

Lesson 2: Part I - Bohr Diagrams

Notes:

The purpose of these diagrams is to show the nucleus with its correct number of protons and neutrons, but also, more importantly, to give a more detailed view of electrons, one that will help explain the chemical properties of elements.

Rules for the *First Twenty Elements*.

1. When placing electrons in shells you have to fill, if possible the innermost shell before beginning to fill the next shell.
2. The maximum number of electrons in the first shell is 2, which is the number of elements in the first horizontal row of the periodic table.
3. The maximum number of electrons in the second shell is 8, which is the number of elements in the second horizontal row of the periodic table.
4. The maximum number of electrons in the third shell is 8. Any remaining e- will go in the 4th shell b/c we are only responsible for the first 20 elements.

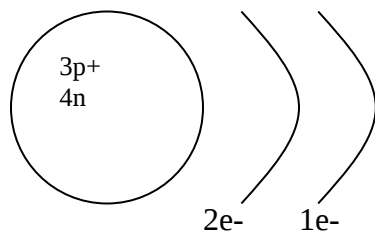
Examples:

1. Draw a Bohr diagram for an atom of Li.

ANSWER: *Lithium 7* has 3 protons and 4 neutrons, and because it's neutral, it has 3 electrons.

Orally:

We first fill the first shell with 2 electrons(abbreviated 2e-): The remaining electron has to go into the second shell.

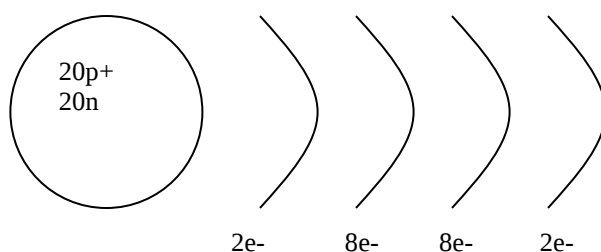


2. Draw a Bohr diagram for an atom of Ca.

ANSWER: *Calcium 40* has 20 protons and 20 neutrons, and because it's neutral, it has 20 electrons.

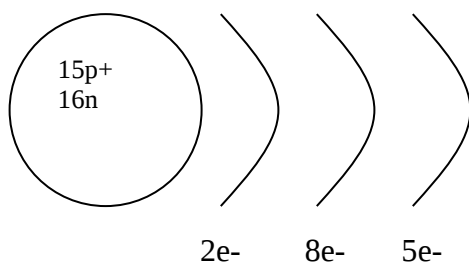
Orally:

We first fill the first shell with 2 electrons (rule #1) The second shell can hold 8 more, so a total of 10 electrons have been placed, so far. (rule #2) The third shell can hold 8 more (for the first 20 elements; rule # 3), so the last two electrons end up in the fourth shell.

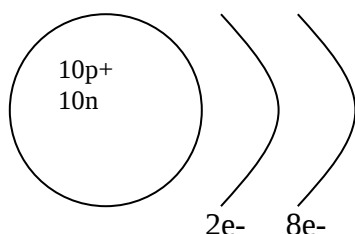


3. Draw a Bohr diagram for an atom of P

ANSWER: *Phosphorus 31* has 15 protons and 16 neutrons, and because it's neutral, it has 15 electrons.



4. Draw a Bohr Diagram for an atom of Ne



Orally:

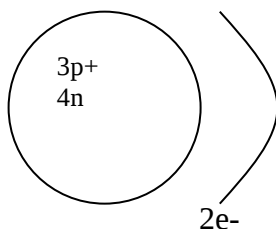
Q: Why is Neon a non-reactive element?

A: Chemists have found, through experimentation, that elements that have a full outer shell of electrons are chemically stable (i.e., they don't react)

Part II: Predicting the charge on elements when they react.

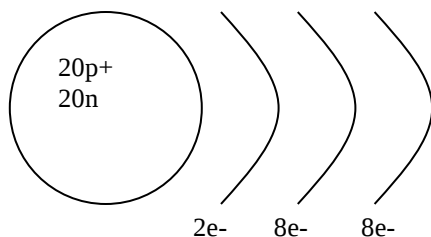
Orally:

Look at the previous examples of Bohr diagrams and ask yourself this: Is it easier to fill the outer shell by gaining or losing electrons? (i.e., which method is the quicker of the two?)



Lithium Ion (ion means the species has some charge)

For the lithium atom it is “easier” to lose 1e- than it is to gain 7e-. When lithium reacts it forms a +1 ion (**Li⁺**). i.e., when lithium reacts it gives one of its electrons to another element. *Use brackets around the Bohr diagram and show charge.

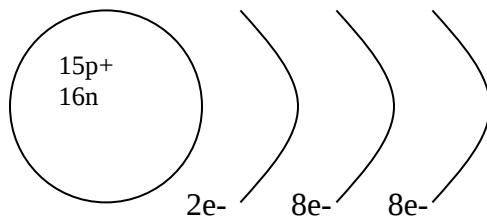


Calcium Ion

Have students predict what happens to Calcium.

Answer: Ca^{+2} (easier to lose $2e^-$ than gain $6e^-$)

Phosphorus Ion



For Phosphorus, it's easier to gain $3e^-$ in the outer shell than it is to lose $5e^-$, so the predicted ion after Phosphorus reacts is P^{-3} . i.e., Phosphorus gains $3e^-$ from another element when it reacts.

Assign: Check your understanding 7.4 page 223 #1, 6, 7, 8, 11