

# Welcome CHEM 232

Instructor: Prof. Duncan Wardrop

Time/Day: T & R, 12:30-1:45 p.m.

January 12, 2010

# Course Website

<http://www.chem.uic.edu/chem232>

- Syllabus
- Course Policies
- TA office hours and info
- Lecture slides (updated each week)
- Other handouts
- Announcements (Course News)
- Course Calendar

# Assessment

- Quizzes: 25 x 10 points = 250 points (25%)
- Exams: 3 x 150 points = 450 points (50%)
- Final Exam: 250 points (25%)

# To Do This Week

**1. Attend your discussion section.**

a. Check your course registration against TA roster.






b. Master functional groups. Prepare for quiz.

**2. Purchase *Carey* and Molecular Models**

**3. Read Chapter I from *Carey*.**

**4. Read Handouts on Website**

# Keys to Success

-  1. Attend all lectures and discussion sections.
-  2. Don't fall behind. Organic chemistry is easy, but each topic builds on the previous.
-  3. Don't memorize. Organic chemistry is conceptual.
-  4. Work through homework carefully. Take notes.
-  5. Always ask yourself "Why" for everything you read or hear. You may not always find the answer, but just asking will help you to find connections and remember more.

# Origins and Examples of Organic Chemistry

Introduction

# Vitalism

Living



- possesses vital force
- compounds derived from are “organic” (coined by J. Berzelius, 1807)
- could not be synthesized in the laboratory

Nonliving.



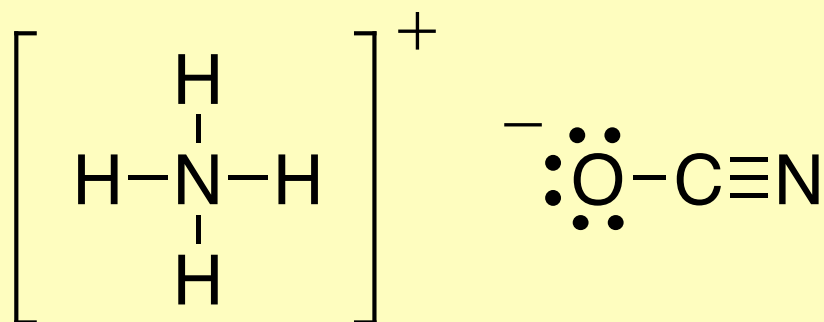
vs.

- termed “inorganic”
- derived from *nonliving* matter
- can be synthesized in the lab

# Wohler Synthesis Debunks Vitalism

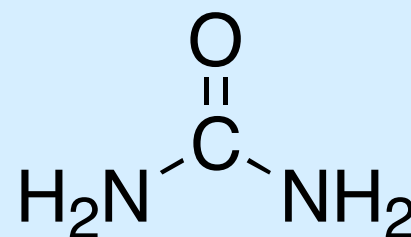


## Expected Product



ammonium cyanate  
(inorganic)

## Actual Product



urea  
(organic)

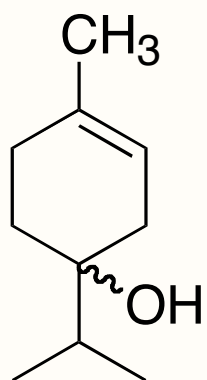


# Self Test Question

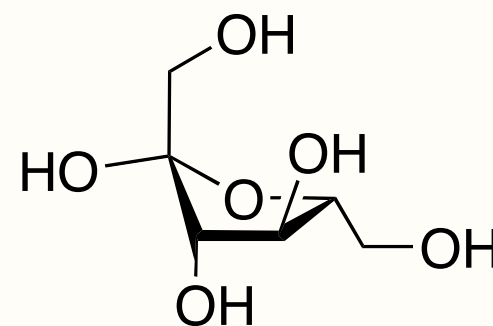
What is the minimum requirement, *today*, for a *chemical substance* to be classified as *organic*?

- A. derived from living matter
- B. contains carbon
- C. cannot be synthesized
- D. bought at *Whole Foods*
- E. combustion yields  $\text{SO}_2$

# Vitalism Lives On...

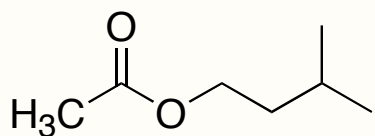


**terpinen-4-ol**  
sold as tea tree oil  
or Melaleuca oil

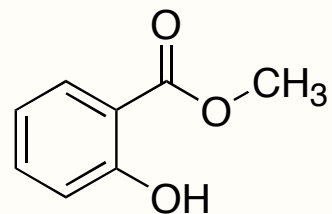


**fructose**  
“fruit sugar”  
also in HFCS

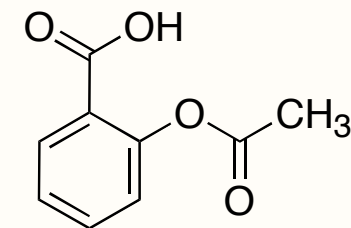
# Organic Chemistry Everywhere



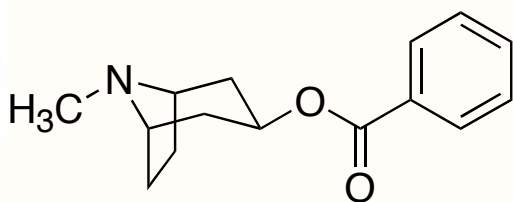
3-methylbutyl acetate  
(bananas)



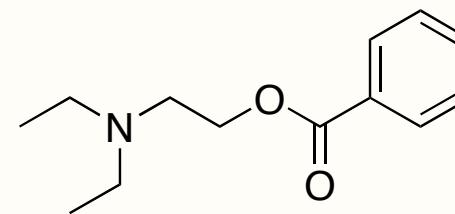
methyl salicylate  
(oil of wintergreen)



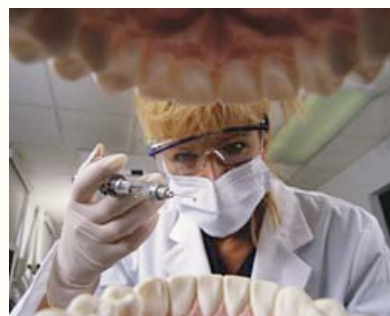
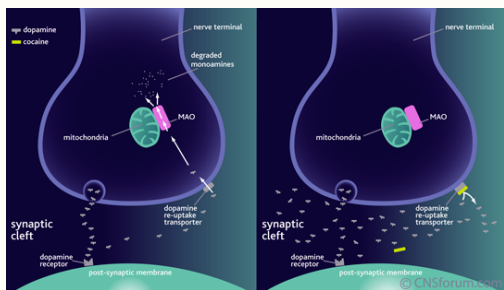
aspirin  
(analgesic)



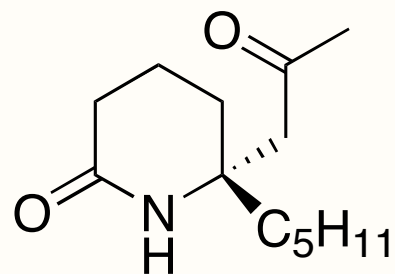
cocaine  
(analgesic)



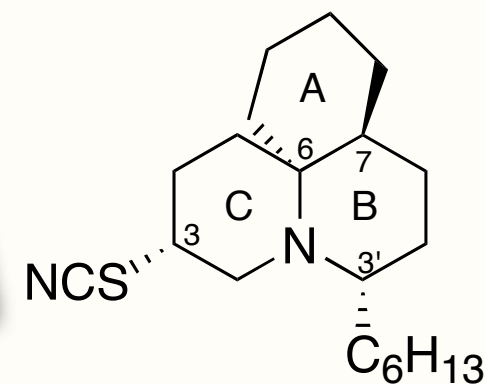
procaine, "Novocaine"  
(analgesic)



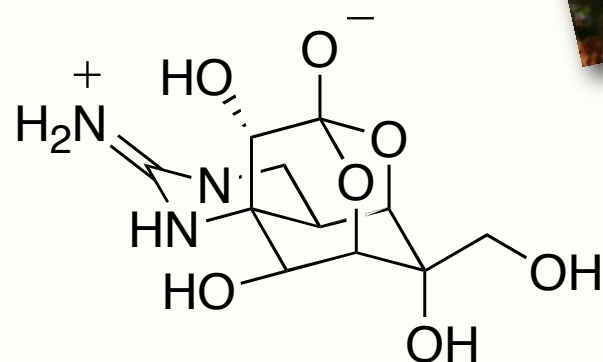
# Natural Products



(-)-adalinine

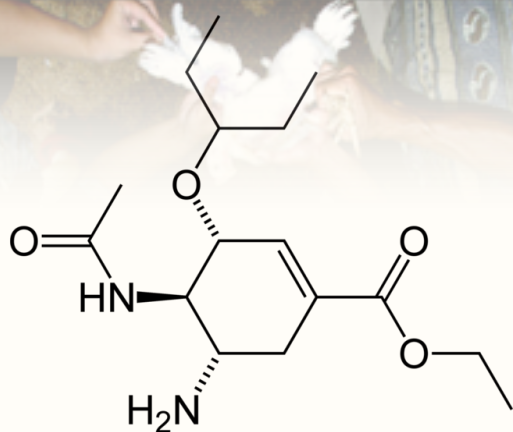


fasicularin

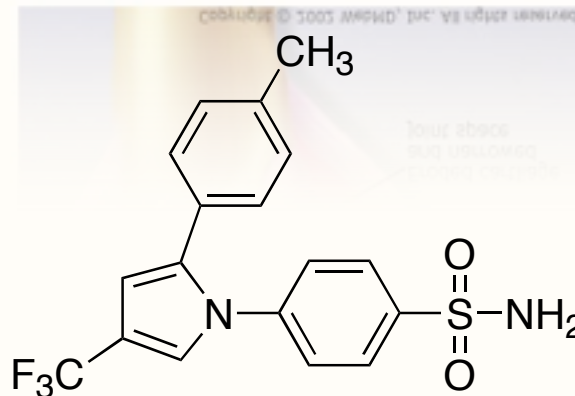


(-)-tetrodotoxin

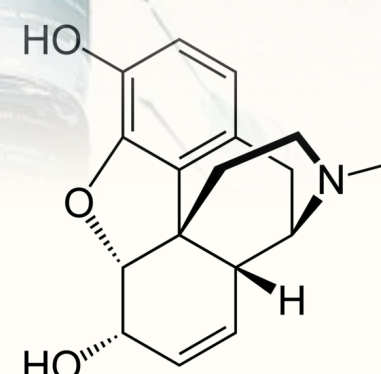
# Pharmaceuticals



**Tamiflu**  
(influenza)

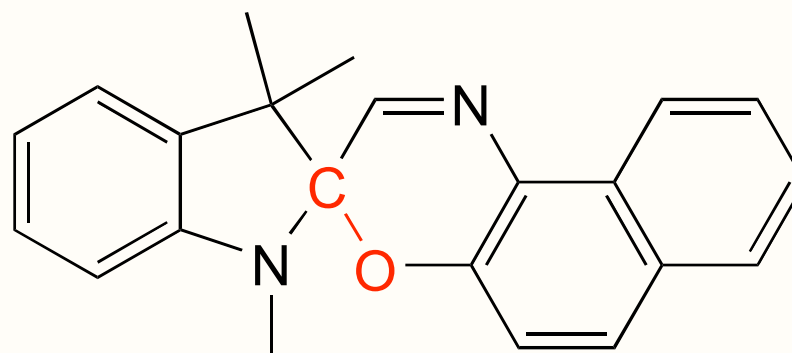


**Celebrex**  
(arthritis)

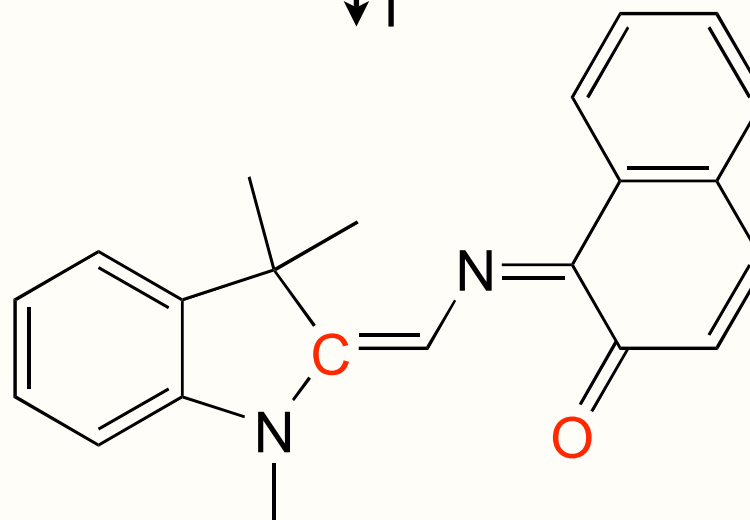
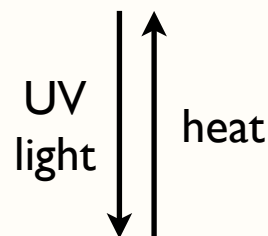


**Morphine**  
(analgesic)

# Optics - Transition Lenses?



does not absorb visible light



does absorb visible light

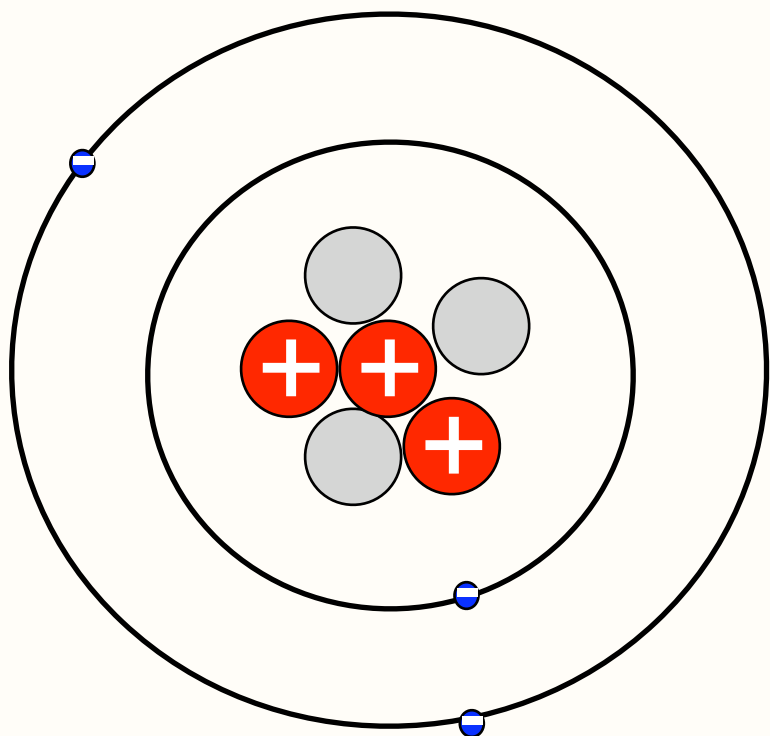
# **Atomic Structure**

# **A General Chemistry**


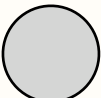

# **Review**

Section: 1.1

# Atomic Composition



Bohr Model

	particle	charge	mass molar mass	symbol
	proton	positive	$1.6726 \times 10^{-24} \text{ g}$ 1.0073 g/mol	p
	neutron	neutral	$1.6750 \times 10^{-24} \text{ g}$ 1.0087 g/mol	n
	electron	negative	$9.1096 \times 10^{-38} \text{ g}$ $5.486 \times 10^{-4} \text{ g/mol}$	$e^{-}$

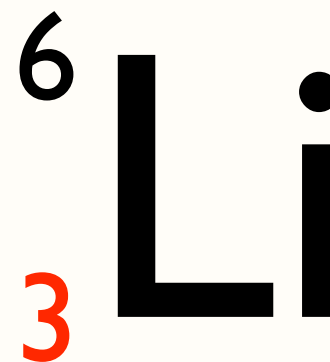
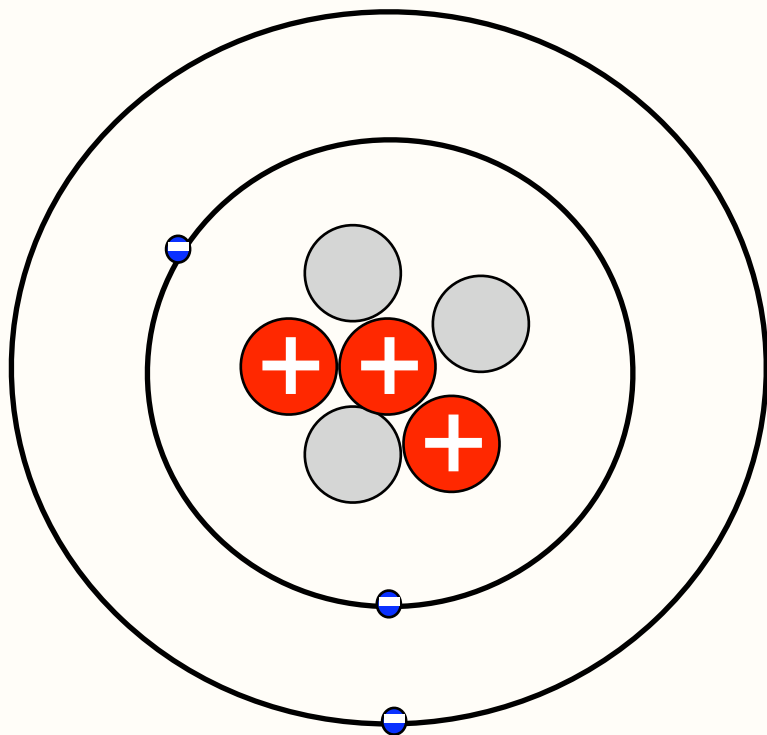


# Atomic Number & Mass Number



A = protons + neutrons

Z = protons



For neutral molecules, the number of electrons equals the number of protons.

# Self Test Question

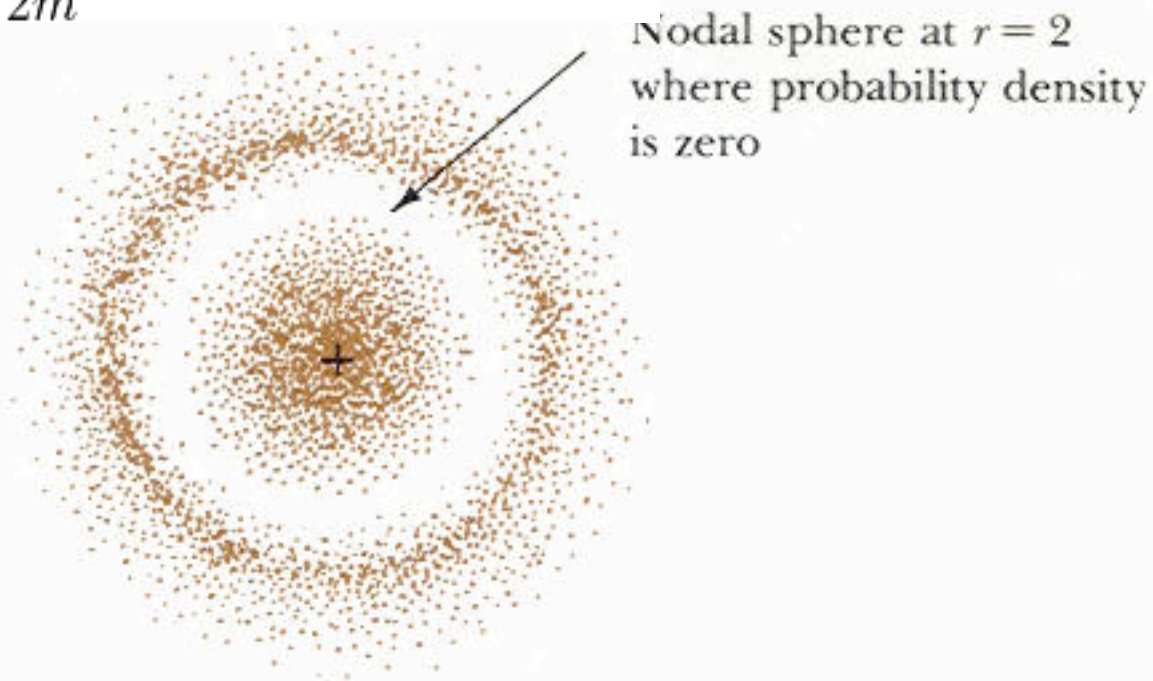
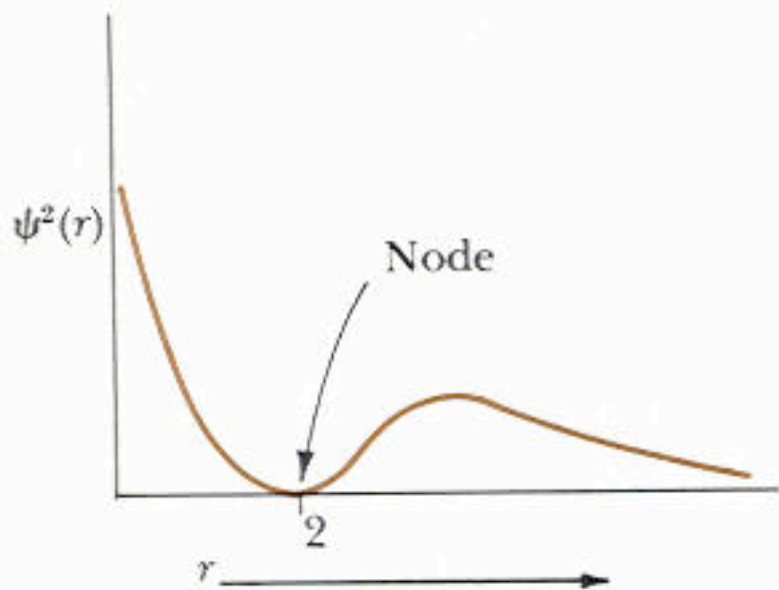
How many neutrons are in the following atom:



- A. 14
- B. 6
- C. 8
- D. 20
- E. cannot be determined

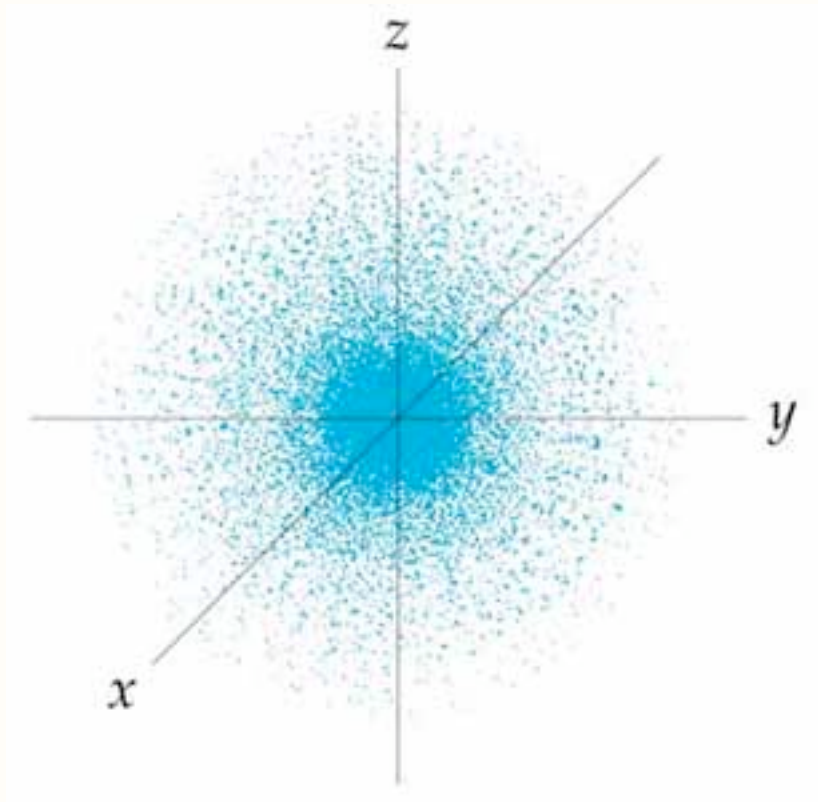
# Tenets of Schrödinger Equation

$$i\frac{\partial}{\partial t}\Psi(x, t) = -\frac{1}{2m}\nabla^2\Psi(x, t) + V(x)\Psi(x, t).$$

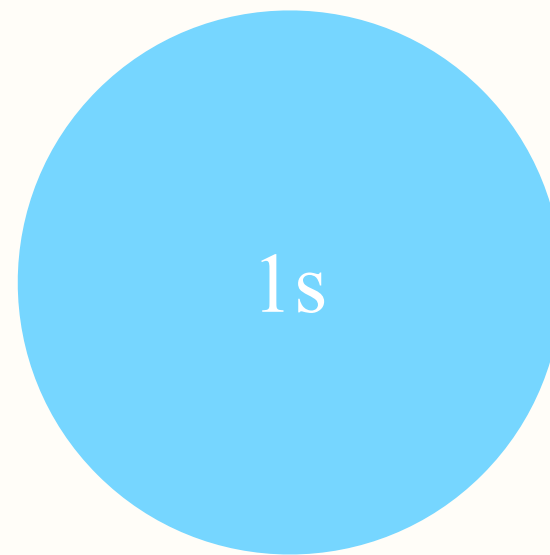


- electrons have wave properties
- wave equation gives energy of electron at a location
- solutions to wave equation are wave functions ( $\Psi$ ); a.k.a orbitals
- probability distribution =  $\Psi^2$  (Heisenburg uncertainty principle)

# Probability Distribution vs. Boundary Surface



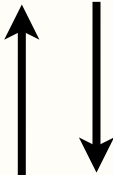
Probability distribution ( $\Psi^2$ )  
("electron cloud")



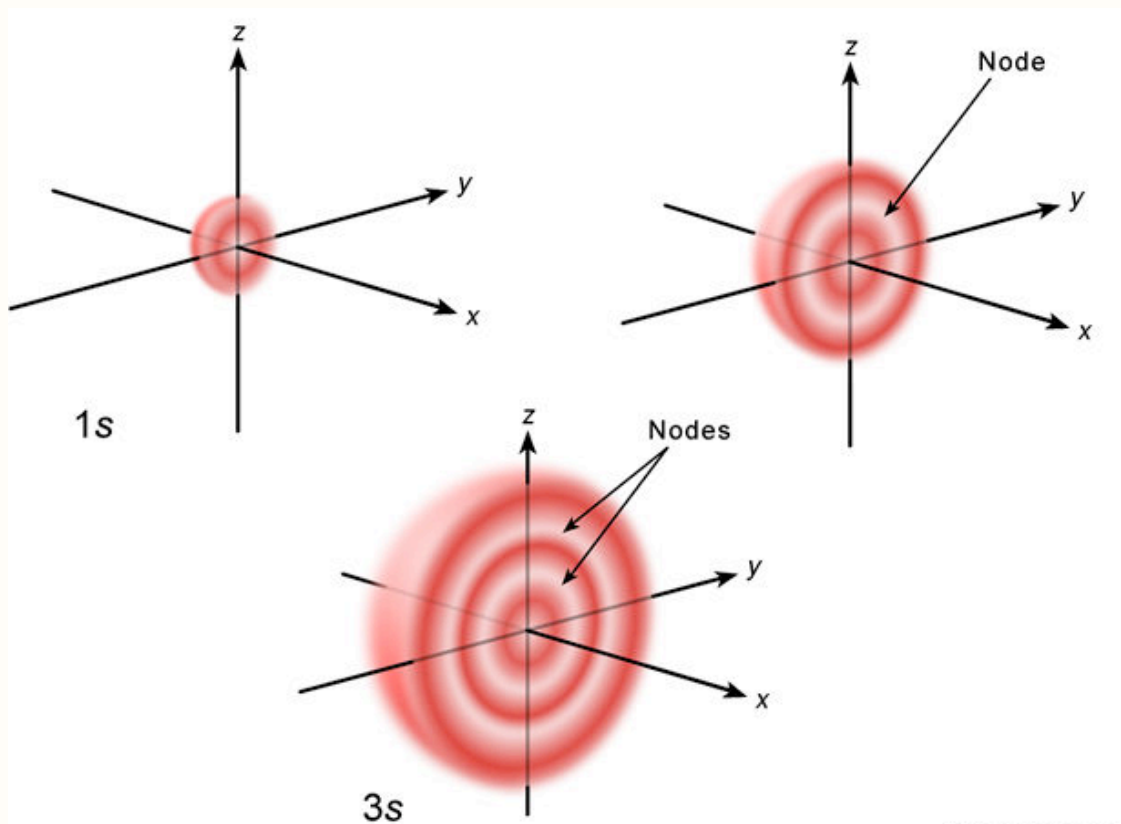
Boundary Surface (1s orbital)  
(where the probability = 90-95%)

# Wave Function Values: Quantum Numbers

- Shrodinger equation  $\rightarrow$  wave function (orbital,  $\Psi$ )
- many solutions for  $\Psi$ , energies of electrons in atom

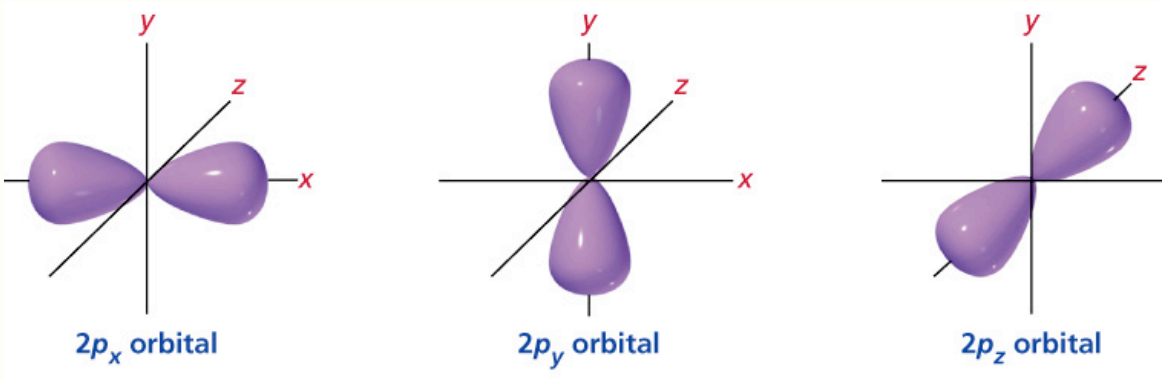
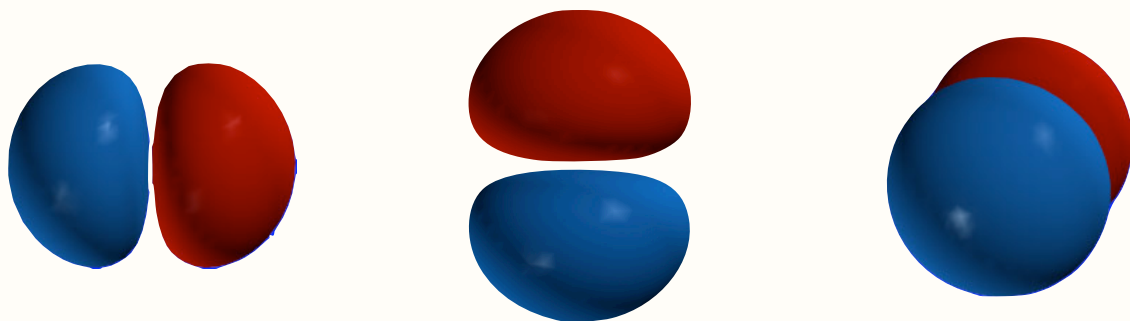
quantum number	principle	orbital	magnetic	spin
symbol	$n$	$l$	$m_l$	$m_s$
values	1, 2, 3...	0, 1, ... n-1	( $m_l = -l, -l+1 \dots 0 \dots l-1, l$ )	+1/2 or -1/2
examples/ abbreviations		$l=0$ , s $l=1$ , p $l=2$ , d $l=3$ , f	s: 1 orbital p: three orbitals d: five orbitals f: seven orbitals	

# s-Orbitals



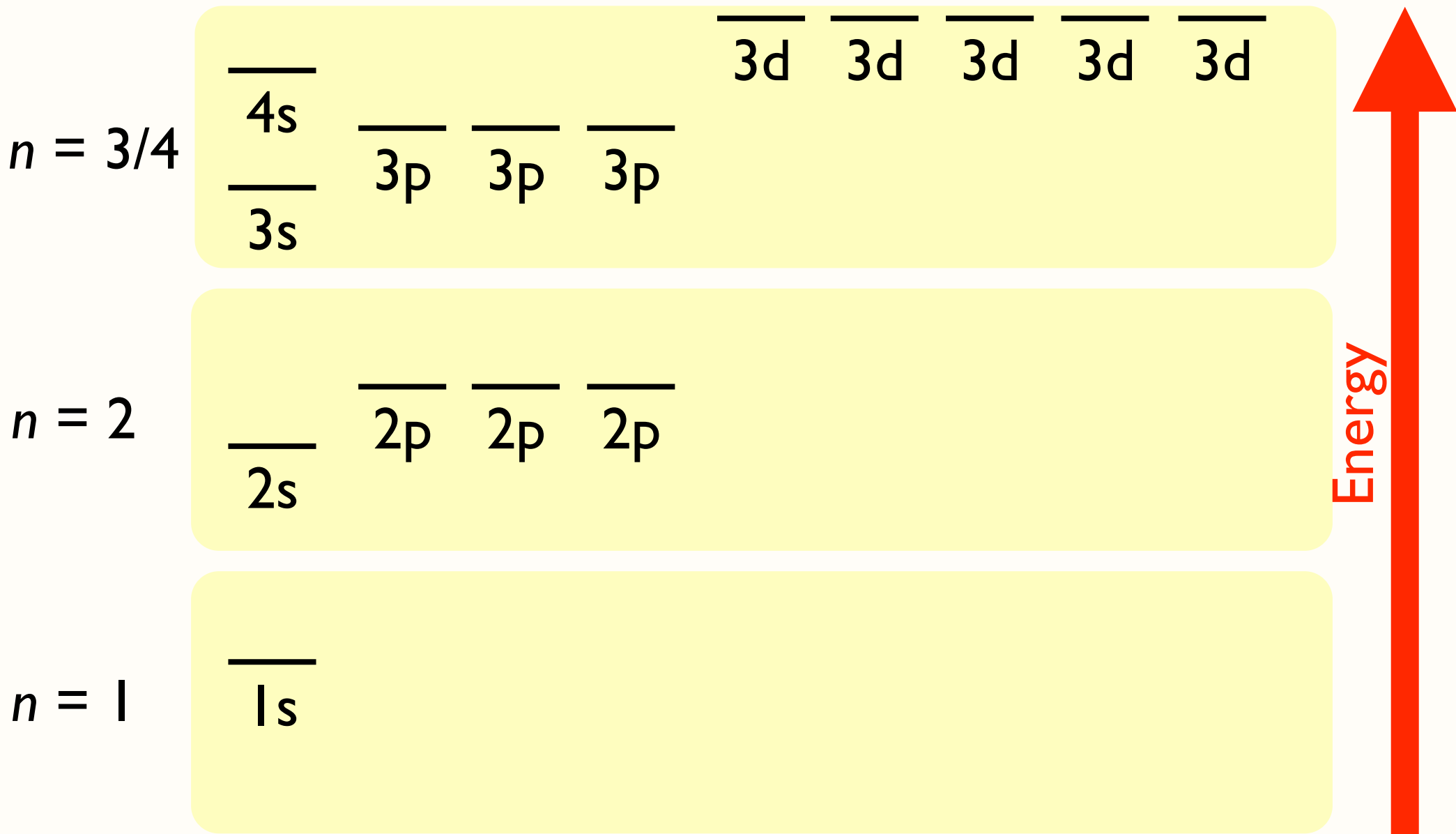
- spherically symmetric
- possible for  $n \geq 1$
- 1 s-orbitals for each value of  $n$
- 1s = no nodes, 2s = 1 nodes, 3s = 2 nodes, etc.
- probability of finding s-electron at nodal surface = 0
- s-orbital energy increases with increasing nodes (as  $n$  increases)

# p-Orbitals



- shaped like dumbbells
- not possible for  $n = 1$  ( $n \geq 2$ )
- 3 p-orbitals for each value of  $n$ ; they are degenerate (equal in energy)
- wave function changes sign at the nucleus (node)
- probability of finding p-electron at nodal plane = 0
- higher in NRG than s-orbitals of the same shell

# Relative Energies of Orbitals





# Order of Orbitals from Periodic Table

Read left to right starting at the top left; just like a typewriter.

hydrogen 1 <b>1s</b> 1.0079																		helium 2 <b>He</b> 4.0026						
lithium 3 <b>2s</b> 6.941	beryllium 4 <b>Be</b> 9.0122																		boron 5 <b>2p</b> 10.81	carbon 6 <b>C</b> 12.011	nitrogen 7 <b>N</b> 14.007	oxygen 8 <b>O</b> 15.999	fluorine 9 <b>F</b> 18.998	neon 10 <b>Ne</b> 20.180
sodium 11 <b>3s</b> 22.990	magnesium 12 <b>Mg</b> 24.305																		aluminum 13 <b>3p</b> 26.982	silicon 14 <b>Si</b> 28.086	phosphorus 15 <b>P</b> 30.974	sulfur 16 <b>S</b> 32.065	chlorine 17 <b>Cl</b> 35.453	argon 18 <b>Ar</b> 39.948
potassium 19 <b>4s</b> 39.098	calcium 20 <b>Ca</b> 40.078	scandium 21 <b>3d</b> 44.956	titanium 22 <b>Ti</b> 47.867	vanadium 23 <b>V</b> 50.942	chromium 24 <b>Cr</b> 51.996	manganese 25 <b>Mn</b> 54.938	iron 26 <b>Fe</b> 55.845	cobalt 27 <b>Co</b> 58.933	nickel 28 <b>Ni</b> 58.693	copper 29 <b>Cu</b> 63.546	zinc 30 <b>Zn</b> 65.39	gallium 31 <b>4p</b> 69.723	germanium 32 <b>Ge</b> 72.61	arsenic 33 <b>As</b> 74.922	selenium 34 <b>Se</b> 78.96	bromine 35 <b>Br</b> 79.904	krypton 36 <b>Kr</b> 83.80							
rubidium 37 <b>5s</b> 85.468	strontium 38 <b>Sr</b> 87.62	yttrium 39 <b>4d</b> 88.906	zirconium 40 <b>Zr</b> 91.224	niobium 41 <b>Nb</b> 92.906	molybdenum 42 <b>Mo</b> 95.94	technetium 43 <b>Tc</b> [98]	ruthenium 44 <b>Ru</b> 101.07	rhodium 45 <b>Rh</b> 102.91	palladium 46 <b>Pd</b> 106.42	silver 47 <b>Ag</b> 107.87	cadmium 48 <b>Cd</b> 112.41	indium 49 <b>5p</b> 114.82	tin 50 <b>Sn</b> 118.71	antimony 51 <b>Sb</b> 121.76	tellurium 52 <b>Te</b> 127.60	iodine 53 <b>I</b> 126.90	xenon 54 <b>Xe</b> 131.29							
caesium 55 <b>6s</b> 132.91	barium 56 <b>Ba</b> 137.33	* 57-70 <b>5d</b>	lutetium 71 <b>5d</b> 174.97	hafnium 72 <b>Hf</b> 178.49	tantalum 73 <b>Ta</b> 180.95	tungsten 74 <b>W</b> 183.84	rhenium 75 <b>Re</b> 186.21	osmium 76 <b>Os</b> 190.23	iridium 77 <b>Ir</b> 192.22	platinum 78 <b>Pt</b> 195.08	gold 79 <b>Au</b> 196.97	mercury 80 <b>Hg</b> 200.59	thallium 81 <b>6p</b> 204.38	lead 82 <b>Pb</b> 207.2	bismuth 83 <b>Bi</b> 208.98	polonium 84 <b>Po</b> [209]	astatine 85 <b>At</b> [210]	radon 86 <b>Rn</b> [222]						
francium 87 <b>7s</b> [223]	radium 88 <b>Ra</b> [226]	** 89-102 <b>6d</b>	lawrencium 103 <b>6d</b> [262]	rutherfordium 104 <b>Rf</b> [261]	dubnium 105 <b>Db</b> [262]	seaborgium 106 <b>Sg</b> [266]	bohrium 107 <b>Bh</b> [264]	hassium 108 <b>Hs</b> [269]	meitnerium 109 <b>Mt</b> [268]	ununnium 110 <b>Uun</b> [271]	ununium 111 <b>Uuu</b> [272]	unubium 112 <b>Uub</b> [277]	ununquadium 114 <b>7p</b> [283]											

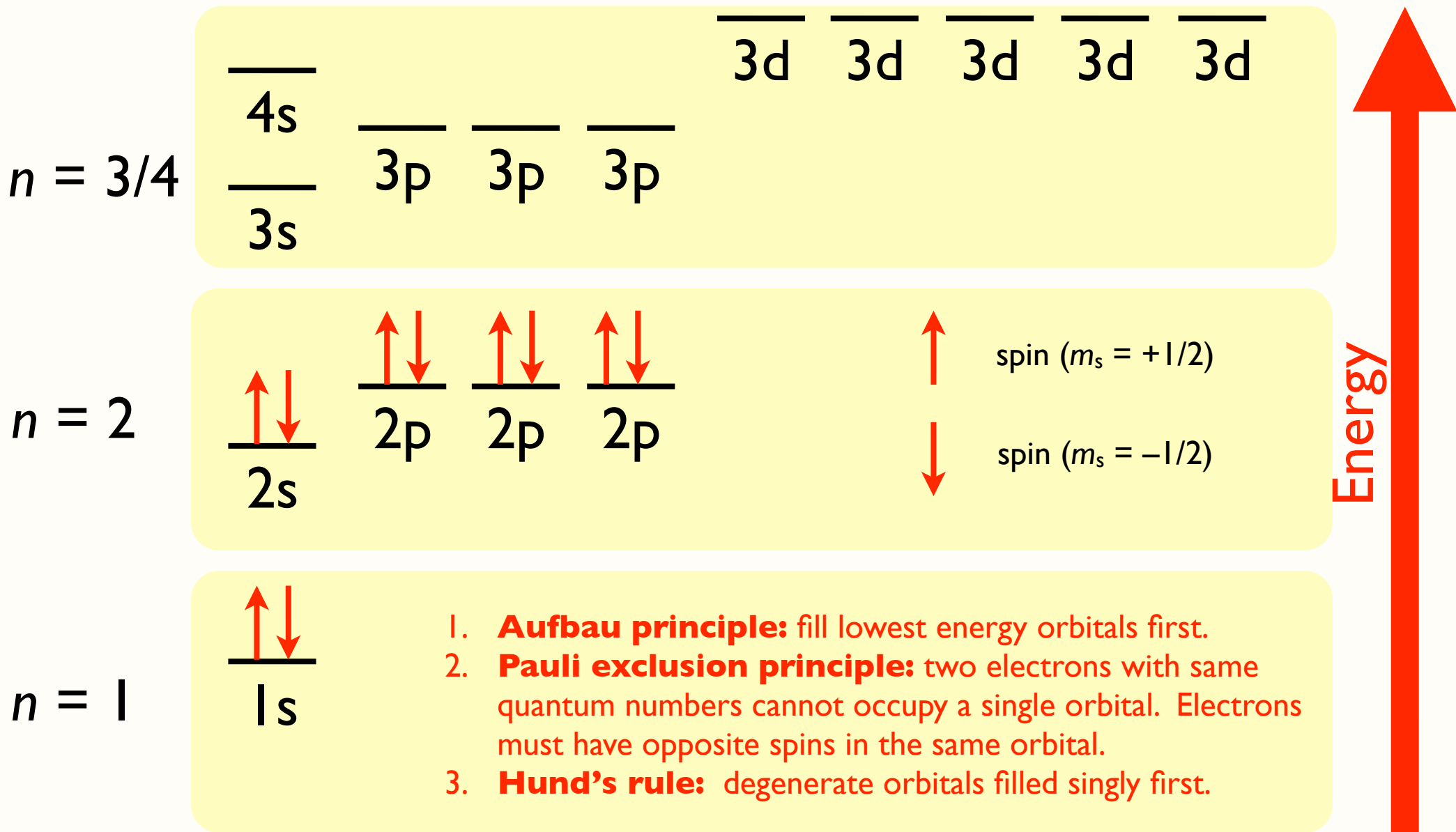
\* Lanthanide series

lanthanum 57 <b>4f</b> 138.91	cerium 58 <b>Ce</b> 140.12	praseodymium 59 <b>Pr</b> 140.91	neodymium 60 <b>Nd</b> 144.24	promethium 61 <b>Pm</b> [145]	samarium 62 <b>Sm</b> 150.36	europium 63 <b>Eu</b> 151.96	gadolinium 64 <b>Gd</b> 157.25	terbium 65 <b>Tb</b> 158.93	dysprosium 66 <b>Dy</b> 162.50	holmium 67 <b>Ho</b> 164.93	erbium 68 <b>Er</b> 167.26	thulium 69 <b>Tm</b> 168.93	ytterbium 70 <b>Yb</b> 173.04
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\*\* Actinide series

actinium 89 <b>5f</b> [227]	thorium 90 <b>Th</b> 232.04	protactinium 91 <b>Pa</b> 231.04	uranium 92 <b>U</b> 238.03	neptunium 93 <b>Np</b> [237]	plutonium 94 <b>Pu</b> [244]	americium 95 <b>Am</b> [243]	curium 96 <b>Cm</b> [247]	berkelium 97 <b>Bk</b> [247]	californium 98 <b>Cf</b> [251]	einsteinium 99 <b>Es</b> [252]	fermium 100 <b>Fm</b> [257]	mendelevium 101 <b>Md</b> [258]	nobelium 102 <b>No</b> [259]
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# Electron Configuration: Filling Orbitals



# Self Test Question

Which of the following orbitals is *highest* in energy?

hydrogen 1 H 1.0079																	helium 2 He 4.0026						
lithium 3 Li 6.941	beryllium 4 Be 9.0122																	boron 5 B 10.811	carbon 6 C 12.011	nitrogen 7 N 14.007	oxygen 8 O 15.999	fluorine 9 F 18.998	neon 10 Ne 20.180
sodium 11 Na 22.990	magnesium 12 Mg 24.305																	aluminum 13 Al 26.982	silicon 14 Si 28.086	phosphorus 15 P 30.974	sulfur 16 S 32.065	chlorine 17 Cl 35.453	argon 18 Ar 39.948
potassium 19 K 39.098	calcium 20 Ca 40.078	scandium 21 Sc 44.956	titanium 22 Ti 47.867	vanadium 23 V 50.942	chromium 24 Cr 51.996	manganese 25 Mn 54.938	iron 26 Fe 55.845	cobalt 27 Co 58.933	nickel 28 Ni 58.693	copper 29 Cu 63.546	zinc 30 Zn 65.39	gallium 31 Ga 69.723	germanium 32 Ge 72.61	arsenic 33 As 74.922	seletem 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.80						
rubidium 37 Rb 85.468	strontium 38 Sr 87.62	yttrium 39 Y 88.906	zirconium 40 Zr 91.224	niobium 41 Nb 92.906	molybdenum 42 Mo 95.94	technetium 43 Tc [98]	ruthenium 44 Ru 101.07	rhodium 45 Rh 102.91	nickel 46 Pd 106.42	silver 47 Ag 107.87	cadmium 48 Cd 112.41	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	xenon 54 Xe 131.29						
cesium 55 Cs 132.91	barium 56 Ba 137.33	lanthanum 57 Lu 174.97	hafnium 71 Hf 178.49	tantalum 72 Ta 180.95	tungsten 73 W 183.84	rhenium 74 Re 186.21	osmium 75 Os 190.23	iridium 76 Ir 192.22	platinum 77 Pt 195.08	gold 78 Au 196.97	mercury 79 Hg 200.59	thallium 80 Tl 204.38	lead 81 Pb 207.2	bismuth 82 Bi 208.98	polonium 83 Po [209]	astatine 84 At [210]	radon 85 Rn [222]						
francium 87 Fr [223]	radium 88 Ra [226]	* 57-70																unquadecium 114 Uuq [288]					
		* Lanthanide series																					
		lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 Yb 173.04								
		** Actinide series																					
		actinium 89 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendelevium 101 Md [258]	nobelium 102 No [259]								

- A. 3f
- B. 3p
- C. 2s
- D. 3s
- E. 2d

# Self Test Question

Which is the correct electron configuration for carbon?

hydrogen 1 H 1.0079																	helium 2 He 4.0026			
lithium 3 Li 6.941	beryllium 4 Be 9.0122											boron 5 B 10.811	carbon 6 C 12.011	nitrogen 7 N 14.007	oxygen 8 O 15.999	fluorine 9 F 18.998	neon 10 Ne 20.180			
sodium 11 Na 22.989	magnesium 12 Mg 24.305											aluminum 13 Al 26.982	silicon 14 Si 28.086	phosphorus 15 P 30.974	sulfur 16 S 32.065	chlorine 17 Cl 35.453	argon 18 Ar 39.948			
potassium 19 K 39.098	calcium 20 Ca 40.078	scandium 21 Sc 44.956	titanium 22 Ti 47.867	vanadium 23 V 50.942	chromium 24 Cr 51.996	manganese 25 Mn 54.938	iron 26 Fe 55.845	cobalt 27 Co 58.933	nickel 28 Ni 58.693	copper 29 Cu 63.546	zinc 30 Zn 65.39	gallium 31 Ga 69.723	germanium 32 Ge 72.61	arsenic 33 As 74.922	selecnium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.80			
rubidium 37 Rb 85.468	strontium 38 Sr 87.62	yttrium 39 Y 88.906	zirconium 40 Zr 91.224	niobium 41 Nb 92.906	molybdenum 42 Mo 95.94	technetium 43 Tc [98]	ruthenium 44 Ru 101.07	rhodium 45 Rh 102.91	palladium 46 Pd 106.42	silver 47 Ag 107.87	cadmium 48 Cd 112.41	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	xenon 54 Xe 131.29			
cesium 55 Cs 132.91	barium 56 Ba 137.33	* 57-70	lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 Yb 173.04	radium 88 Ra [226]			
francium 87 Fr [223]	radium 88 Ra [226]	* *	actinium 89 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendelevium 101 Md [258]	nobelium 102 No [259]	unnilium 110 Uun [271]	ununium 111 Uuu [272]	ununium 112 Uub [273]	ununium 114 Uuq [289]
* Lanthanide series																				
** Actinide series																				

- A.  $1s^2, 2s^8$
- B.  $1s^2, 2s^4$
- C.  $1s^2, 2s^2, 2s^2$
- D.  $1s^2, 2s^2, 2p^2$
- E. none of the above

# Bonding and Molecular Structure

Sections: 2.2, 2.3, 2.4, 1.3, 1.5, 1.6, 1.9

*You are responsible for sections 1.2, 1.4, 1.7, 1.10*

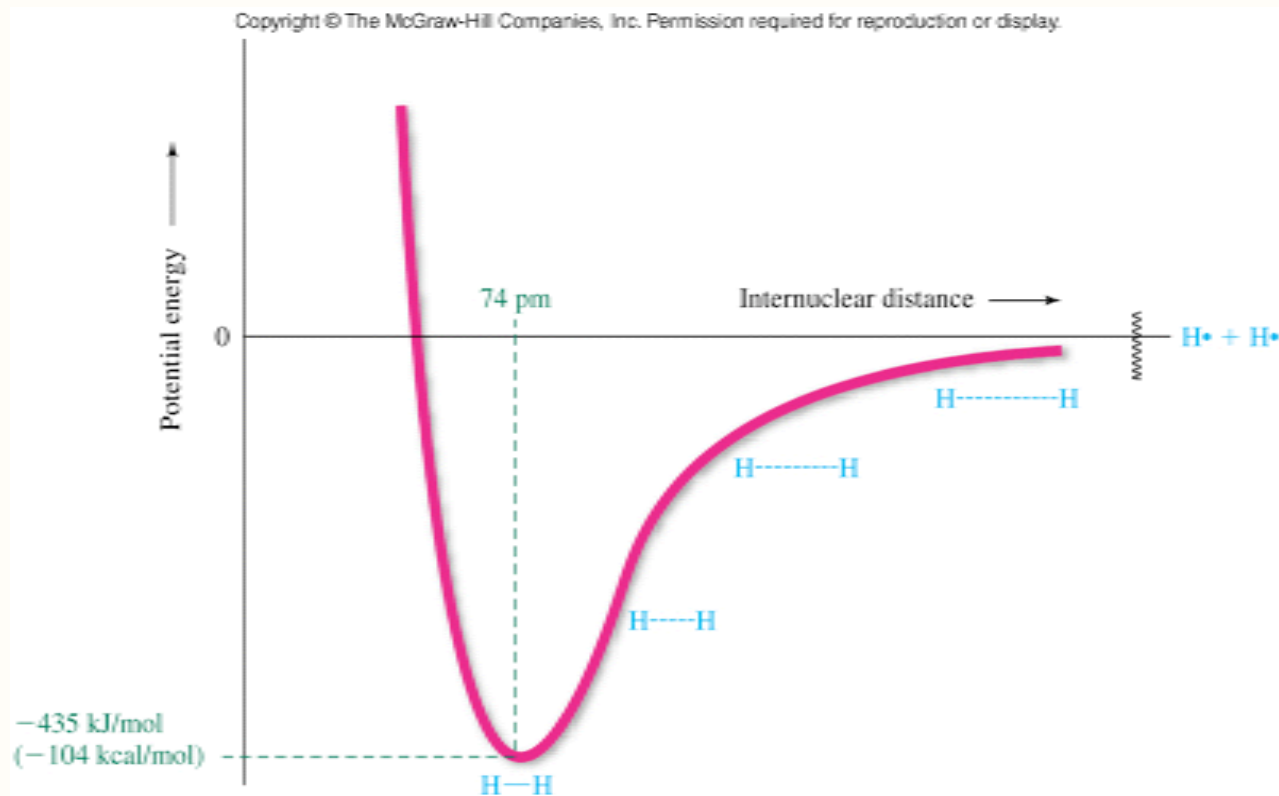
# What is a Covalent Chemical Bond?

valent = bonding

covalent = electrons shared between two nuclei

## Forces involved:

- electron-electron repulsion
- nucleus-nucleus repulsion
- electron-nucleus attraction



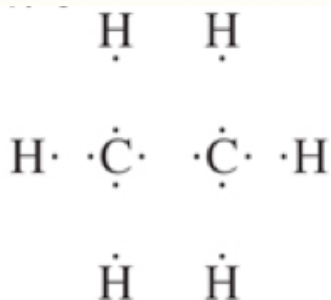
electron-electron repulsion < electron-nucleus attraction

# Three Models of Bonding

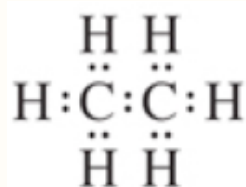
## Lewis Model:

- atoms gain, lose or share electrons in order to achieve a closed-shell electron configurations (all orbitals fully occupied)
- closed-shell for row 2 = 8 electrons (octet rule)
- only valence electrons (in outermost shell) are involved in bonding

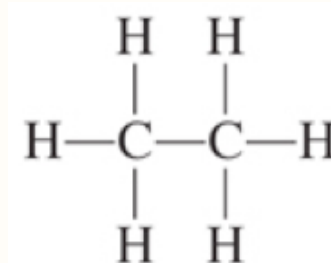
### Atomic Structures



### Molecular Lewis Structures



### Molecular Lewis Structures

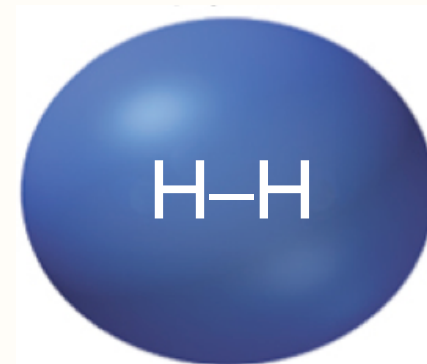


# Three Models of Bonding

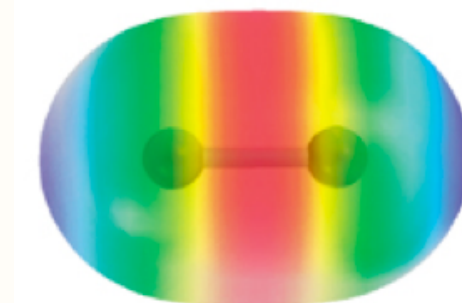
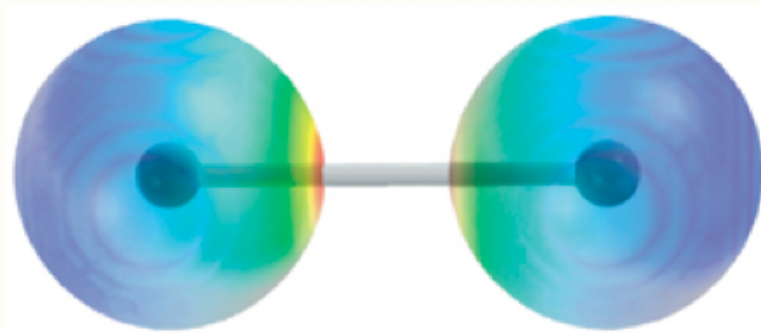
## Valence Bond Model:

- in-phase overlap of two half-filled orbitals
- in-phase = constructive interference
- increases probability electrons *between* two nuclei

Boundary  
Surfaces



Electrostatic  
Potential maps:  
red = negative  
blue = positive

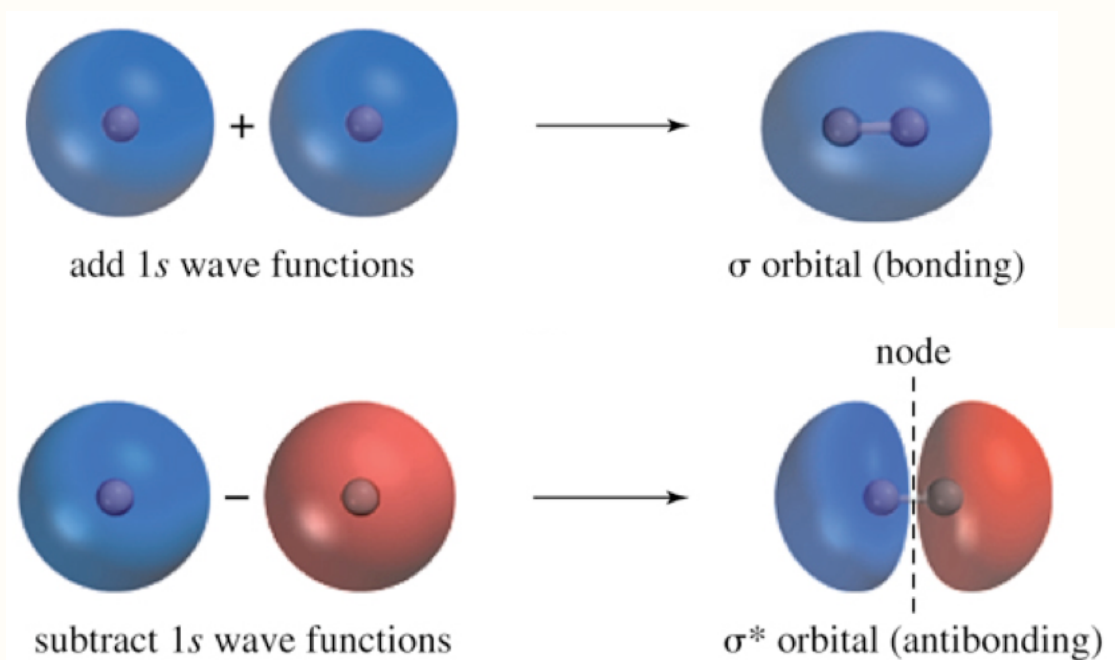




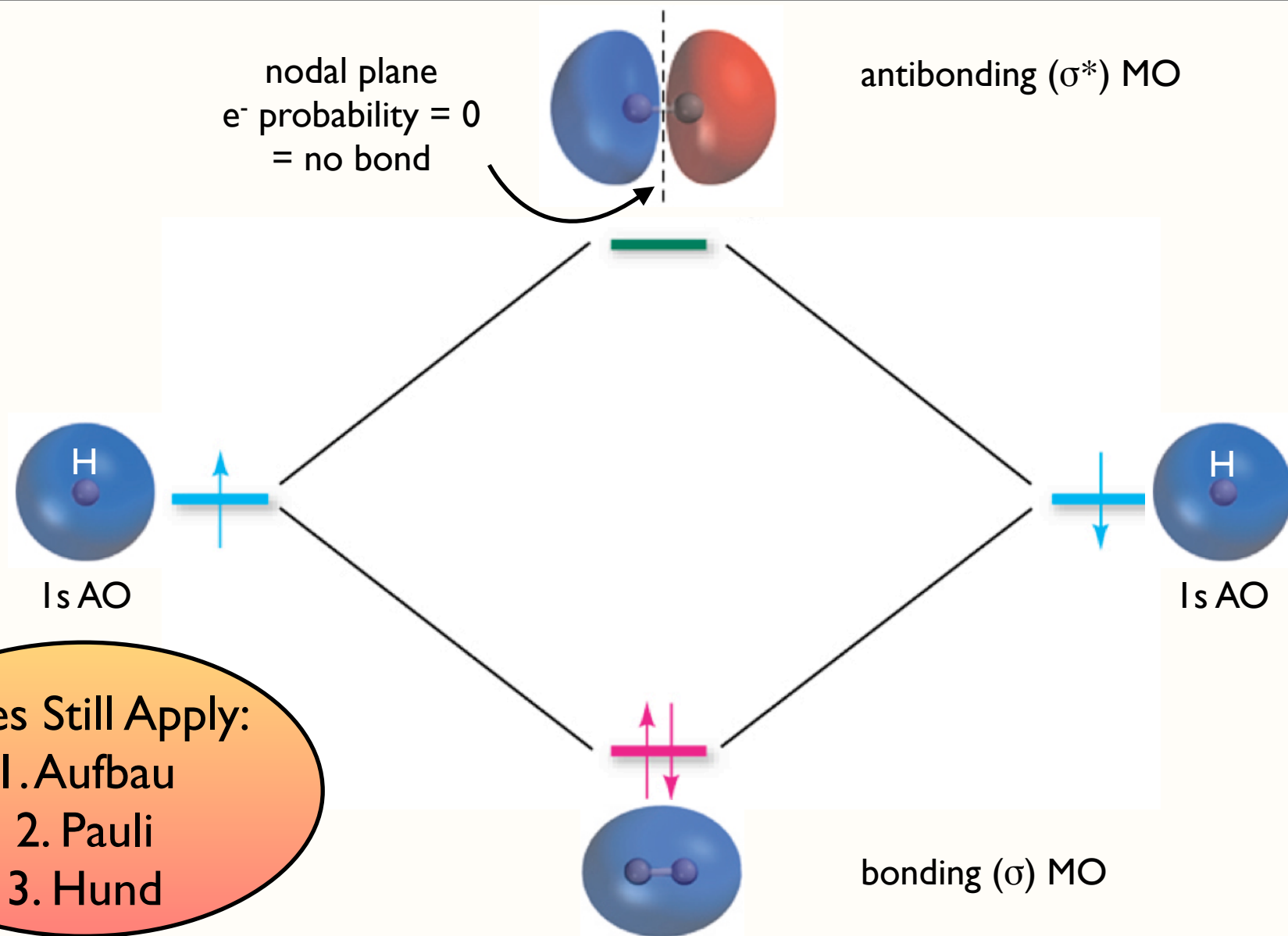
# Three Models of Bonding

## Molecular Orbital (MO) Model:

- combine atomic orbitals (AO) of all atoms, then extract molecular orbitals
- number of atomic orbitals in equals the number of molecular orbitals out
- combination possibilities:
  - additive = produces bonding molecular orbitals
  - subtractive = produces antibonding molecular orbitals



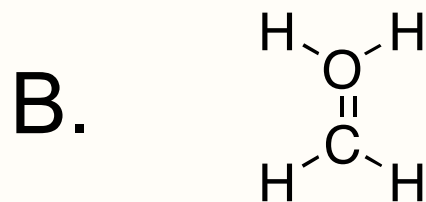
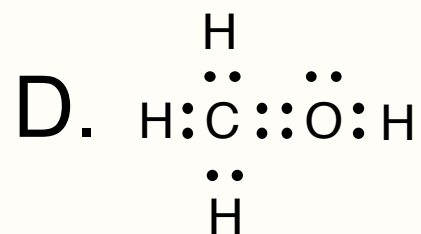
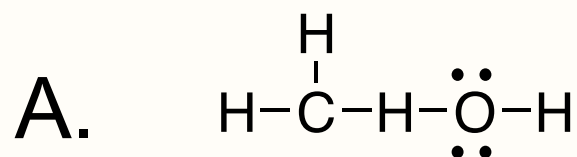
# Molecular Orbital Diagram



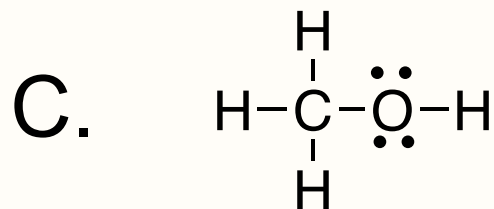
Rules Still Apply:  
1. Aufbau  
2. Pauli  
3. Hund

# Self Test Question

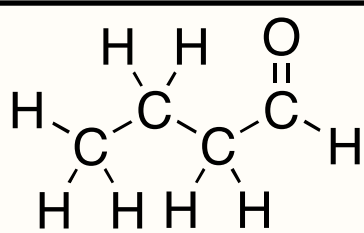
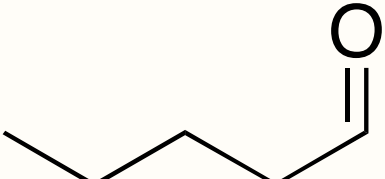
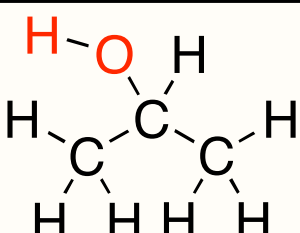
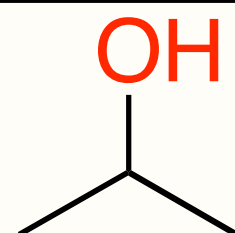
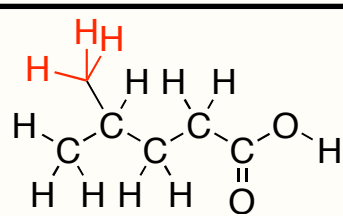
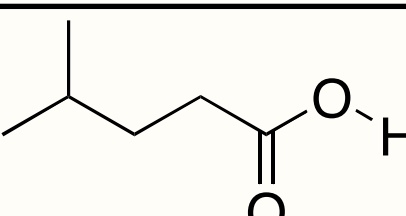
Which is the correct Lewis dot structure for CH<sub>4</sub>O?



E. none of the above



# Structural, Bond-line and Condensed Formulas

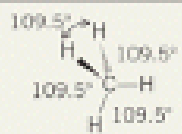





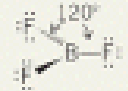





Structural	Bond-line	Condensed
<ul style="list-style-type: none"> <li>•format varies; typically <i>most</i> covalent bonds are drawn out</li> <li>•bonds are lines</li> <li>•only lone-pair (nonbonding) electrons are drawn as dots</li> </ul>	<ul style="list-style-type: none"> <li>•only atoms written are those that are <i>not</i> C or H bound to C</li> <li>•intersection of two lines is C</li> <li>•terminus of a line is -CH<sub>3</sub> group</li> <li>•# H atoms is assumed for C</li> <li>•chains drawn as “zig-zag”</li> </ul>	<ul style="list-style-type: none"> <li>•all or most covalent bond lines are omitted</li> <li>•groups are separated by parentheses (infers group is attached to carbon with available valency on left or right)</li> </ul>
		$\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$
		$\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$
		$(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{CO}_2\text{H}$

# VSEPR: Quick Review

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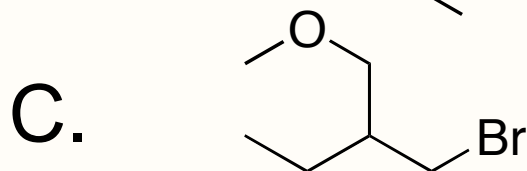
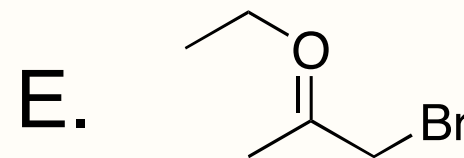
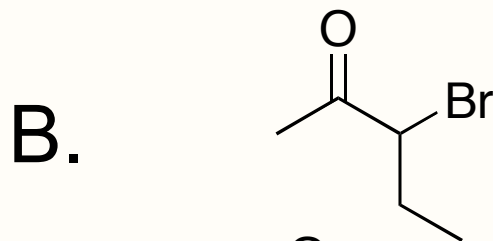
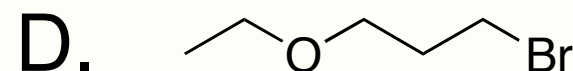
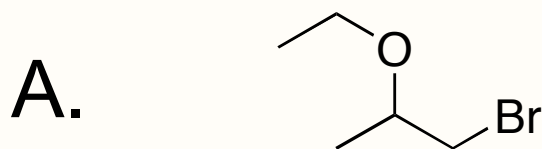
**TABLE 1.7**

VSEPR and Molecular Geometry

Compound	Structural formula	Repulsive electron pairs	Arrangement of electron pairs	Molecular shape	Molecular model
Methane (CH <sub>4</sub> )		Carbon has four bonded pairs	Tetrahedral	Tetrahedral	
Water (H <sub>2</sub> O)		Oxygen has two bonded pairs + two unshared pairs	Tetrahedral	Bent	
Ammonia (NH <sub>3</sub> )		Nitrogen has three bonded pairs + one unshared pair	Tetrahedral	Trigonal pyramidal	
Boron trifluoride (BF <sub>3</sub> )		Boron has three bonded pairs	Trigonal planar	Trigonal planar	
Formaldehyde (H <sub>2</sub> CO)		Carbon has two bonded pairs + one double bond, which is counted as one bonded pair	Trigonal planar	Trigonal planar	
Carbon dioxide (CO <sub>2</sub> )		Carbon has two double bonds, which are counted as two bonded pairs	Linear	Linear	

# Self Test Question

Which bond-line drawing correctly represents the following condensed formula?



# Functional Groups


Sections: textbook inside cover, Table 4.1 (pg. 140)

# Memorize These Functional Groups NOW

**functional group:** a defined group of atoms with a specific connectivity

















- responsible for properties
- predictable reactivity
- well-defined nomenclature

Memorizing: “What is the minimum number of atoms needs to define a functional group and in what order are they bonded?” Flashcards!

Table 4.1, page 140 

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**TABLE 4.1** Functional Groups in Some Important Classes of Organic Compounds

Class	Generalized abbreviation*	Representative example	Name of example <sup>†</sup>
Alcohol	ROH	CH <sub>3</sub> CH <sub>2</sub> OH	Ethanol
Alkyl halide	RCI	CH <sub>3</sub> CH <sub>2</sub> Cl	Chloroethane
Amine <sup>‡</sup>	RNH <sub>2</sub>	CH <sub>3</sub> CH <sub>2</sub> NH <sub>2</sub>	Ethanamine
Epoxide			Oxirane
Ether	ROR	CH <sub>3</sub> CH <sub>2</sub> OCH <sub>2</sub> CH <sub>3</sub>	Diethyl ether
Nitrile	RC≡N	CH <sub>3</sub> CH <sub>2</sub> C≡N	Propanenitrile
Nitroalkane	RNO <sub>2</sub>	CH <sub>3</sub> CH <sub>2</sub> NO <sub>2</sub>	Nitroethane
Sulfide	RSR	CH <sub>3</sub> SCH <sub>3</sub>	Dimethyl sulfide
Thiol	RSH	CH <sub>3</sub> CH <sub>2</sub> SH	Ethanethiol
Aldehyde			Ethanal
Ketone			2-Butanone
Carboxylic acid			Ethanoic acid
Carboxylic acid derivatives			
Acyl halide			Ethanoyl chloride
Acid anhydride			Ethanoic anhydride
Ester			Ethyl ethanoate
Amide			Ethanamide

\*When more than one R group is present, the groups may be the same or different.

<sup>†</sup>Most compounds have more than one acceptable name.

<sup>‡</sup>The example given is a primary amine (RNH<sub>2</sub>). Secondary amines have the general structure R<sub>2</sub>NH; tertiary amines are R<sub>3</sub>N.



# Next Lecture...

Sections: 1.5, 1.8, 1.10-1.17