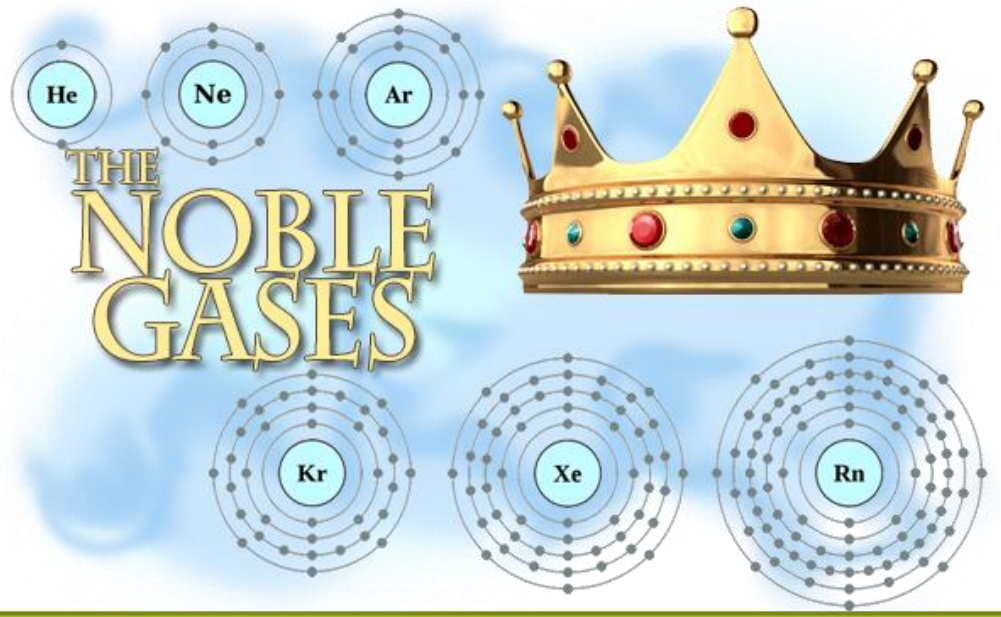
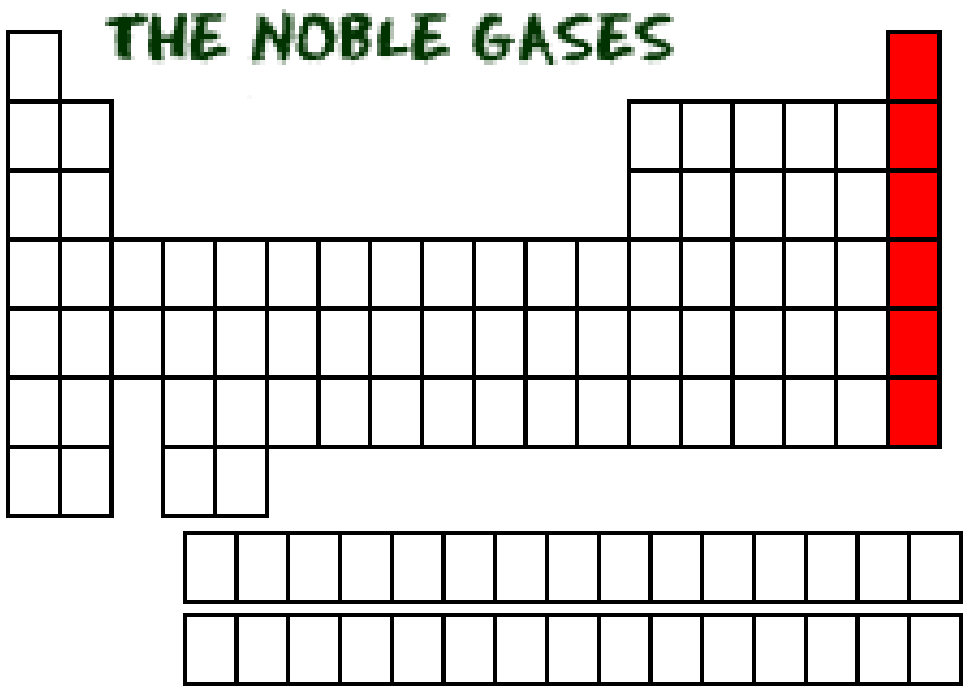


N 13 – Noble Gas Configurations and Configurations of Ions

Noble Gases

Have a full "valence shell" – meaning their outer s and p orbitals are full! "8 is great!"

- **Makes them very stable**
- **They don't react with other things**
- **They are "inert"**



Noble Gases – Examples of Full Shells

He: $1s^2$

Ne: $1s^2\ 2s^2\ 2p^6$

Ar: $1s^2 2s^2 2p^6\ 3s^2\ 3p^6$

Kr: $1s^2 2s^2 2p^6 3s^2 3p^6\ 4s^2\ 3d^{10}\ 4p^6$

Xe: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6\ 5s^2\ 4d^{10}\ 5p^6$

Finding Noble Gas Configuration

A short cut method of writing configurations

- Since noble gases are "special" – reference all configurations against the PREVIOUS noble gas
    1. Find the previous noble gas
    2. Write that noble gas in brackets [ ]
    3. List any remaining electron configuration left over until you get to the element you are trying to write

He: $1s^2$

Lithium

$1s^2$ $2s^1$

Helium + extra!

[He] $2s^1$

He: $1s^2$

Nitrogen

$1s^2$ $2s^2 2p^3$

Helium + extra!

[He] $2s^2 2p^3$

Ne: $1s^2 2s^2 2p^6$

Sodium

$1s^2 2s^2 2p^6$ $3s^1$

Neon + extra!

[Ne] $3s^1$

Noble Gas Configurations!

Previous = Ar

Iron

$1s^2 2s^2 2p^6\ 3s^2\ 3p^6$

$4s^2 3d^6$

Argon + extra!

$[Ar]\ 4s^2 3d^6$

Previous = Xe

Barium

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2\ 3d^{10} 4p^6\ 5s^2\ 4d^{10}\ 5p^6$

$6s^2$

Xenon + extra!

$[Xe]\ 6s^2$

Previous = Ar

Krypton

$1s^2 2s^2 2p^6\ 3s^2\ 3p^6$

$4s^2 3d^{10} 4p^6$

Argon + extra!

$[Ar]\ 4s^2 3d^{10} 4p^6$

Noble Gas Configuration!

Configurations of Ions

Ion

- An atom with a charge
- Has a change to it's normal # of electrons

(normally #protons = #electrons → neutral, no charge)

Why make ions???

Atoms want to look like a noble gas!!!

They want a full s and p orbital set!

Making Ions

Cation	Anion
Lost e-	Gained e-
p+ > *e*-	*p*+ < *e*-
+++ > --	+++ < ----
+ Charge	- Charge

How do you know how many electrons to loose or gain?

Look for the CLOSEST noble gas! Adjust your # of electrons until you are at the closest one.

Finding the Closest Noble Gas

Lithium	Calcium	Phosphorus
3 e-	20 e-	15 e-
He = 2 e-	Ar = 18 e-	Ne = 10 e-
Ne = 10 e-	Kr = 36 e-	Ar = 18 e-
Helium is closer!	Argon is closer!	Argon is closer!
Lose 1 e- to look like Helium	Lose 2 e- to look like Argon	Gain 3 e- to look like Argon
Li^{+}	Ca^{2+}	P^{3-}

Which electrons are you removing when making cations?

Always remove highest ENERGY LEVEL electrons first!

We do not REMOVE electrons from orbitals in the same order that we filled the orbitals!

Once orbitals have electrons in them, their energy levels shift around

BE CAREFUL with d-block and f-block elements!

Configuration of Ions - Examples

Li: $1s^2\ 2s^1$

Li^+: $1s^2$

Now it looks just like Helium doesn't it!

Highest Energy Level Electrons – 4 is highest! LOSE THOSE ELECTRONS FIRST!

Configuration of Ions - Examples

Ca: $1s^2 2s^2 2p^6 \ 3s^2 \ 3p^6 \ 4s^2$

Highest Energy Level Electrons – 4 is highest! LOSE THOSE ELECTRONS FIRST!

Ca^{2+}: $1s^2 2s^2 2p^6 \ 3s^2 \ 3p^6$

Now it looks just like Argon doesn't it!

Configuration of Ions – d-block

d-block elements are called "transition metals." They can make several different charges.

Cu: $1s^2 2s^2 2p^6 \ 3s^2 \ 3p^6 \ 4s^2 \ 3d^9$

Cu^+: $1s^2 2s^2 2p^6 \ 3s^2 \ 3p^6 \ 4s^1 \ 3d^9$

CAREFUL!!!

Highest Energy Level Electrons – 4 is highest! LOSE THOSE ELECTRONS FIRST!

Configuration of Ions – d-block

d-block elements are called "transition metals." They can make several different charges.

Cu: $1s^2 2s^2 2p^6 \ 3s^2 \ 3p^6 \ 4s^2 \ 3d^9$

Cu^{2+}: $1s^2 2s^2 2p^6 \ 3s^2 \ 3p^6 \ 3d^9$

CAREFUL!!!

Highest Energy Level Electrons – 4 is highest! LOSE THOSE ELECTRONS FIRST!

Configuration of Ions

No matter what, take electrons from the highest energy level orbitals!

- **Take from highest p,**
- **Then highest s,**
- **Then come back and do lower d if needed**

Configuration of Ions

Ga: $1s^2 2s^2 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10} 4p^1$

Ga^+: $1s^2 2s^2 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}$ — Take 4p first

Ga^{2+}: $1s^2 2s^2 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^{10}$ — Take 4s next

Ga^{3+}: $1s^2 2s^2 2p^6\ 3s^2\ 3p^6\ 3d^{10}$ — Take last 4s

Ga^{4+}: $1s^2 2s^2 2p^6\ 3s^2\ 3p^6\ 3d^9$ — THEN you can take 3d !