Hydrogen nucleus
1 proton

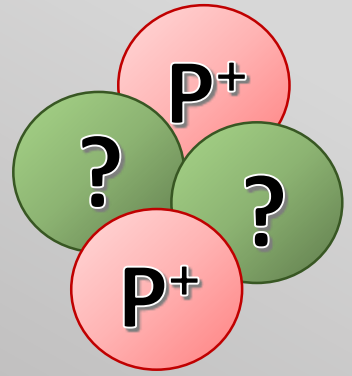
Helium nucleus
2 protons
4x the mass
? ? ? ?

James Chadwick

1
H
1.01

P+

2
He
4.00



Neutron

- Slightly more mass than a proton
- Neutral
- Help stabilize the nucleus

James Chadwick

1
H
1.01

P^+

2
He
4.00

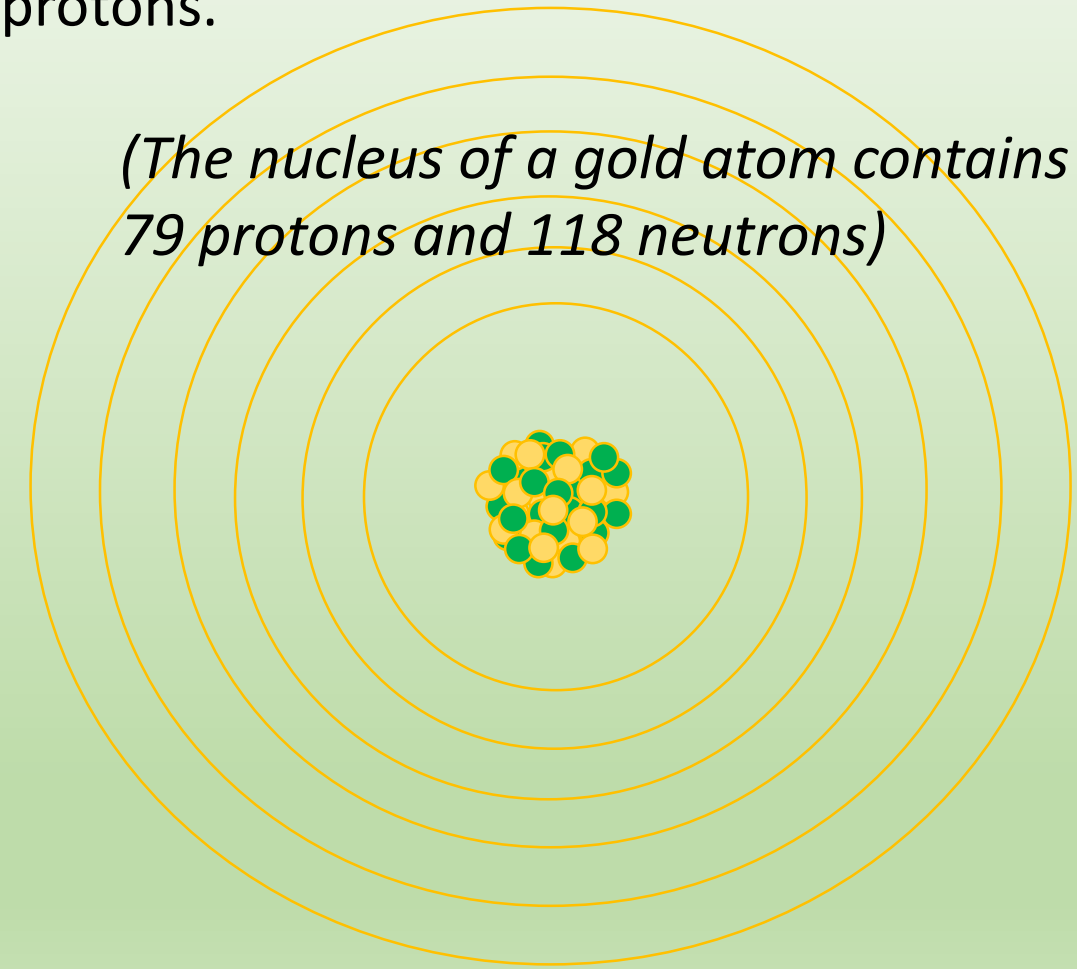
P^+ n^o n^o P^+

- The nucleus of an atom is made up of protons (+) and neutrons.
- Electrons (—) orbit the nucleus in specific energy levels

Subatomic particle	Electric charge	M (g)
Proton	Positive	1.67×10^{-24}
Neutron	Neutral	$\times 10^{-24}$
Electron	Negative	$\times 10^{-28}$

- The number of neutrons in a nucleus is not necessarily the same as the number of protons.

(The nucleus of a gold atom contains 79 protons and 118 neutrons)

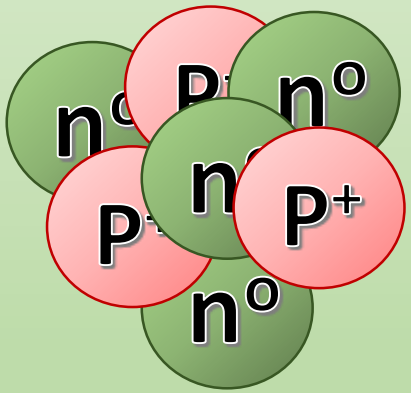


- Atoms of the same element must have the same number of protons as each other.

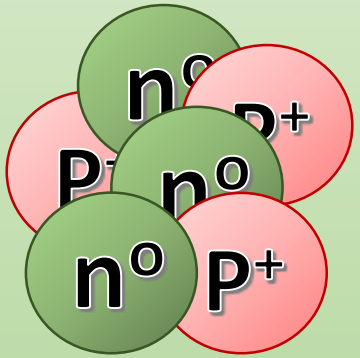
(All lithium atoms have 3 protons)

- Atoms of the same element do not necessarily have the same number of neutrons as each other.

(Most lithium atoms have 4 neutrons, some have 3 neutrons)



3
Li
6.94



- Atoms of the same element that have a different number of neutrons are called **isotopes**.

- The number of protons in the nucleus of an atom determines which element it is.

  The number of **protons** is called the **atomic number**.

- The mass of an atom is determined by the number of protons and neutrons in the nucleus of an atom *(electrons, being so much smaller, have little effect on the mass)*.

  The number of **protons + neutrons** is called the **mass number**.

Example: **Boron**

Boron atoms all contain 5 protons:

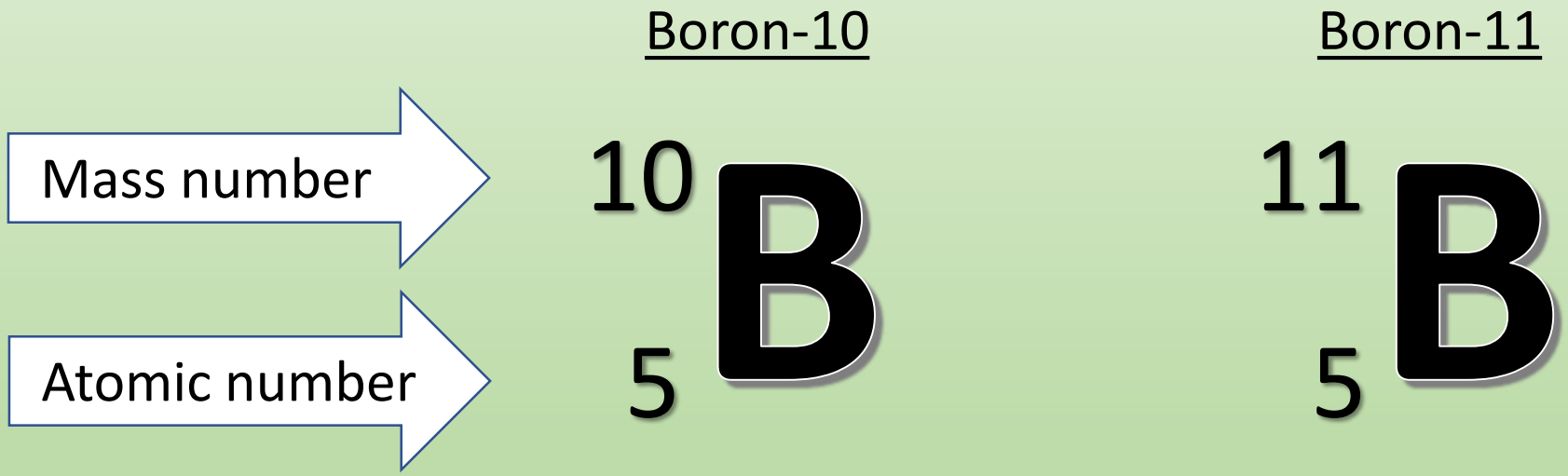
Atomic number = 5

Some boron atoms contain 5 neutrons:

Mass number = 10

Most boron atoms contain 6 neutrons:

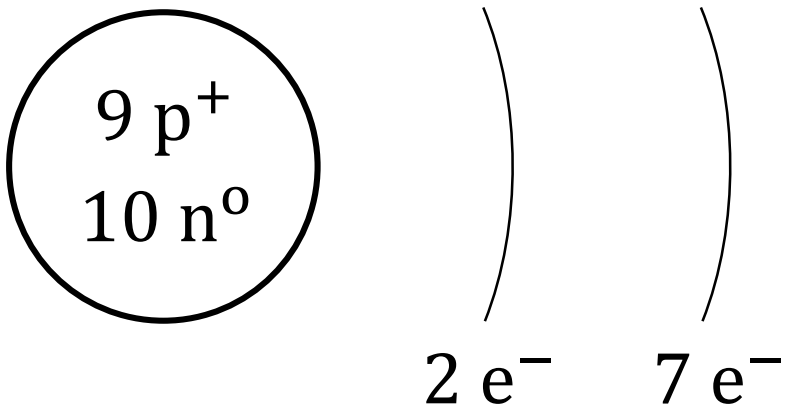
Mass number = 11



Illustrating Atoms *(to include neutrons)*

Simplified Atomic Model (SAM)

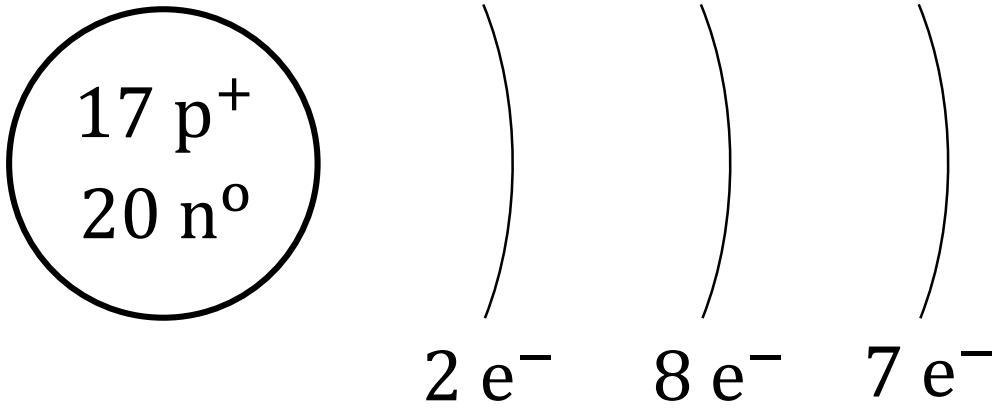
Fluorine-19 $^{19}_{9}\mathrm{F}$



Illustrating Atoms *(to include neutrons)*

Simplified Atomic Model (SAM)

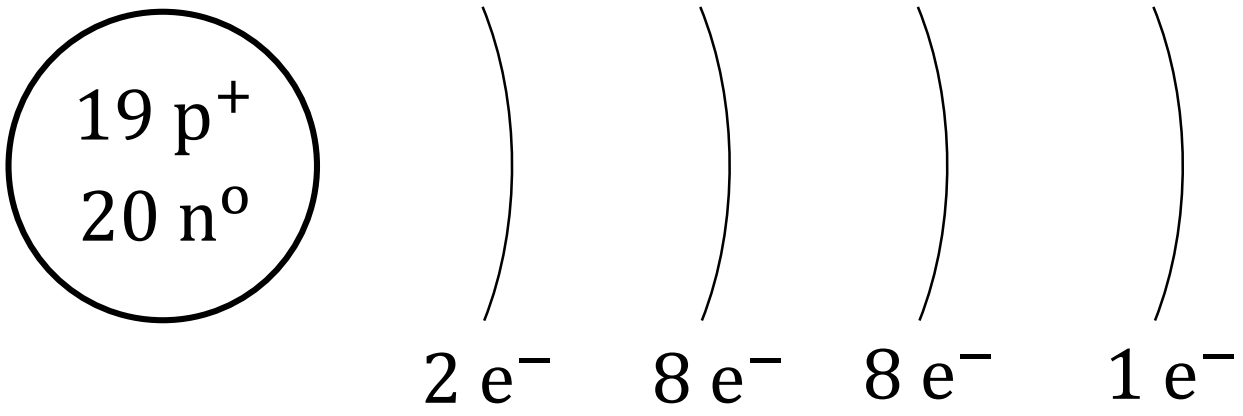
Chlorine-37 $^{37}_{17}\mathrm{Cl}$

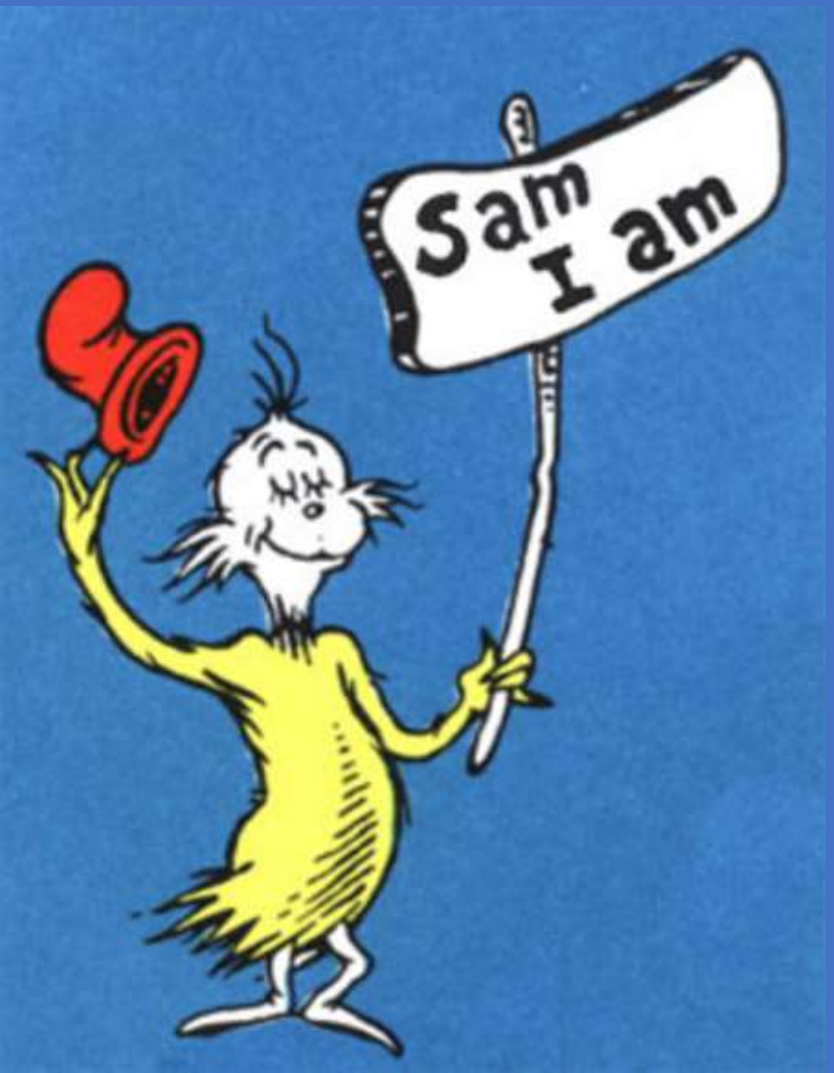


Illustrating Atoms *(to include neutrons)*

Simplified Atomic Model (SAM)

Potassium-39 $^{39}_{19}\mathrm{K}$





$19\ p^{+}$
$20\ n^{o}$

$2\ e^{-}$ $8\ e^{-}$ $8\ e^{-}$ $1\ e^{-}$