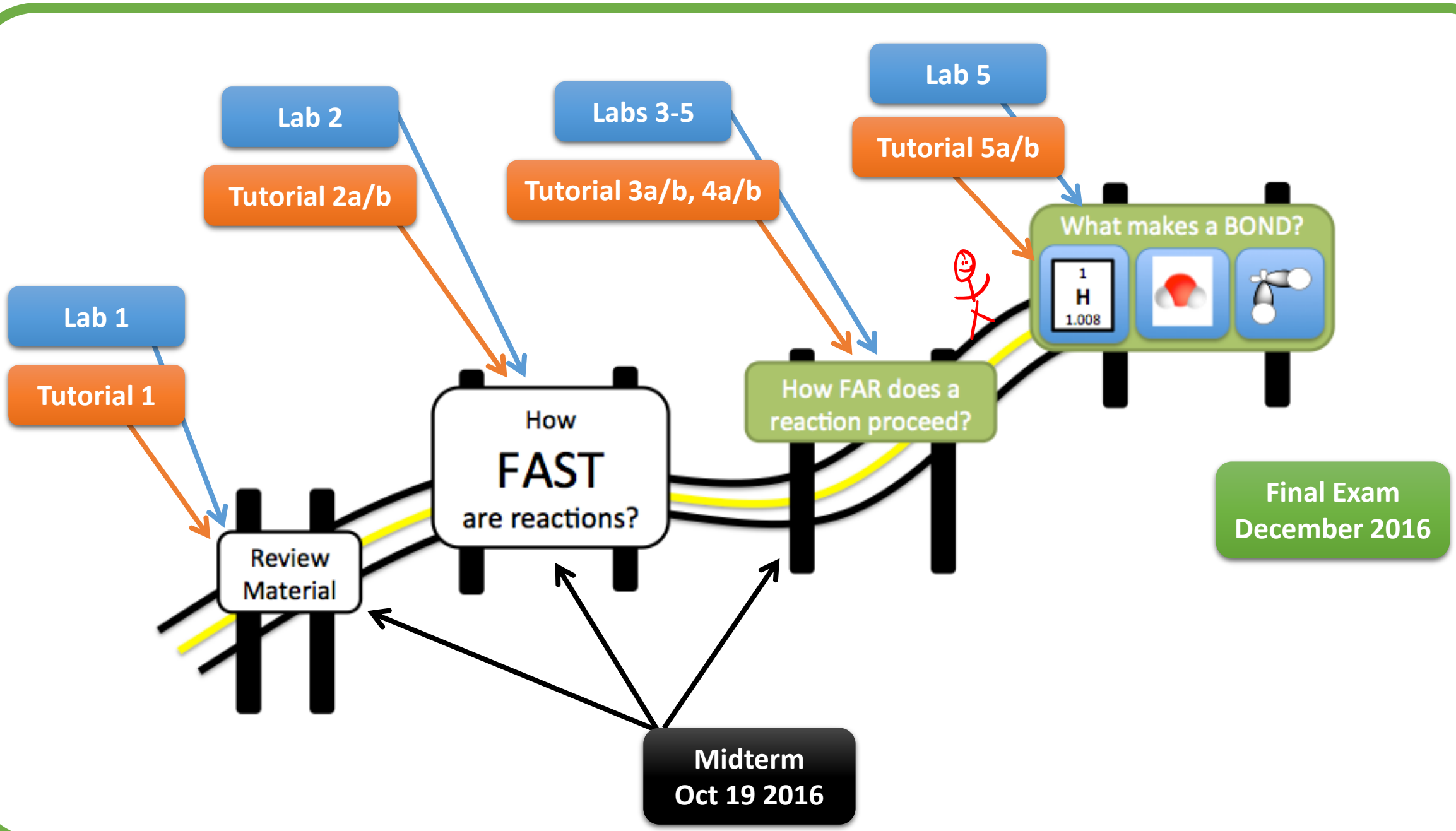
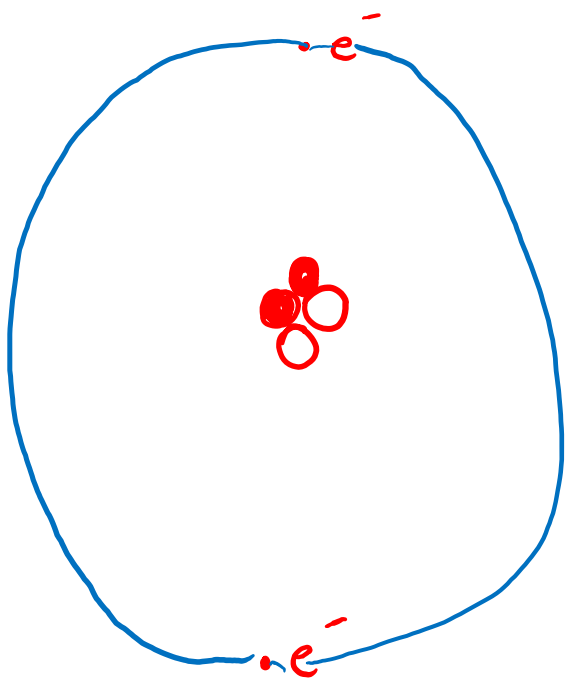

Lab 5
Tutorial 5a/b
Lab 2
Tutorial 2a/b
Labs 3-5
Tutorial 3a/b, 4a/b
What makes a BOND?
1
H
1.008
Lab 1
Tutorial 1
How
FAST
are reactions?
How FAR does a reaction proceed?
Review Material
Final Exam
December 2016
Midterm
Oct 19 2016

Atomic Structure & Periodicity

"How are BONDS formed?" – Chapter 6 & 7

What's inside an atom?



Bohr model of atom → OK

● - proton
+1 charge
1 amu

○ - neutron
0 charge
1 amu

• - electron
−1
very light (negligible)

Atomic symbols:

mass number (p⁺ + n⁰ total mass)

Atomic symbol implies a specific Z

$^{14}_{6}C$

nuclear charge ≡ atomic number (Z)

^{14}C
^{13}C
^{12}C
} isotopes

Too many or too few electrons:

(ions)

^{14}C

$+e^-$ → $^{14}C^-$

$-e^-$ → $^{14}C^+$

Periodic table tells us about the reactivity of the elements!

→ Structure of atoms influences reactivity

So... periodic table must tell me about atomic structure

Lighter

heavier

Periodic Table

Legend:

1 ← Atomic number (Z)
H ← Atomic symbol
1.008 ← Atomic mass (amu)

* mass → nucleus
* reactivity → electrons

1 1A												13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
1 **H** 1.008	2 2A																2 **He** 4.003
3 **Li** 6.941	4 **Be** 9.012											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.31	3	4	5	6	7	8	9	10	11	12	13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.07	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.88	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.38	31 **Ga** 69.72	32 **Ge** 72.59	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	57* **La** 138.9	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.9	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** 226.0	89** **Ac** (227)	104 **Rf** (261)	105 **Ha** (262)	106 **Sg** (263)	107 **Ns** (262)	108 **Hs** (265)	109 **Mt** (266)	110 **Uun** (269)	111 **Uuu** (272)							

Electronic Structure

→ describing electrons as waves

Electrons in an atom are arranged in *shells, subshells, and orbitals*.

- **Orbitals** describe the physical distribution of electrons within an atom. There are several kinds of orbitals, each with a characteristic shape. Each orbital can contain a <u>maximum of 2 electrons</u>.

- **Subshells** are collections of orbitals with a similar shape. These are usually described by letters (*s, p, d, f, …*) where all orbitals in the *p* subshell have a similar shape.

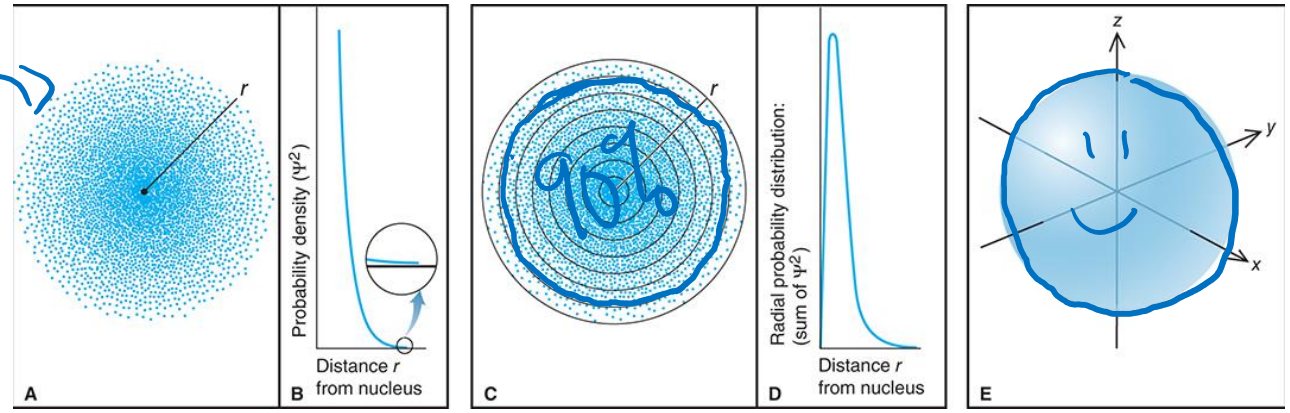
1s → s orbital/subshell in the 1st energy level

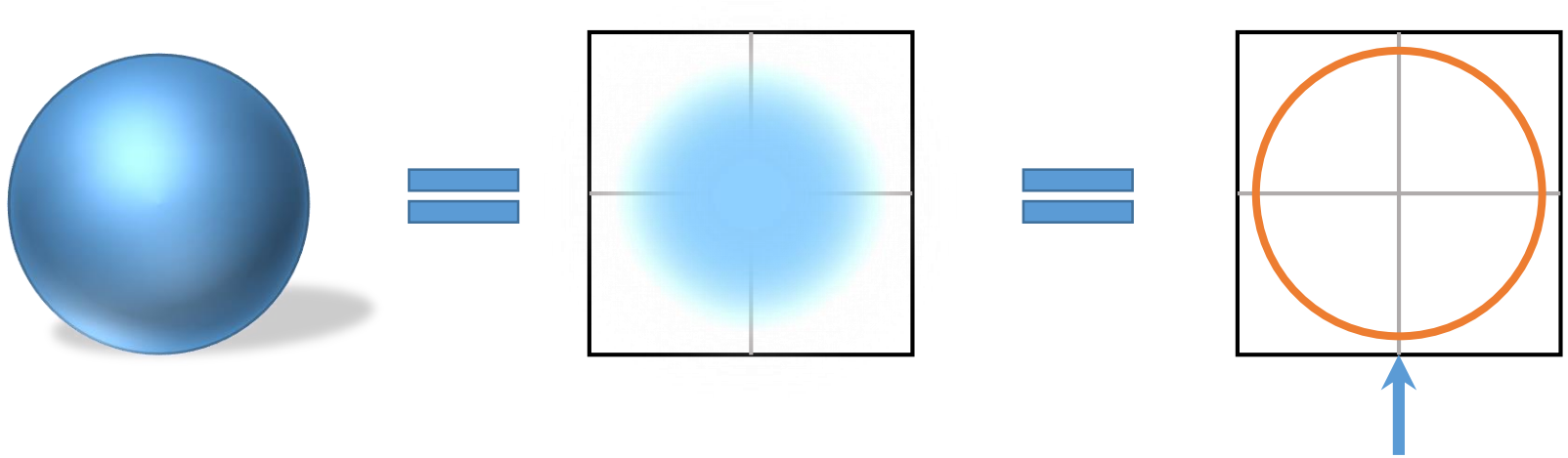
- **Shells**, or energy levels, are numbered (n = 1, 2, 3, …) with each shell describing orbitals and subshells with a similar size and energy. Lower-numbered shells are lower energy and smaller.

✓ *Recognize* atomic orbital shapes (*s, p* and *d*) and *predict* their relative energies.

Representations of Orbitals

Cloud diagram

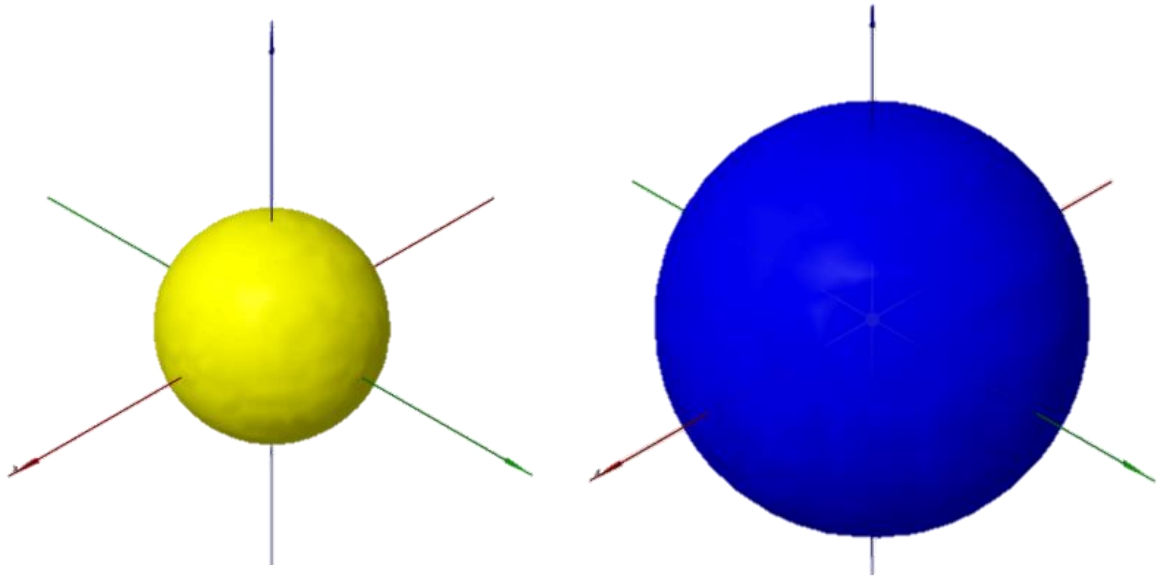




90% probability of finding the electron within this circle

✓ *Recognize* atomic orbital shapes (*s, p* and *d*) and *predict* their relative energies.

s orbitals



1*s* 2*s*

higher energy level
→ bigger

s orbitals are spherical.

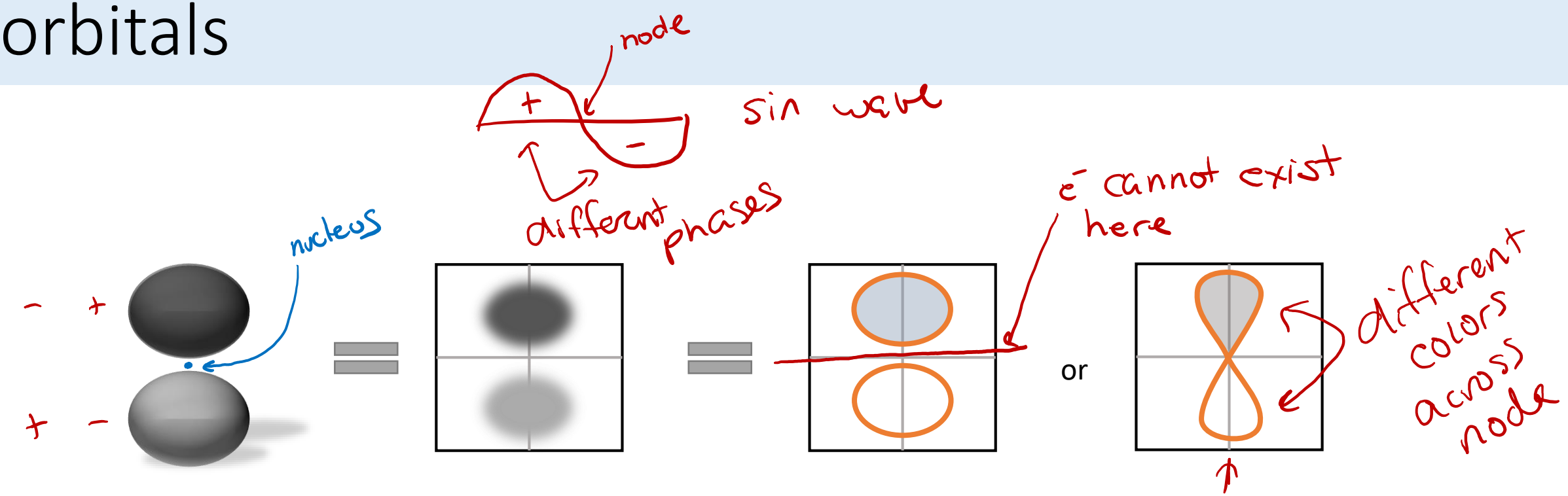
There is only one *s* orbital per subshell.

In the s subshell there is 1 orbital.

The *s* subshell is the lowest-energy subshell in any energy level.

✓ *Recognize* atomic orbital shapes (*s, p* and *d*) and *predict* their relative energies.

p orbitals

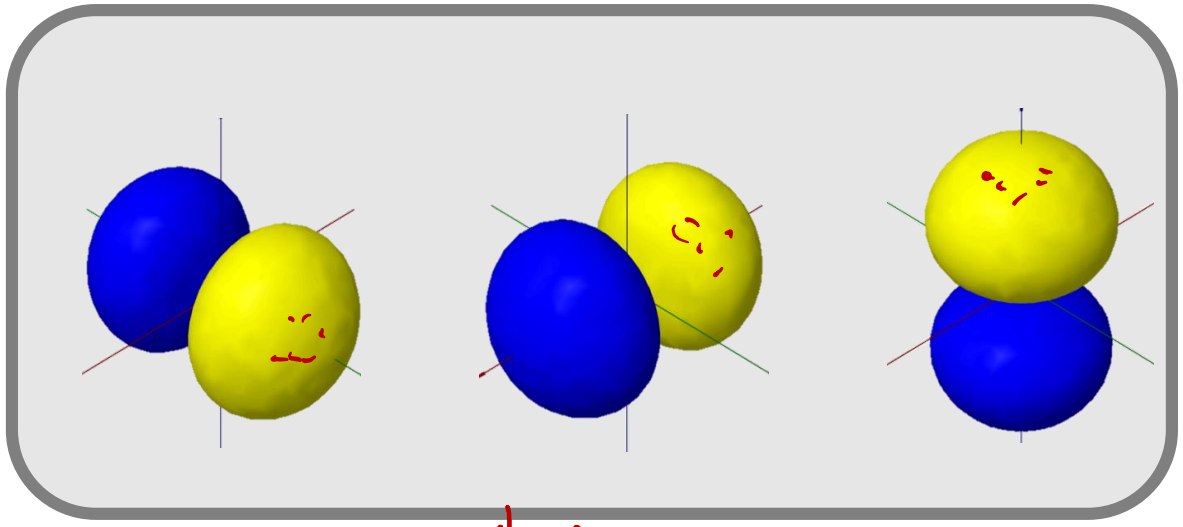


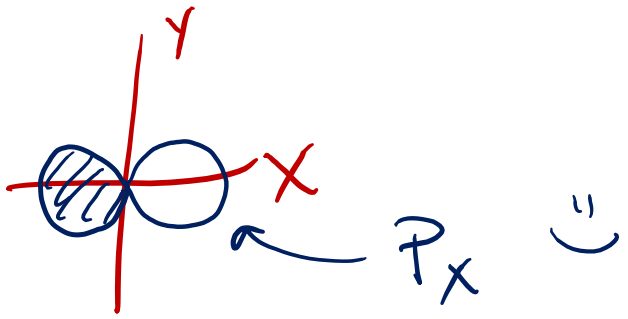
p orbitals have one *angular node* – one region where there is zero electron density.

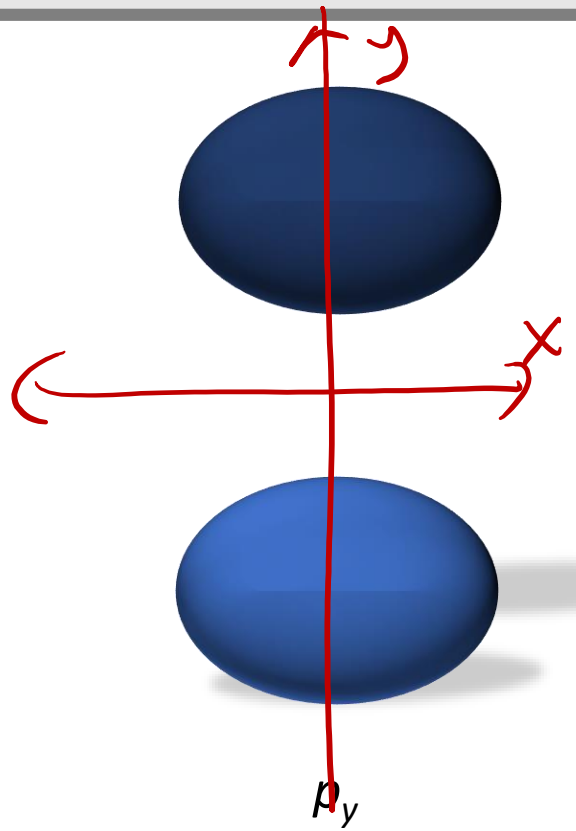
There are three possible orientations for *p* orbitals (x, y, z) – and so three *p* orbitals per subshell.

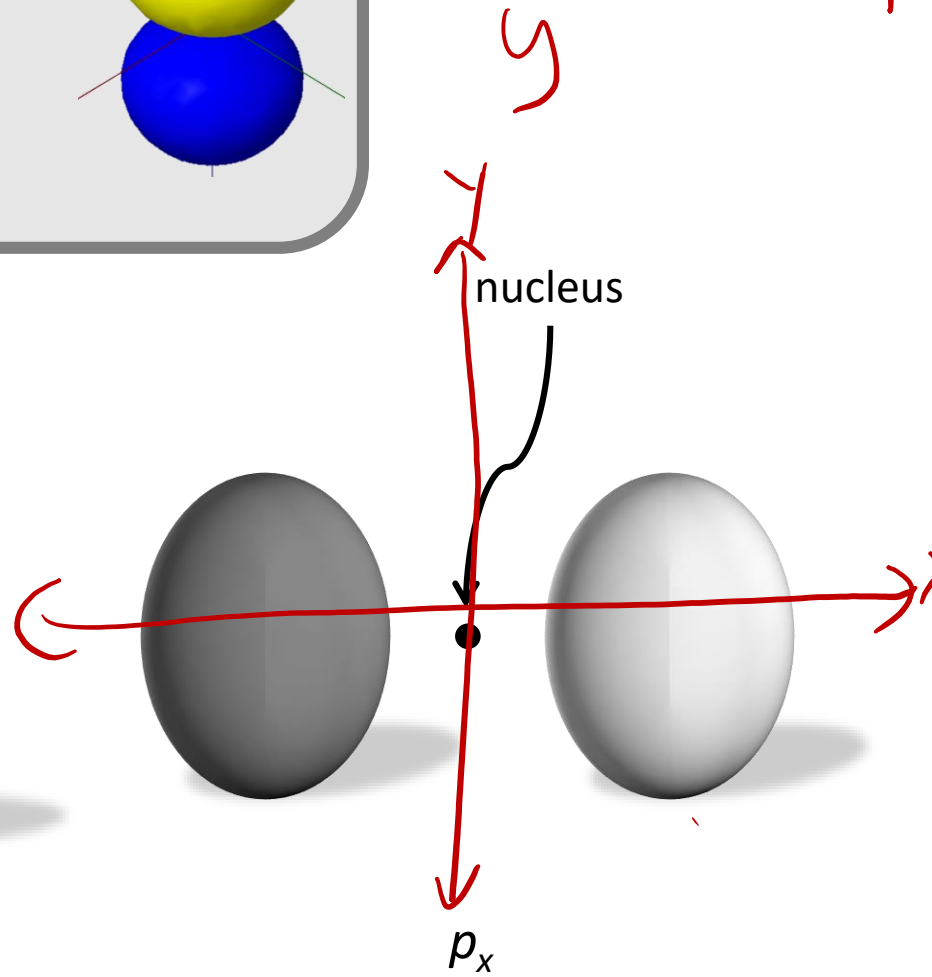
The *p* subshell is higher energy than the *s* subshell in the same energy level.

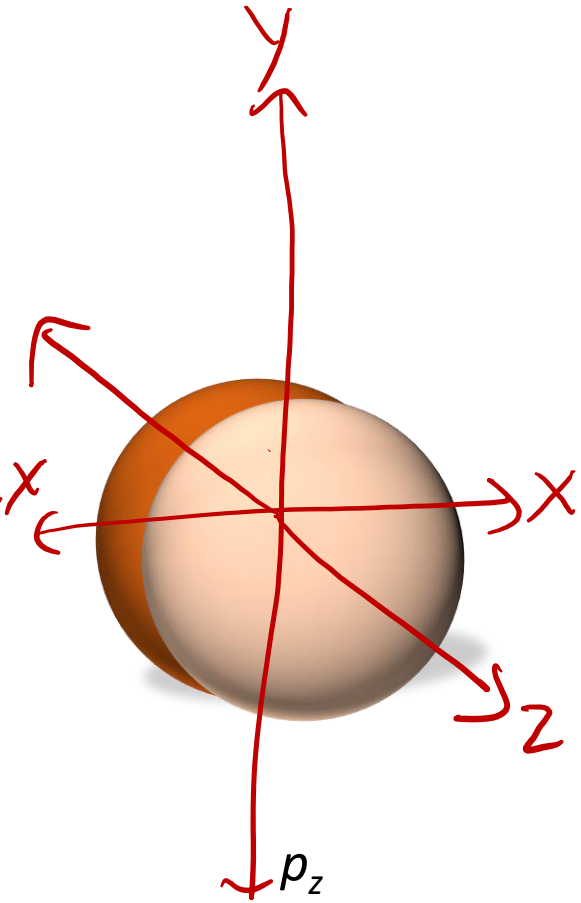
✓ *Recognize* atomic orbital shapes (*s, p* and *d*) and *predict* their relative energies.



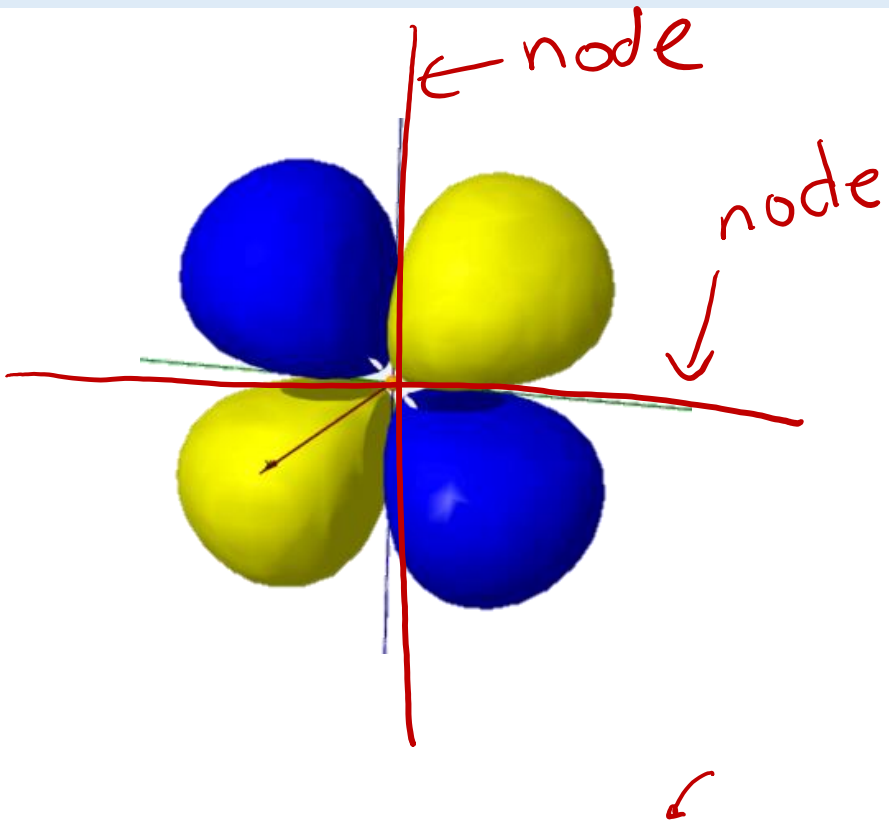

y
x
p_x


y
x
p_y


y
nucleus
x
p_x


y
x
z
p_z

d orbitals



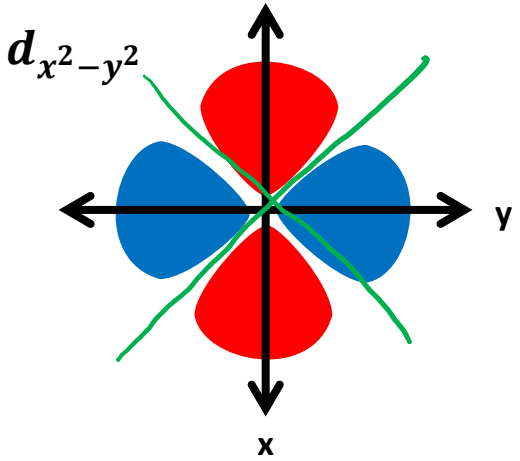
d orbitals have two *angular nodes.*

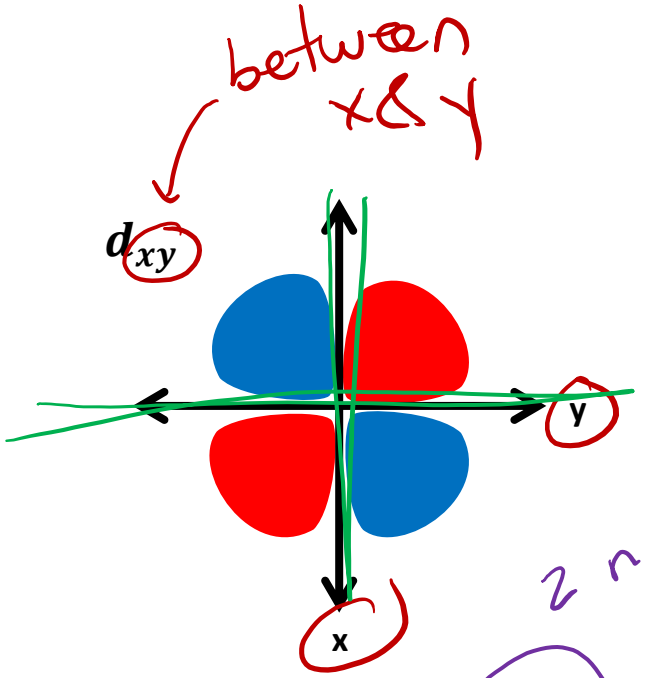
There are five possible orientations and so five *d* orbitals per subshell.

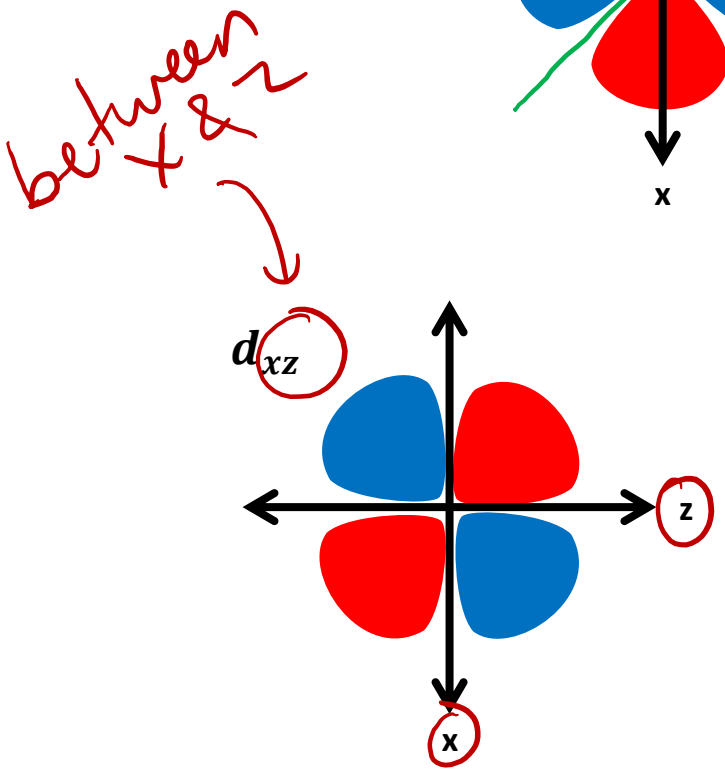
The *d* subshell is higher energy than the *s* and *p* subshells in the same energy level.

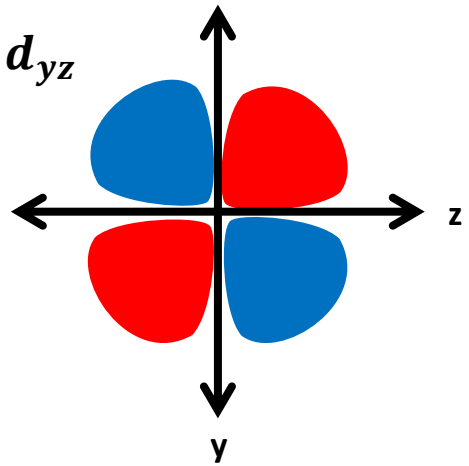
✓ *Recognize* atomic orbital shapes (*s, p* and *d*) and *predict* their relative energies.

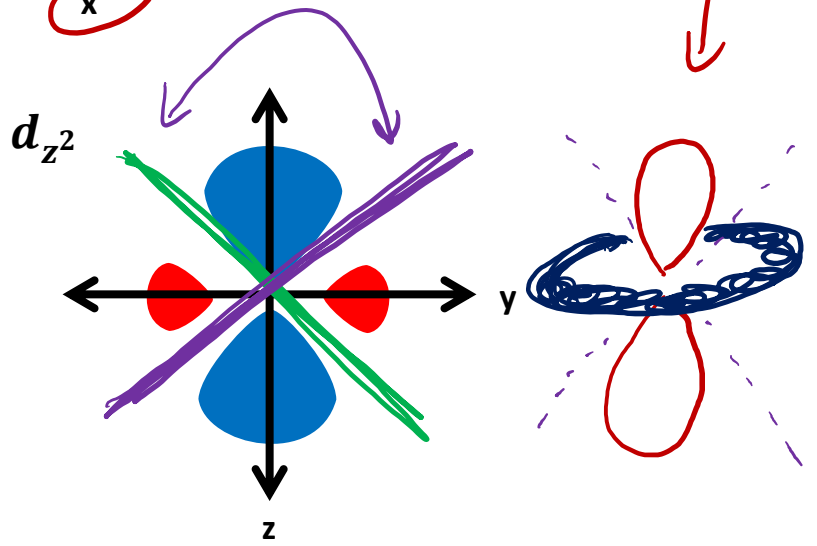
d orbitals


$d_{x^2-y^2}$
y
x


between x & y
d_{xy}
y
x


between x & z
d_{xz}
z
x


d_{yz}
z
y


2 nodes
d_{z^2}
donut
y
z