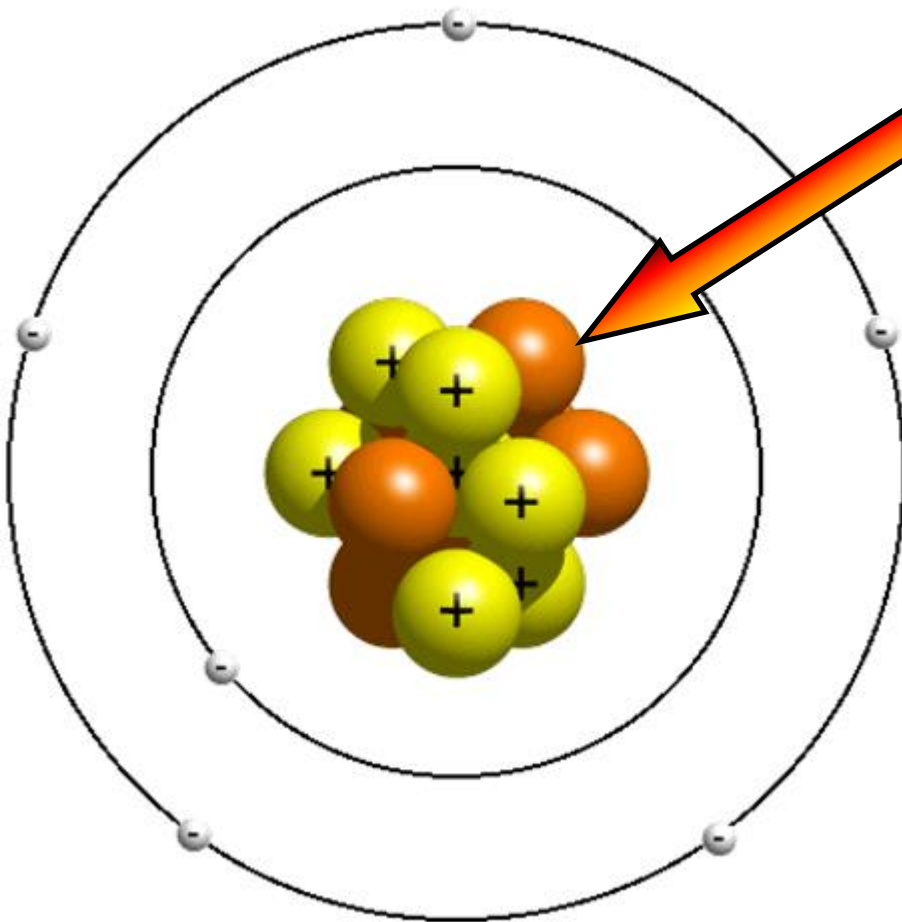


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Atomic structure

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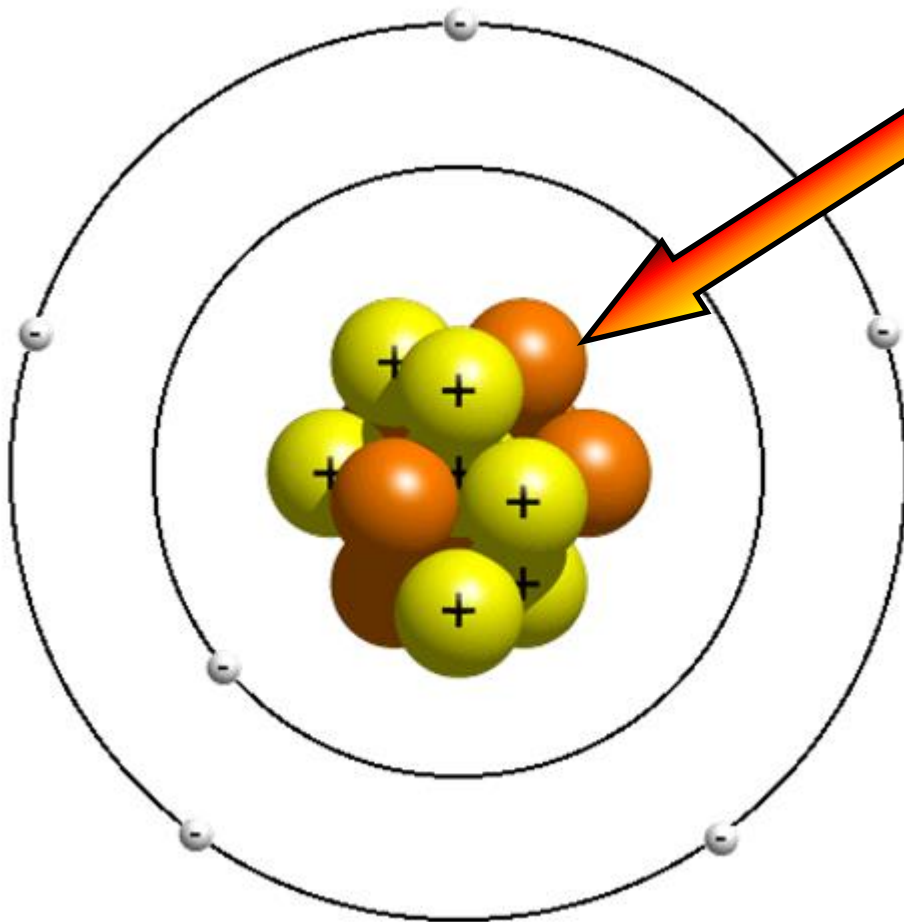
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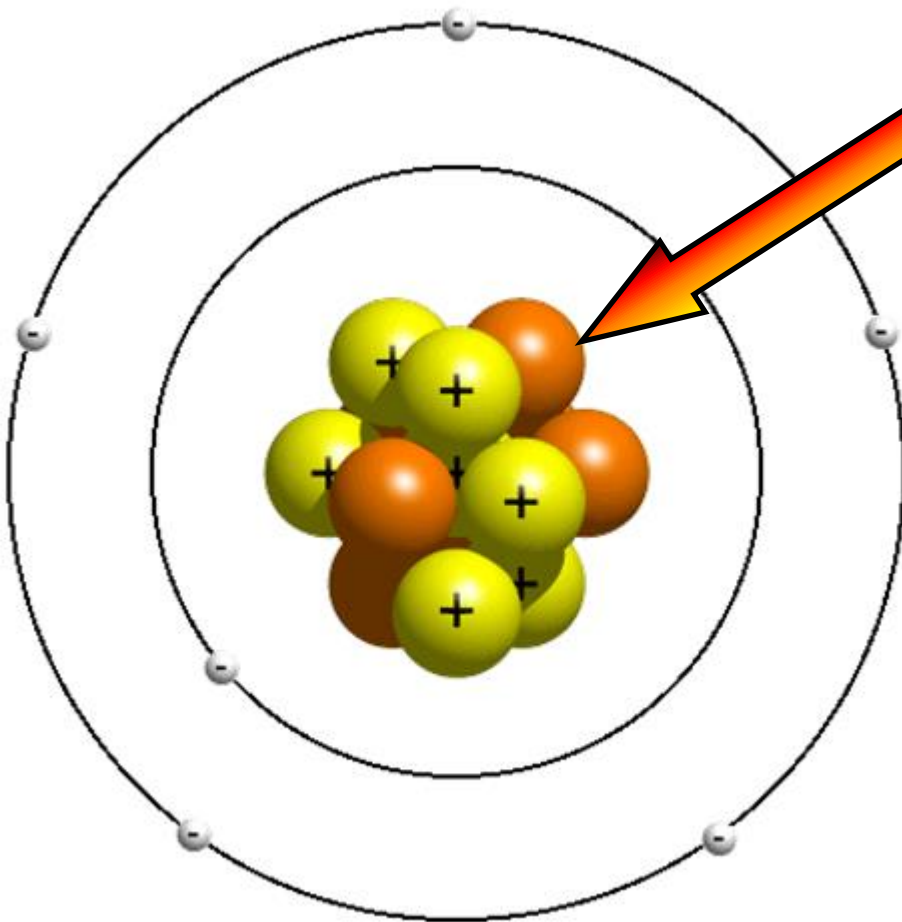


- 1) It's in the middle of the atom
- 2) It contains protons and neutrons

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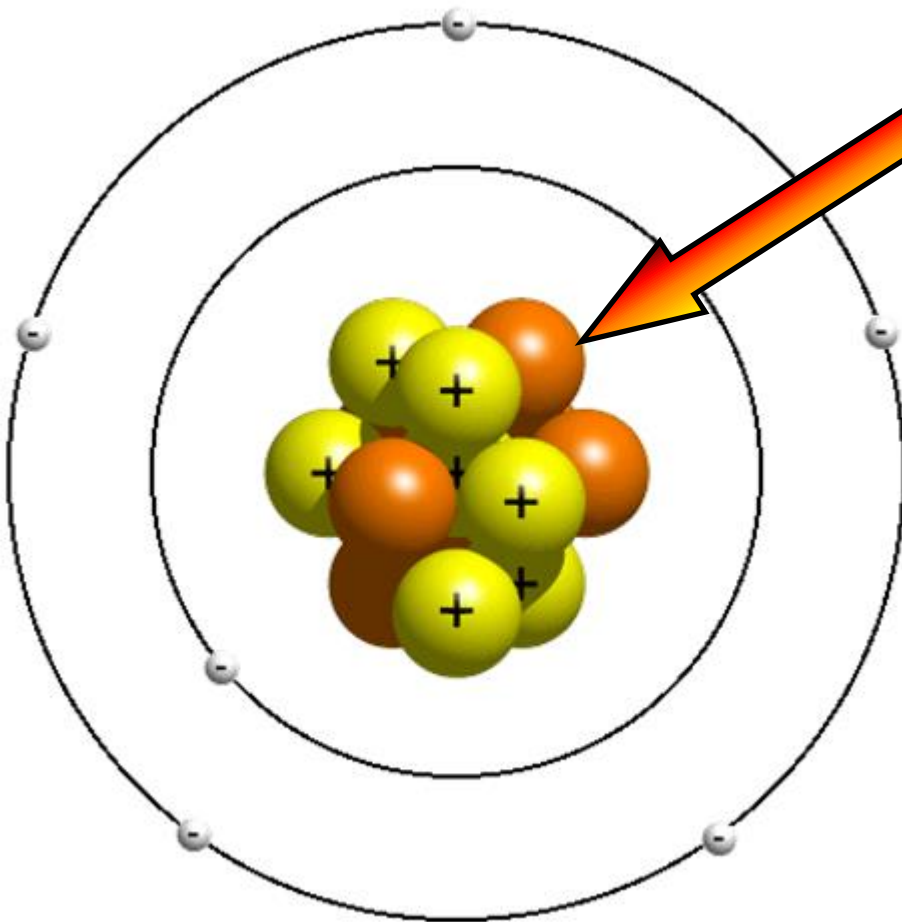


- 1) It's in the middle of the atom
- 2) It contains protons and neutrons
- 3) It has a positive charge because of the protons.

Atoms

Atomic structure

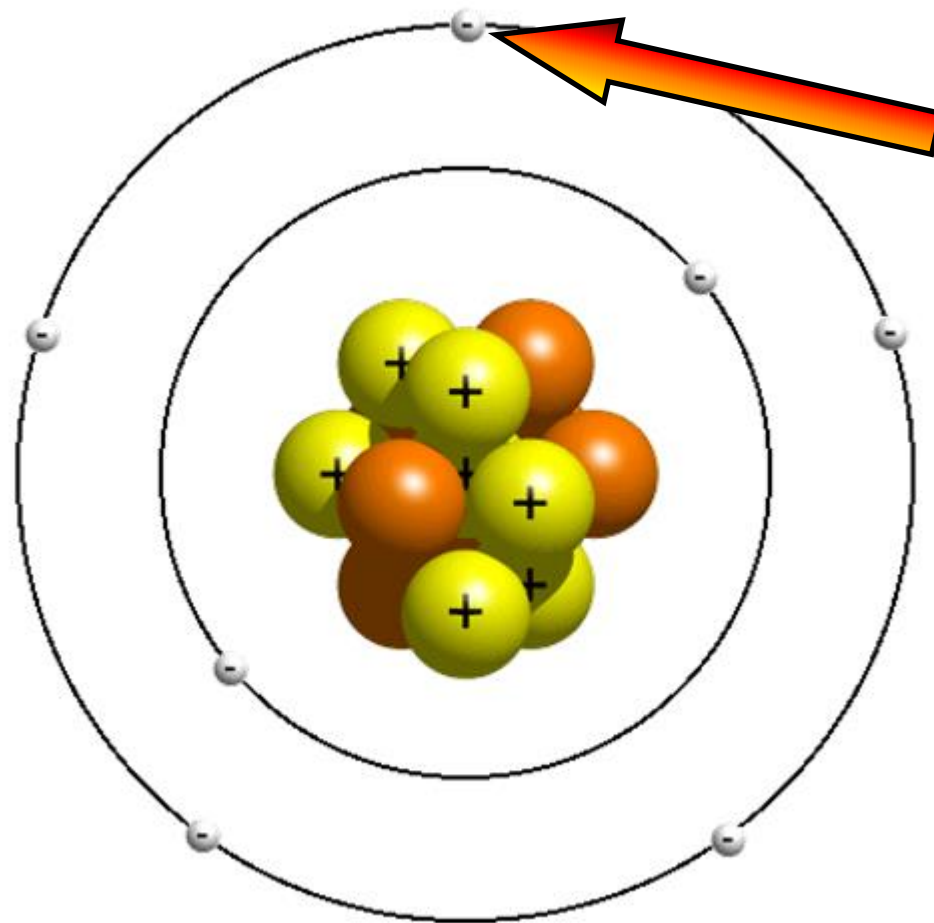
The Nucleus



- 1) It's in the middle of the atom
- 2) It contains protons and neutrons
- 3) It has a positive charge because of the protons.
- 4) Almost the whole mass of the atom is concentrated in the nucleus.

Atoms

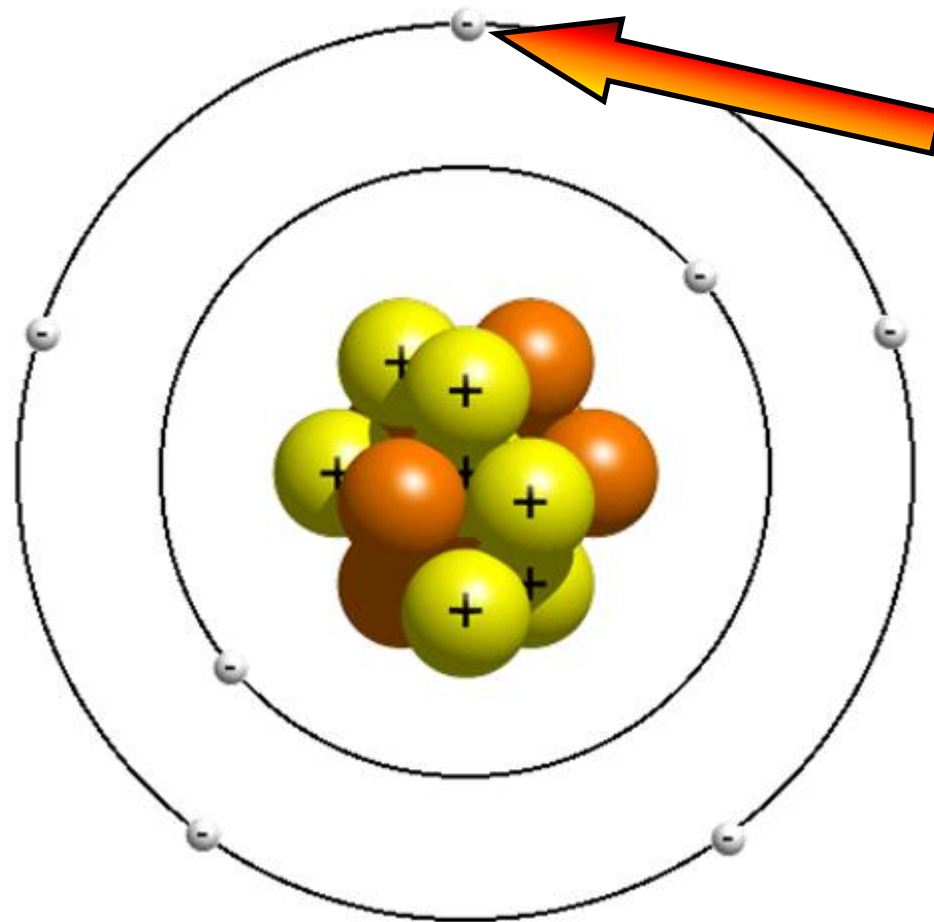
Atomic structure



The Electrons

Atoms

Atomic structure

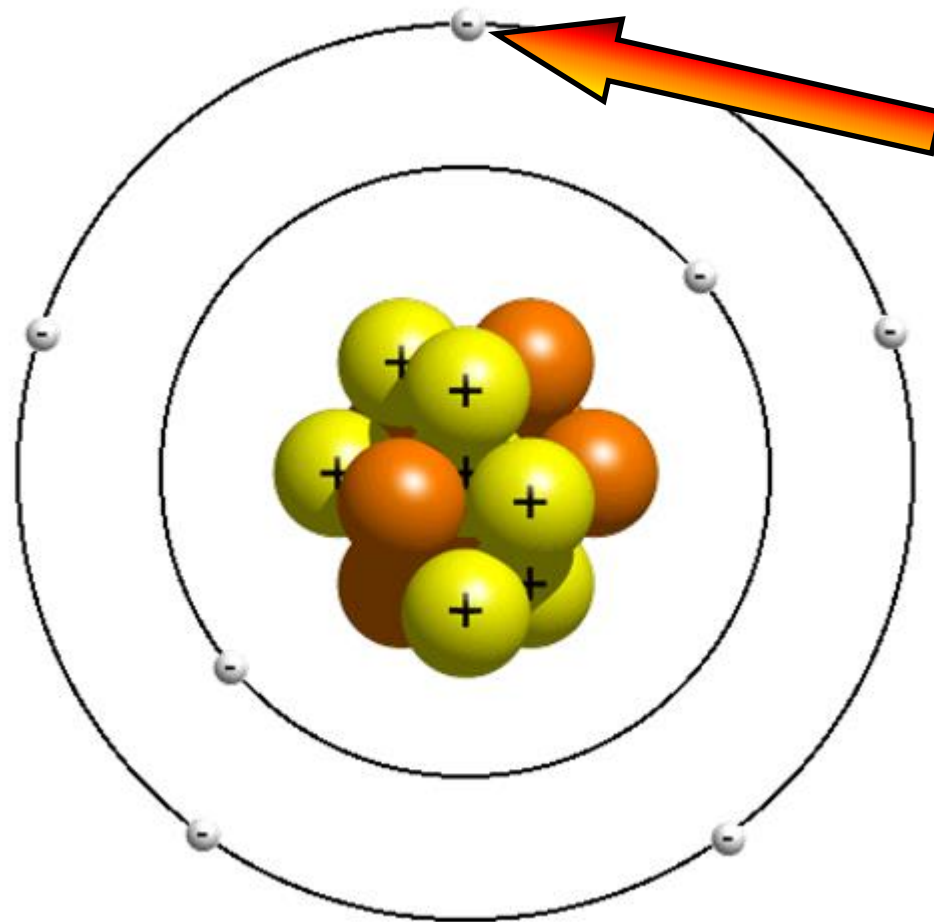


The Electrons

- 1) Move around the nucleus.

Atoms

Atomic structure

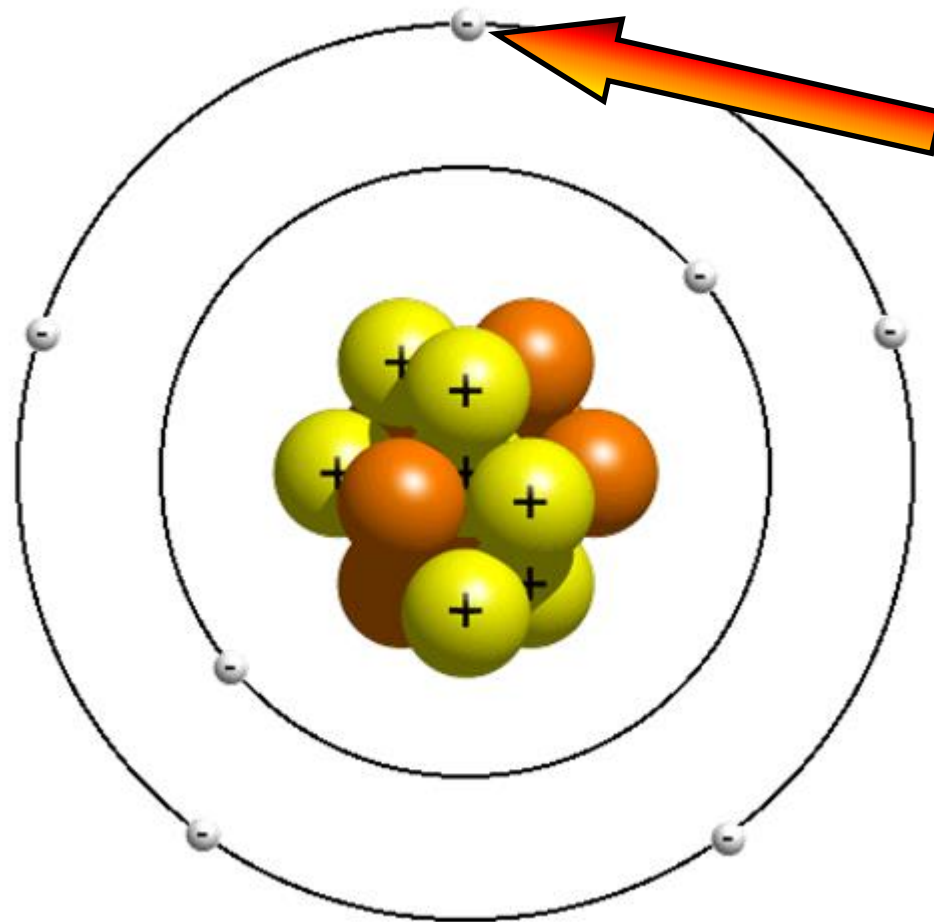


The Electrons

- 1) Move around the nucleus
- 2) They're negatively charged. .

Atoms

Atomic structure

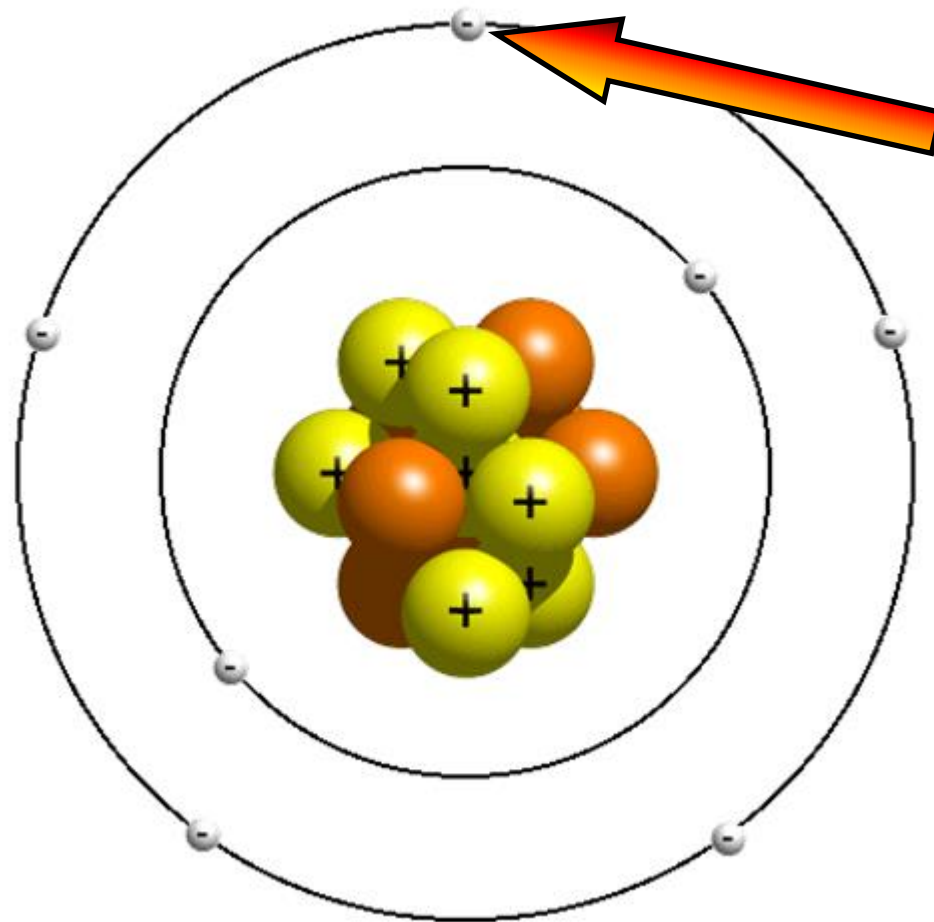


The Electrons

- 1) Move around the nucleus
- 2) They're negatively charged.
- 3) They're tiny, but they cover a lot of space..

Atoms

Atomic structure

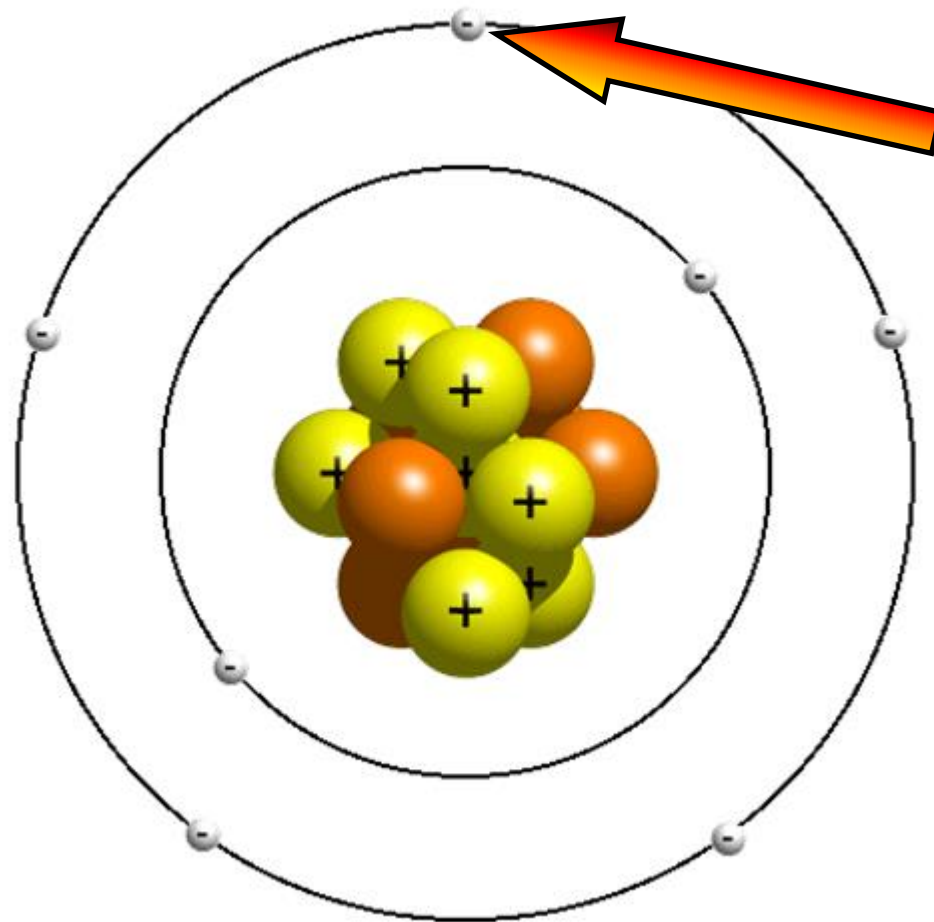


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Atomic structure



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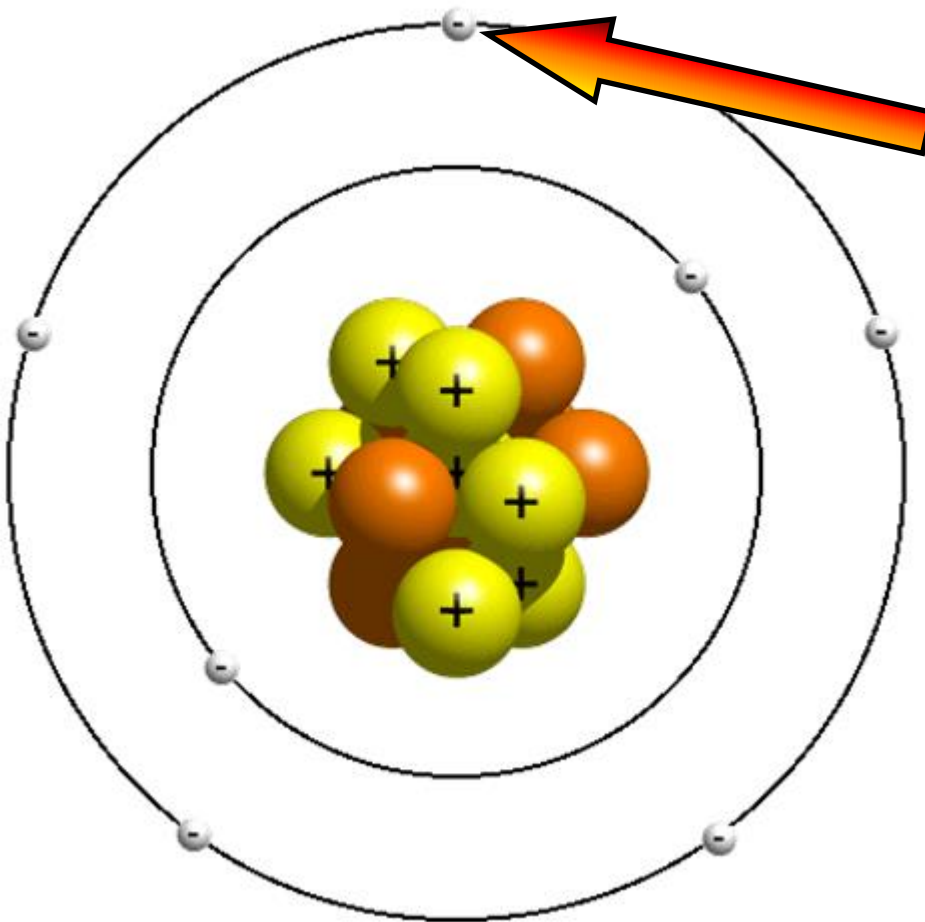
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- 6) They occupy shells around the nucleus.

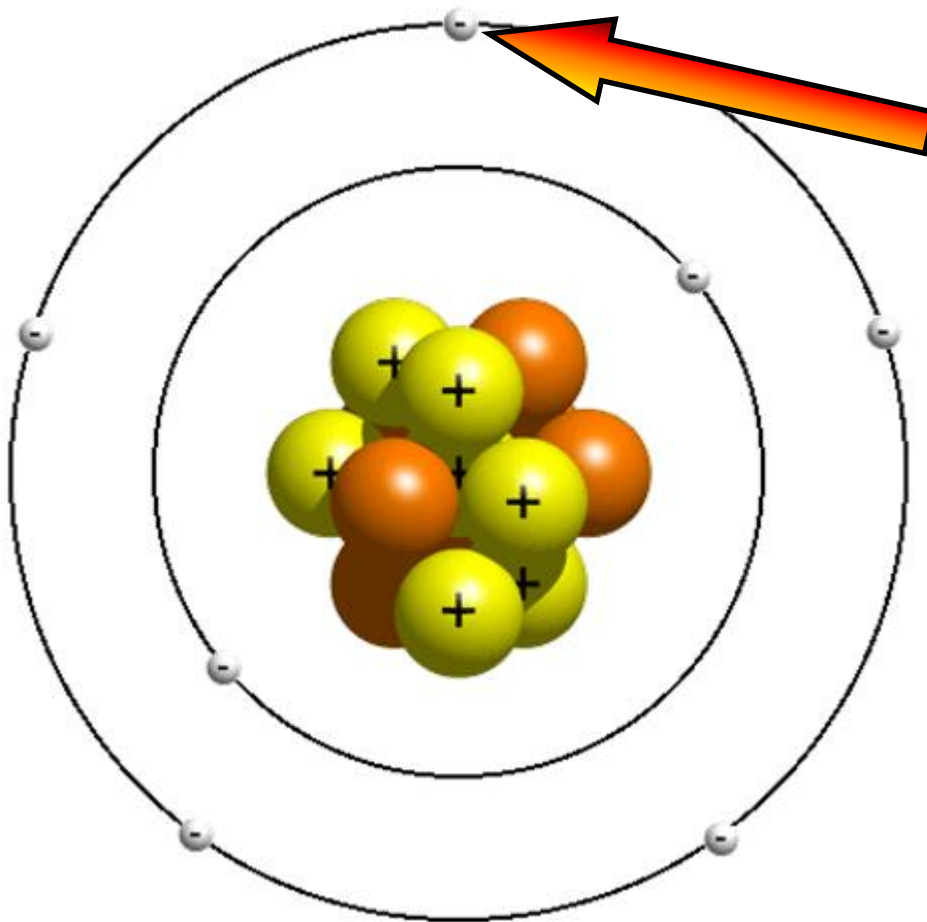


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Atomic structure

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- 5) They have virtually no mass.
- 6) They occupy shells around the nucleus.
- 7) These shells explain the whole of chemistry.



Atoms

Atomic structure

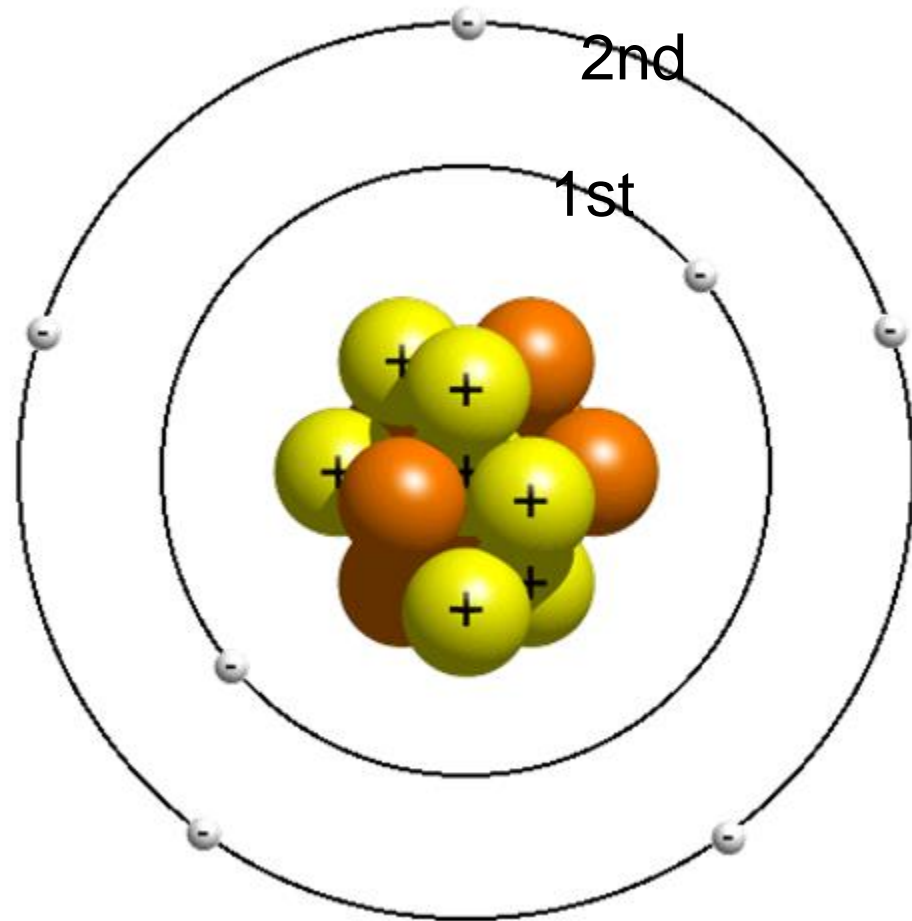
Summary

Particle	Mass	Charge
Proton	1	+1
Neutron	1	0
Electron	1/2000	-1

Atoms

Electron Shell Rules

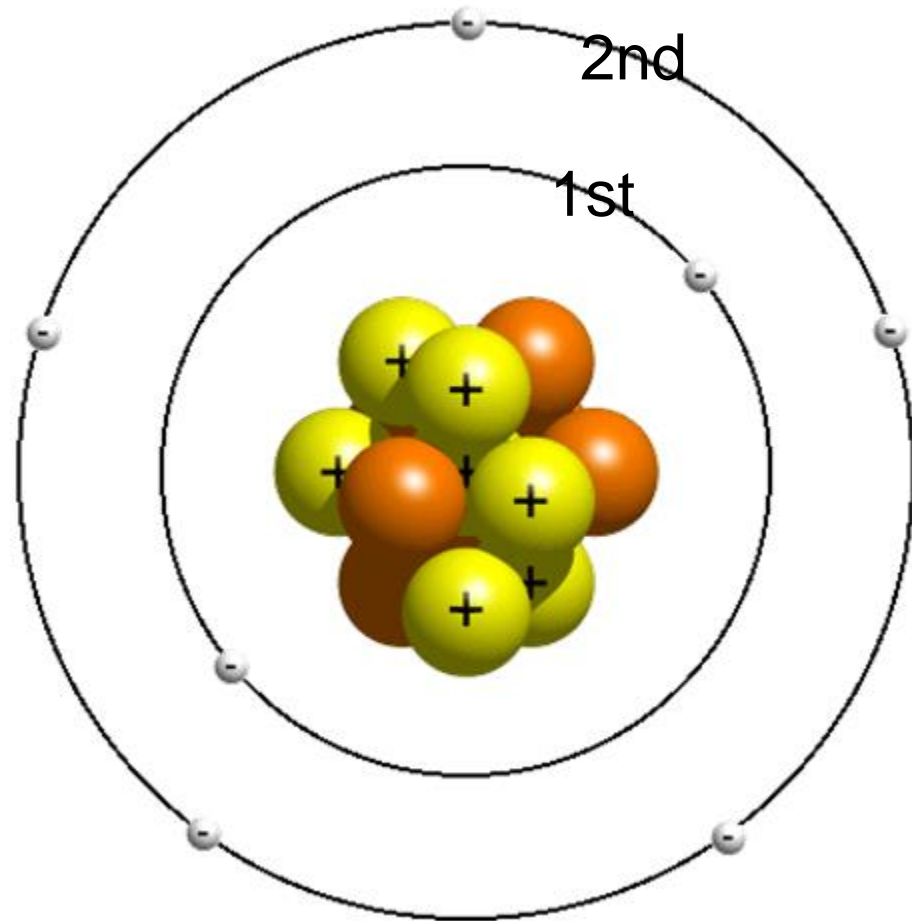
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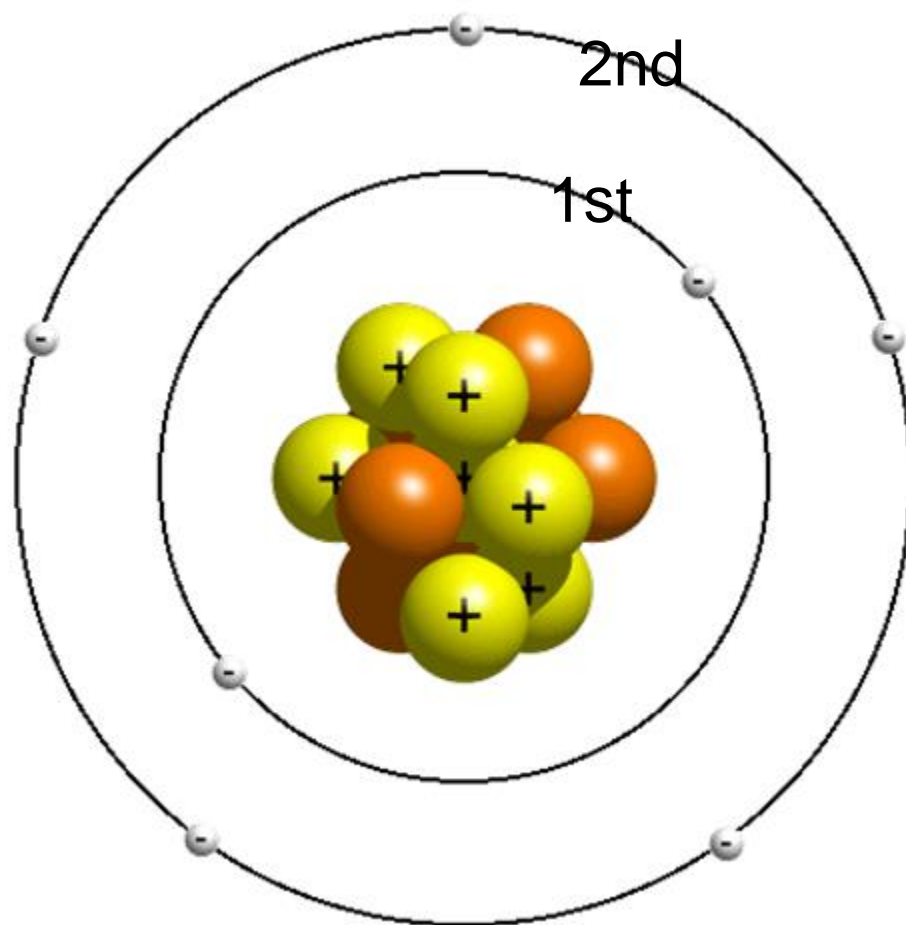
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- 3) Only a certain number of electrons are allowed in each shell:

1st shell: 2

2nd shell: 8

3rd shell: 8

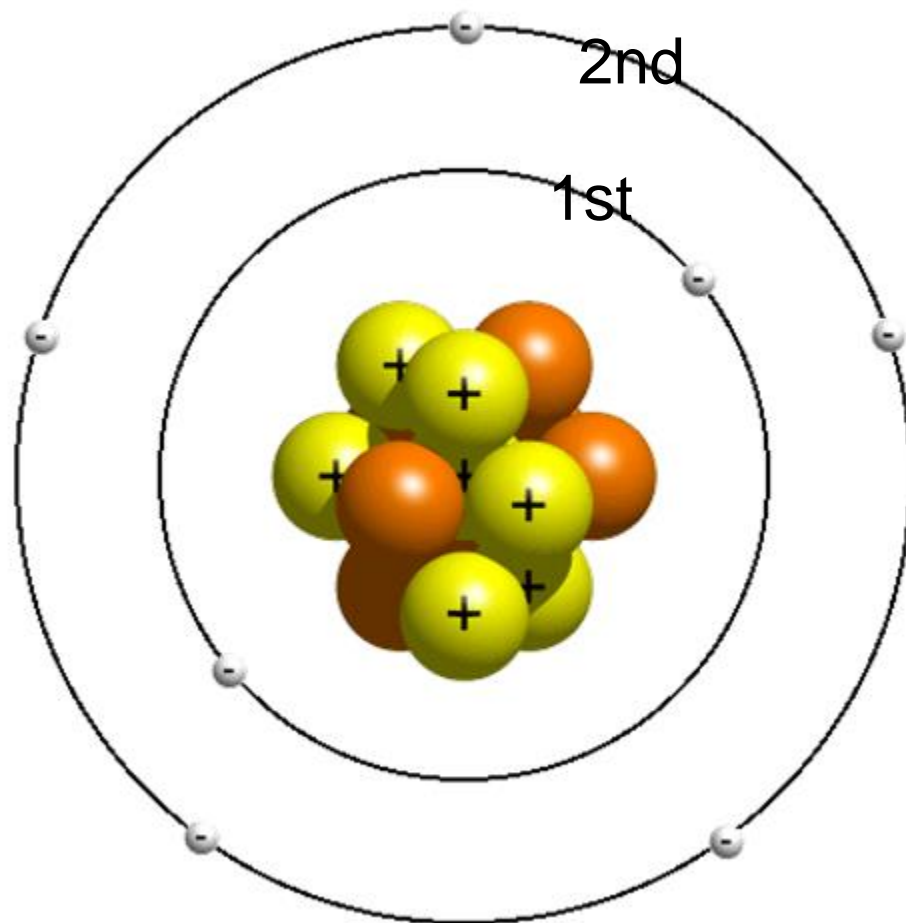


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- 4) Atoms are much HAPPIER when they have FULL electron shells.

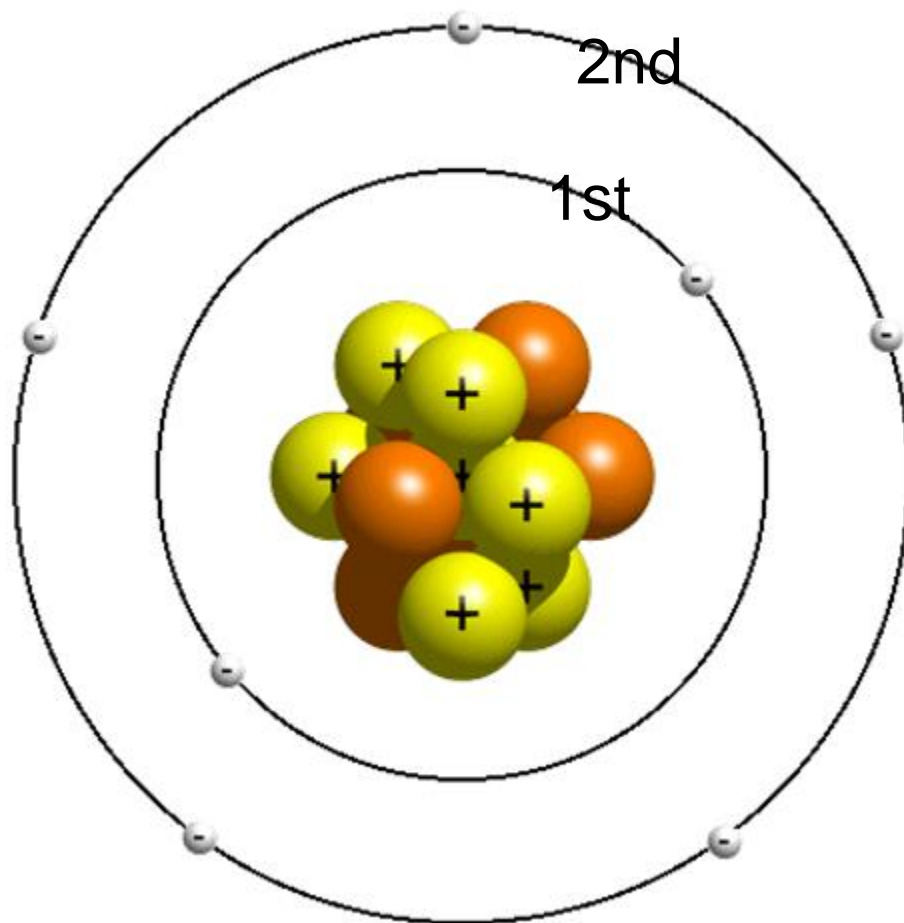


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- 5) In most atoms the OUTER SHELL is NOT FULL and this makes the atom want to REACT.

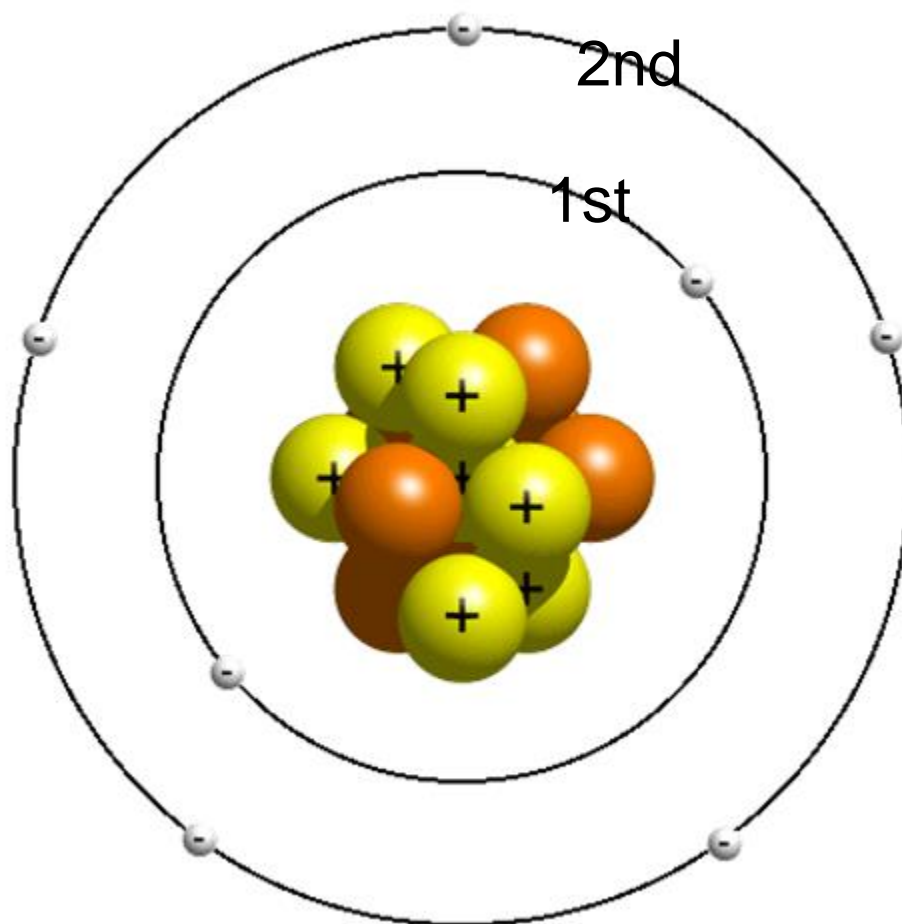


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So, how do we know how many electrons, protons and neutrons there are?

Atoms

Atomic Number and Mass Number



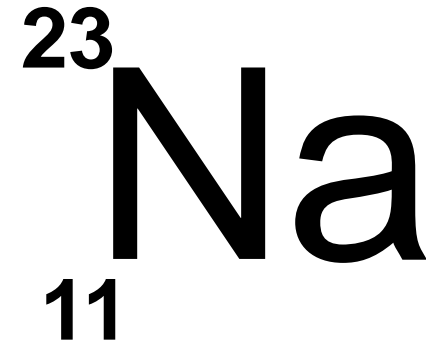
We just need to know
these two simple numbers

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Atoms

Atomic Number and Mass Number

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THE MASS NUMBER

- Total of Protons and Neutrons



Atoms

Atomic Number and Mass Number

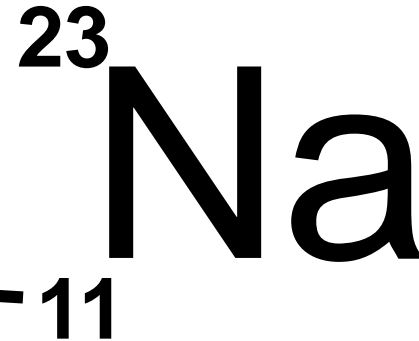
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THE ATOMIC NUMBER

- Number of Protons (and electrons)



Atoms

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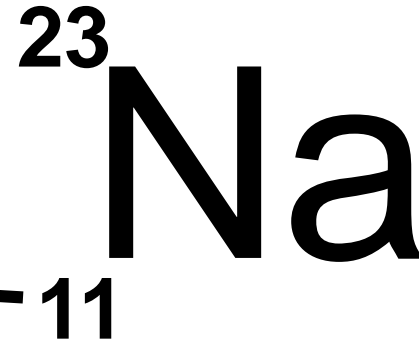
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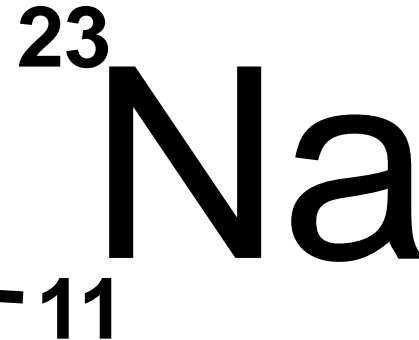
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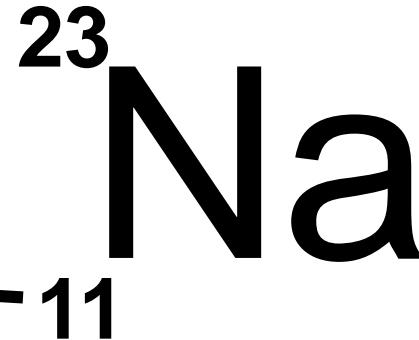
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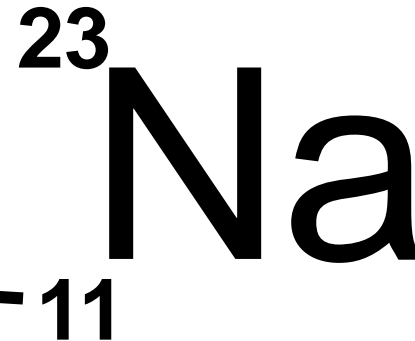
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- 4) The mass number is always the biggest number. It tells you the relative mass of the atom.

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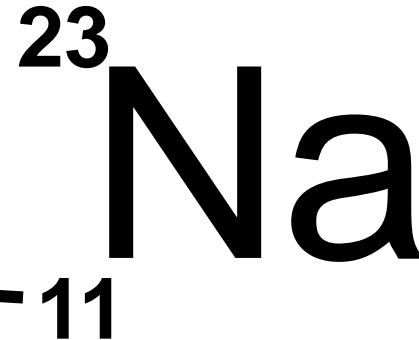
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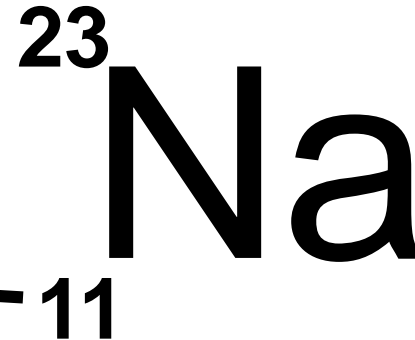
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- 4) The mass number is always the biggest number. It tells you the relative mass of the atom.
- 5) The mass number is always roughly double the atomic number.
- 6) Which means there's about the same number of protons as neutrons in any nucleus.

Atoms

Atomic Number and Mass Number

THE MASS NUMBER

- Total of Protons and Neutrons

23

Also known as the
NUCLEON NUMBER (A)

Na

THE ATOMIC NUMBER

- Number of Protons (and electrons)

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*This is known as
the NUCLIDE
NOTATION*

Na

$\begin{matrix} A \\ Z \end{matrix} X$

*Each different
type of atom is
called a NUCLIDE*

Atoms

Supplement

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Balance equations involving nuclide notation

Na

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Atoms

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+

4

2 He

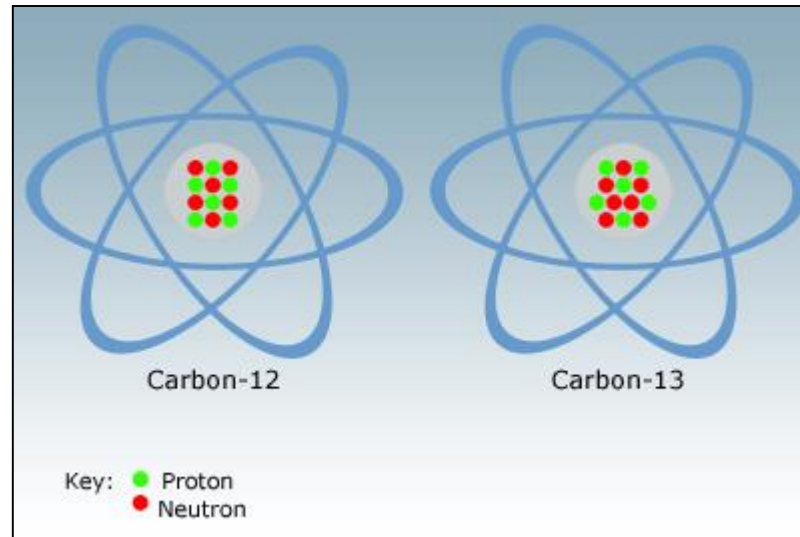
ISOTOPES

Different forms of the same element

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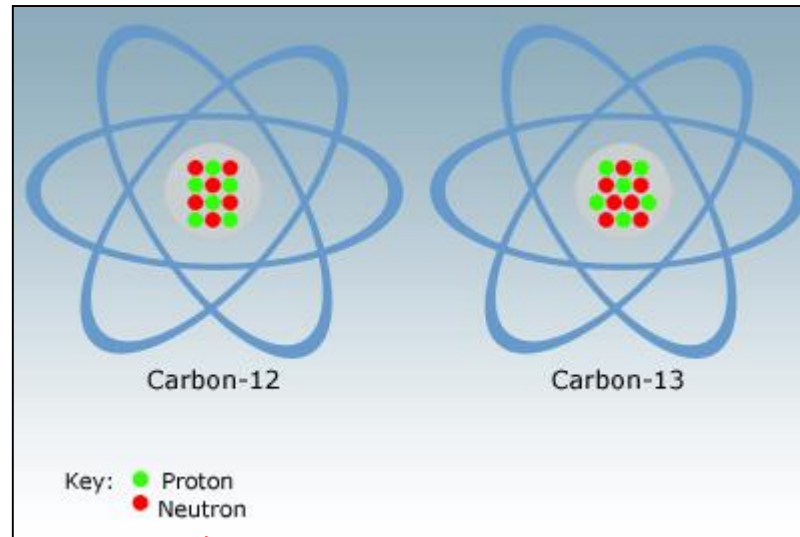
What's the
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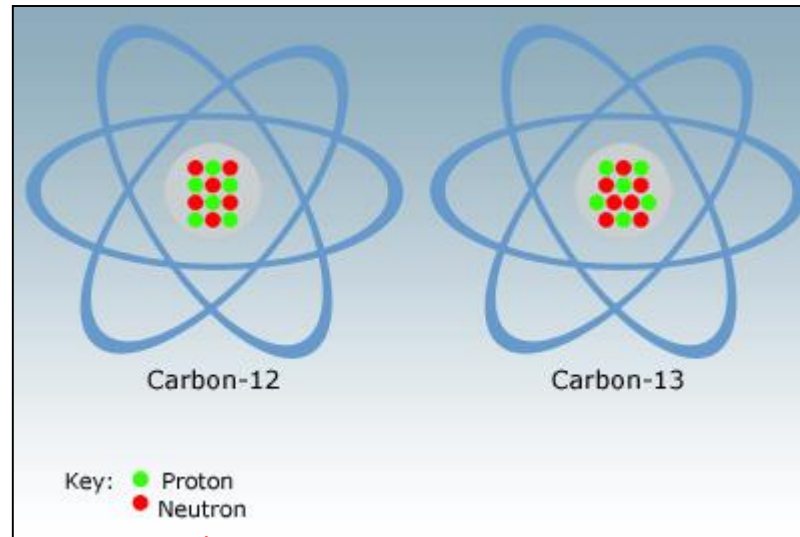


In the nucleus, this one has 6 protons and 6 neutrons.

ISOTOPES

Different forms of the same element

What's the difference between these two?



In the nucleus, this one has 6 protons and 6 neutrons.

In the nucleus, this one has 6 protons and 7 neutrons.

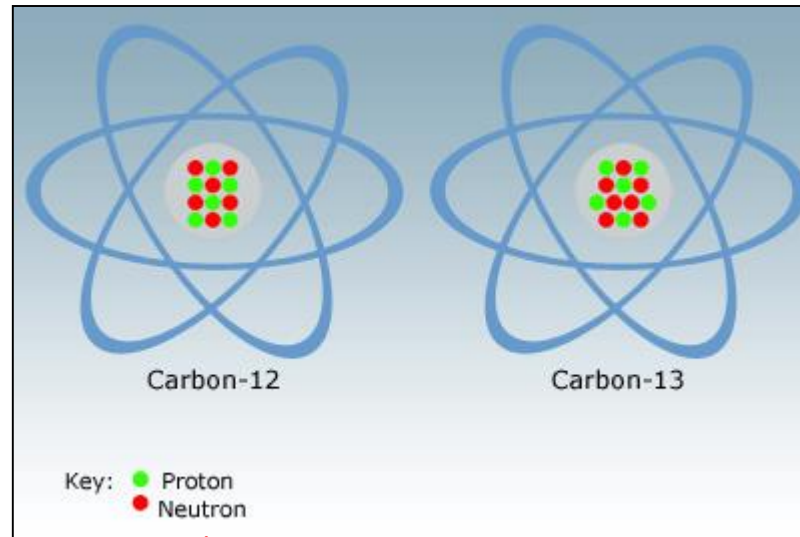
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ISOTOPES

Different forms of the same element

Isotopes have the same atomic number, but different mass numbers

What's the difference between these two?

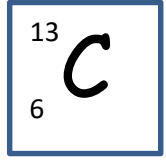
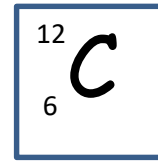


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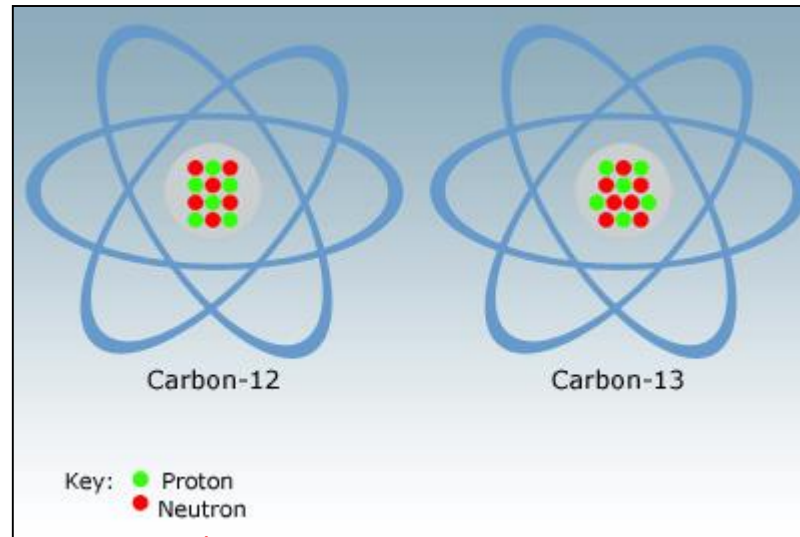
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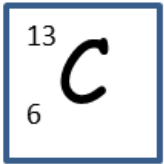
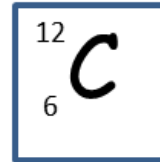
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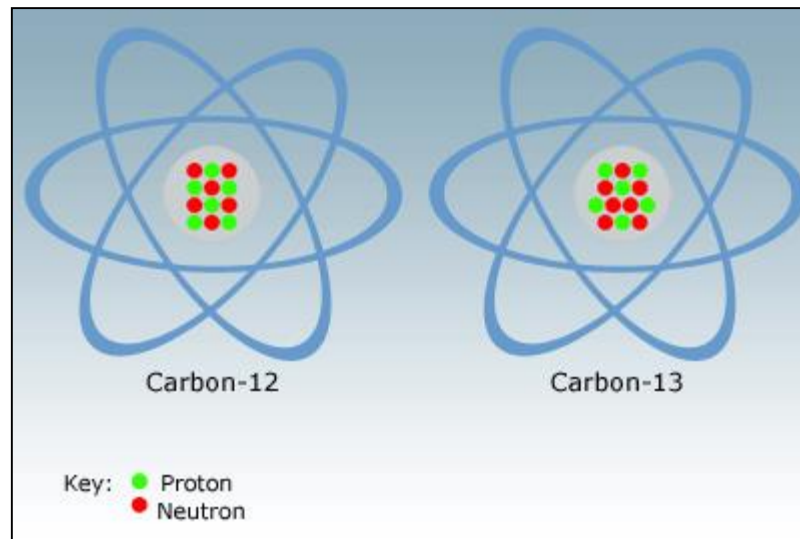
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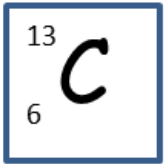
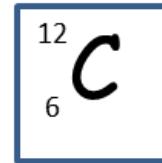


What are the
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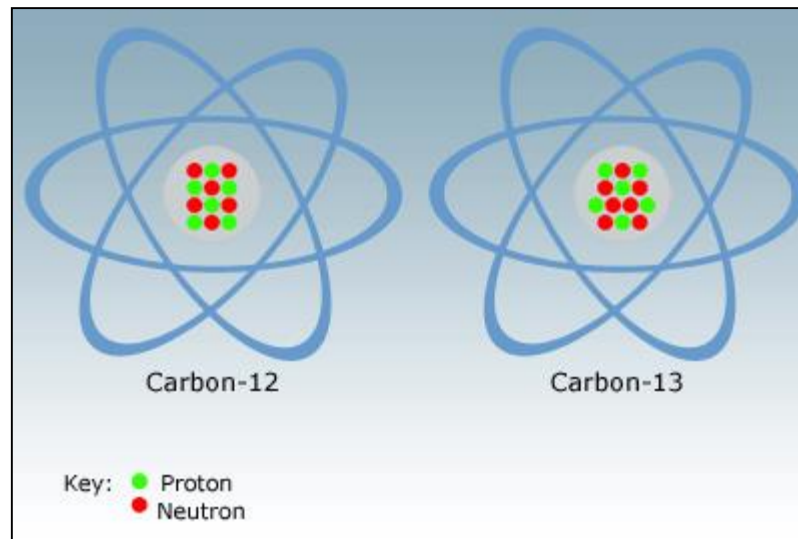


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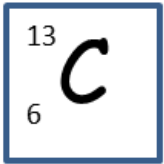
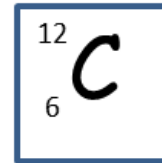
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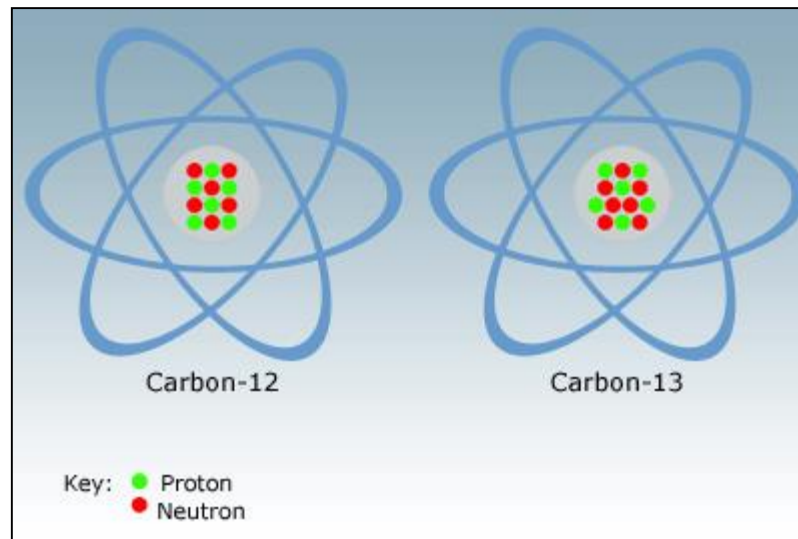
Most elements have different isotopes but there's usually only one or two stable ones.

ISOTOPES

Different forms of the same element



What are the features of isotopes?



Most elements have different isotopes but there's usually only one or two stable ones.

The other isotopes tend to be radioactive, which means that they decay into other elements and give out radiation. This is where all radioactivity comes from - unstable radioactive isotopes undergoing nuclear decay and spitting out high energy particles.

ATOMIC STRUCTURE

Supplement

WHAT EVIDENCE IS THERE?

ATOMIC STRUCTURE

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WHAT EVIDENCE IS THERE?

Describe how the scattering of α -particles by thin metal foils provides evidence for the nuclear atom

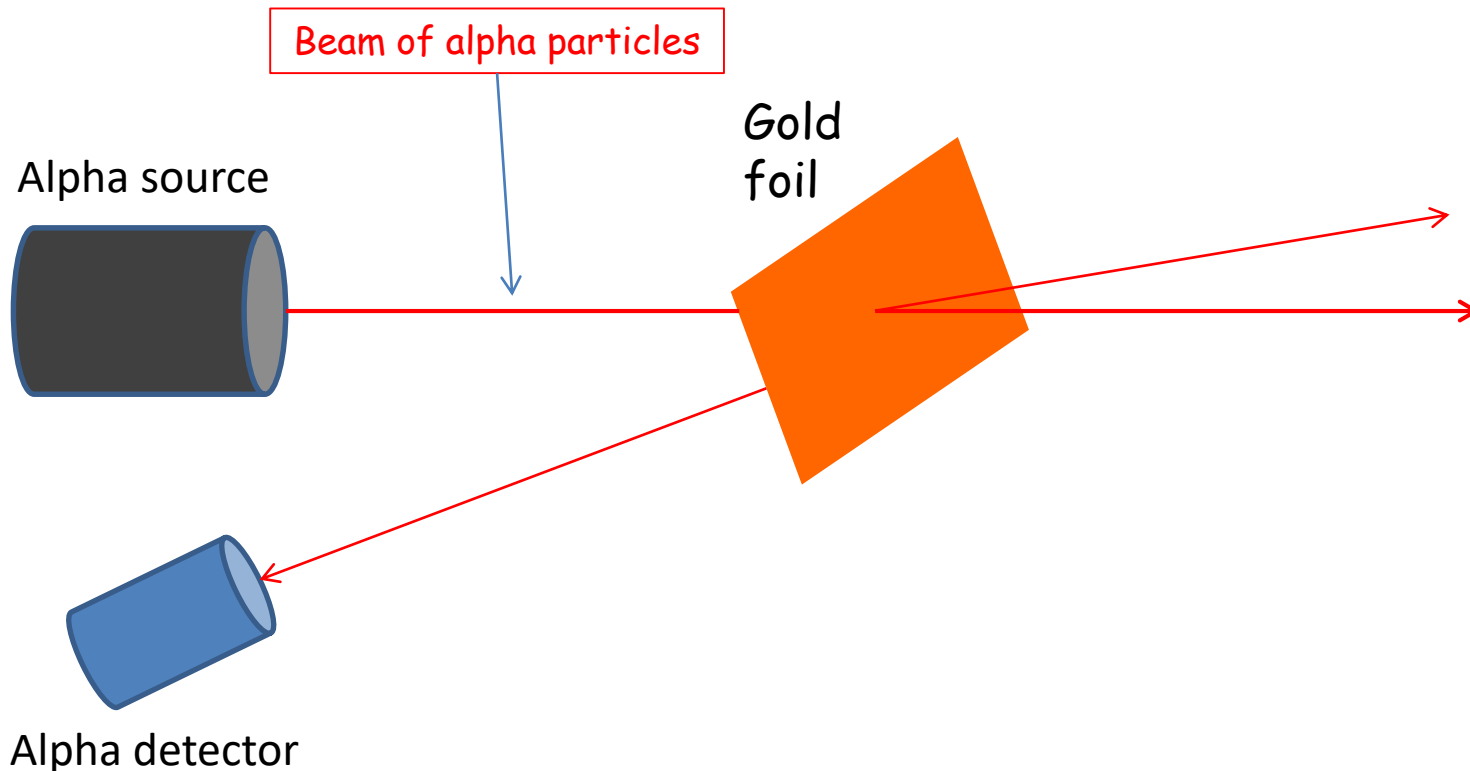
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1911 Rutherford, Geiger and Marsden



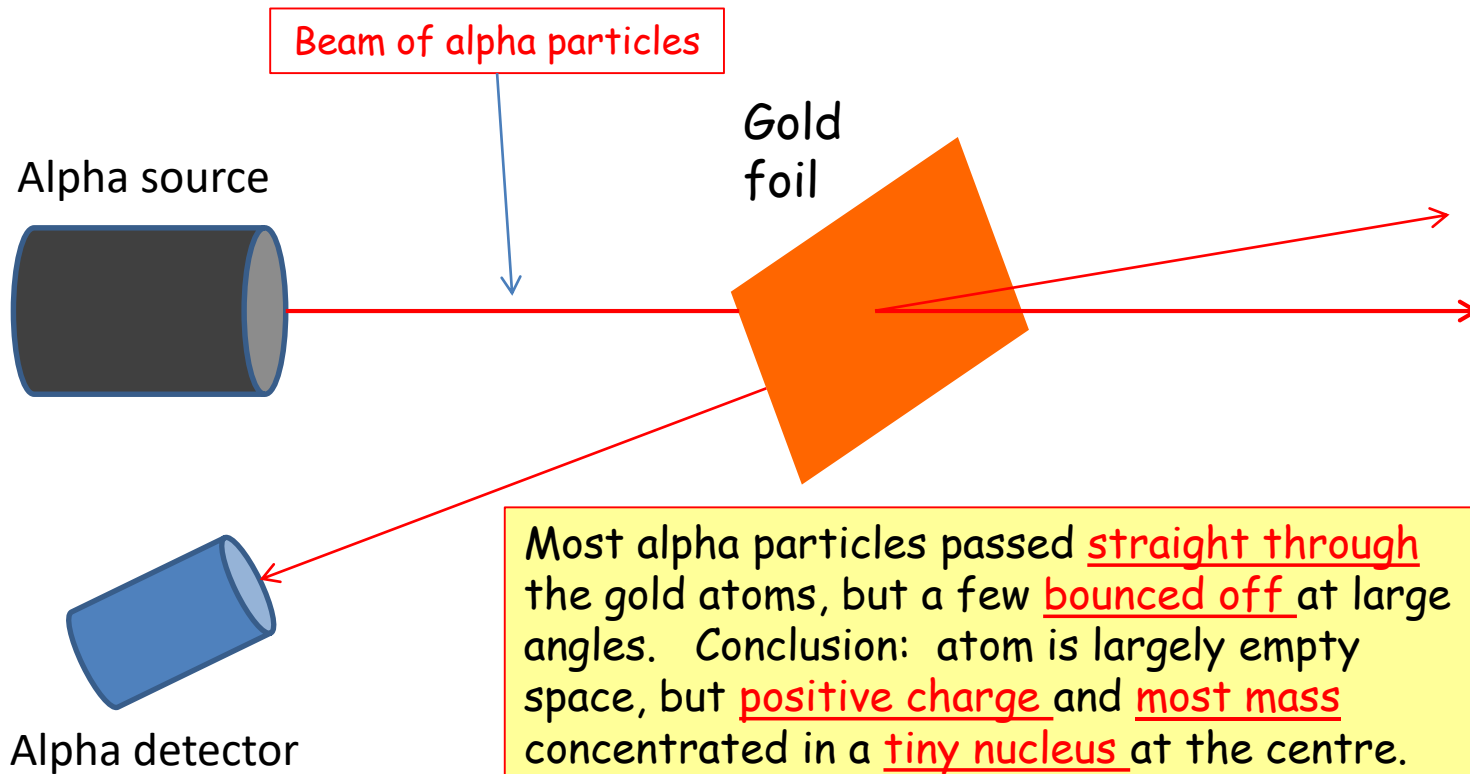
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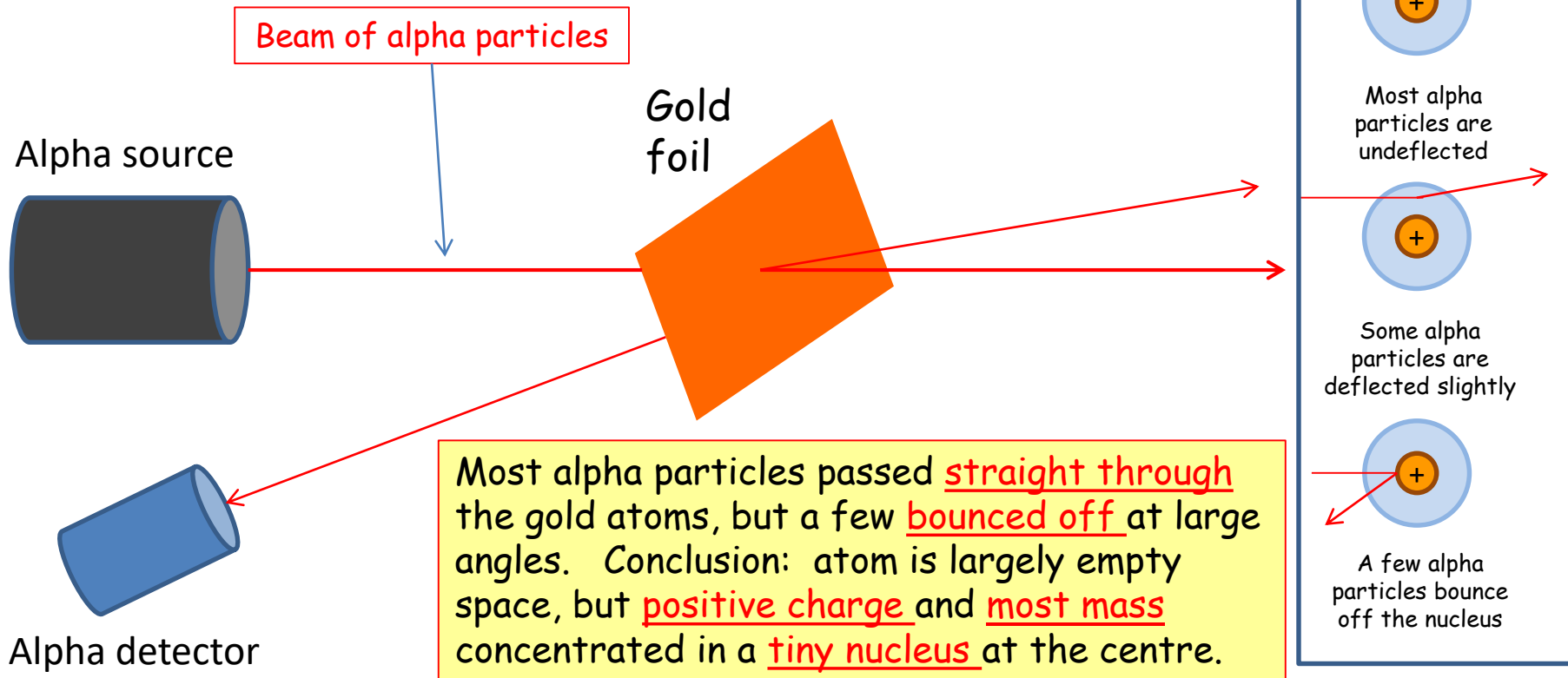
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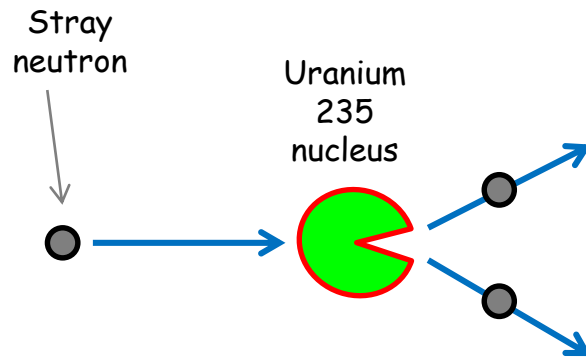
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ATOMIC STRUCTURE

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State the meaning of nuclear fission and nuclear fusion



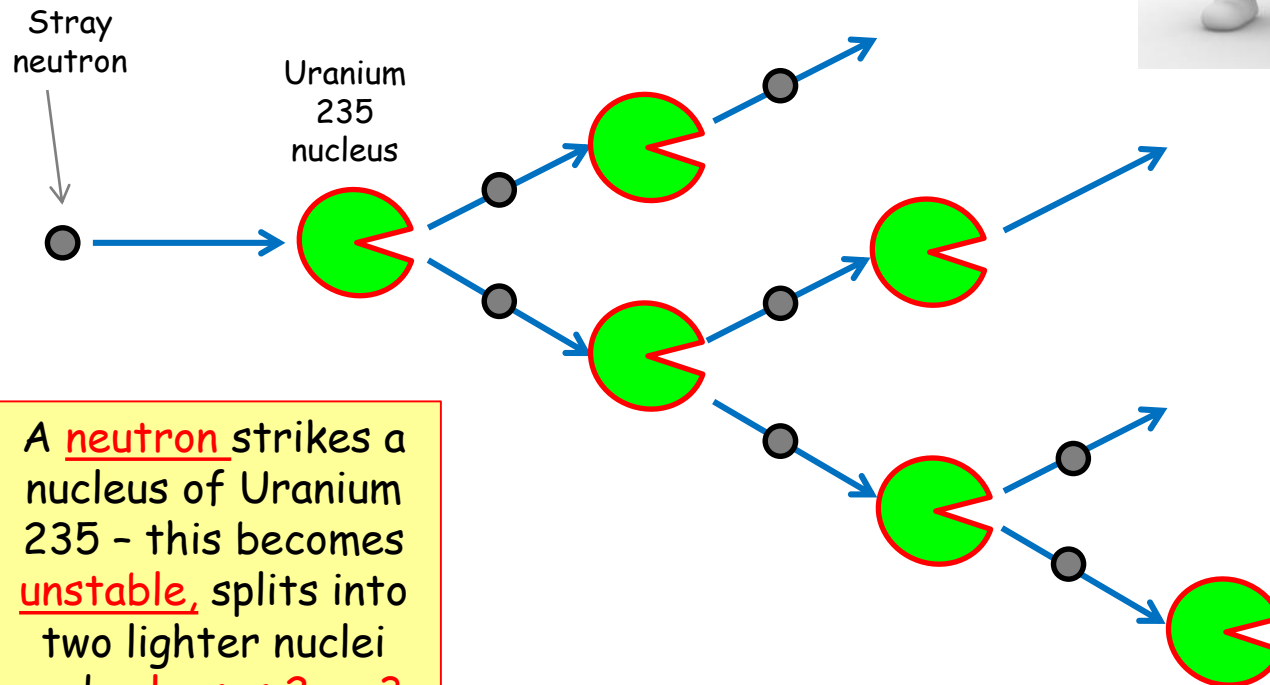
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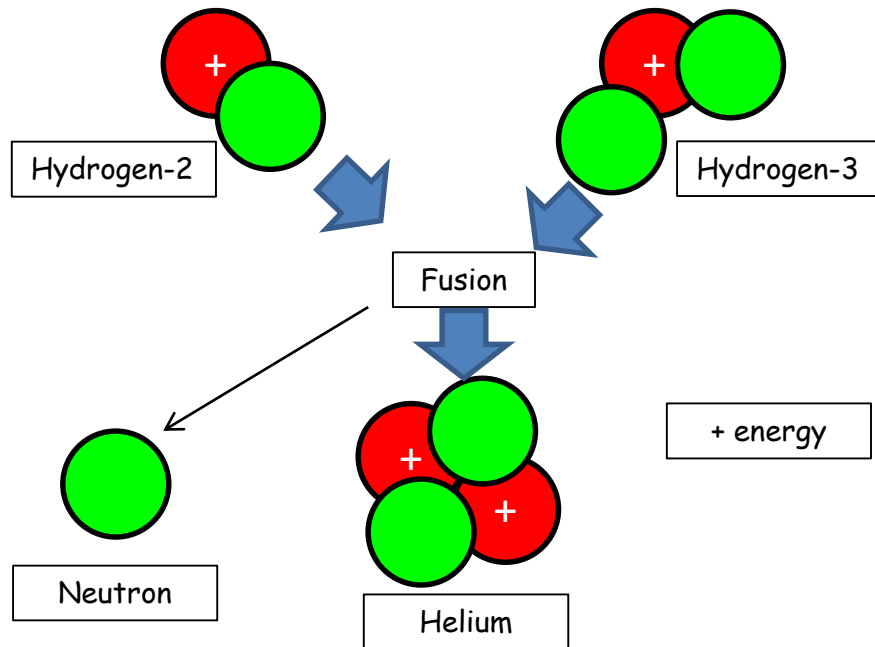
The emitted neutrons go on to split other nuclei, and so on ... the result is a chain reaction, releasing huge amounts of energy

ATOMIC STRUCTURE

Supplement

State the meaning of nuclear fission and nuclear fusion

Energy can be released by fusing (joining together) very light nuclei to make heavier ones. For example, two hydrogen nuclei can be joined together to form helium.

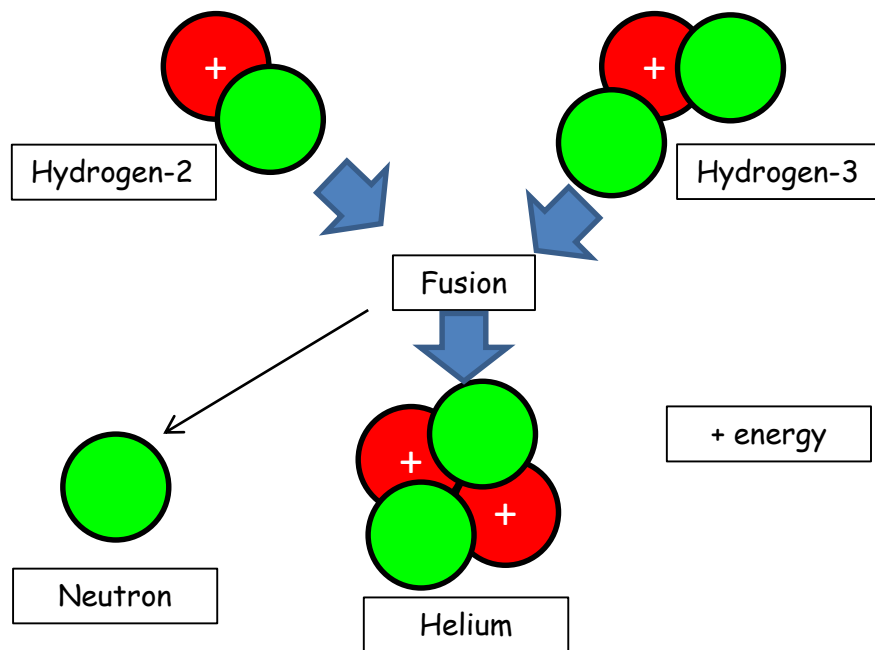


ATOMIC STRUCTURE

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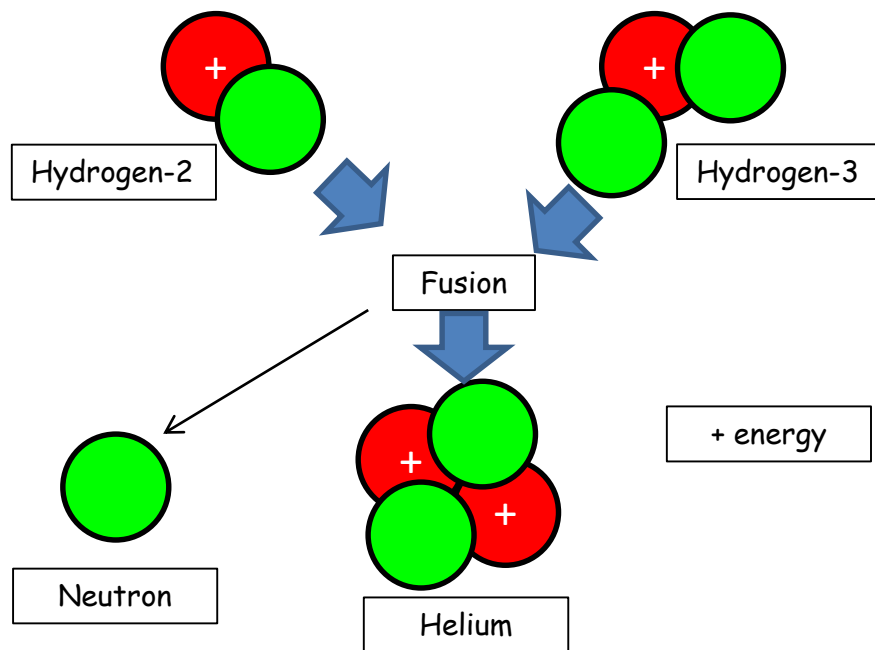
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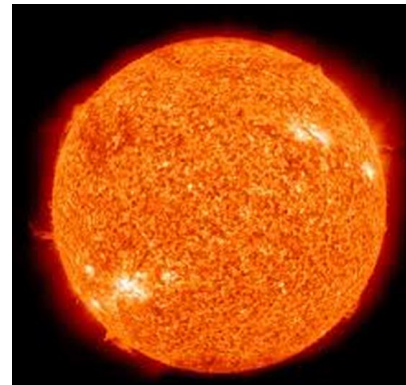
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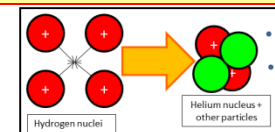
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Fusion occurs naturally on the Sun, where four hydrogen nuclei fuse to form helium.



LEARNING OBJECTIVES

Core

- Describe the structure of an atom in terms of a positive nucleus and negative electrons

- Describe the composition of the nucleus in terms of protons and neutrons
- State the charges of protons and neutrons
- Use the term proton number Z
- Use the term nucleon number A
- Use the term nuclide and use the nuclide notation ${}^A_Z\text{X}$
- Use and explain the term isotope

Supplement

- Describe how the scattering of α -particles by thin metal foils provides evidence for the nuclear atom
- State the meaning of nuclear fission and nuclear fusion
- Balance equations involving nuclide notation

PHYSICS
CLASS

$$E = m \cdot c^2$$

$$P = \frac{F}{A}$$

$$V = a \cdot t$$

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$



PHYSICS - The Nuclear Atom