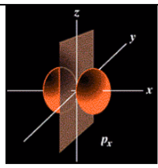
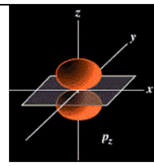
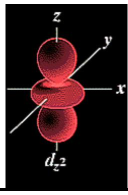
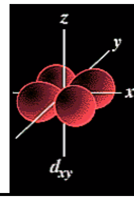




Shapes and Orientations of Orbitals





Periodic table and quantum theory

- The 2, 6, 10, 14 columns of the periodic table correspond to s (l=0, m_l=0), p (l=1, m_l= -1,0,1), d (l=2, m_l= -2,-1,0,1,2) and f (-3,-2,-1,0,1,2,3)
- See fig. 6.21 (pg. 208) and fig. 6.22 (pg. 209)
- Note that electron configurations are true whether we are speaking of an atom or ion: $1s^2 2s^2 2p^6$ describes both Ne and Na^+

Q – based on figure 6.22 what are the shorthand electron configurations for Br^-, Sn, Sn^{2+}, Pb?

Unusual electron configurations

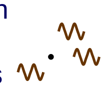
- Reference: 6.8 (pg. 207 - 8)
- Look at your value for Cu ($[Ar]4s^2 3d^9$).
- The actual value for Cu is $[Ar]4s^1 3d^{10}$… why?
- The explanation is that there is some sort of added stability provided by a filled (or half-filled subshell).
- The only exceptions that you need to remember are Cr, Cu, Ag, and Au.
- The inner transition elements also do not follow expected patterns. However, we do not address this in OAC chemistry.

Heisenberg's uncertainty principle

The location of electrons is described by: n, l, m_l

n = size, *l* = shape, m_l = orientation

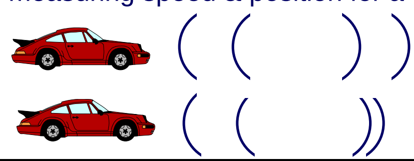
- Electrons are difficult to visualize. As a simplification we will picture them as tiny wave/particles around a nucleus.



- Heisenberg showed it is impossible to know both the position and velocity of an electron.
- Think of measuring speed & position for a car.

Slow

Fast

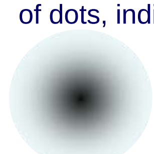


Heisenberg's uncertainty principle

- The distance between 2+ returning signals gives information on position and velocity.
- A car is massive. The energy from the radar waves will not affect its path. However, because electrons are so small, anything that hits them will alter their course.
- The first wave will knock the electron out of its normal path.
- Thus, we cannot know both position and velocity because we cannot get 2 accurate signals to return.

Electron clouds

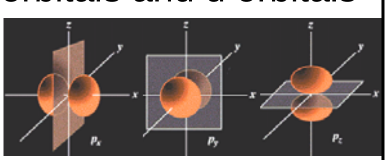
- Although we cannot know how the electron travels around the nucleus we can know where it spends the majority of its time (thus, we can know position but not trajectory).
- The "probability" of finding an electron around a nucleus can be calculated.
- Relative probability is indicated by a series of dots, indicating the "electron cloud".



- 90% electron probability/cloud for 1s orbital (notice higher probability toward the centre)

Summary: p orbitals and d orbitals

p orbitals look like a dumbell with 3 orientations: p_x, p_y, p_z ("p sub z").



Four of the d orbitals resemble two dumbells in a clover shape. The last d orbital resembles a p orbital with a donut wrapped around the middle.