Physics 100 - Spring 2007 - Recitation 6

(1) Two jugglers toss batons back and forth. How are they like a chemical bond? Are they more like an ionic bond or a covalent bond?

(2) A 142 gram baseball is thrown at 92 mph (41 m/s). Suppose you measure the velocity of the baseball to a precision of .000000001 m/s = 10^{-9} m/s, how well could you measure the instantaneous position of the baseball if you had an instrument able to measure positions perfectly? (Assume the mass of the baseball is exactly 142 grams.)

(3) IT happens that when you calculate the energy of a multi-electron atom using a full-blown quantum mechanical treatment, the atom is MOST stable if it has all the possible quantum STATES in its outermost energy level filled.

(a) What do I mean by the words "MOST STABLE"?

According to quantum mechanics:

Energy level	Number of electrons Allowed
1S	2
2S	2
2P	6
3S	2
3P	6

Increasing energy ↓

Look on the periodic chart.

(b) How can you tell the number of protons in each of the listed element?

(c) Elements are defined primarily by their chemical characteristics.

What do I mean by this?

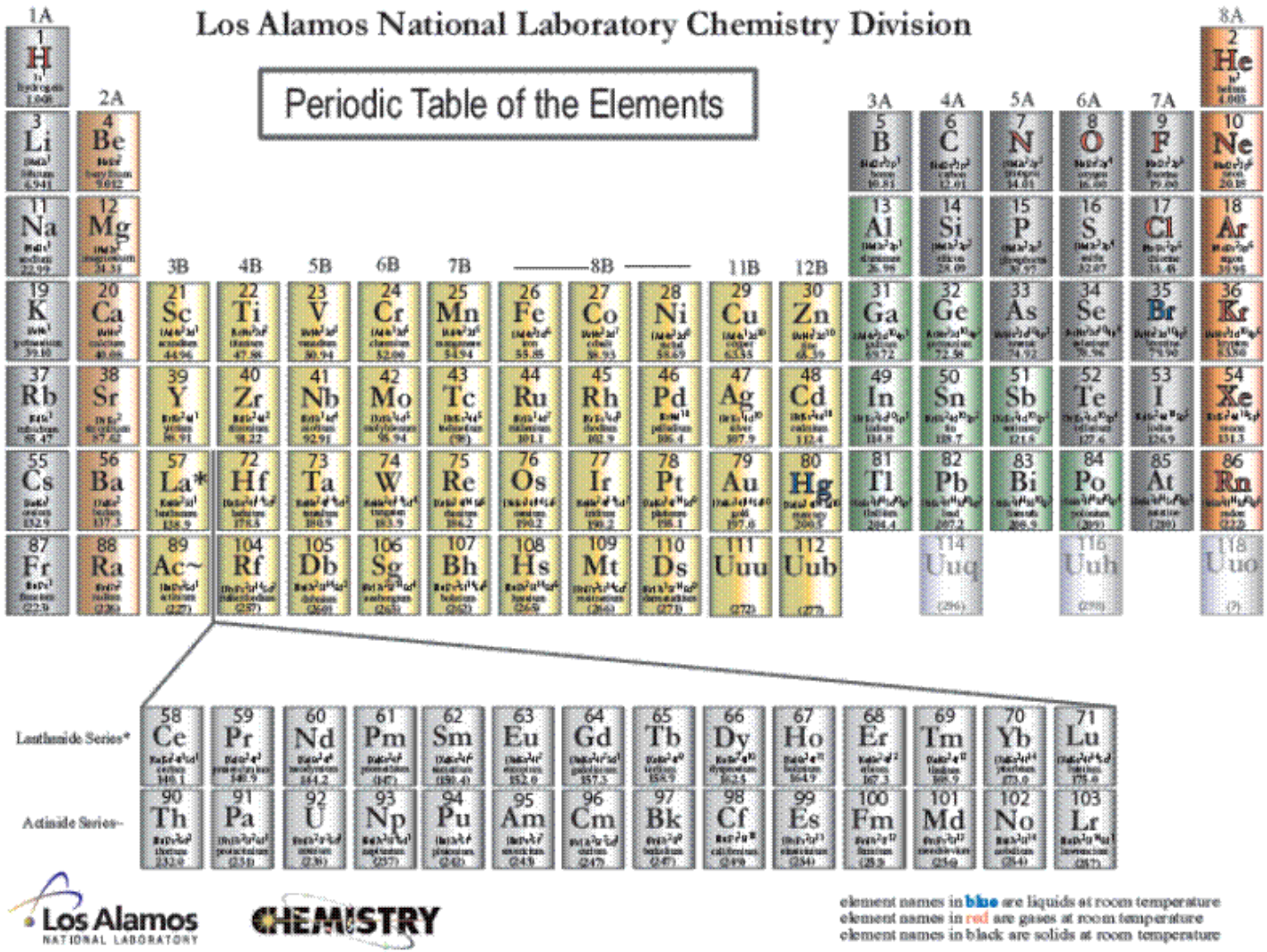
(d) Considering atoms with $Z=1$ (hydrogen) through $Z=18$ (Argon $\equiv$ Ar), which elements would you expect to be most stable (least chemically reactive)?

(e) Can you determine the number of neutrons for each element listed in the Periodic chart?

(f) Do you think the number of neutrons in an atom's nucleus has an affect on it's chemical characteristics?

(g) Which atom would you expect to be larger ... Ne $\equiv$ Neon or Ar $\equiv$ Argon ?

$Z = 10$ $Z = 18$


Los Alamos National Laboratory Chemistry Division
Periodic Table of the Elements
1A
2A
3B
4B
5B
6B
7B
8B
11B
12B
3A
4A
5A
6A
7A
8A
Lanthanide Series*
Actinide Series~
Los Alamos
NATIONAL LABORATORY
CHEMISTRY
element names in blue are liquids at room temperature
element names in red are gases at room temperature
element names in black are solids at room temperature

(4)

hydrogen ($Z=1$, H) reacts with chlorine ($Z=17$, Cl) to form hydrogen chloride molecules which consist of 1 H and 1 Cl atom, written as HCl

From what you know about quantum stability and its dependence on the electron configuration (how the electrons fill the available orbitals),

can you motivate why H and Cl join in a 1-to-1 ratio?

What other atoms would you expect to join with chlorine in a 1-to-1 ratio in a chemical reaction?

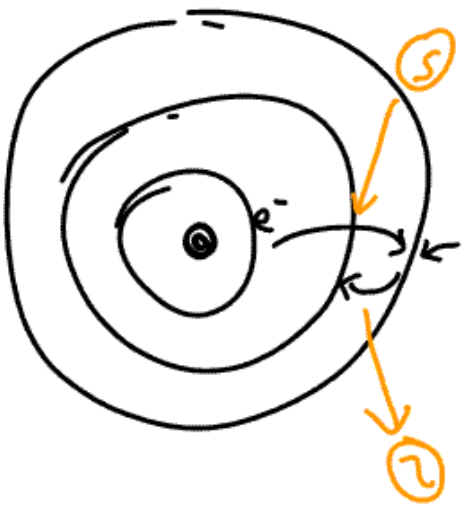
What do you suppose might be the ratio of magnesium (Mg) to chlorine (Cl) after a chemical reaction?

5

How well can you measure the speed of an electron in a hydrogen atom (in principle)?

6

Most excited STATE orbitals in an atom only exist for a very short time (known as the lifetime) before the STATE decays emitting a photon while the e^- jumps to a lower energy orbital.



What does Heisenberg's uncertainty Principle tell you this will do to the color of the emitted photon?