**Protons, Electrons, and Neutrons**

**Learning Goal 12:** I can determine the number of protons, neutrons, and electrons in atoms when given atom symbols, illustrations of basic atom models, and/or a periodic table.

**Subatomic Particles**: particles that compose atoms.

* **Protons**
* Located in the nucleus
  + - Positive charge
* **Neutrons**
* Located in the nucleus

**Vocabulary!**

* No charge
* **Electrons**
* Located in mostly empty space

surrounding the nucleus

* Negative charge
* Very, very tiny

* **Open the envelope labeled “Atom Card Set” and tear out the “Atom Data Sheet” on page \_\_\_\_\_\_\_.**

This card set contains ten cards:

* + Five of the cards show illustrations of the subatomic particles in

lithium atoms.

* + Five of the cards show illustrations of the subatomic particles in

nitrogen atoms.

The subatomic particles on each card are illustrated as shown below:

**Atom Card Key**

**Nucleus**

**Neutron (White)**

**Proton (Red)**

**Electron (Black)**

* Sort the cards into two groups based on whether they illustrate

lithium or nitrogen atoms.

* Count the number of protons, neutrons, and electrons on each card

and record your answers on the “**Atom Data Sheet**”.

**Part 1: Protons**

* **Use the information that you recorded on the “Atom Data Sheet”**

**to answer the following questions.**

* + Which subatomic particle is present in the same amount in all

of the lithium atoms?



* Which subatomic particle is present in the same amount in all

of the nitrogen atoms?



* What do you think determines the identity of an atom - the

number of protons, the number of neutrons, or the number

of electrons?



* **Look at the atom symbol indicated for each atom on the cards and**

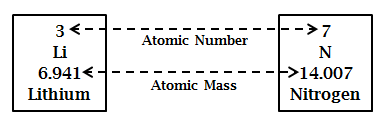
**the “Atom Data Sheet”.**

* Which part of the atom symbol do you think indicates the number

of protons?



* **Look at the periodic table boxes for lithium and nitrogen.**



* Which number in the periodic table boxes do you think indicates

the number of protons?



The **Atomic Number**:

* + is the whole number in the periodic table square.
  + is the bottom, left number in an atom symbol.
  + is always equal to the number of protons.

**Vocabulary!**

* + is equal to the number of electrons in a **neutral**

**atom.** (See Part 2: Electrons.)

* + will tell you the identity of an atom, because

each atom has a different atomic number.

* **Ask your teacher for a set of “Proton Task Cards” and get out the**

**“Task Card Answer Sheet”.**

* Answer each of the questions on the Proton Task Cards. **Record your**

**answers on your “Task Card Answer Sheet”.**

**Part 2: Electrons**

* **Look at the handout titled “Atoms and Charge”.**

This handout illustrates the number of protons and electrons that

can be found in lithium and nitrogen atoms.

* Notice that:
  + each proton adds one positive (+) charge to the atom.
  + each electron adds one negative (-) charge to the atom.
  + there are two versions of each atom, neutral and ion

**Neutral Atoms**

* **Look at the neutral lithium and nitrogen atoms on the “Atoms**

**and Charge” card.**

* + What do you notice about the number of protons relative to the

number of electrons in a neutral atom?



* **Look at the atom symbols below. They are the atom symbols for**

**neutral lithium and neutral nitrogen atoms.**

73Li 147N

* + What part of the atom symbol can you use to determine the

number of electrons in a neutral atom? (Hint: Think about your

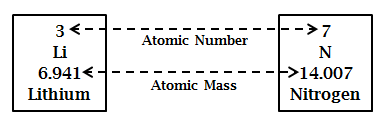
answer to the previous question and what you just learned about

protons.)



* **Look again at the periodic table squares for lithium and nitrogen**

**shown below.**



* Which number do you think indicates the number of electrons

in a neutral atom, the atomic number or the atomic mass?



A **neutral atom** has the same number of

**Vocabulary!**

electrons and protons.

The charge of a neutral atom is equal to zero.

**Ions**

* **Return to the handout titled “Atoms and Charge”.**
  + **Look at the lithium ion on the “Atoms and Charge” card.**
  + What happens to the electrons of a neutral lithium atom when it

becomes a lithium ion?



* **Look at the atom symbols below. They are the atom symbols for**

**neutral lithium atoms and lithium ions.**

73Li 73Li1+

* + What is the difference between the atom symbol for the neutral

lithium atom and the atom symbol for the lithium ion?



* + Why does the lithium ion symbol have a positive charge? (Hint:

Refer back to the “Atoms and Charge” card.)



* + What do you think the small number “1” indicates in the lithium

ion atom symbol? (Hint: Refer back to the “Atoms and Charge”

card.)



* When an ion has a positive charge, it means that the atom has

\_\_\_\_\_\_\_\_\_ (less or more) electrons than its neutral form.



**Vocabulary!**

An **ion** is an atom with a charge.

An ion with a positive charge is called

a **cation.**

**Vocabulary!**

A cation is formed when a neutral atom

**loses electrons.**

* **Return to the handout titled “Atoms and Charge”.**
  + **Look at the nitrogen ion on the “Atoms and Charge” card.**
  + What happens to the electrons of a neutral nitrogen atom when it

becomes a nitrogen ion?



* **Look at the atom symbols below. They are the atom symbols for**

**neutral nitrogen atoms and nitrogen ions.**

147N 147N3-

* + What is the difference between the atom symbol for the neutral

nitrogen atom and the atom symbol for the nitrogen ion?



* + Why does the nitrogen ion symbol have a negative charge? (Hint:

Refer back to the “Atoms and Charge” card.)



* + What do you think the small number “3” indicates in the nitrogen

ion atom symbol? (Hint: Refer back to the “Atoms and Charge”

card.)



* When an ion has a negative charge, it means that the atom has

\_\_\_\_\_\_\_\_\_ (less or more) electrons than its neutral form.



An ion with a negative charge is called

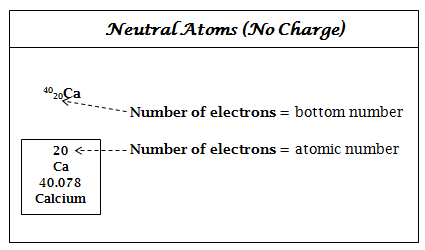
an **anion.**

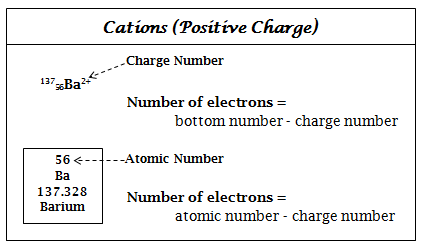
**Vocabulary!**

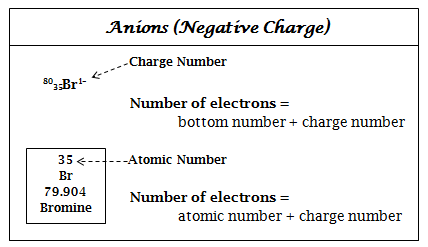
An anion is formed when a neutral atom

**gains electrons.**

* **Summary: How to determine the number of electrons.**







* **Ask your teacher for a set of “Electron Task Cards” and get out the**

**“Task Card Answer Sheet”.**

* Answer each of the questions on the Electron Task Cards. **Record your**

**answers on your “Task Card Answer Sheet”.**

**Part 3: Neutrons**

* **Return to the information that you recorded on your “Atom Data**

**Sheet”.**

* **Look at the three neutral lithium atoms.**
  + What are two differences between the three neutral lithium atoms?



* **The top number to the left of the atom symbol is called the mass**

**number.**

The mass number is equal to the sum of two of the subatomic particles.

* Use the information on your “Atom Data Sheet” to determine

whether the mass number is equal to: the number of protons plus

electrons, the number of protons plus neutrons, or the number of

neutrons plus electrons.



* How can you determine the number of neutrons in an atom?

(Hint!: Refer back to your last answer and construct a mathematic

equation.)



* How can you use an atom symbol to determine the number of

neutrons in an atom? (Hint: Remember, the top number is

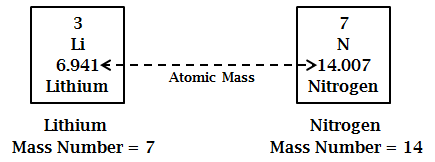
the mass number and the bottom number is the number of

protons.)



* **Look again at the periodic squares for lithium and nitrogen below.**

The mass numbers for lithium and nitrogen are also shown.



* Compare the atomic mass and mass number for lithium and nitrogen.
* How is the mass number related to the atomic mass?



* How can you use the periodic table to determine the number of

neutrons? (Hint: Remember, the atomic number is equal to the

number of protons and the atomic mass (rounded) is equal to

the mass number.)



The **Atomic Mass**:

* is equal to the average weighted mass of the

different forms of the same type of atom.

* is usually written as a decimal in the periodic

table.

The **Mass Number**:

**Vocabulary!**

* is equal to the mass of a particular form of an

atom.

* is often written as the atomic mass rounded to

a whole number.

* is the top, left number in an atom symbol.
* is equal to the # protons + # neutrons.
* **Ask your teacher for a set of “Neutron Task Cards” and get out the**

**“Task Card Answer Sheet”.**

* Answer each of the questions on the Neutron Task Cards. **Record your**

**answers on your “Task Card Answer Sheet”.**

* **Indicate the location and number of protons, electrons, and**

**neutrons in each of the atoms shown below.** The first one has

been done for you.

p = protons

n = neutrons

e = electrons

Cl

168O2-

115B

5e

5p, 6n

199F

Mg2+

188O

Ba

4020Ca2+

21H1+

**Protons, Electrons, and Neutrons**

**Study Sheet – Page 1**

**Vocabulary**

**Subatomic Particle**: particles smaller than an atom

**Proton**: a positively charged subatomic particle located

in the nucleus of an atom

**Electron:**  a tiny, negatively charged subatomic particle

located in mostly empty space around the nucleus of

an atom

**Neutron:** a subatomic particle with no charge located in

the nucleus of an atom

**Neutral Atom**: an atom with the same number of protons

and electrons

**Ion**: an atom that has gained or lost electrons - creates

a positive or negative charge on the atom

**Cation**: an atom that has LOST one or more electrons -

creates a positive charge on the atom

**Anion**: an atom that has GAINED one or more electrons –

creates a negative charge on the atom

**Atomic Number**: indicates the number of protons;

indicates the number of electrons in a neutral atom;

is the whole number in periodic table blocks; is the

bottom, left number in an atom symbol.

**Atomic Mass**: is the average weighted mass of all of the

forms of a particular type of atom; is the decimal

number in the periodic table

**Mass Number**: describes the mass of each form of an

of an atom; can be equal to the atomic mass rounded

to a whole number; is used in calculations to determine

determine the number of neutrons; is the top, left

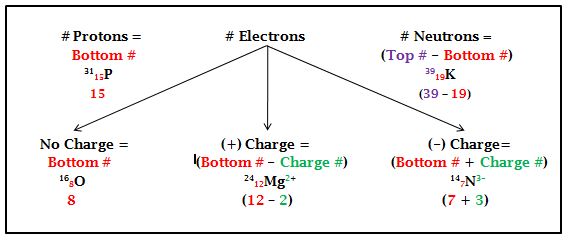
number in an atom symbol

**Protons, Electrons, and Neutrons**

**Study Sheet – Page 2**

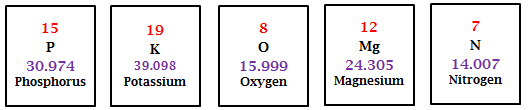
**How to Find the Number of Protons, Electrons, and Neutrons**

**from an Atom Symbol**



**How to Find the Number of Protons, Electrons, and Neutrons**

**from the Periodic Table**



** \*\*Round atomic mass numbers to a whole number!**

**Atoms and Charge**

**Lithium Atom – Neutral, Li**

**Li**

**Proton Charges**:

**Electron Charges**:

**Lithium Atom – Ion, Li1+**

**Li1+**

**Proton Charges**:

**Electron Charges**:

**Nitrogen Atom – Neutral, N**

**N**

**Proton Charges**:

**Electron Charges**:

**Nitrogen Atom – Ion, N3-**

**N3-**

**Proton Charges**:

**Electron Charges**:

**Atom Data Sheet**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Symbol** | **Type of Atom** | **# Protons** | **# Electrons** | **#Neutrons** |
| **63Li** | lithium atom - neutral |  |  |  |
| **73Li** | lithium atom - neutral |  |  |  |
| **93Li** | lithium atom - neutral |  |  |  |
|  |  |  |  |  |
| **63Li1+** | lithium ion (cation) |  |  |  |
| **73Li1+** | lithium ion (cation) |  |  |  |
|  |  |  |  |  |
| **137N** | nitrogen atom – neutral |  |  |  |
| **147N** | nitrogen atom – neutral |  |  |  |
| **157N** | nitrogen atom - neutral |  |  |  |
|  |  |  |  |  |
| **147N3-** | nitrogen ion (anion) |  |  |  |
| **157N3-** | nitrogen ion (anion) |  |  |  |

**Task Card Answer Sheet**

**Proton Task Card Answers**

**Card Color \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

|  |  |  |  |
| --- | --- | --- | --- |
| **1** | **2** | **3** | **4** |
| **5** | **6** | **7** | **8** |

**Electron Task Card Answers**

**Card Color \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

|  |  |  |  |
| --- | --- | --- | --- |
| **1** | **2** | **3** | **4** |
| **5** | **6** | **7** | **8** |

**Neutron Task Card Answers**

**Card Color \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

|  |  |  |  |
| --- | --- | --- | --- |
| **1** | **2** | **3** | **4** |
| **5** | **6** | **7** | **8** |