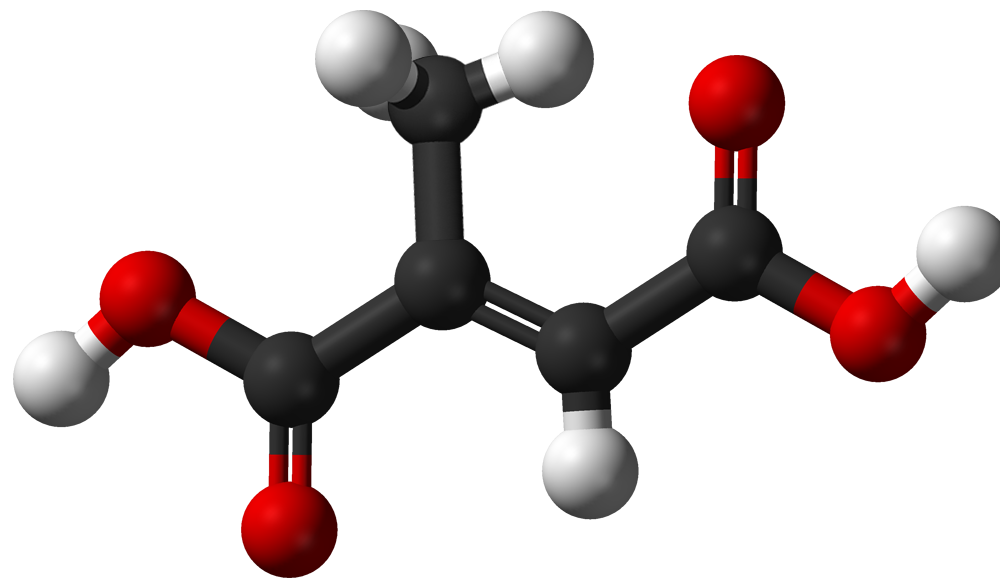


# FUNDEMENTALS OF ORGANIC CHEMISTRY



SPLASH 2018  
Matthew Yarnall

# Periodic Table of the Elements

1 IA 1A																	13 IIIA 3A	14 IVA 4A	15 VA 5A	16 VIA 6A	17 VIIA 7A	18 VIIIA 8A	
1 H Hydrogen 1.008																	5 B Boron 10.81	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180	
3 Li Lithium 6.941	4 Be Beryllium 9.012																	13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.066	17 Cl Chlorine 35.453	18 Ar Argon 39.948
11 Na Sodium 22.990	12 Mg Magnesium 24.305	3 IIIB 3B	4 IVB 4B	5 VB 5B	6 VIB 6B	7 VIIB 7B	8 VIII 8	9 VIII 8	10 VIII 8	11 IB 1B	12 IIB 2B	13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.066	17 Cl Chlorine 35.453	18 Ar Argon 39.948						
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.867	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.631	33 As Arsenic 74.922	34 Se Selenium 78.972	35 Br Bromine 79.904	36 Kr Krypton 83.798						
37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.95	43 Tc Technetium 98.907	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.906	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.711	51 Sb Antimony 121.760	52 Te Tellurium 127.6	53 I Iodine 126.904	54 Xe Xenon 131.294						
55 Cs Cesium 132.905	56 Ba Barium 137.328	57-71	72 Hf Hafnium 178.49	73 Ta Tantalum 180.948	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.217	78 Pt Platinum 195.085	79 Au Gold 196.967	80 Hg Mercury 200.592	81 Tl Thallium 204.383	82 Pb Lead 207.2	83 Bi Bismuth 208.980	84 Po Polonium [208.982]	85 At Astatine 209.987	86 Rn Radon 222.018						
87 Fr Francium 223.020	88 Ra Radium 226.025	89-103	104 Rf Rutherfordium [261]	105 Db Dubnium [262]	106 Sg Seaborgium [266]	107 Bh Bohrium [264]	108 Hs Hassium [269]	109 Mt Meitnerium [278]	110 Ds Darmstadtium [281]	111 Rg Roentgenium [280]	112 Cn Copernicium [285]	113 Nh Nihonium [286]	114 Fl Flerovium [289]	115 Mc Moscovium [289]	116 Lv Livermorium [293]	117 Ts Tennessine [294]	118 Og Oganesson [294]						

Atomic Number
<b>Symbol</b>
Name
Atomic Mass

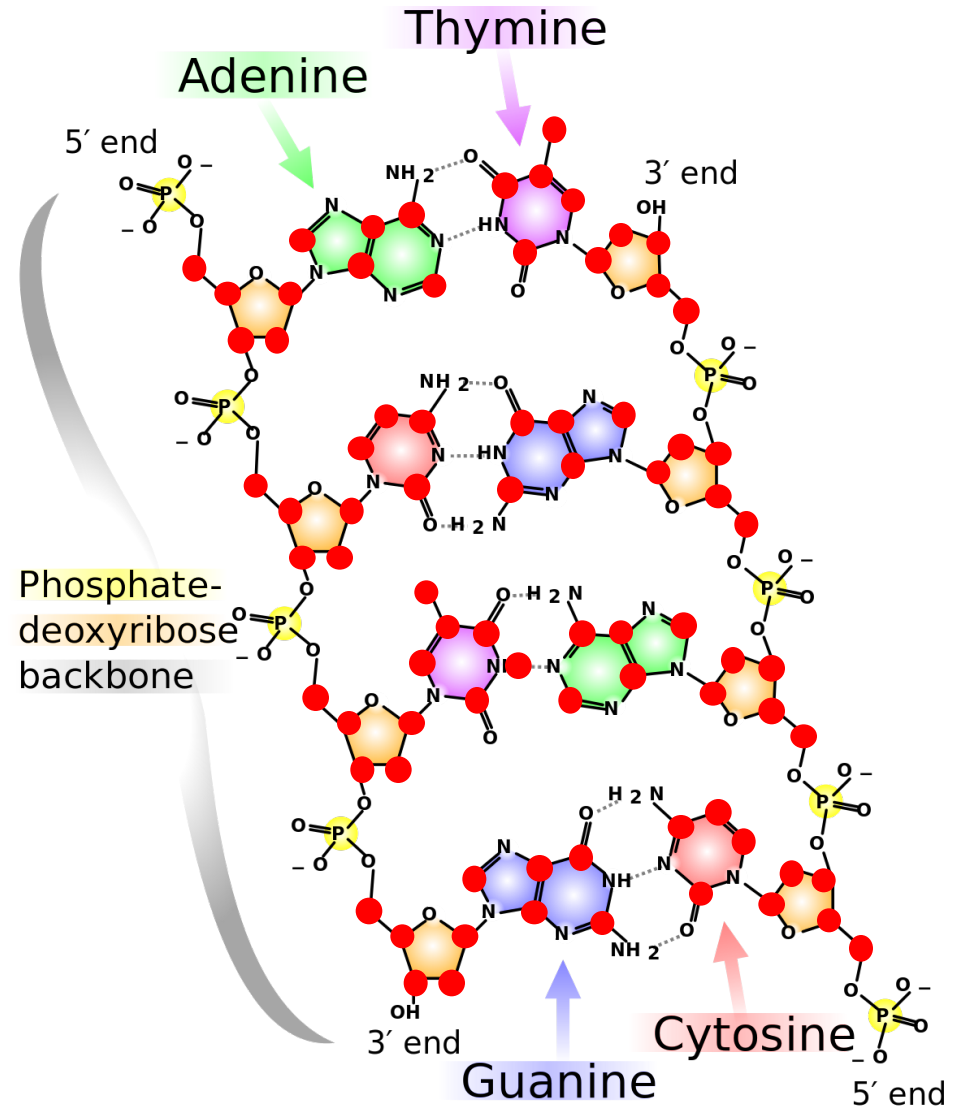
Lanthanide Series	57 La Lanthanum 138.905	58 Ce Cerium 140.116	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.242	61 Pm Promethium 144.913	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.925	66 Dy Dysprosium 162.500	67 Ho Holmium 164.930	68 Er Erbium 167.259	69 Tm Thulium 168.934	70 Yb Ytterbium 173.055	71 Lu Lutetium 174.967
Actinide Series	89 Ac Actinium 227.028	90 Th Thorium 232.038	91 Pa Protactinium 231.036	92 U Uranium 238.029	93 Np Neptunium 237.048	94 Pu Plutonium 244.064	95 Am Americium 243.061	96 Cm Curium 247.070	97 Bk Berkelium 247.070	98 Cf Californium 251.080	99 Es Einsteinium [254]	100 Fm Fermium 257.095	101 Md Mendelevium 258.1	102 No Nobelium 259.101	103 Lr Lawrencium [262]

- Alkali Metal
- Alkaline Earth
- Transition Metal
- Basic Metal
- Semimetal
- Nonmetal
- Halogen
- Noble Gas
- Lanthanide
- Actinide

# Carbon is EVERYWHERE!

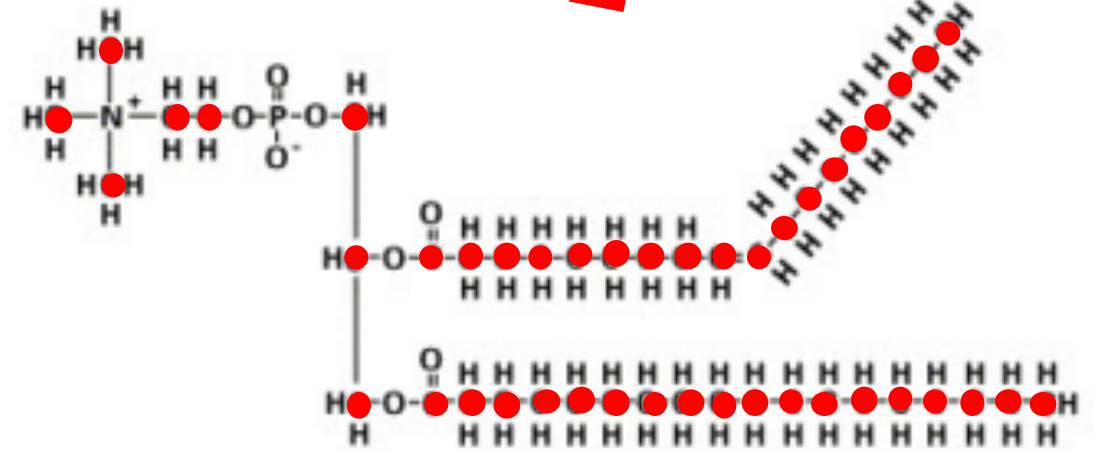
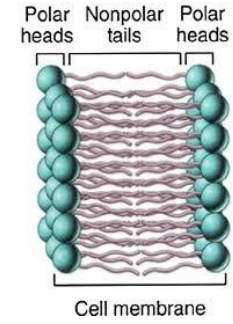
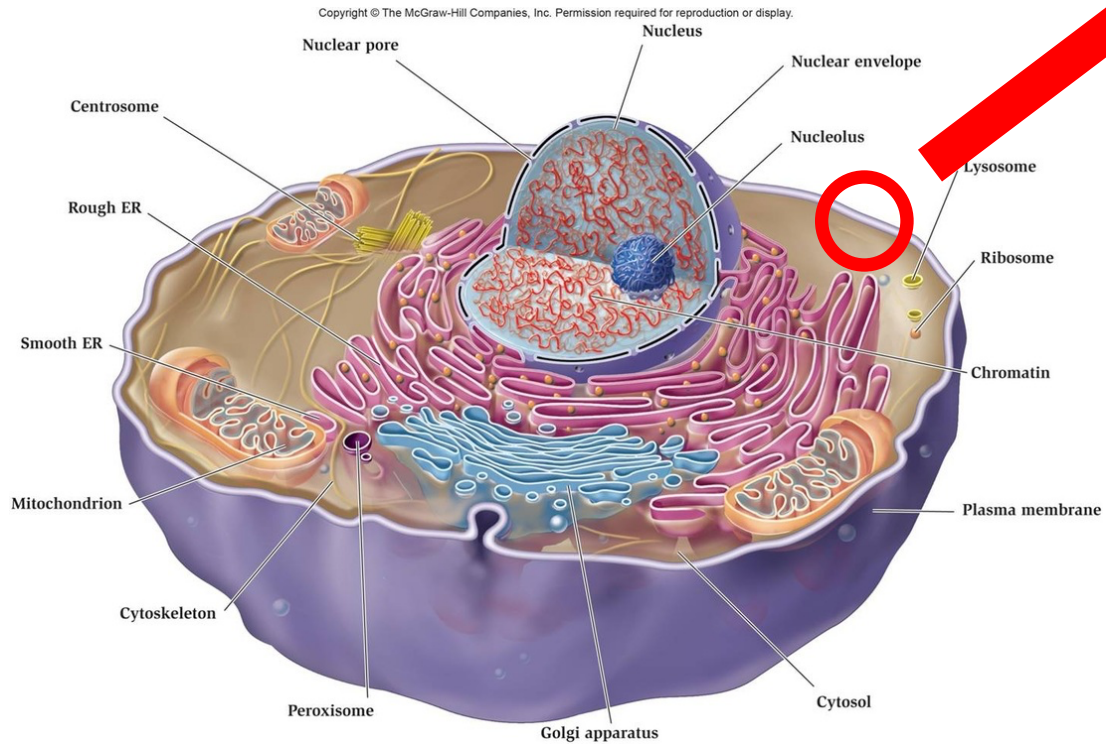


DNA



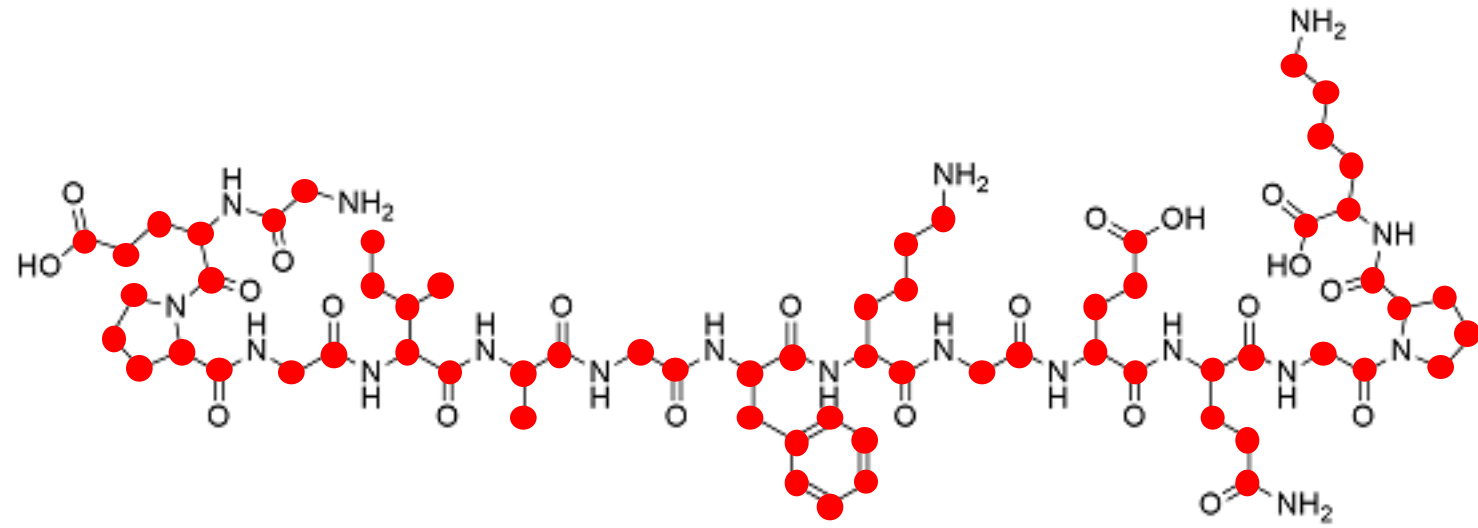
# Carbon is EVERYWHERE!

## Cell Membranes



# Carbon is EVERYWHERE!

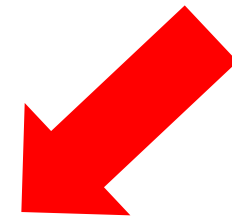
## Bones



Type II-Collagen

# The Periodic Table

Why Carbon?



1 IA 1A																	18 VIIIA 8A
1 H Hydrogen 1.008																	2 He Helium 4.003
3 Li Lithium 6.941	4 Be Beryllium 9.012											5 B Boron 10.81	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180
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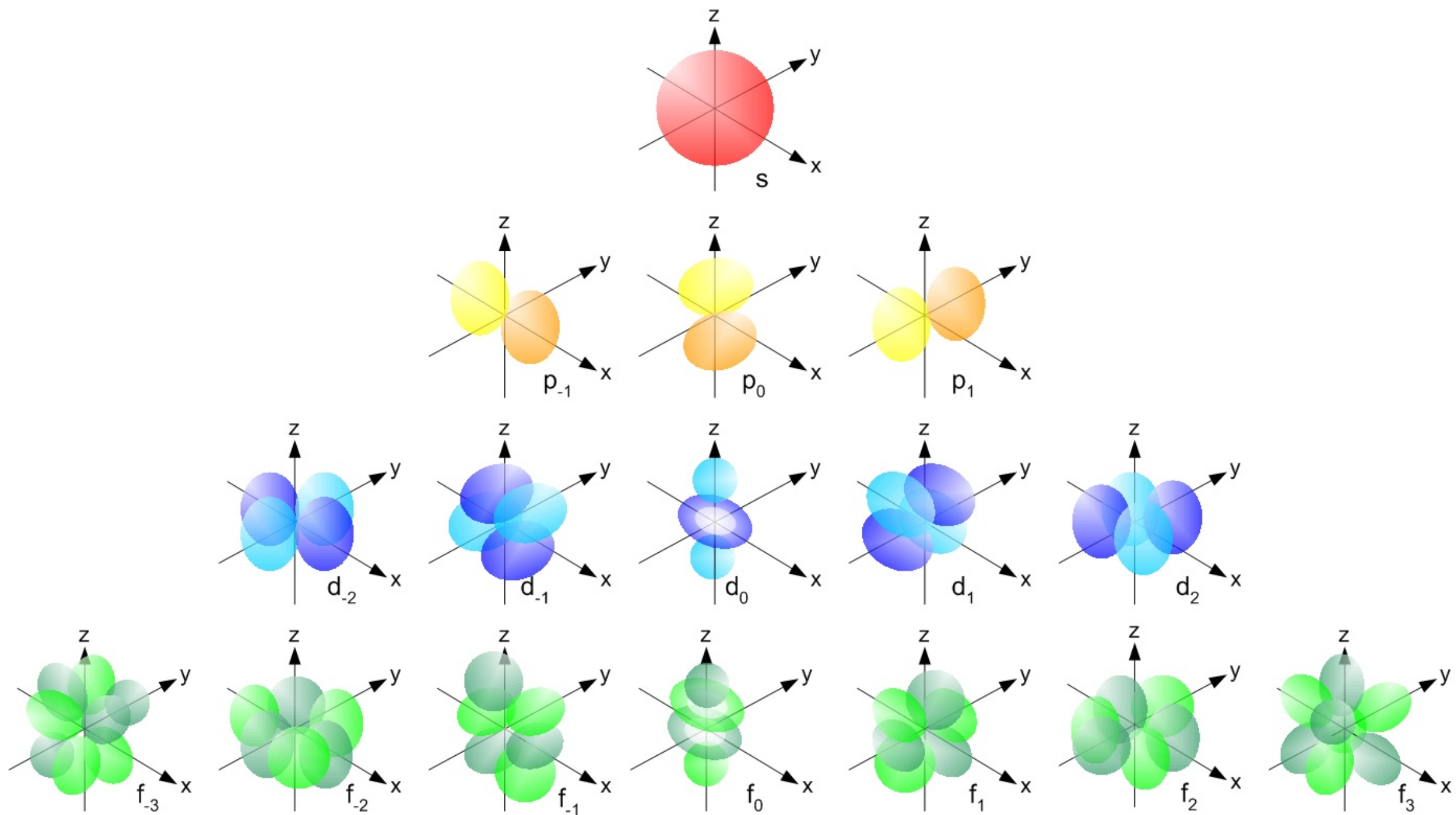
Lanthanide Series	57 La Lanthanum 138.905	58 Ce Cerium 140.116	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.242	61 Pm Promethium 144.913	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.925	66 Dy Dysprosium 162.500	67 Ho Holmium 164.930	68 Er Erbium 167.259	69 Tm Thulium 168.934	70 Yb Ytterbium 173.055	71 Lu Lutetium 174.967
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## Electron Configurations in the Periodic Table

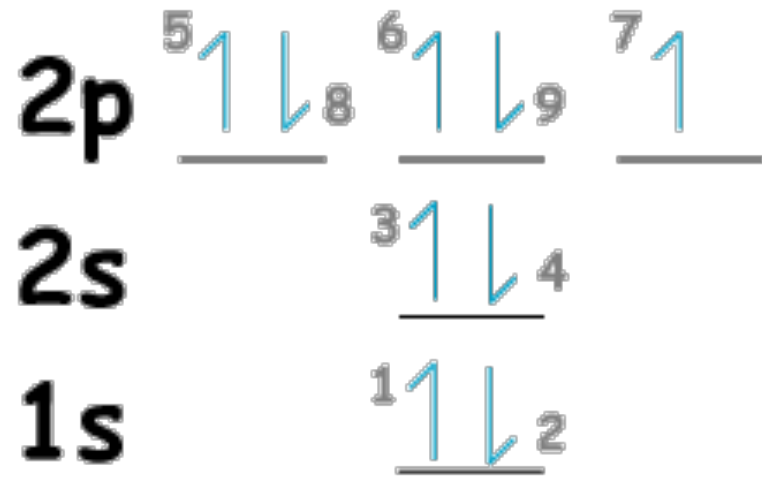
1 <b>H</b> 1s																	2 <b>He</b> 1s
3 <b>Li</b> 2s	4 <b>Be</b>											5 <b>B</b>	6 <b>C</b>	7 <b>N</b>	8 <b>O</b>	9 <b>F</b>	10 <b>Ne</b>
11 <b>Na</b> 3s	12 <b>Mg</b>											13 <b>Al</b>	14 <b>Si</b>	15 <b>P</b>	16 <b>S</b>	17 <b>Cl</b>	18 <b>Ar</b>
19 <b>K</b> 4s	20 <b>Ca</b>	21 <b>Sc</b>	22 <b>Ti</b>	23 <b>V</b>	24 <b>Cr</b>	25 <b>Mn</b>	26 <b>Fe</b>	27 <b>Co</b>	28 <b>Ni</b>	29 <b>Cu</b>	30 <b>Zn</b>	31 <b>Ga</b>	32 <b>Ge</b>	33 <b>As</b>	34 <b>Se</b>	35 <b>Br</b>	36 <b>Kr</b>
37 <b>Rb</b> 5s	38 <b>Sr</b>	39 <b>Y</b>	40 <b>Zr</b>	41 <b>Nb</b>	42 <b>Mo</b>	43 <b>Tc</b>	44 <b>Ru</b>	45 <b>Rh</b>	46 <b>Pd</b>	47 <b>Ag</b>	48 <b>Cd</b>	49 <b>In</b>	50 <b>Sn</b>	51 <b>Sb</b>	52 <b>Te</b>	53 <b>I</b>	54 <b>Xe</b>
55 <b>Cs</b> 6s	56 <b>Ba</b>	57 <b>La</b>	72 <b>Hf</b>	73 <b>Ta</b>	74 <b>W</b>	75 <b>Re</b>	76 <b>Os</b>	77 <b>Ir</b>	78 <b>Pt</b>	79 <b>Au</b>	80 <b>Hg</b>	81 <b>Tl</b>	82 <b>Pb</b>	83 <b>Bi</b>	84 <b>Po</b>	85 <b>At</b>	86 <b>Rn</b>
87 <b>Fr</b> 7s	88 <b>Ra</b>	89 <b>Ac</b>	104 <b>Rf</b>	105 <b>Db</b>	106 <b>Sg</b>	107 <b>Bh</b>	108 <b>Hs</b>	109 <b>Mt</b>	110	111	112	113	114				
		58 <b>Ce</b>	59 <b>Pr</b>	60 <b>Nd</b>	61 <b>Pm</b>	62 <b>Sm</b>	63 <b>Eu</b>	64 <b>Gd</b>	65 <b>Tb</b>	66 <b>Dy</b>	67 <b>Ho</b>	68 <b>Er</b>	69 <b>Tm</b>	70 <b>Yb</b>	71 <b>Lu</b>		
		90 <b>Th</b>	91 <b>Pa</b>	92 <b>U</b>	93 <b>Np</b>	94 <b>Pu</b>	95 <b>Am</b>	96 <b>Cm</b>	97 <b>Bk</b>	98 <b>Cf</b>	99 <b>Es</b>	100 <b>Fm</b>	101 <b>Md</b>	102 <b>No</b>	103 <b>Lr</b>		

by: Sarah Faizi





Orbital diagram for  $1s^2 2s^2 2p^5$



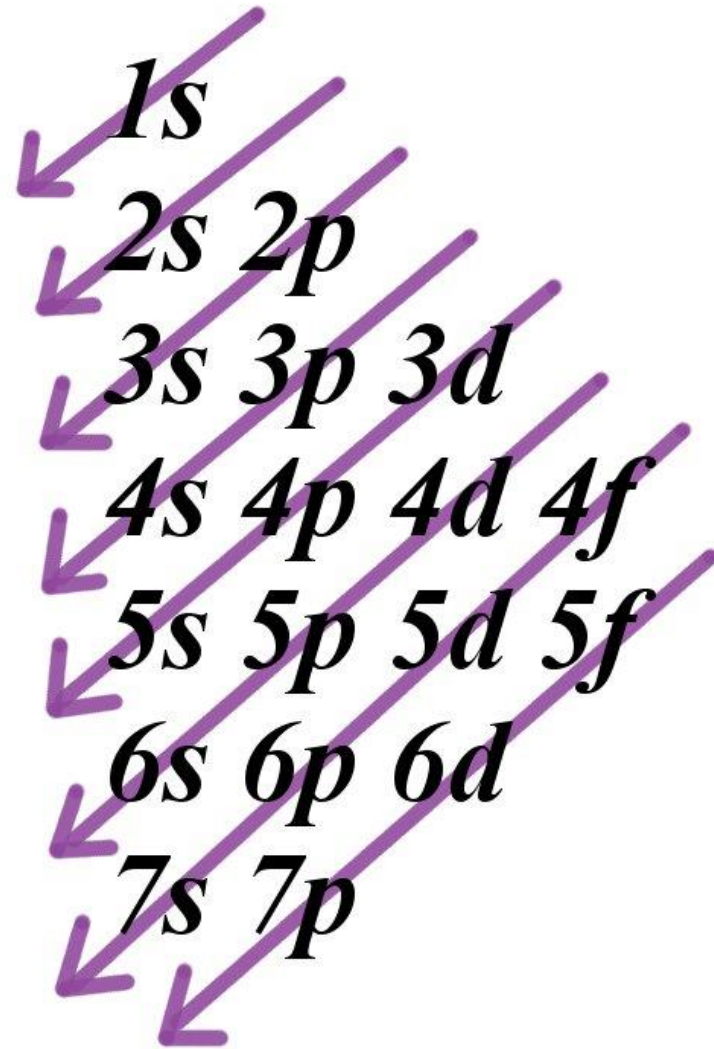
$\uparrow$  :  $e^-$  with spin = +1/2

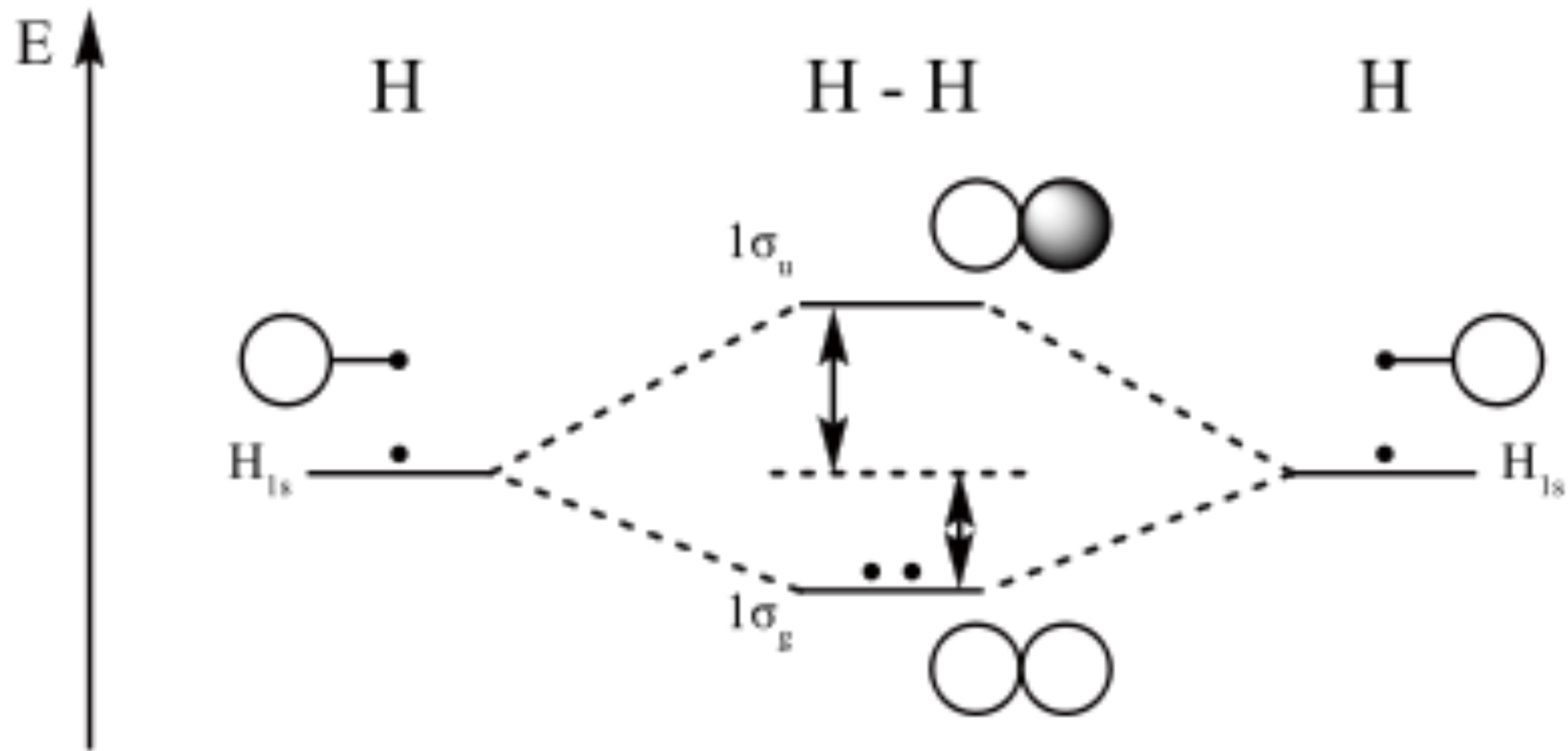
$\downarrow$  :  $e^-$  with spin = -1/2

# : order  $e^-$  is filled




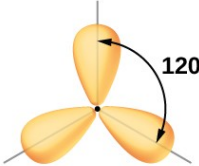
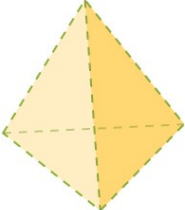
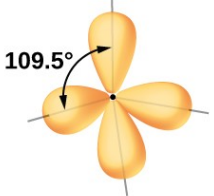
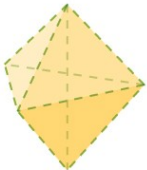
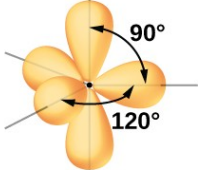
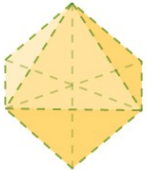
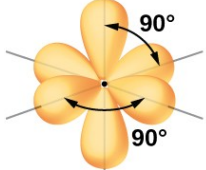
\_\_\_\_\_ : orbital

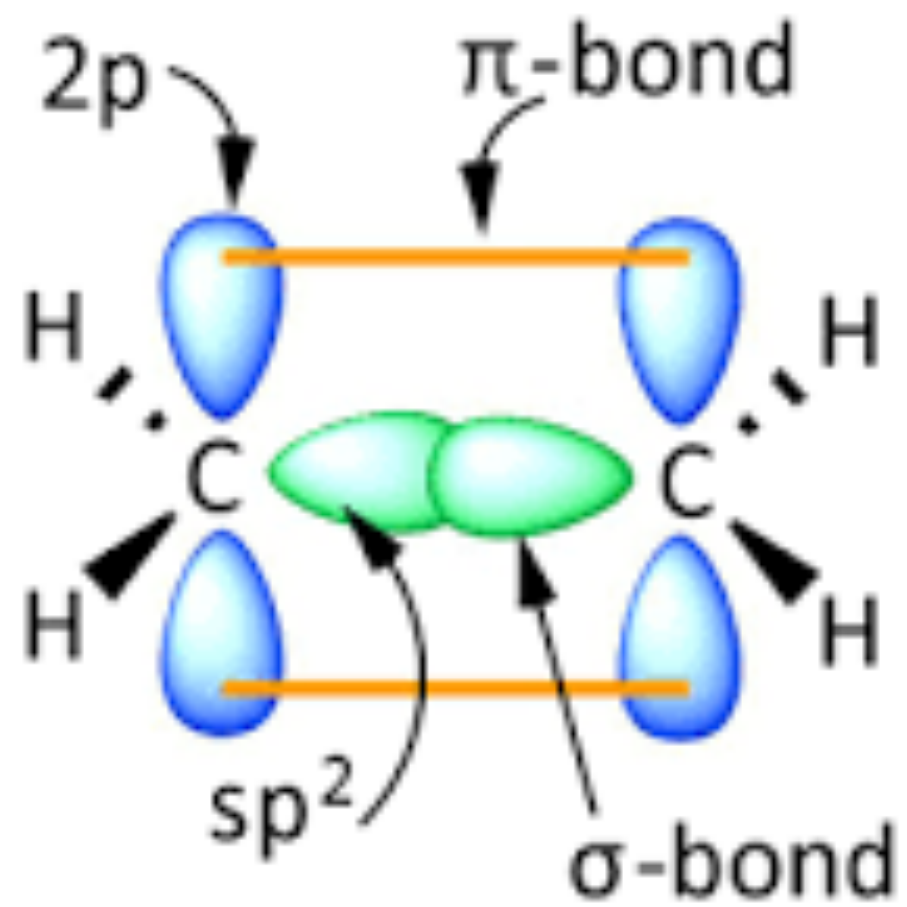
*1s*  
*2s 2p*  
*3s 3p 3d*  
*4s 4p 4d 4f*  
*5s 5p 5d 5f*  
*6s 6p 6d*  
*7s 7p*

A diagram illustrating the filling order of atomic orbitals. The orbitals are listed in rows, with purple arrows pointing downwards and to the left, indicating the sequence of filling. The rows are: 1s; 2s 2p; 3s 3p 3d; 4s 4p 4d 4f; 5s 5p 5d 5f; 6s 6p 6d; 7s 7p. The arrows show that the orbitals are filled in order of increasing principal quantum number n, with the exception of the d and f orbitals which are filled after the s orbitals of the next principal quantum number.

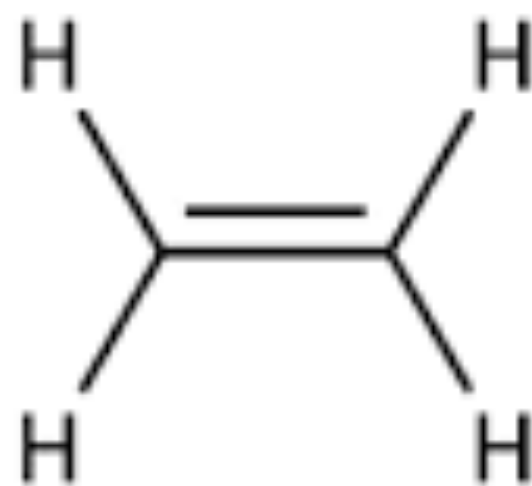


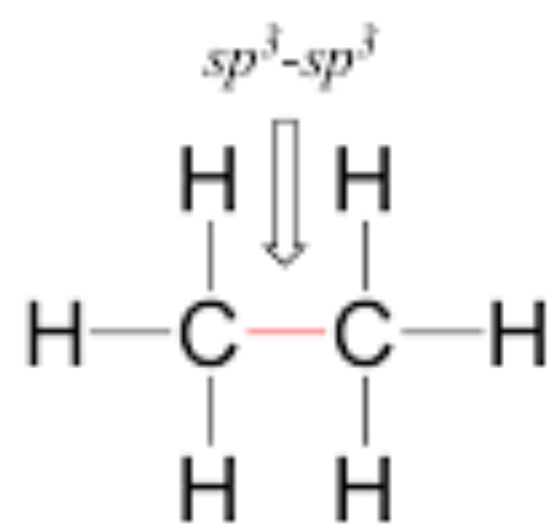
# Orbital Hybridization

Regions of Electron Density	Arrangement		Hybridization	
2		linear	$sp$	
3		trigonal planar	$sp^2$	
4		tetrahedral	$sp^3$	
5		trigonal bipyramidal	$sp^3d$	
6		octahedral	$sp^3d^2$	

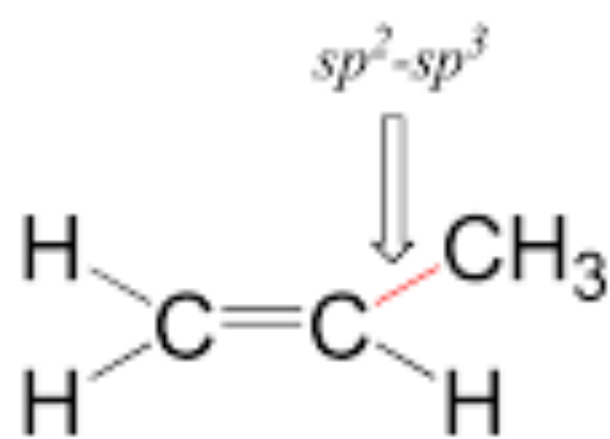


Ethene

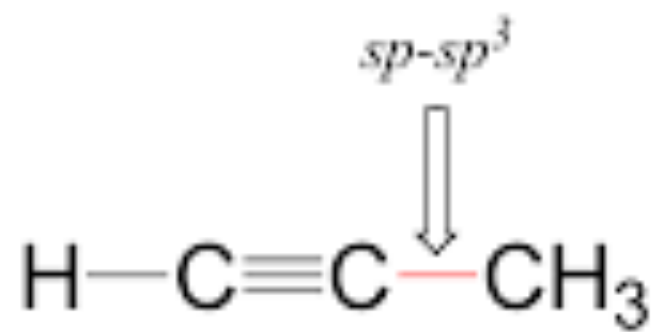




A



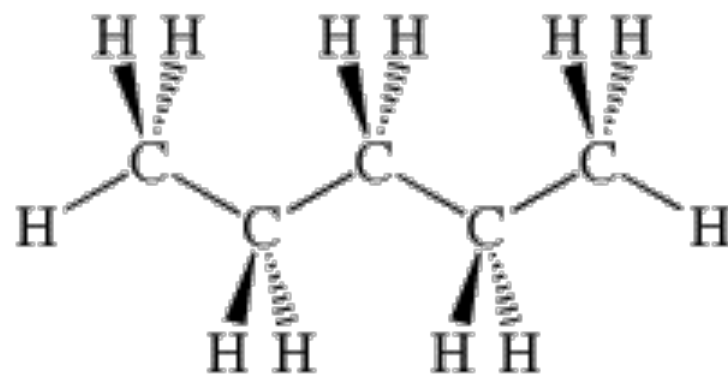
B



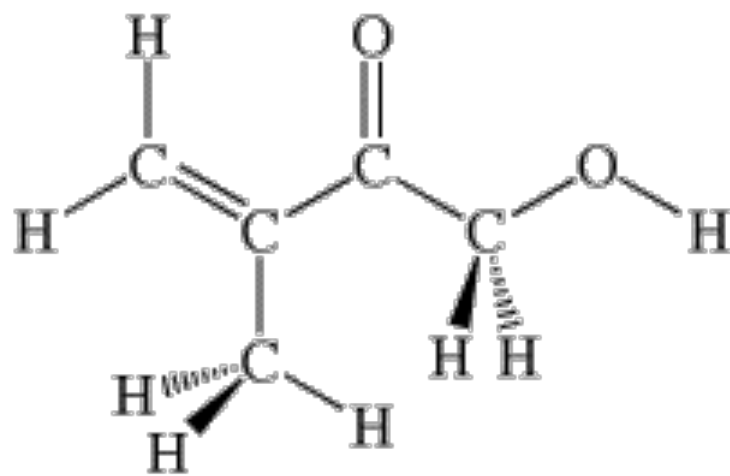
C

Why no quadruple bonds?

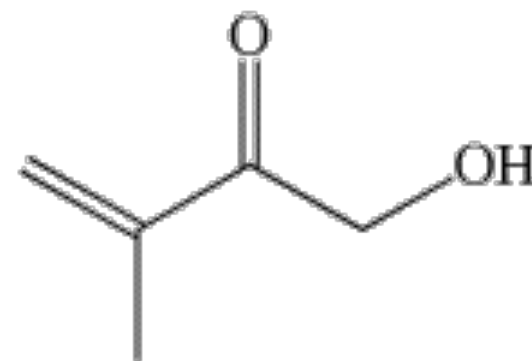


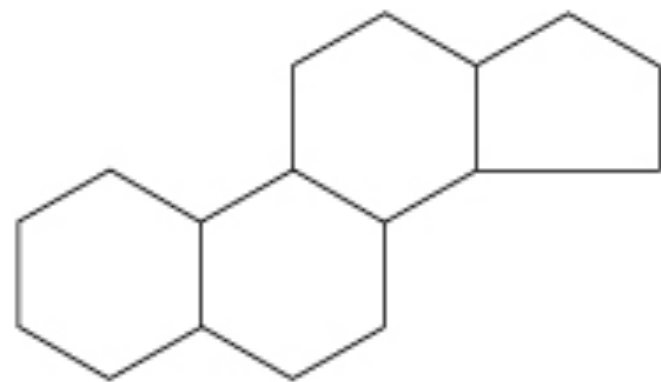


is

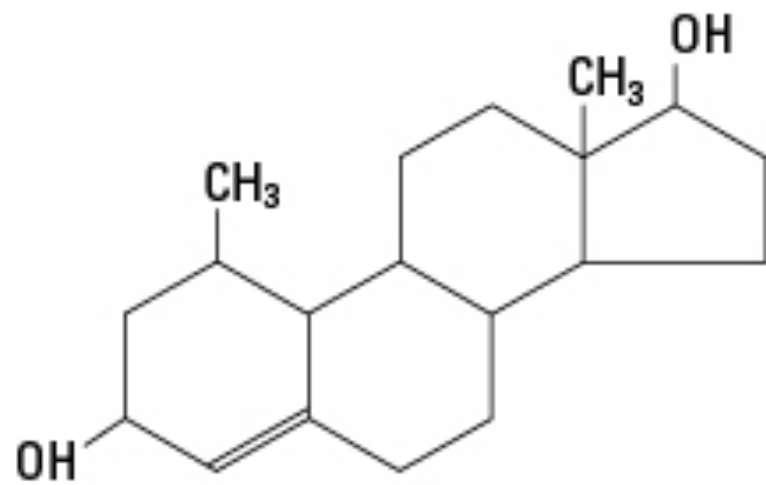


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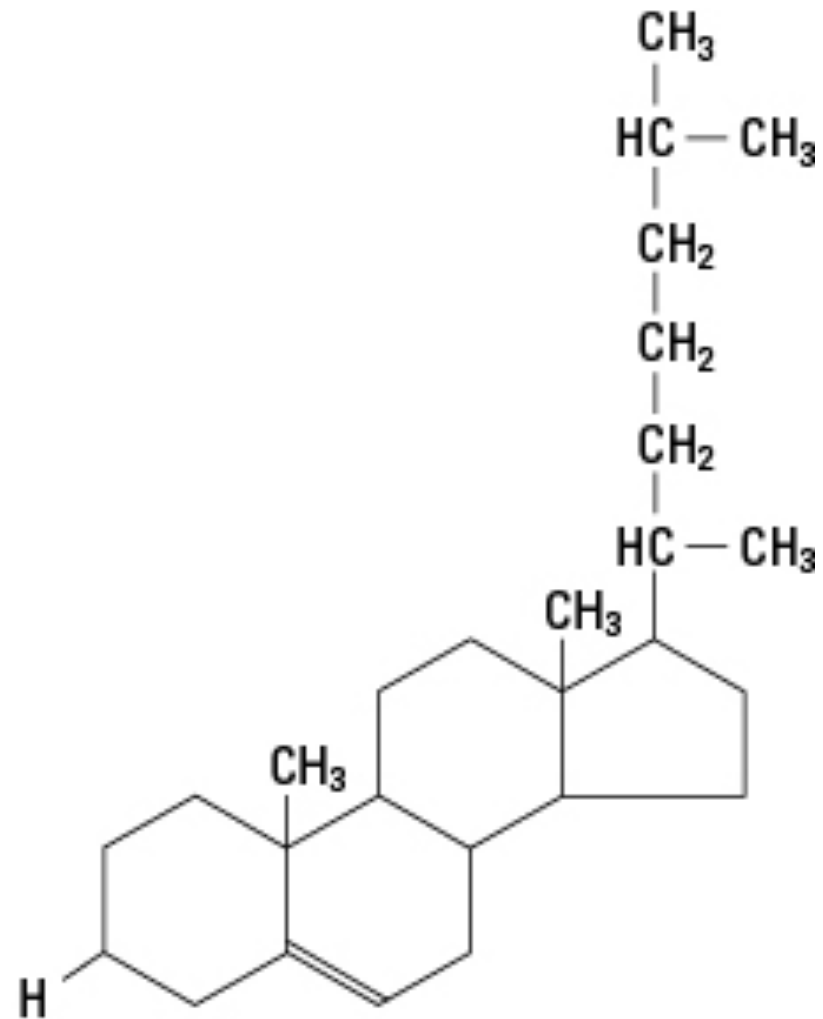




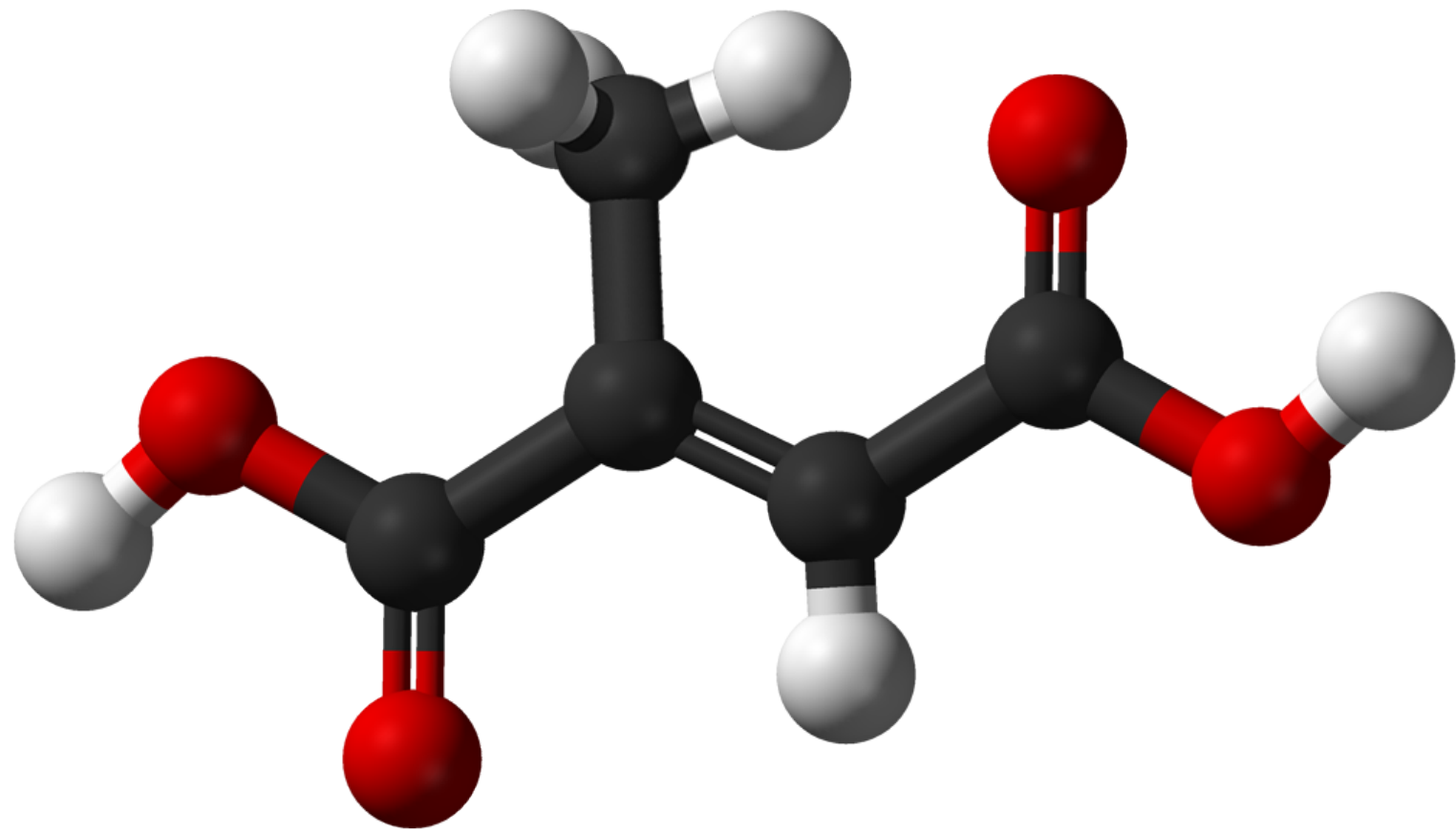
steroid backbone



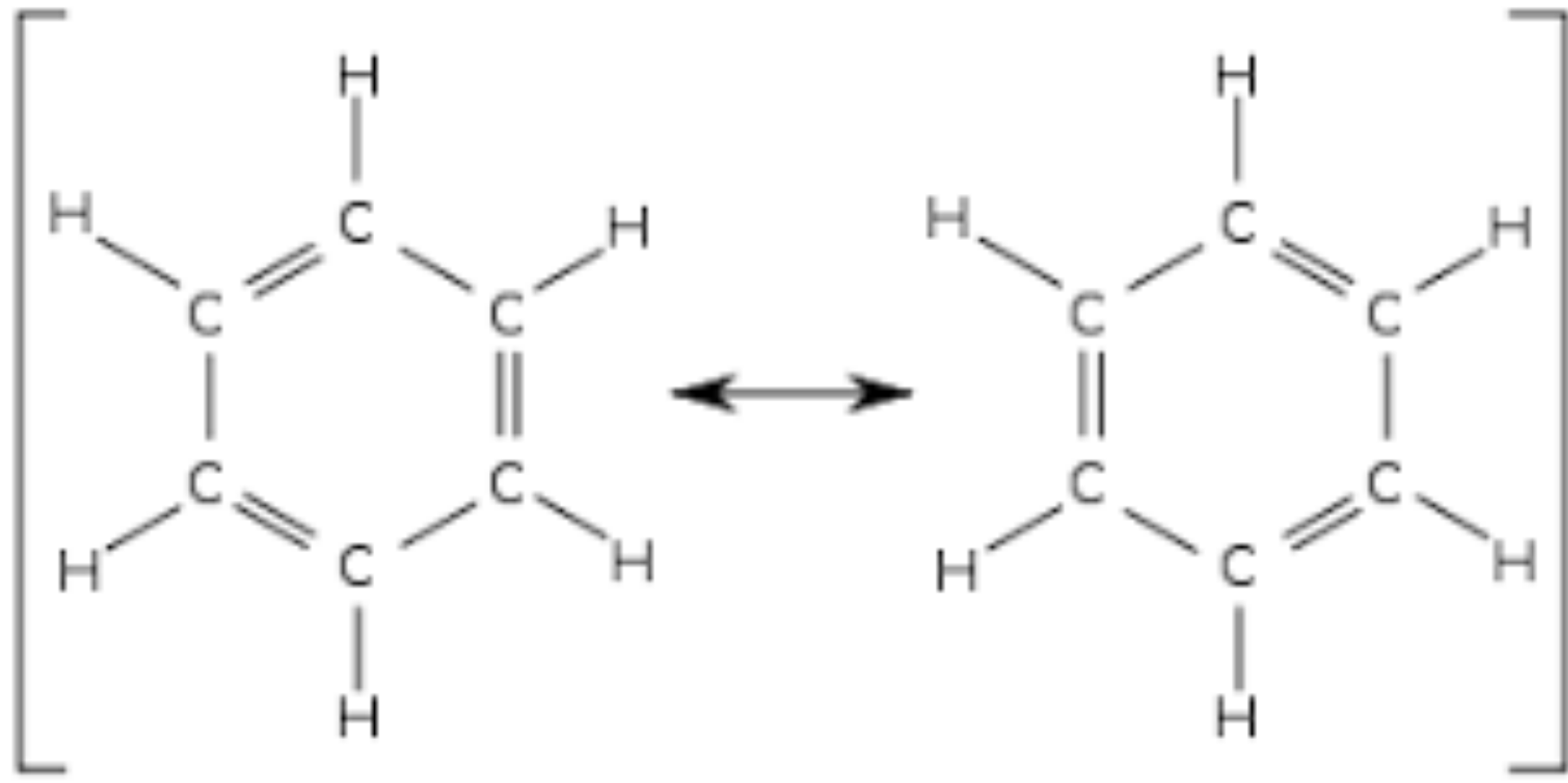
testosterone

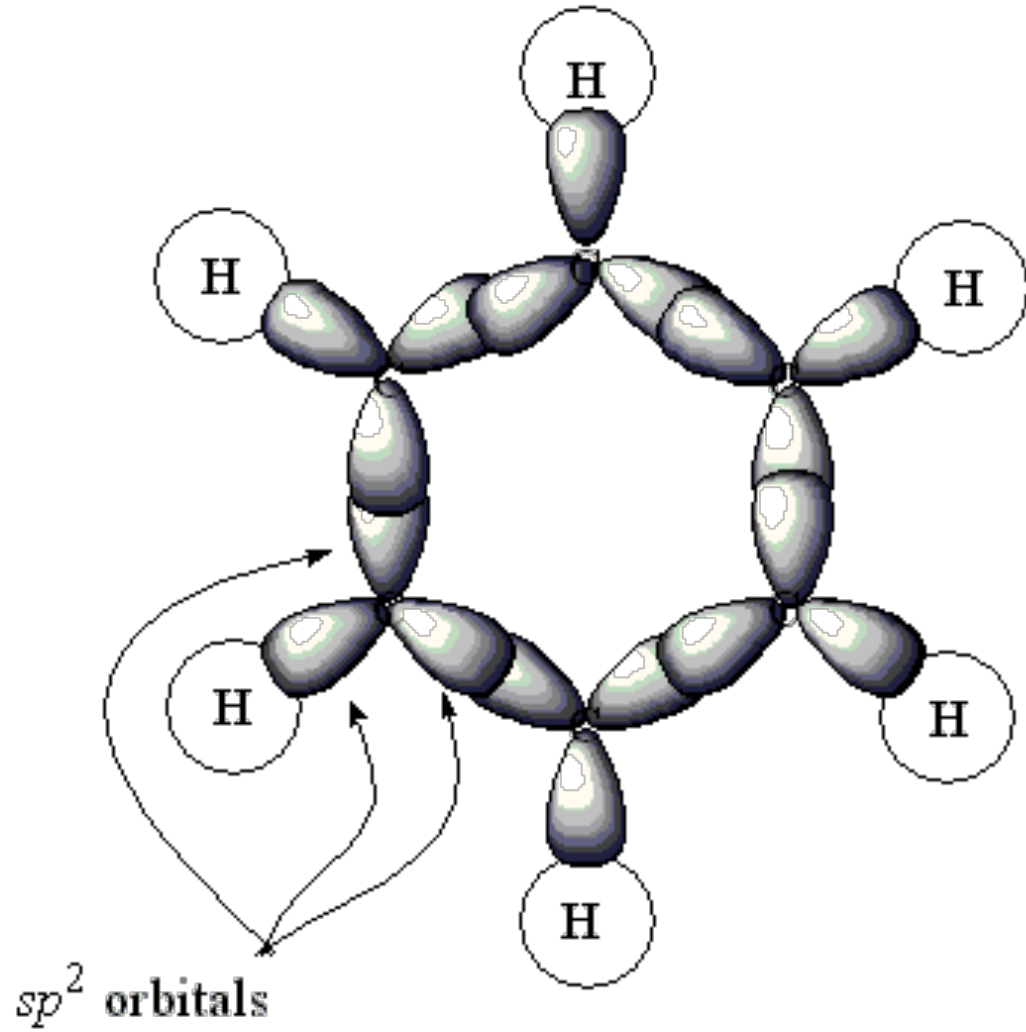


cholesterol

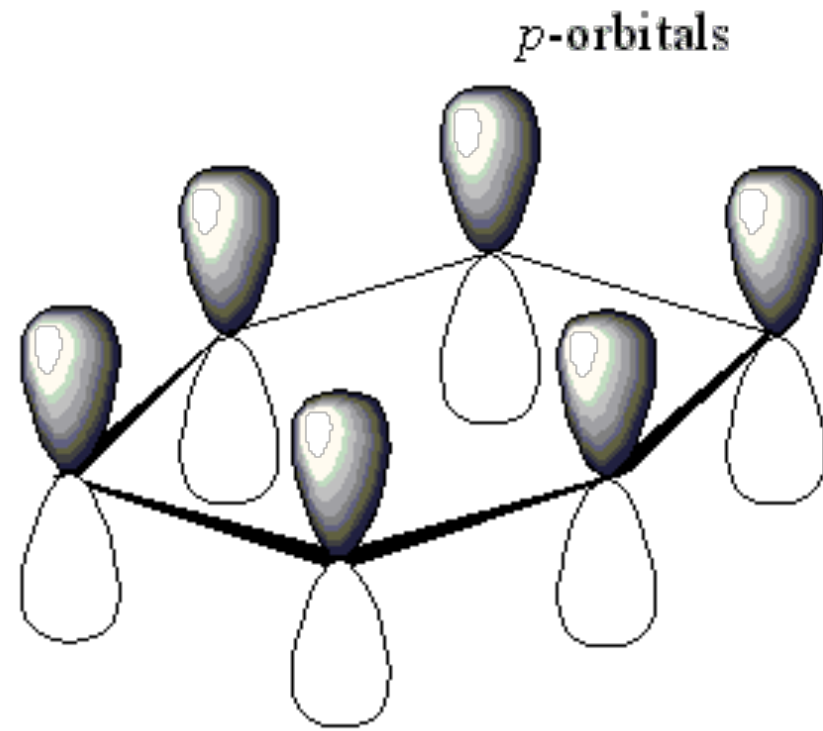


Resonance

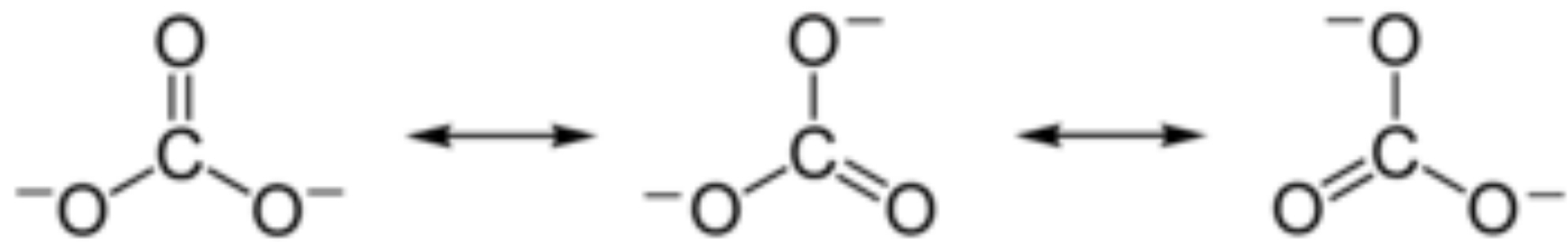


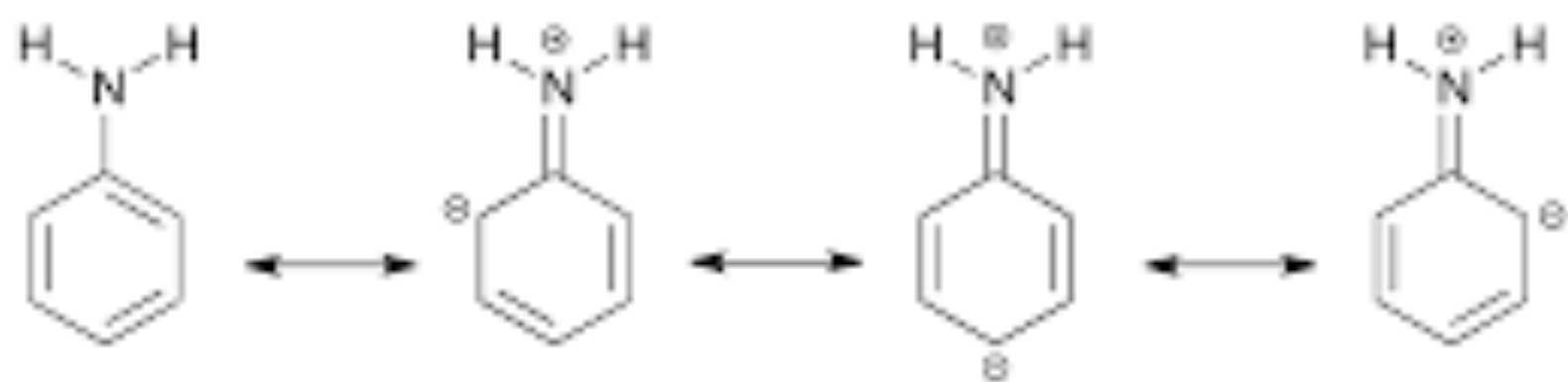


*Top view*

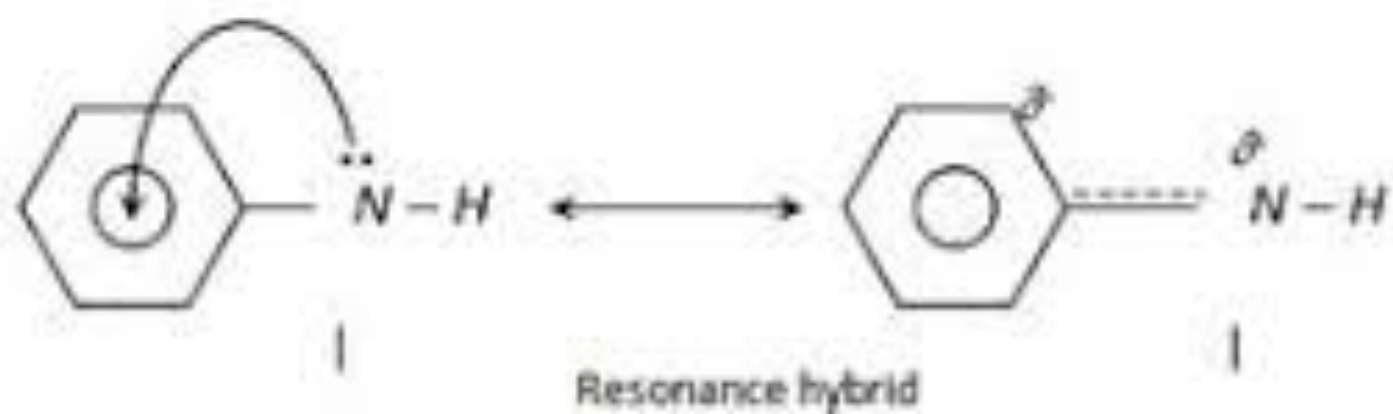
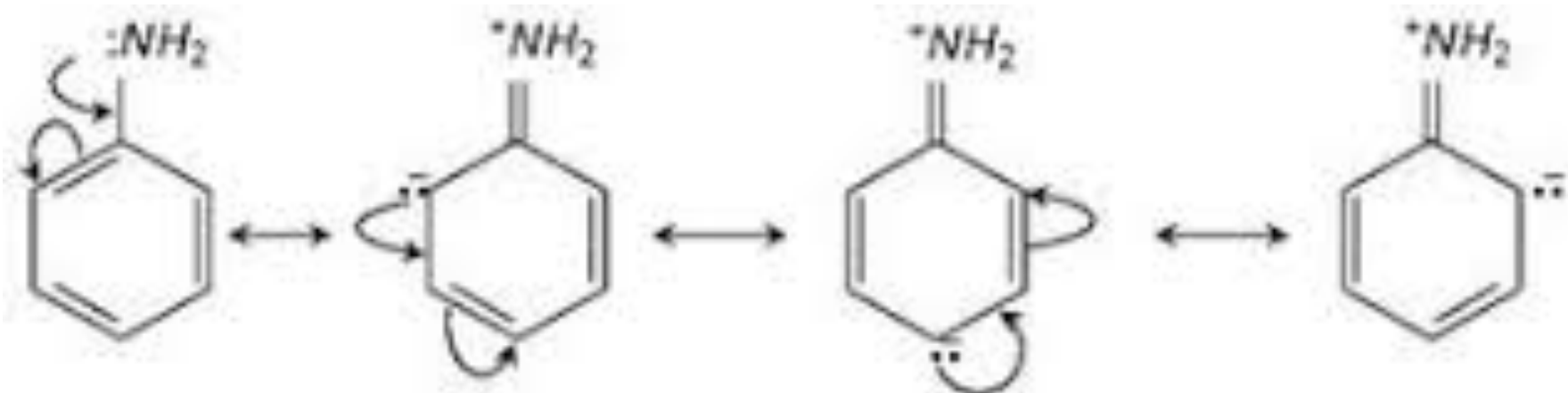


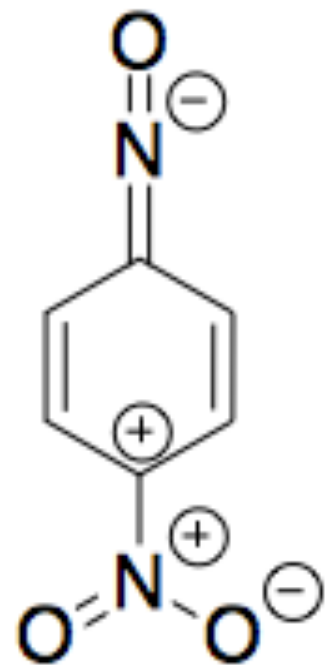
*Side view*



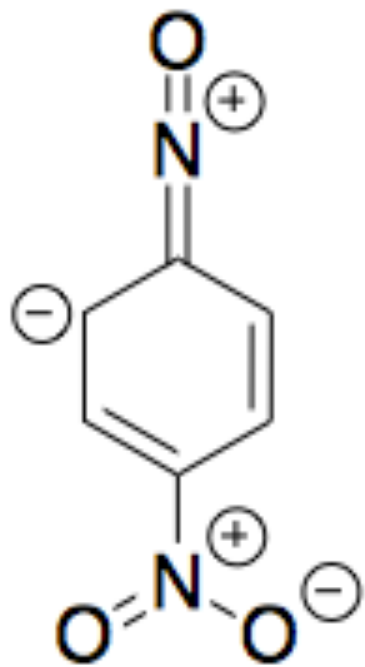




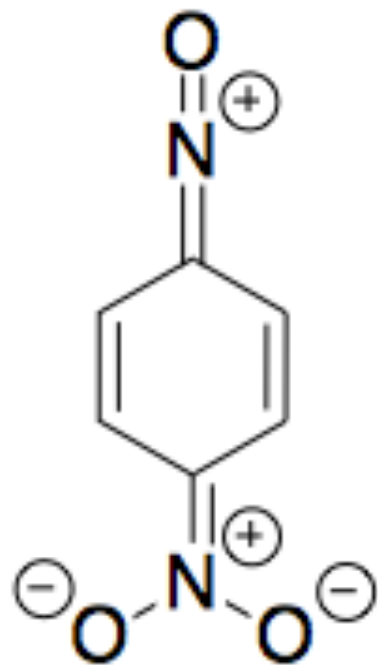




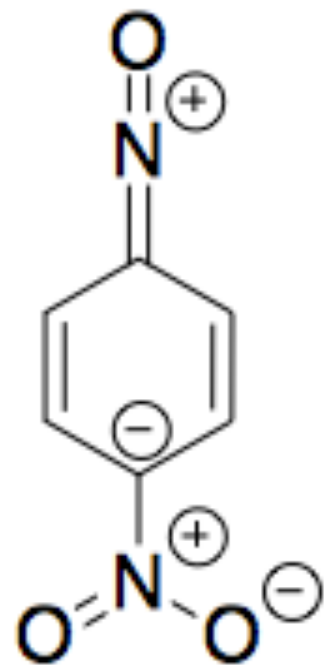
**1**



**2**

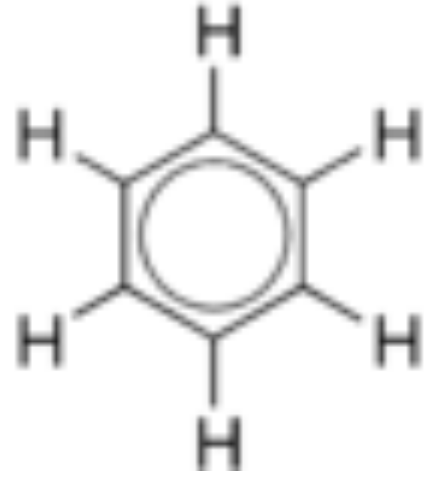
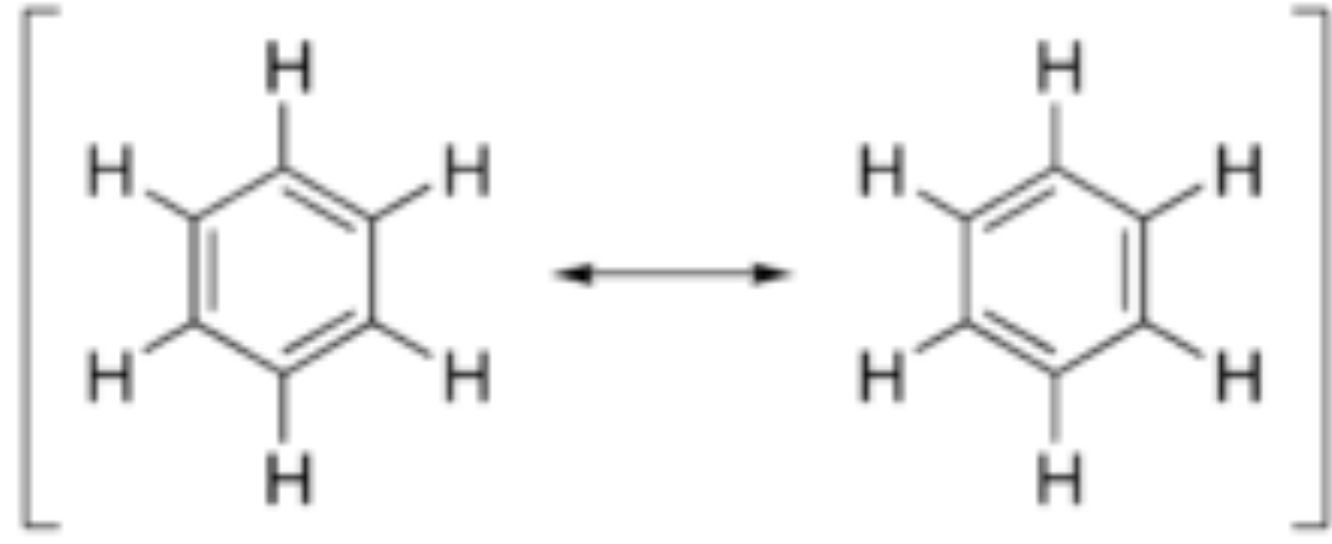


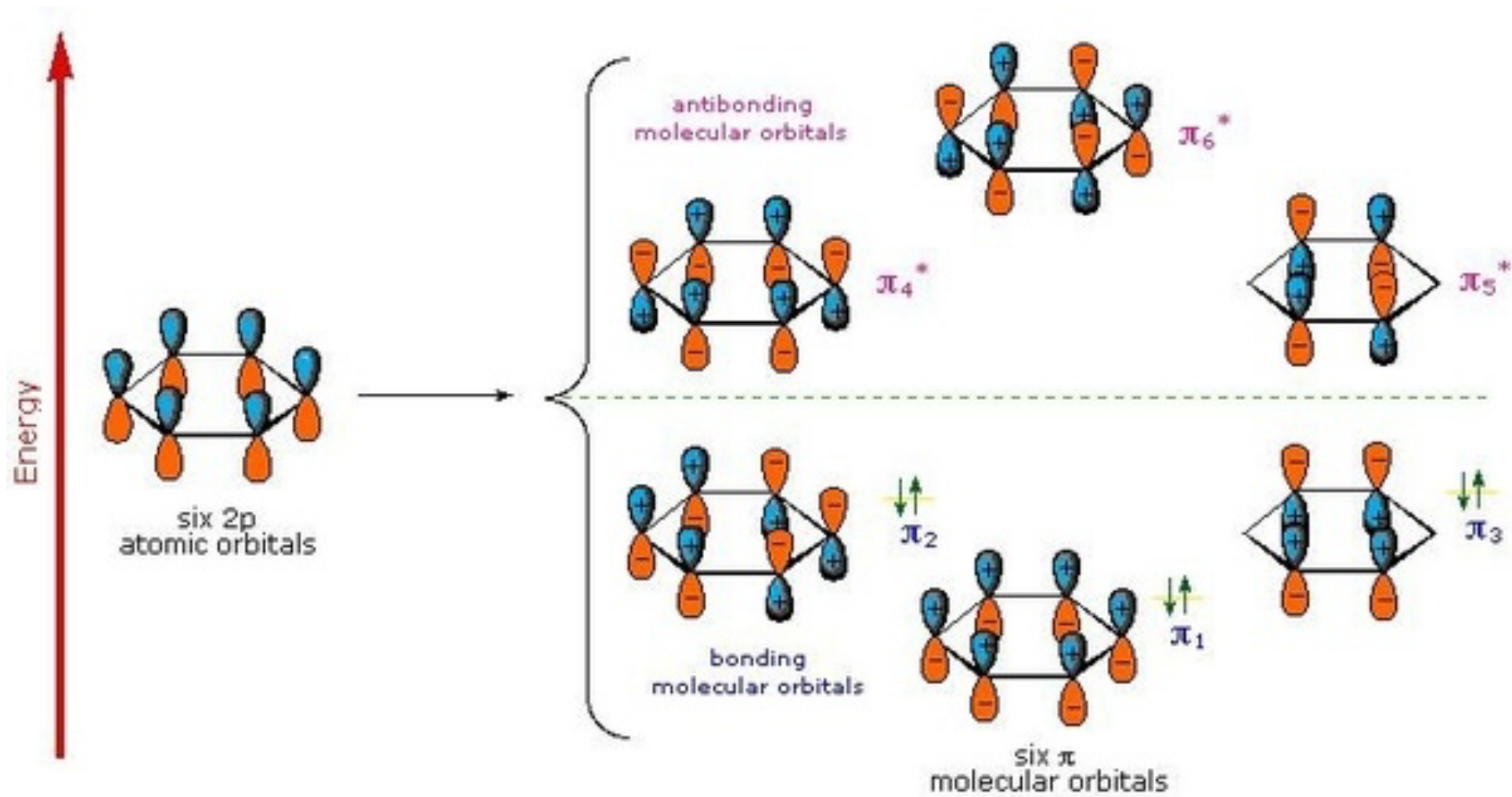
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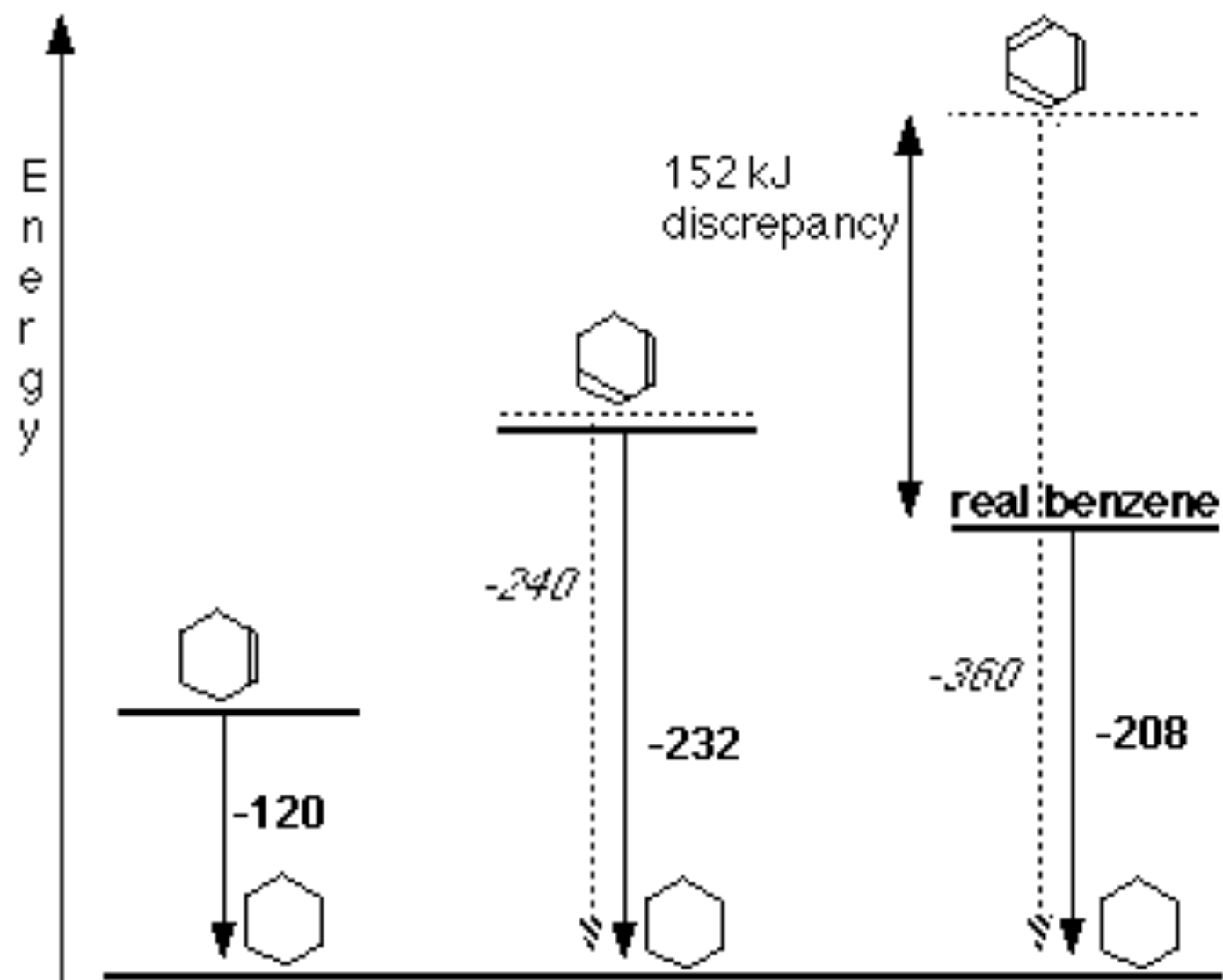


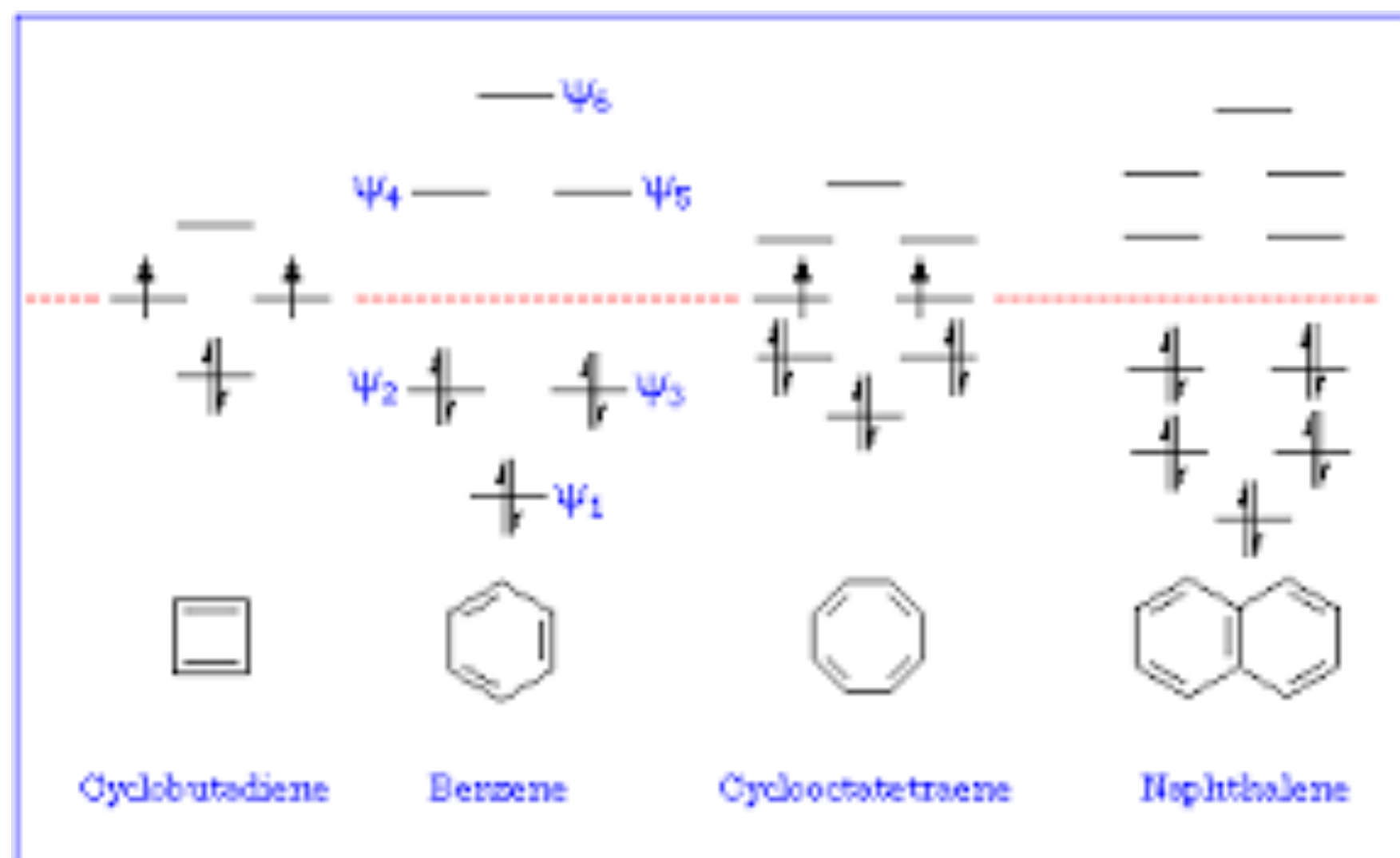
**4**

AROMATICITY









### Aromatic

- Cyclic
- Conjugated
- $(4n+2)$  Pi electrons
- Flat



benzene

### Anti-Aromatic

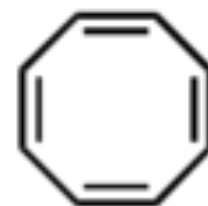
- Cyclic
- Conjugated
- $(4n)$  Pi electrons
- Flat



cyclobutadiene

### Non-Aromatic

*Fails any one  
of the criteria  
on the left*



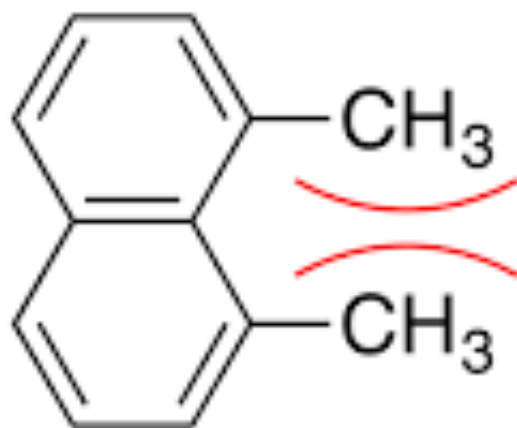
cyclooctatetraene

*(?!!)*

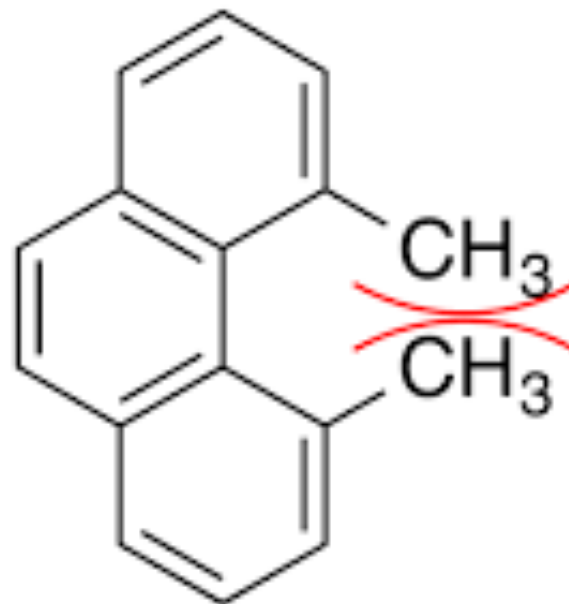


# The Stability of Organic Molecules

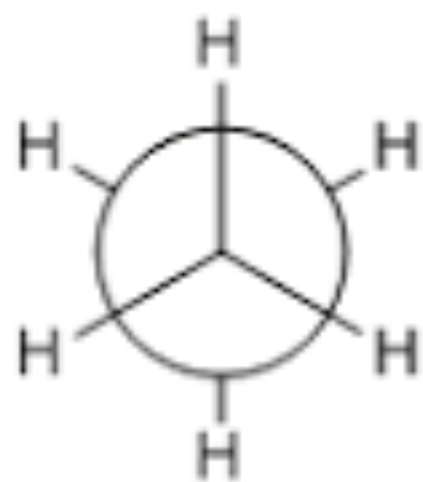
# Torsional Strain



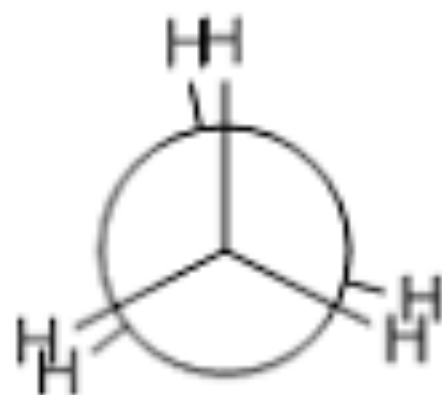
7.6 kcal/mol



12–15 kcal/mol

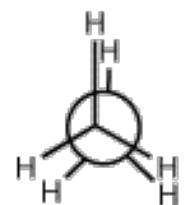


staggered



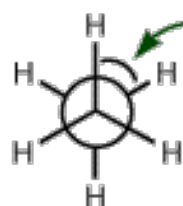
eclipsed

**ECLIPSED CONFORMATION**



*least stable*

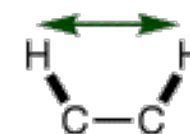
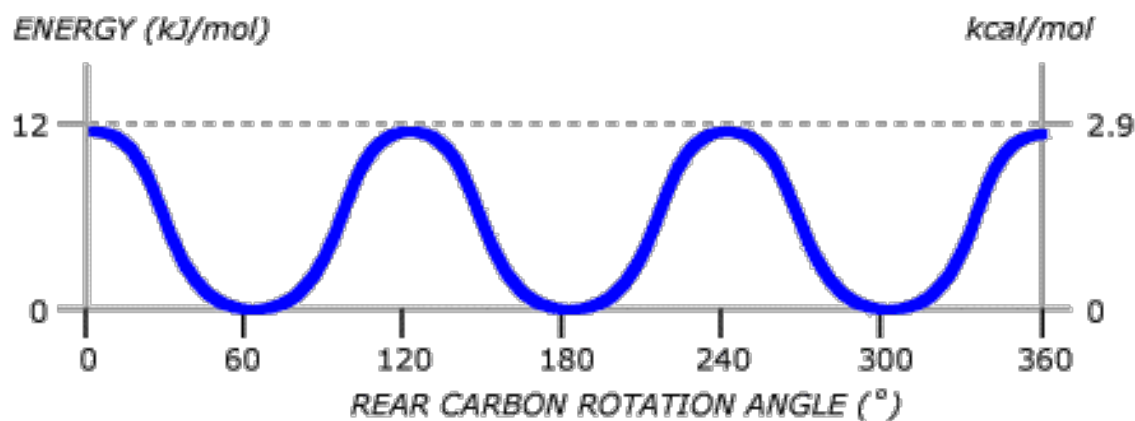
**STAGGERED CONFORMATION**



*most stable*

*dihedral angle*

**A Newman projection**

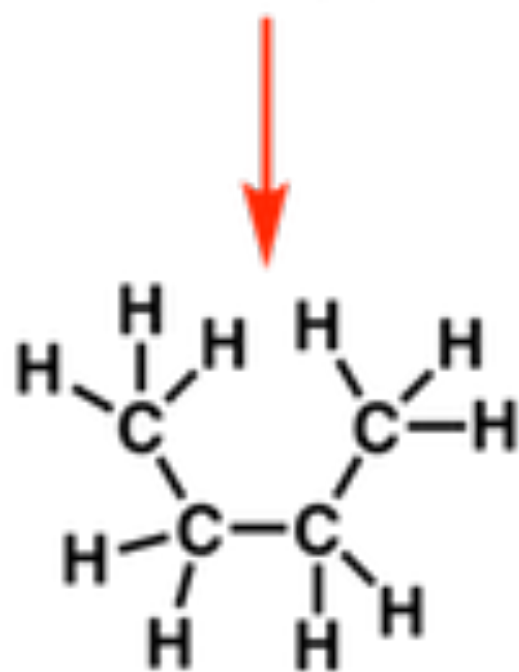


Eclipsed: 2.29Å  
Staggered: 2.55Å

**TORSIONAL STRAIN**  
(Mutual repulsion of eclipsed bonds)  
Each 'costs' 4 kJ/mol

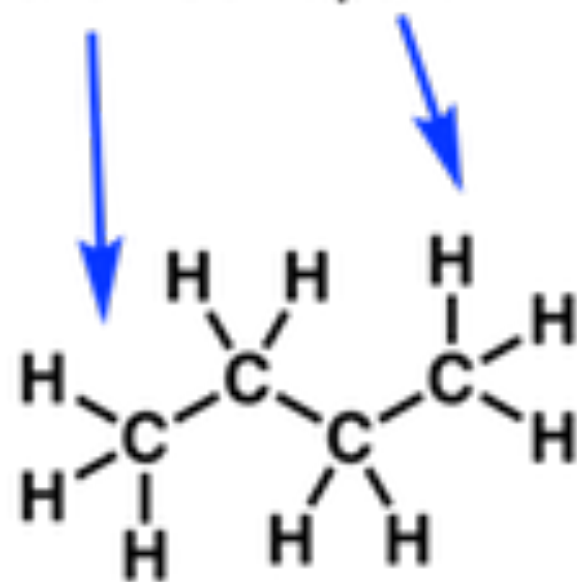
# Steric Strain

**Steric strain** caused by two eclipsed CH<sub>3</sub> groups



**Eclipsed Conformation**

The two CH<sub>3</sub> groups are 180° apart



**Anti Conformation**

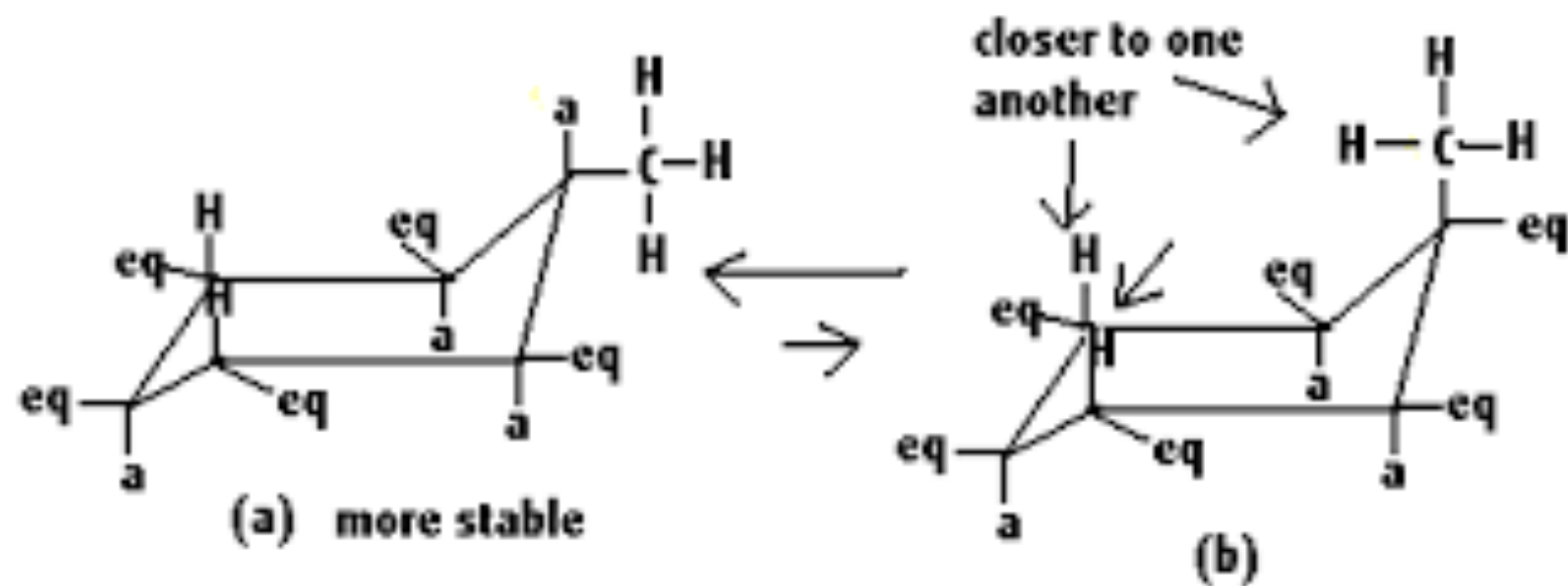
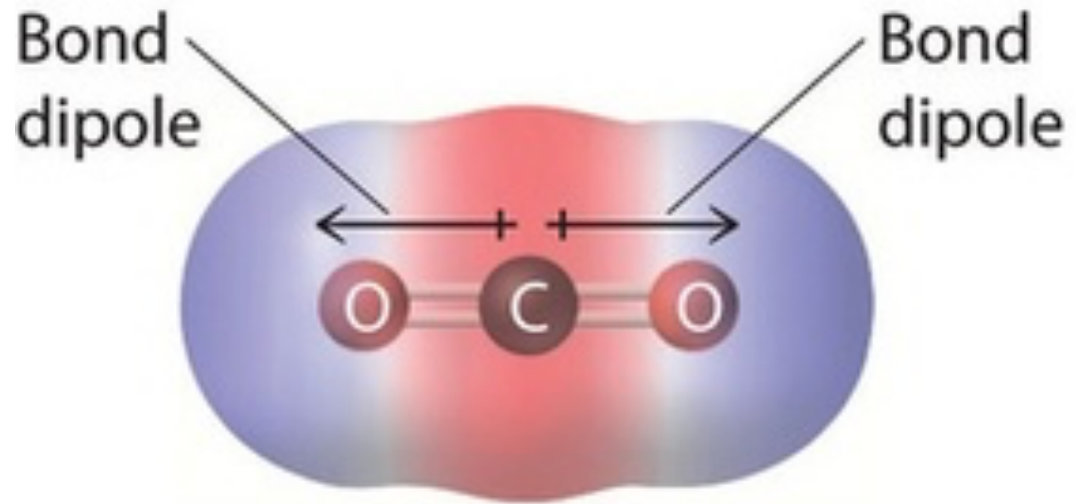


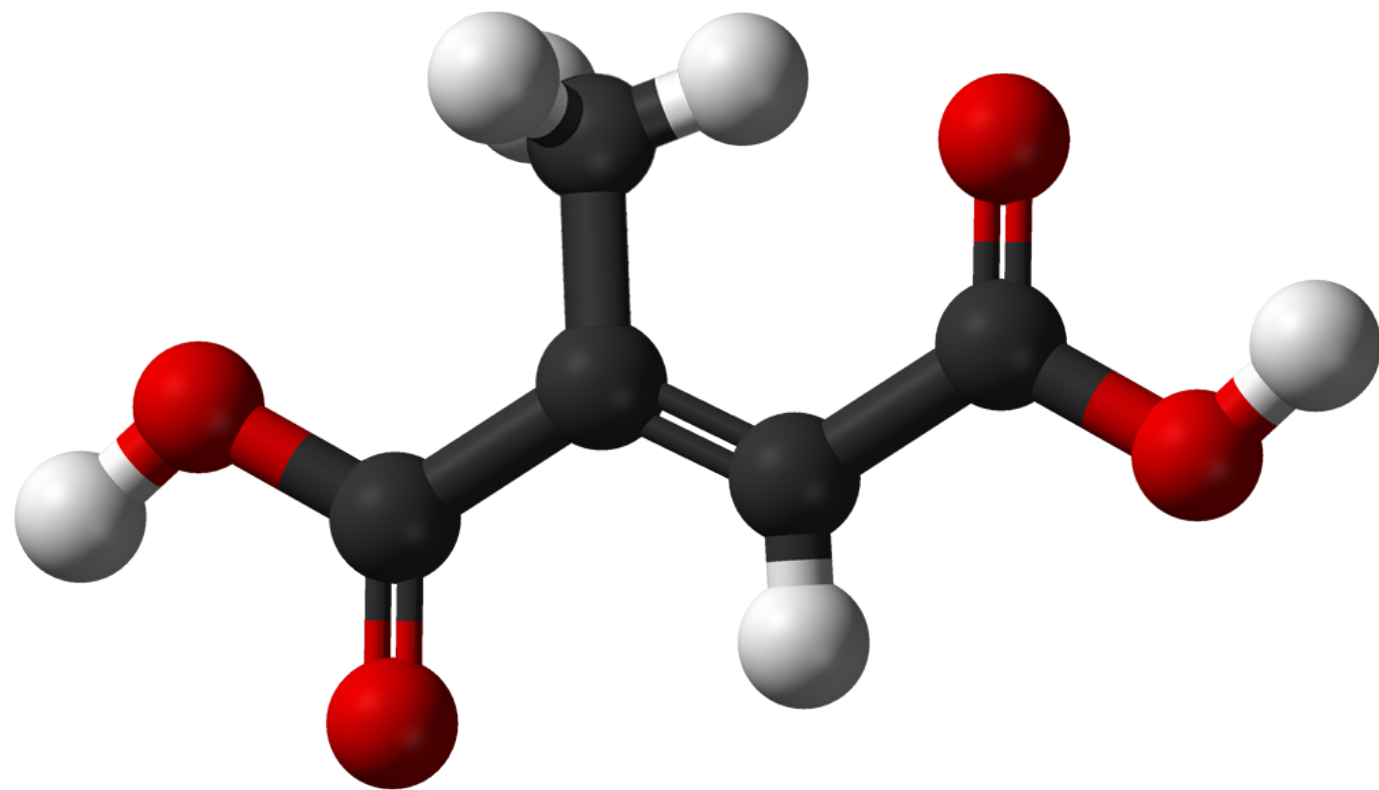
Fig 8- Methyl Cyclohexane Conformers

# A Preview of What's Next:

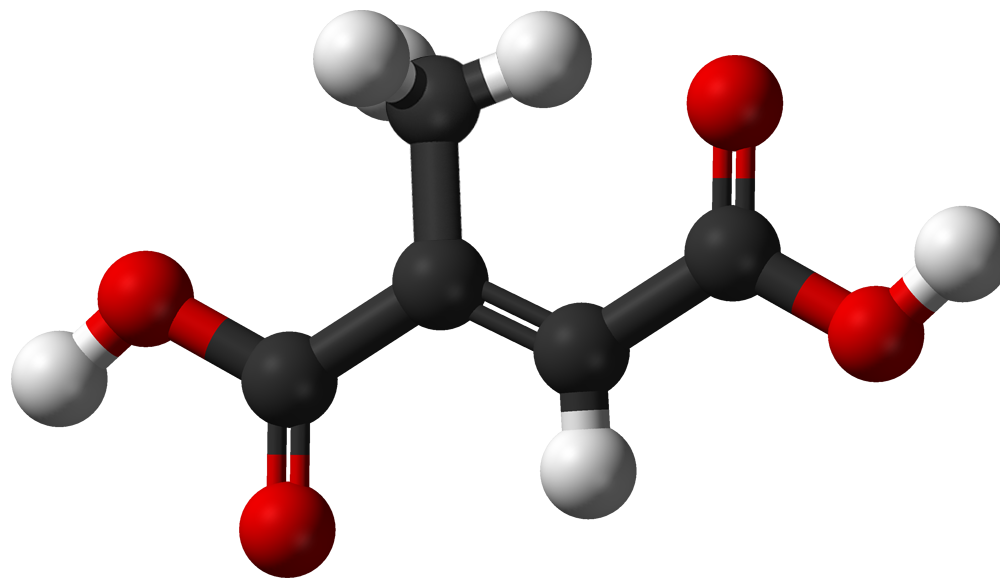


(a) No net dipole moment





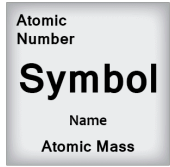
# ORGANIC CHEMISTRY II: Reactions of Small Molecules



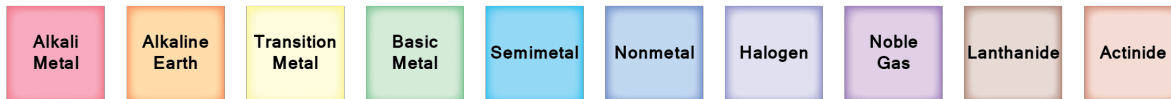
SPLASH 2018  
Matthew Yarnall

# Periodic Table of the Elements

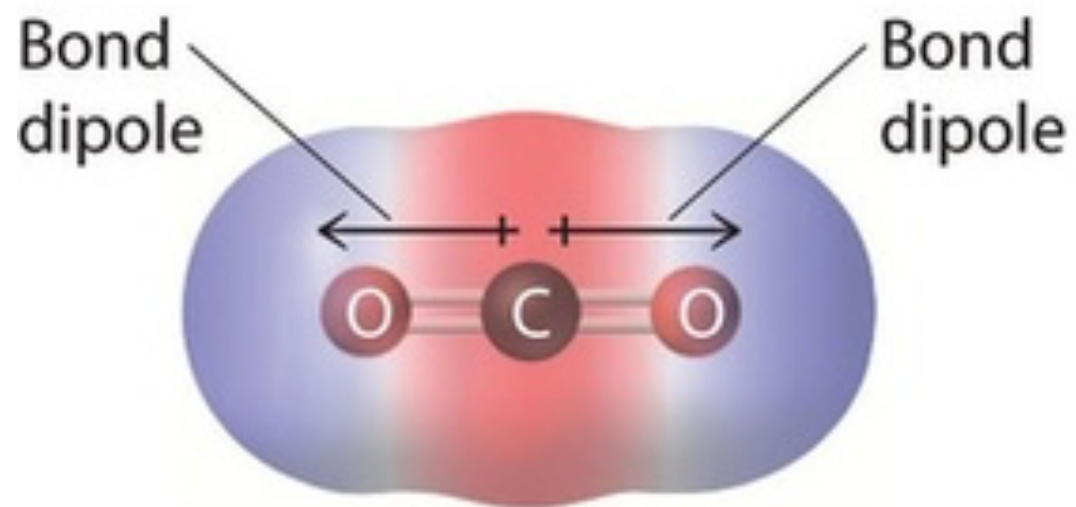
1 IA 1A																	18 VIIIA 8A						
1 <b>H</b> Hydrogen 1.008																	2 <b>He</b> Helium 4.003						
3 <b>Li</b> Lithium 6.941	4 <b>Be</b> Beryllium 9.012																	5 <b>B</b> Boron 10.811	6 <b>C</b> Carbon 12.011	7 <b>N</b> Nitrogen 14.007	8 <b>O</b> Oxygen 15.999	9 <b>F</b> Fluorine 18.998	10 <b>Ne</b> Neon 20.180
11 <b>Na</b> Sodium 22.990	12 <b>Mg</b> Magnesium 24.305	3 IIIB 3B	4 IVB 4B	5 VB 5B	6 VIB 6B	7 VIIB 7B	8 VIII 8	9 VIII 8	10 VIII 8	11 IB 1B	12 IIB 2B	13 <b>Al</b> Aluminum 26.982	14 <b>Si</b> Silicon 28.086	15 <b>P</b> Phosphorus 30.974	16 <b>S</b> Sulfur 32.066	17 <b>Cl</b> Chlorine 35.453	18 <b>Ar</b> Argon 39.948						
19 <b>K</b> Potassium 39.098	20 <b>Ca</b> Calcium 40.078	21 <b>Sc</b> Scandium 44.956	22 <b>Ti</b> Titanium 47.867	23 <b>V</b> Vanadium 50.942	24 <b>Cr</b> Chromium 51.996	25 <b>Mn</b> Manganese 54.938	26 <b>Fe</b> Iron 55.845	27 <b>Co</b> Cobalt 58.933	28 <b>Ni</b> Nickel 58.693	29 <b>Cu</b> Copper 63.546	30 <b>Zn</b> Zinc 65.38	31 <b>Ga</b> Gallium 69.723	32 <b>Ge</b> Germanium 72.631	33 <b>As</b> Arsenic 74.922	34 <b>Se</b> Selenium 78.972	35 <b>Br</b> Bromine 79.904	36 <b>Kr</b> Krypton 83.798						
37 <b>Rb</b> Rubidium 85.468	38 <b>Sr</b> Strontium 87.62	39 <b>Y</b> Yttrium 88.906	40 <b>Zr</b> Zirconium 91.224	41 <b>Nb</b> Niobium 92.906	42 <b>Mo</b> Molybdenum 95.95	43 <b>Tc</b> Technetium 98.907	44 <b>Ru</b> Ruthenium 101.07	45 <b>Rh</b> Rhodium 102.906	46 <b>Pd</b> Palladium 106.42	47 <b>Ag</b> Silver 107.868	48 <b>Cd</b> Cadmium 112.411	49 <b>In</b> Indium 114.818	50 <b>Sn</b> Tin 118.711	51 <b>Sb</b> Antimony 121.760	52 <b>Te</b> Tellurium 127.6	53 <b>I</b> Iodine 126.904	54 <b>Xe</b> Xenon 131.294						
55 <b>Cs</b> Cesium 132.905	56 <b>Ba</b> Barium 137.328	57-71	72 <b>Hf</b> Hafnium 178.49	73 <b>Ta</b> Tantalum 180.948	74 <b>W</b> Tungsten 183.84	75 <b>Re</b> Rhenium 186.207	76 <b>Os</b> Osmium 190.23	77 <b>Ir</b> Iridium 192.217	78 <b>Pt</b> Platinum 195.085	79 <b>Au</b> Gold 196.967	80 <b>Hg</b> Mercury 200.592	81 <b>Tl</b> Thallium 204.383	82 <b>Pb</b> Lead 207.2	83 <b>Bi</b> Bismuth 208.980	84 <b>Po</b> Polonium [208.982]	85 <b>At</b> Astatine 209.987	86 <b>Rn</b> Radon 222.018						
87 <b>Fr</b> Francium 223.020	88 <b>Ra</b> Radium 226.025	89-103	104 <b>Rf</b> Rutherfordium [261]	105 <b>Db</b> Dubnium [262]	106 <b>Sg</b> Seaborgium [266]	107 <b>Bh</b> Bohrium [264]	108 <b>Hs</b> Hassium [269]	109 <b>Mt</b> Meitnerium [278]	110 <b>Ds</b> Darmstadtium [281]	111 <b>Rg</b> Roentgenium [280]	112 <b>Cn</b> Copernicium [285]	113 <b>Nh</b> Nihonium [286]	114 <b>Fl</b> Flerovium [289]	115 <b>Mc</b> Moscovium [289]	116 <b>Lv</b> Livermorium [293]	117 <b>Ts</b> Tennessine [294]	118 <b>Og</b> Oganesson [294]						



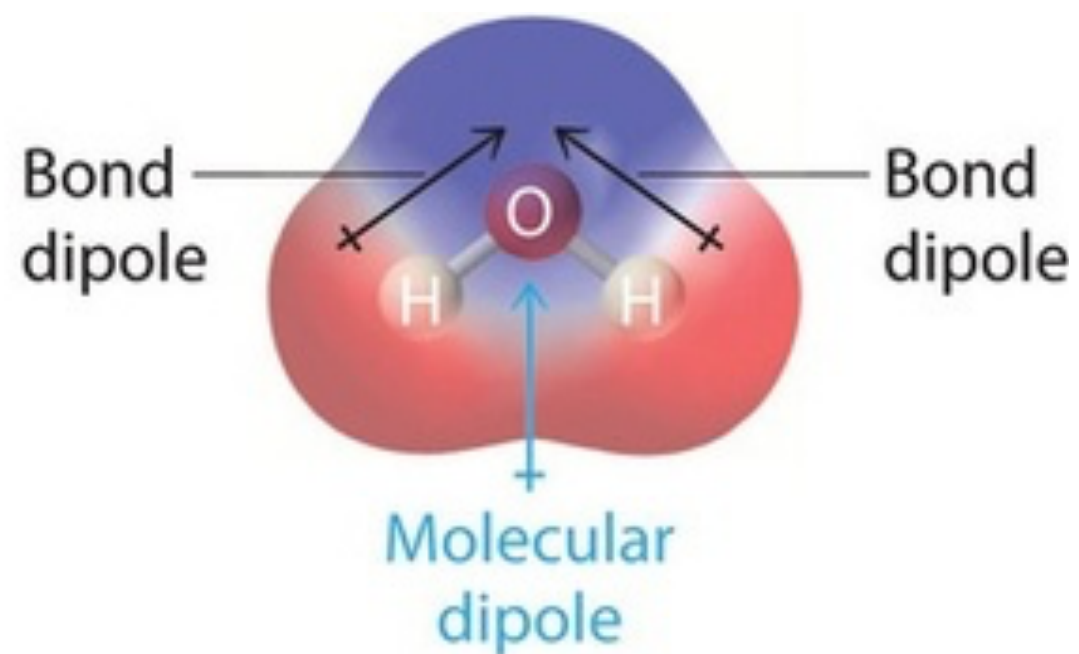
Lanthanide Series	57 <b>La</b> Lanthanum 138.905	58 <b>Ce</b> Cerium 140.116	59 <b>Pr</b> Praseodymium 140.908	60 <b>Nd</b> Neodymium 144.242	61 <b>Pm</b> Promethium 144.913	62 <b>Sm</b> Samarium 150.36	63 <b>Eu</b> Europium 151.964	64 <b>Gd</b> Gadolinium 157.25	65 <b>Tb</b> Terbium 158.925	66 <b>Dy</b> Dysprosium 162.500	67 <b>Ho</b> Holmium 164.930	68 <b>Er</b> Erbium 167.259	69 <b>Tm</b> Thulium 168.934	70 <b>Yb</b> Ytterbium 173.055	71 <b>Lu</b> Lutetium 174.967
Actinide Series	89 <b>Ac</b> Actinium 227.028	90 <b>Th</b> Thorium 232.038	91 <b>Pa</b> Protactinium 231.036	92 <b>U</b> Uranium 238.029	93 <b>Np</b> Neptunium 237.048	94 <b>Pu</b> Plutonium 244.064	95 <b>Am</b> Americium 243.061	96 <b>Cm</b> Curium 247.070	97 <b>Bk</b> Berkelium 247.070	98 <b>Cf</b> Californium 251.080	99 <b>Es</b> Einsteinium [254]	100 <b>Fm</b> Fermium 257.095	101 <b>Md</b> Mendelevium 258.1	102 <b>No</b> Nobelium 259.101	103 <b>Lr</b> Lawrencium [262]



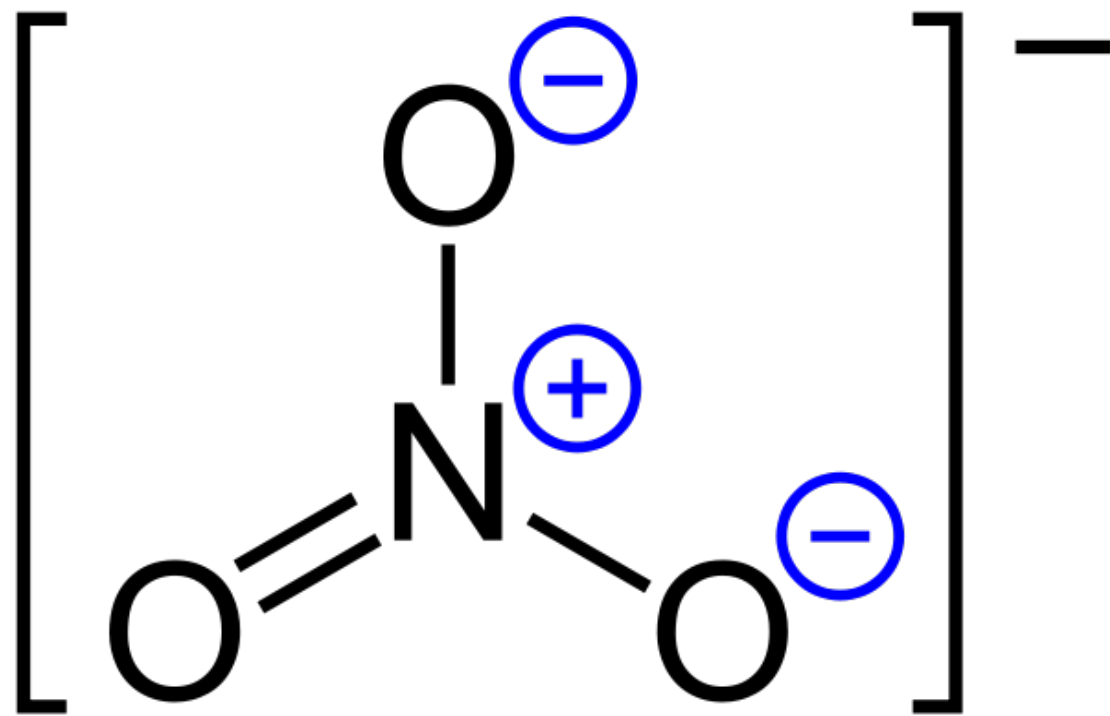
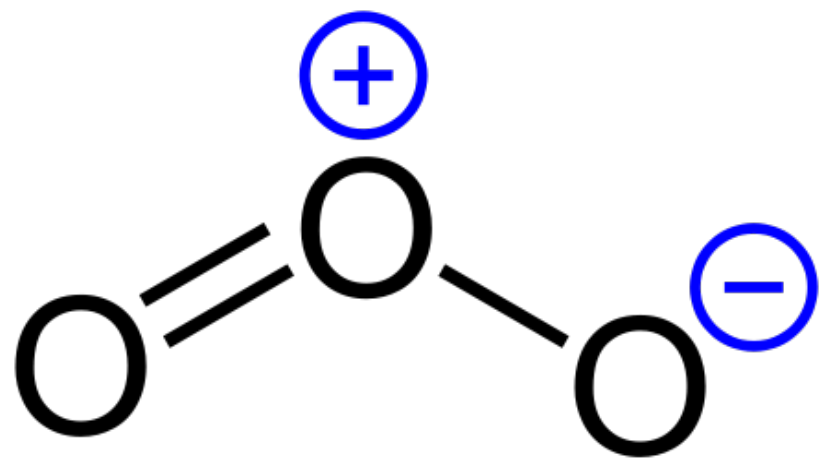
# Molecular Charge Distribution

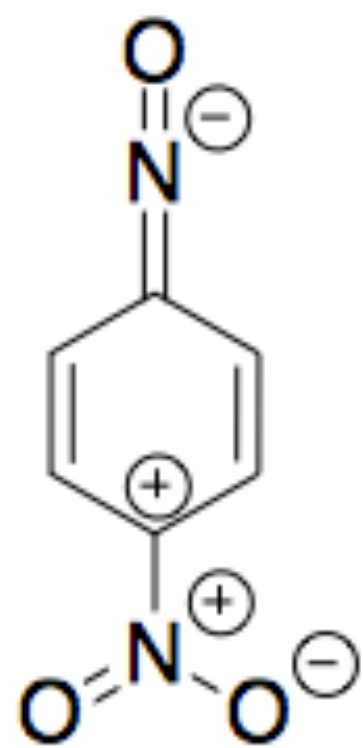


(a) No net dipole moment

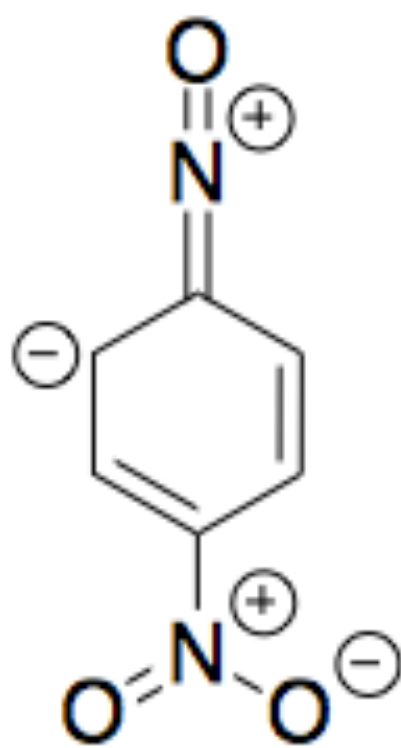


(b) Net dipole moment

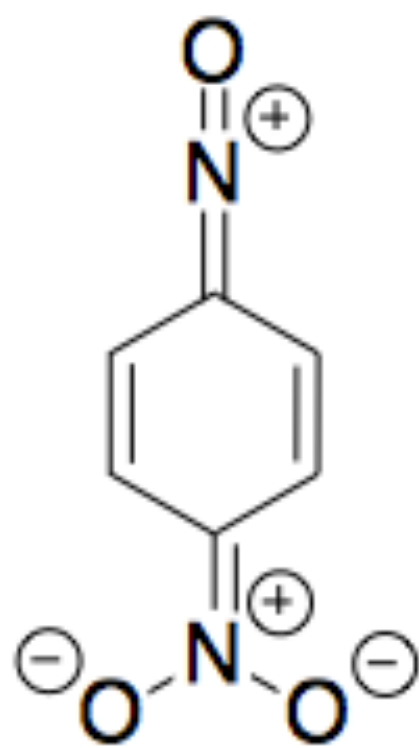




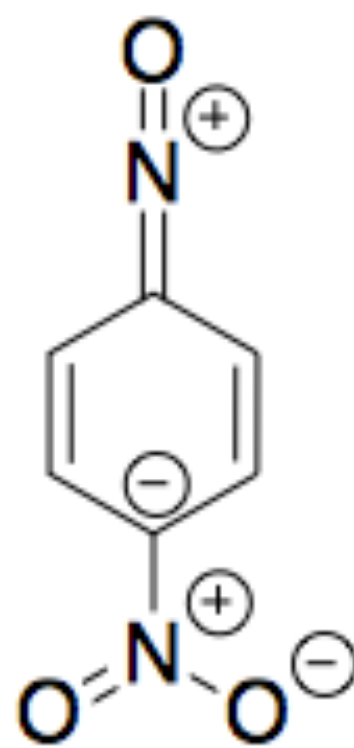
**1**



**2**



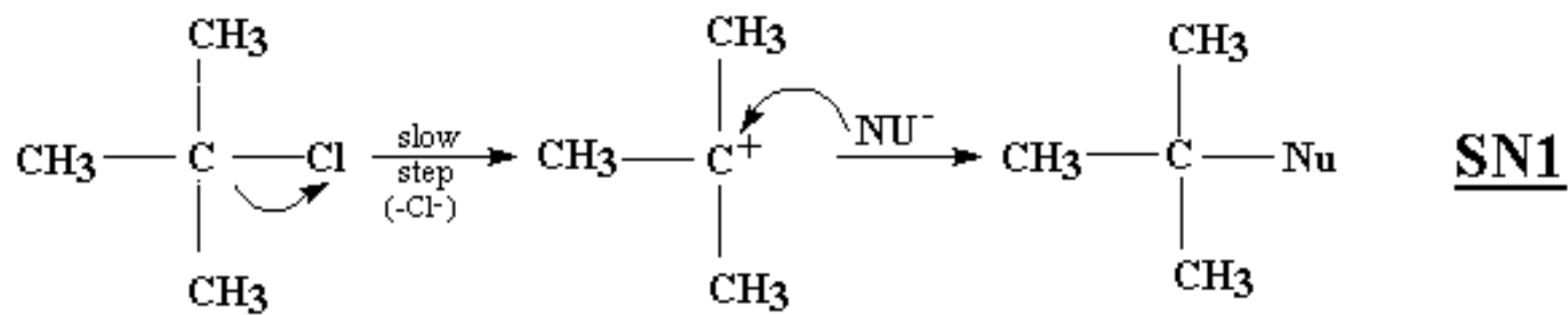
**3**



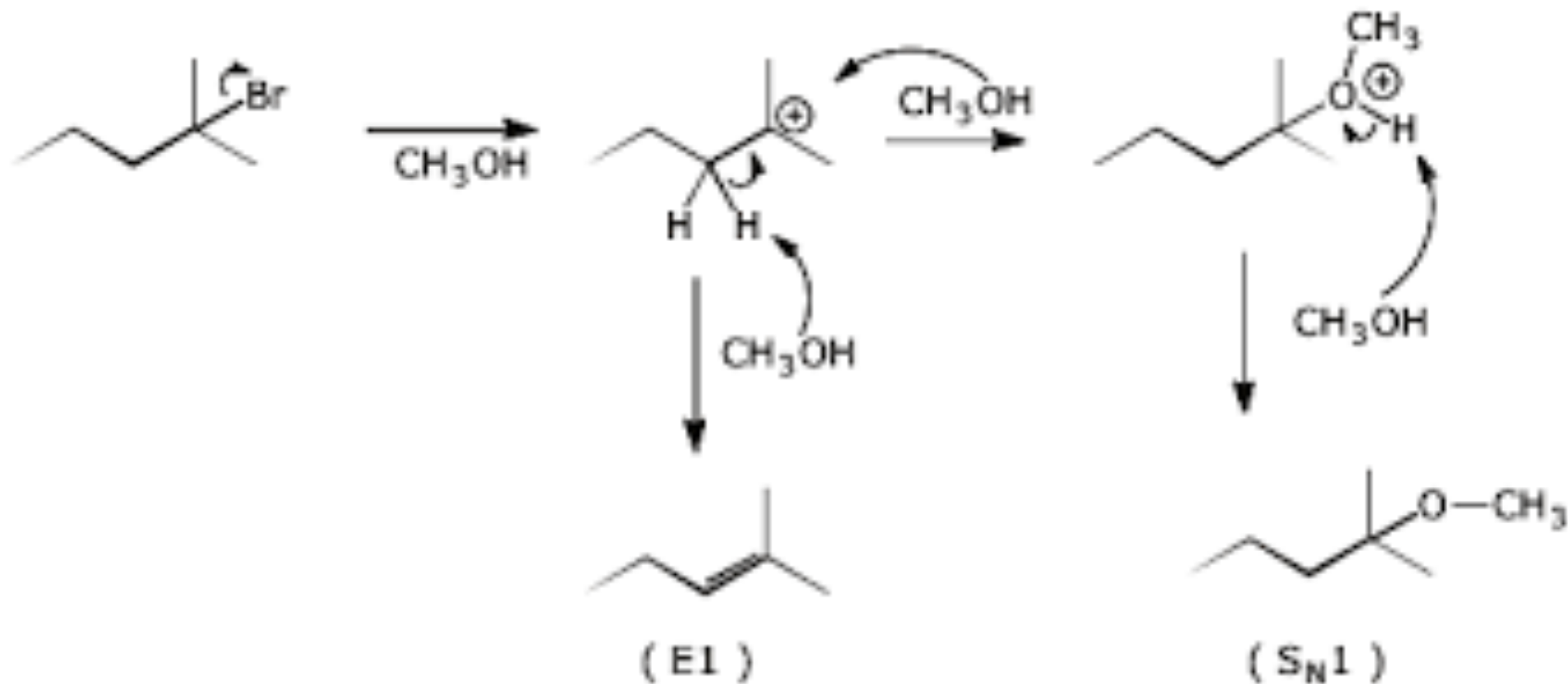
**4**



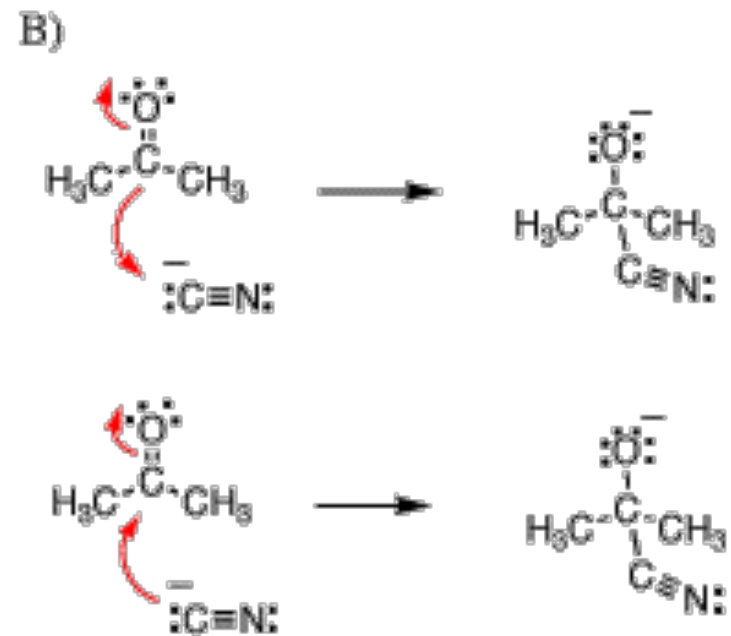
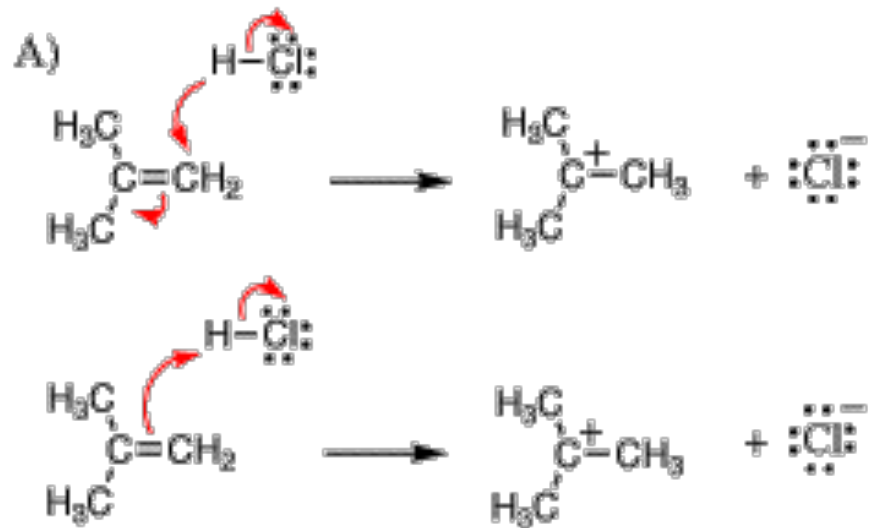
# SN1 Reactions



# Elimination reactions

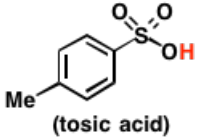
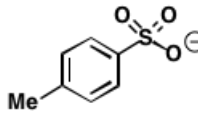
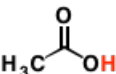
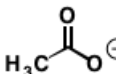
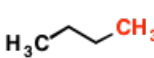
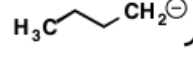


# Alternate Formation of Intermediate



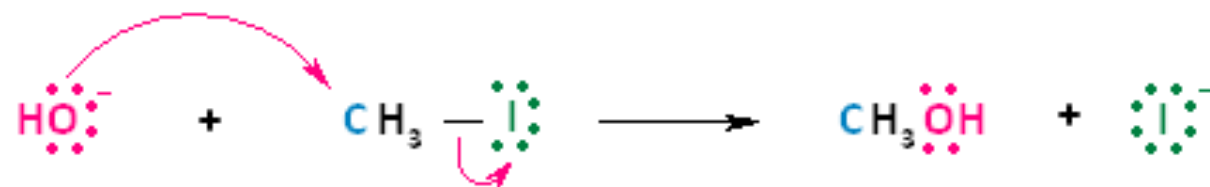
# Leaving Group Stability

A pKa table is a handy guide to leaving groups

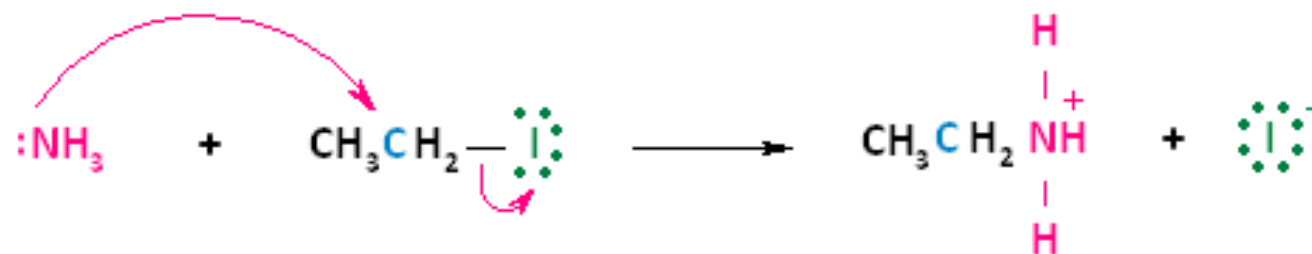
Functional group / Example	pKa	Conjugate base	
Hydroiodic acid <b>HI</b>	-10	$I^-$	} <i>Excellent leaving groups (extremely weak bases)</i>
Hydrobromic acid <b>HBr</b>	-9	$Br^-$	
Hydrochloric acid <b>HCl</b>	-6	$Cl^-$	
Sulfuric acid <b>H<sub>2</sub>SO<sub>4</sub></b>	-3	$HSO_4^-$	
Sulfonic acids  <b>(tosic acid)</b>	-3		
Hydronium ion <b>H<sub>3</sub>O<sup>+</sup></b>	-1.7	$H_2O$	
Hydrofluoric acid <b>H-F</b>	3.2	$F^-$	<b>Exception:</b> $F^-$ is typically an extremely poor leaving group (forms strong bonds)
Carboxylic acids 	4		} <i>Moderate leaving groups (weak bases)</i>
Protonated amines $NH_4^+ Cl^-$	9-11	$NH_3$	
Water <b>HO-H</b>	16	$HO^-$	} <i>Poor leaving groups (strong bases)</i>
Alcohols <b>CH<sub>3</sub>O-H</b>	16-18	$CH_3O^-$	
Amine <b>NH<sub>3</sub></b>	~35	$NH_2^-$	} <i>Extremely poor leaving groups (very strong bases)</i>
Hydrogen <b>H-H</b>	42	$H^-$	
Alkane 	~50		

# SN2 Reactions

Example #1



Example #2



# Nucleophilic Strength

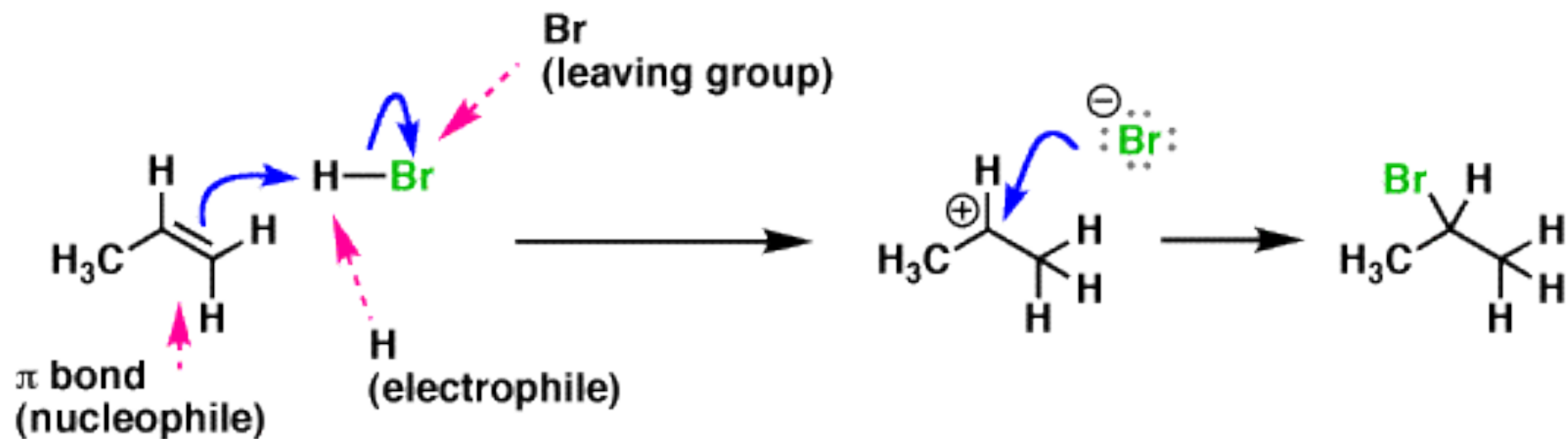
**TABLE 6-3** Some Common Nucleophiles, Listed in Decreasing Order of Nucleophilicity in Hydroxylic Solvents Such as Water and the Alcohols

strong nucleophiles	$(\text{CH}_3\text{CH}_2)_3\text{P:}$ $\text{:}\ddot{\text{S}}\text{—H}$ $\text{:}\ddot{\text{I}}\text{:}^-$ $(\text{CH}_3\text{CH}_2)_2\ddot{\text{N}}\text{H}$ $\text{:}\text{C}\equiv\text{N}$ $(\text{CH}_3\text{CH}_2)_3\text{N:}$ $\text{H—}\ddot{\text{O}}\text{:}^-$ $\text{CH}_3\text{—}\ddot{\text{O}}\text{:}^-$	moderate nucleophiles	$\text{:}\ddot{\text{Br}}\text{:}^-$ $\text{:}\text{NH}_3$ $\text{CH}_3\text{—}\ddot{\text{S}}\text{—CH}_3$ $\text{:}\ddot{\text{Cl}}\text{:}^-$ $\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3\text{C—}\ddot{\text{O}}\text{:}^- \end{array}$
		weak nucleophiles	$\text{:}\ddot{\text{F}}\text{:}^-$ $\text{H—}\ddot{\text{O}}\text{—H}$ $\text{CH}_3\text{—}\ddot{\text{O}}\text{—H}$

- Stronger nucleophiles **react faster** in  $\text{S}_{\text{N}}2$ .
- Strong bases are strong nucleophiles, but not all strong nucleophiles are basic.

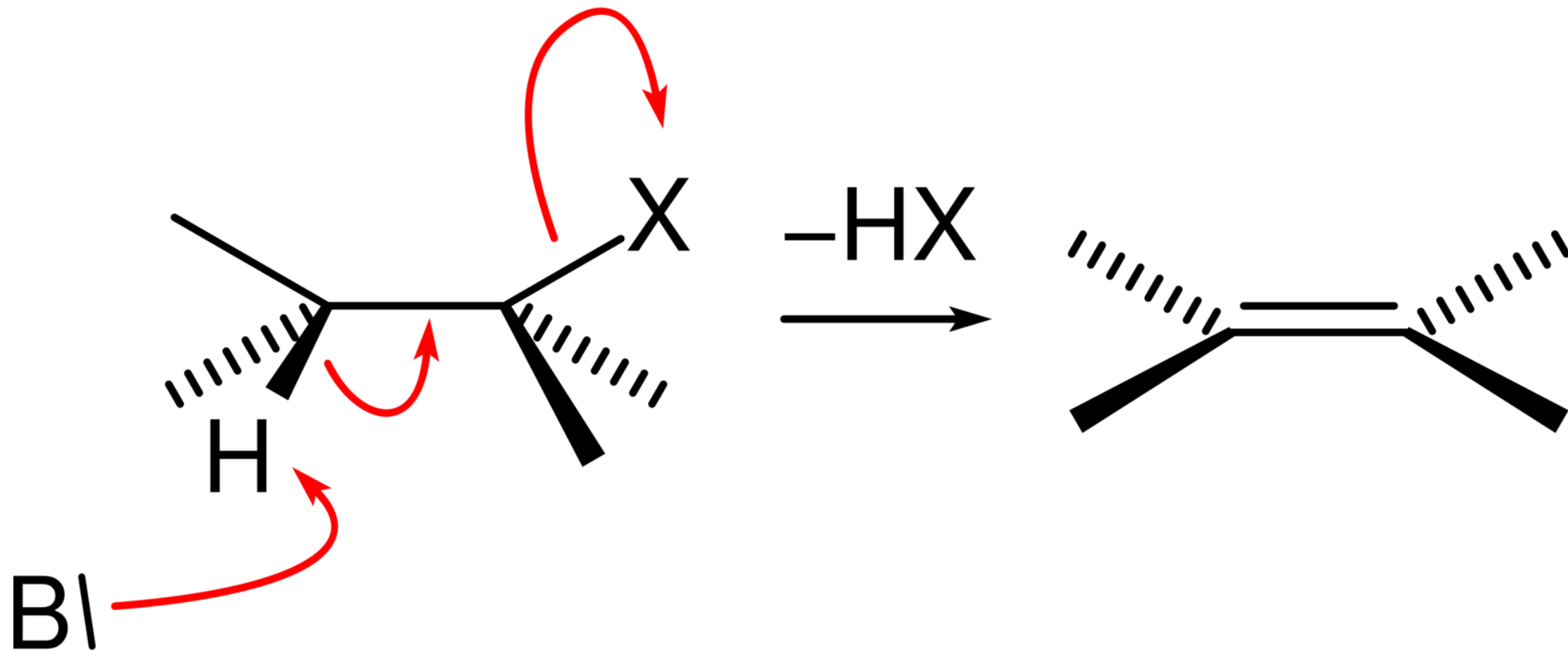
# Unconventional Nucleophile!

In "stepwise" alkene addition mechanisms, the arrows clearly show the role of each component in the reaction

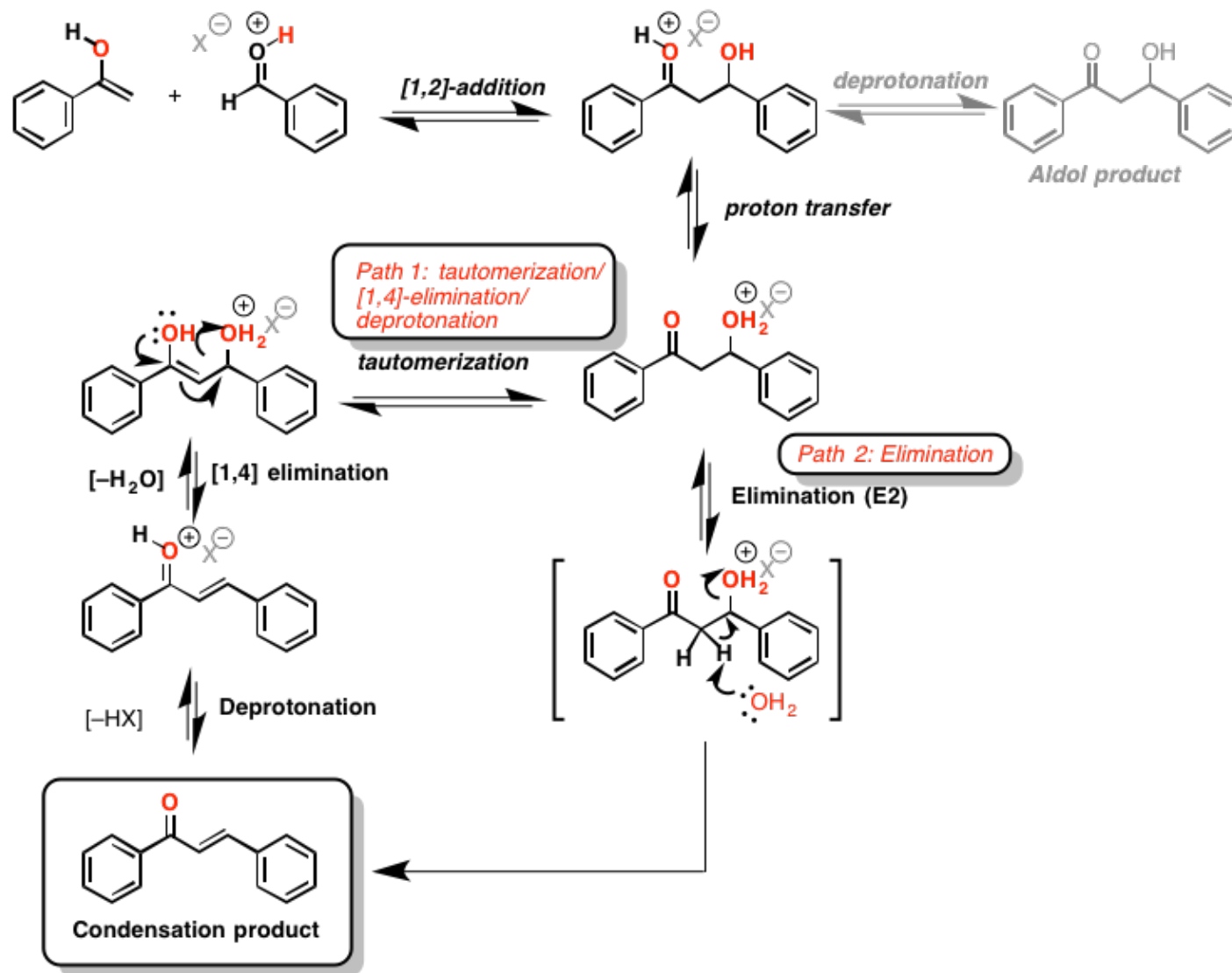




# E2 Elimination Pathway

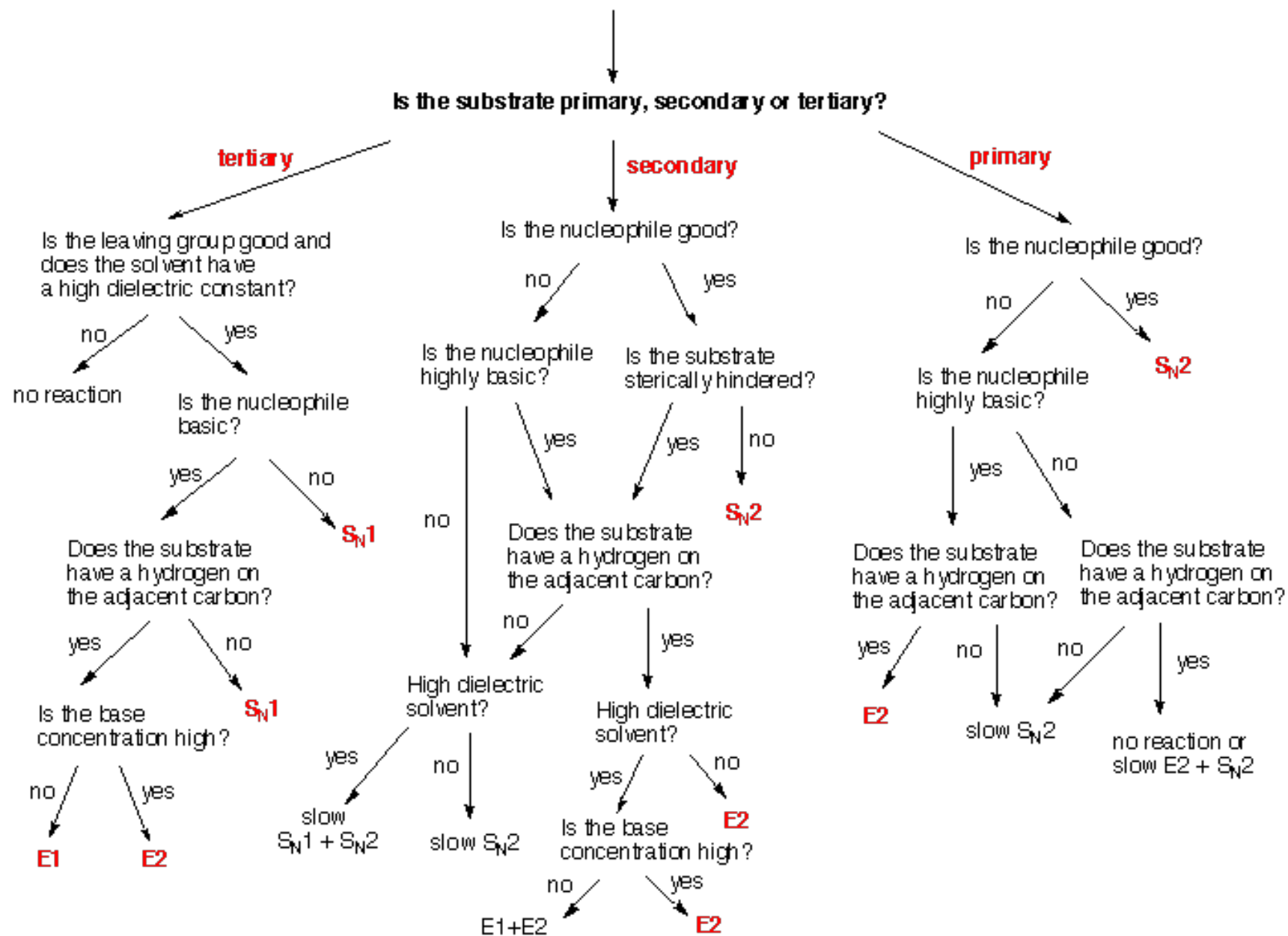


### The Aldol Condensation : Two Paths to Elimination

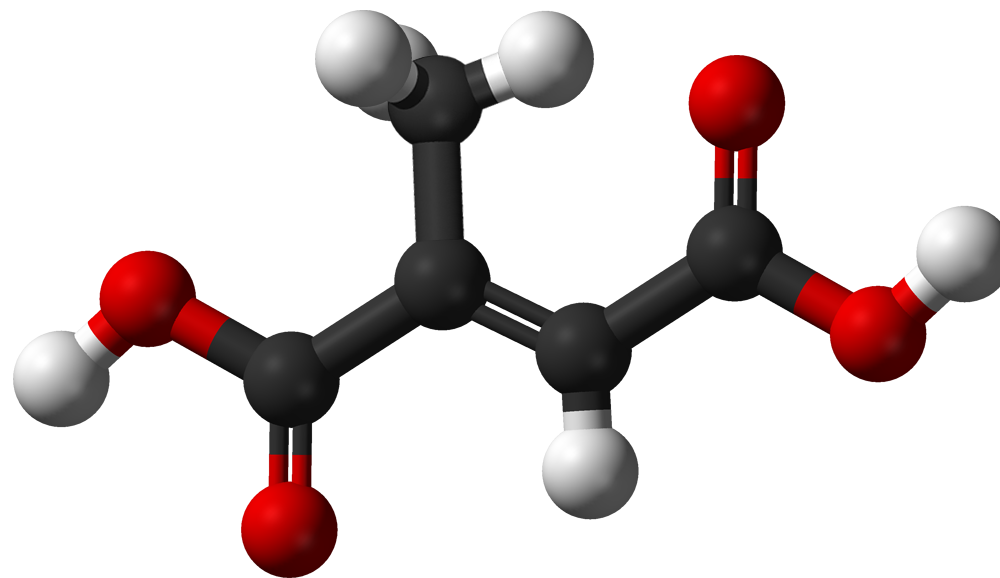


Putting it all together!

Will the predominant reaction mechanism be  $S_N2$ , E2,  $S_N1$  or E1?

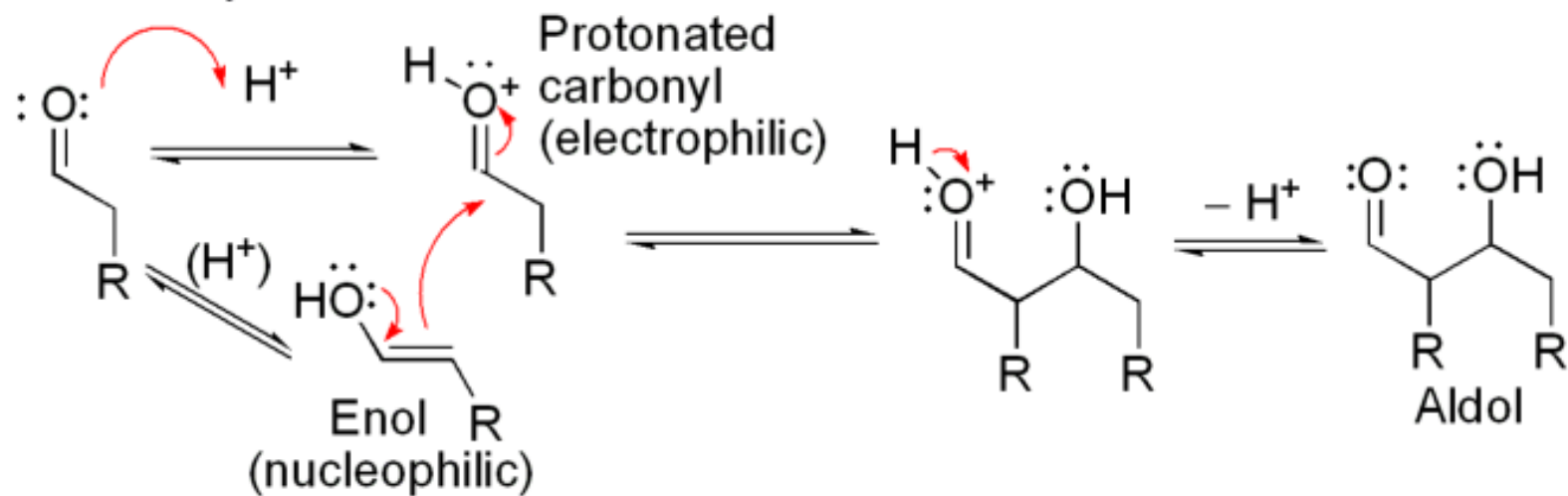


# ORGANIC CHEMISTRY III: Synthesis of Small Molecules



SPLASH 2018  
Matthew Yarnall

### Acid catalyzed aldol reaction



### Acid catalyzed dehydration

