The Periodic Table

How does the wave model account for the rows and columns in the Periodic Chart?

Periodic Table

• Attempt to organize our knowledge of the chemical elements (one provided with each test) – has predictive power.
• Periodicity seen in chemical properties, atomic volumes, and ionization energies.
• This periodicity can be explained in terms of the wave model.

Vocabulary: list at the end of the chapter!
Vocabulary

- families (groups) - column of elements
- periods – row of elements
- valence electrons - # of electrons in unfilled shell
- metals – conduct electricity
- nonmetals – doesn’t conduct electricity
- transition metals – metals in the middle of the table
- main group – elements with “A” label, we’ll “play” with these
- atomic number – number of protons in an atom
- atomic mass – mass per unit atom (~ # of protons and neutrons)

Film Notes

- What you need to know about elements
- Main Idea: elements grouped in columns that have similar properties
- Don’t worry about specific reactions for now
- Mole: a certain fixed number of molecules (6x10^23)
- After note: burning carbon produces carbon dioxide and carbon monoxide
Ionization Energy

- The energy required to remove the one electron.
- The chemical behavior of an element relates to how easily electrons are lost.
  - Metals lose electrons easily.
  - Non-metals don’t lose electrons as easily – especially the noble gases.
The Periodic Chart

- Elements are striking because of their diversity, nevertheless there is some order to them.
- Elements in a column have similar properties (families).
- Elements in a row are called a period (dissimilar properties).

Filling of Atomic Orbitals Explains the Periodic Patterns

- Filled shells are not very reactive.
- Electrons above filled shells (or sub-shells) are called valence electrons.
- The columns in the periodic table consist of elements with the same number of valence electrons.
- The valence electrons determine an element's chemical properties.

Chemical Behavior
Atomic Volumes

- Atomic volumes increase suddenly when the new electron is in the next s orbital and thus is in a standing wave pattern with one additional wavelength.
- Additional electrons as you move along the row have the same number of standing waves; the wave patterns are the only difference. So the diameter is not increased.
- However, more protons pulling on more electrons tends to squeeze the electron probability clouds in closer to the nucleus, decreasing the diameter, and hence volume.
Ionization Energies

- *s* electrons, being distant from the nucleus, are “shielded” from the protons in the nucleus by the inner electrons and are thus not bounded very tightly. Their ionization energies are low.
- A filled *p* orbital set has all the electron “pieces” of the puzzle in place. Each electron “sees” at least 8 protons pulling on it. Their ionization energies are high.

Atomic Properties and the Wave Model

- Chemical Properties
- Size
- Ionization energies