Electron Configurations

Video Workbook with Dr. B

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Enhance your learning by watching my step-by-step video as you follow along with this guide.

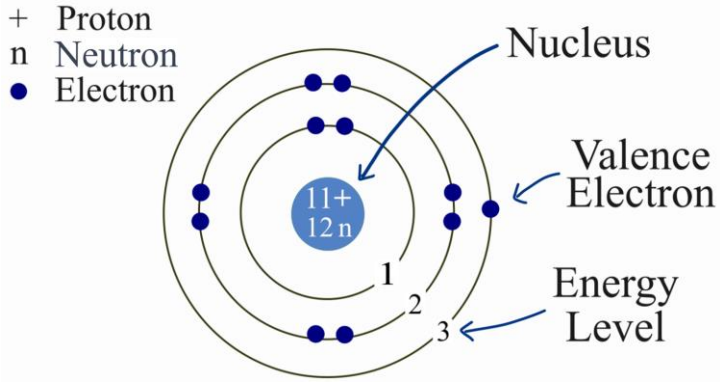
Be active in your learning! Work problems, check your work, and find areas where you are weak and focus your study there.

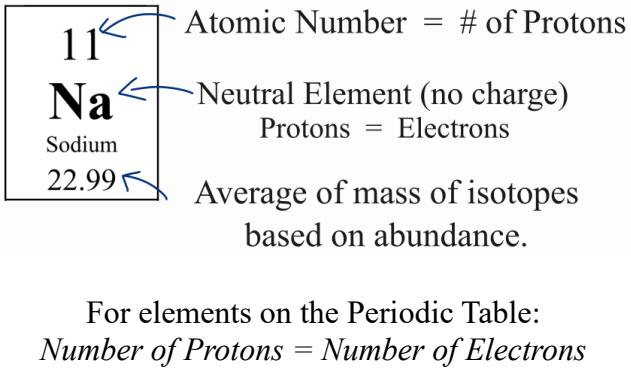
Table of Contents and Key Skills:

- Find the *number of electrons* for an element/atom.
- Write *electron configuration notation*: $1s^2 2s^2 2p^6$ …
- Find the *number of valence electrons* from the electron configuration for an element.
- Write electron *configurations for ions*.
- Write *condensed electron configurations* for elements.
- Recognize *exceptional electron configurations*.

Steps for Writing Electron Configurations

1. **Determine the Number of Electrons**: The total number of electrons in a neutral atom equals its atomic number.
2. **Fill Orbitals Across Energy Levels**: Starting from the lowest energy orbital, move across periods (rows) on the periodic table to fill orbitals (1s, 2s, 2p, 3s, etc.).
3. **Verify Electron Count**: The total number of electrons used should match the atomic number of the element.





For elements on the Periodic Table:
Number of Protons = Number of Electrons

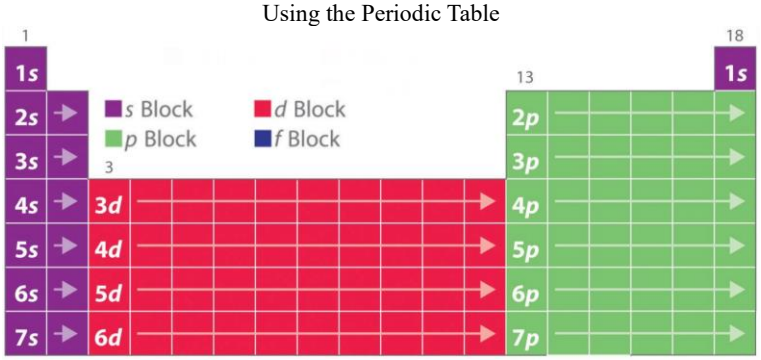
Practice: Determine the total number of electrons for each element:

19	82	30	15
K	**Pb**	**Zn**	**P**
Potassium	Lead	Zinc	Phosphorus
39.10	207.2	65.38	30.97

More Practice: How to find the number of electrons for elements and ions.

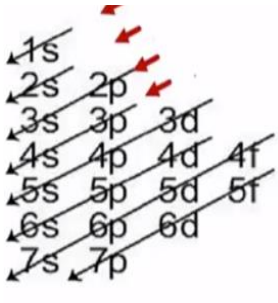
There are two main ways to write the electron configurations for elements.

Using the Periodic Table



Watch the video for further explanation.

Using the Diagonal Chart



Watch the video for a full explanation.

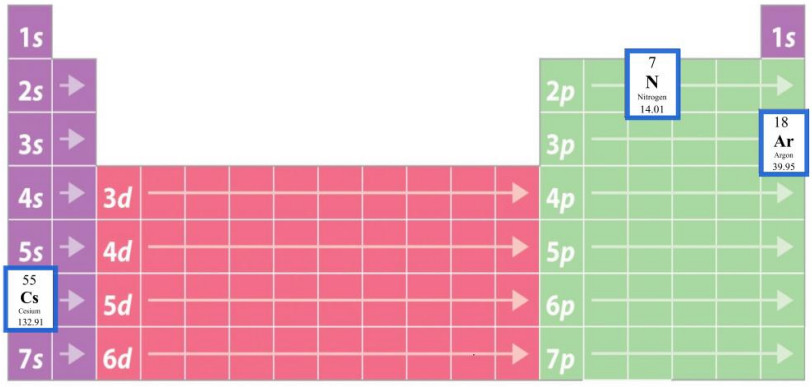
Example: Sodium (Na) is atomic number 11. It has 11 protons and 11 electrons.

Using the Periodic Table below:

- There are *two* electrons in the 1st energy level ($1s^2$).
- There are *eight* electrons in the 2nd energy level ($2s^2 2p^6$).
- There is one electron in the 3rd energy level ($3s^1$).

11
Na
Sodium
22.99

The electron configuration is $1s^2\ 2s^2\ 2p^6\ 3s^1$. The superscripts add up to 11.



Practice: Write the configurations for:

Nitrogen (N):

Argon (Ar):

Cesium (Cs):

Memorize this!

s = 2 p = 6 d = 10 f = 14

Valence Electrons: Electrons in highest energy level. Involved in chemical bonding.

For example: $1s^2$ $2s^2\ 2p^2$

Typically considered to be electrons in the s and p sublevels.

Transition metals get a bit more complicated.

Practice: How many valence electrons?

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

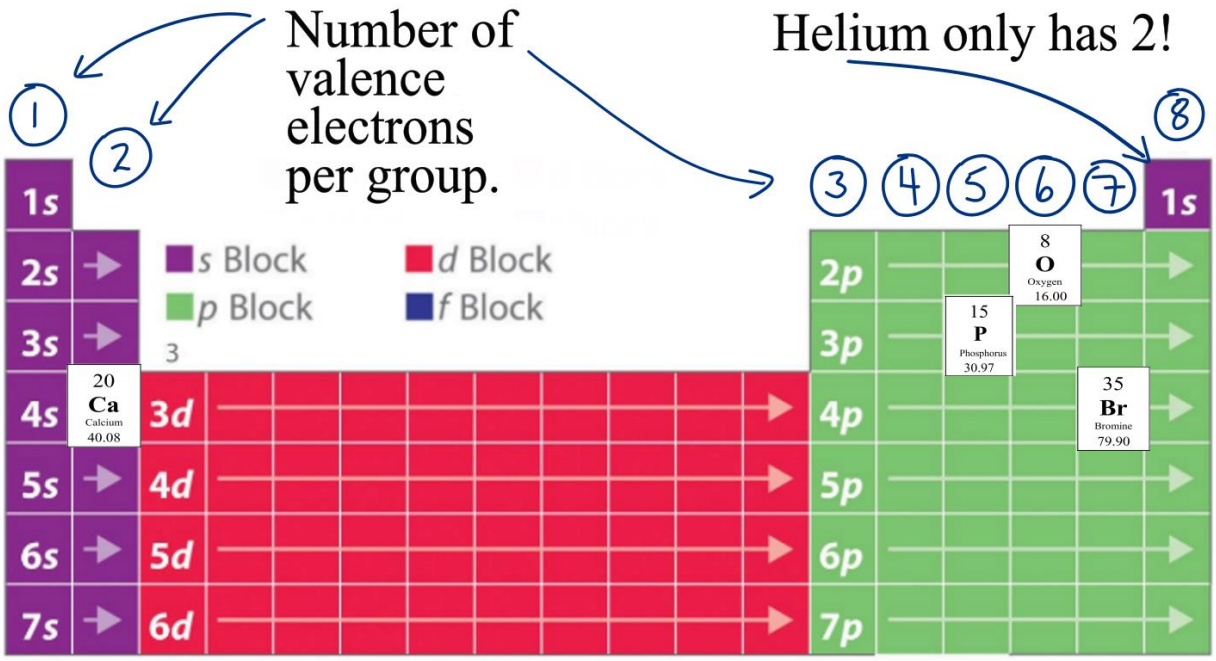
Cl $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$

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

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

The Periodic Table is About Patterns!

Here's how to quickly determine the number of valence electrons for an element. We can do this because of the patterns found in the Periodic Table.



Practice: How many valence electrons are there for: Ca: _____ Br: _____ O: _____ P: _____

Electron Configurations for Ions

For **positive ions** we remove electrons.	For **negative ions** we add electrons.
Na is $1s^2\ 2s^2\ 2p^6\ 3s^1$ Na^+ is $1s^2\ 2s^2\ 2p^6$	Cl is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$ Cl^- is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

Practice: Complete the table below.

Atom Configuration	Ion Configuration
Ca $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$	Ca^{2+}
P $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$	P^{3-}
O $1s^2\ 2s^2\ 2p^4$	O^{2-}
Br $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^5$	Br^-
H $1s^1$	H^+

Condensed Electron Configuration

1. Find the element on the periodic table.
2. Write the electron configuration for electrons in the highest energy level.
3. Use noble gas notation to write the nearest noble gas before the element. For example, Li would be $[He]2s^1$

More help: How to write condensed electron configurations.

Practice: Write the *condensed* electron configurations for the following:

Atom Configuration	Condensed Configuration
Ca $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$	Ca
P $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$	P
O $1s^2\ 2s^2\ 2p^4$	O
Br $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 3p^5$	Br
H $1s^1$	H

Exceptional Electron Configurations

Be familiar with the electron configurations of Cr and Cu, as these are common exam topics.

Both elements exhibit unique configurations that achieve lower energy and increased stability, Cr by half-filling and Cu by fully filling their d subshells.

See my video on Exceptional Electron Configurations.

Exceptional electron configurations.

Extra Practice with Video Explanations

1. Which neutral element has the electron configuration $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2$?
2. What will the last term be in the electron configuration for Mg?
3. How many valence electrons will there be for Cl ($1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$) ?
4. Atoms form ions to achieve _____ configuration to be more stable.
5. What is the condensed configuration for Cl?

1. There are 30 total electrons the atomic number is 30. This is Zinc (Zn). Video Solution
2. You could use the pattern we learned for the periodic table to quickly see it is $3s^2$ Video Solution
3. The highest energy level is 3. So, we add all the electrons in that level. 2 + 5 = 7
4. A Noble gas configuration.
5. $[Ne]\ 3s^2 3p^5$ Video Solution

Write the electron configurations for each element:

Easy	*Medium*	*Difficult*
H https://youtu.be/2_ZlpPKpZzM	F https://youtu.be/ewEy4iEUoOA	Cr https://youtu.be/lwIXF2IHFzU
Li https://youtu.be/IHLuzmv2VzU	Cl^- https://youtu.be/11o5HVFulvE	Cu https://youtu.be/At3j7r1shxE
Mg https://youtu.be/SKISUNpctr8	Kr https://youtu.be/fwTviVyk0TY	Fe https://youtu.be/HcXj60cSUX4

Answers

H $1s^1$

Li $1s^2 2s^1$

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

F $1s^2 2s^2 2p^5$

Cl⁻ $1s^2 2s^2 2p^6 3s^2 3p^6$

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

Cr $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$

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

Fe $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$

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To be added later.