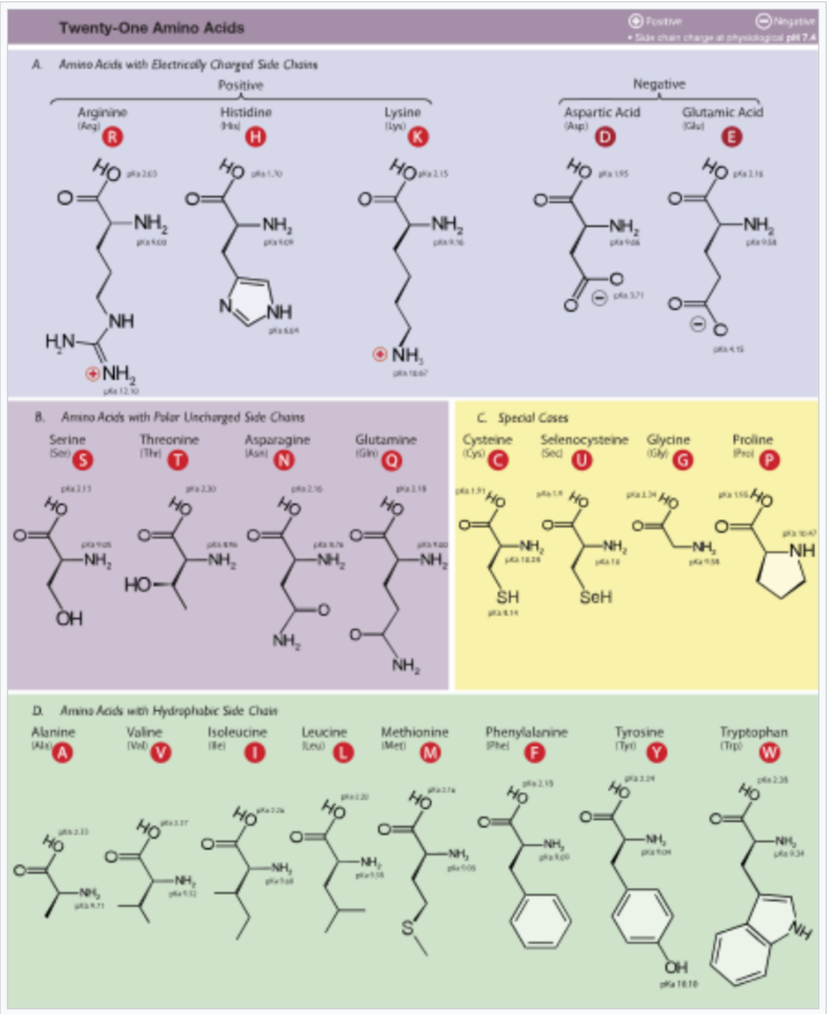
From Wikipedia “Amino Acids” 9-28-2018

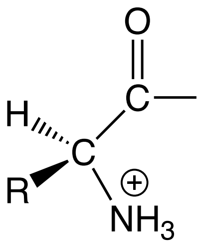
General structure [edit]

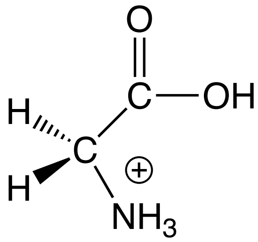


In the structure shown at the top of the page, **R** represents a side chain specific to each amino acid. The carbon atom next to the carboxyl group (which is therefore numbered 2 in the carbon chain starting from that functional group) is called the α–carbon. Amino acids containing an amino group bonded directly to the alpha carbon are referred to as *alpha amino acids*.[34] These include amino acids such as proline which contain secondary amines, which used to be often referred to as "imino acids".[35][36][37]

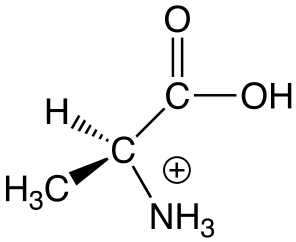
Isomerism [edit]

The alpha amino acids are the most common form found in nature, but only when occurring in the L-isomer. The alpha carbon is a chiral carbon atom, with the exception of glycine which has two indistinguishable hydrogen atoms on the alpha carbon.[38] Therefore, all alpha amino acids but glycine can exist in either of two enantiomers, called L or D amino acids, which are mirror images of each other (*see also Chirality*). While L-amino acids represent all of the amino acids found in proteins during translation in the ribosome, D-amino acids are found in some proteins produced by enzyme posttranslational modifications after translation and translocation to the endoplasmic reticulum, as in exotic sea-dwelling organisms such as cone snails.[39] They are also abundant components of the peptidoglycan cell walls of bacteria,[40] and D-serine may act as a neurotransmitter in the brain.[41] D-amino acids are used in racemic crystallography to create centrosymmetric crystals, which (depending on the protein) may allow for easier and more robust protein structure determination.[42]

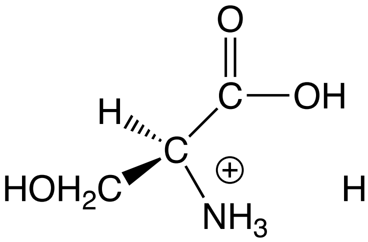




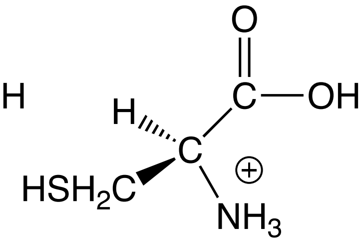
Glycine



Alanine

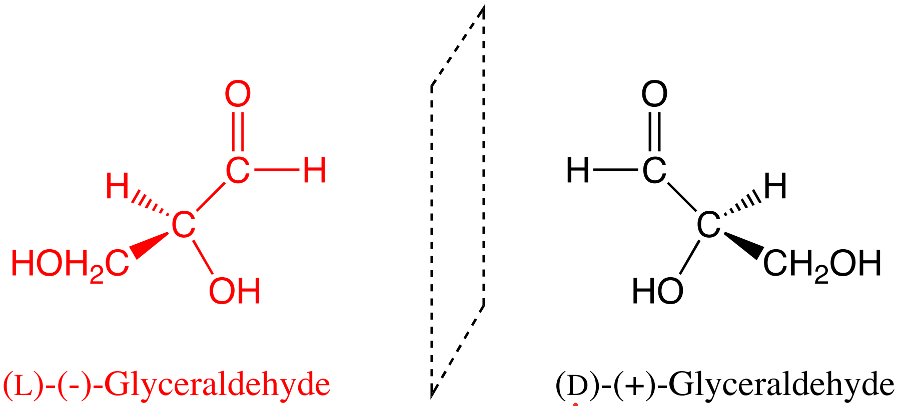


Serine



Cysteine

☐ ☐ ☐ ☐



(L)-(-)-Glyceraldehyde

↑

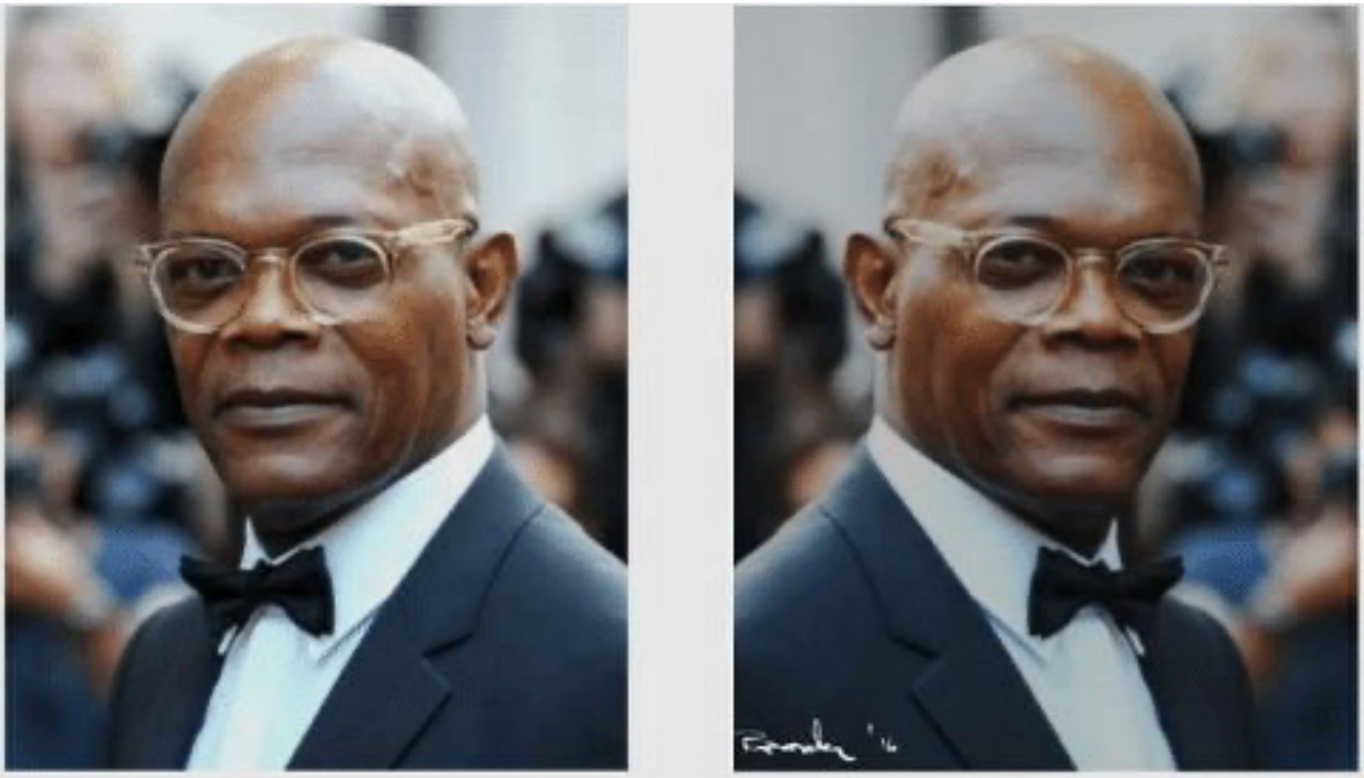
Levorotary

(D)-(+)-Glyceraldehyde

↓

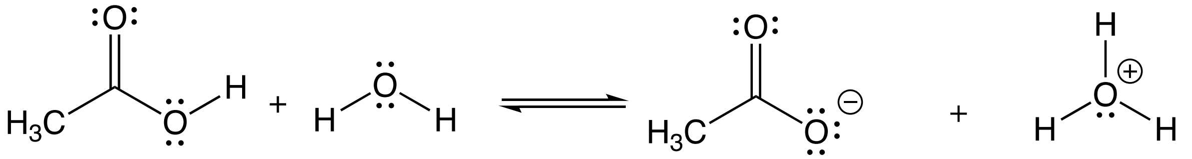
Dextrorotary

The 19 chiral common amino acids are all "L" amino acids (even cysteine!)



Samuel-**L**-Jackson Samuel-**D**-Jackson

I hope this goes chiral



Acid (H-A) Base (B:) Conjugate Base ($A^{\ominus}$) Conjugate Acid ($B\text{-}H^{\oplus}$)

$$\text{At equilibrium:} \quad K_{\text{equilibrium}} = \frac{[\text{Products}]}{[\text{Reactants}]} = \frac{[CH_3CO_2^{\ominus}]\,[H_3O^{\oplus}]}{[CH_3CO_2H]\,[H_2O]}$$

Assume: $[H_2O] = 55$ M and does not change

$$K_a = K_{\text{equilibrium}}\,[H_2O] = K_{\text{equilibrium}}\,[55\text{ M}]$$

$$K_a = \frac{[CH_3CO_2^{\ominus}]\,[H_3O^{\oplus}]}{[CH_3CO_2H]} \qquad pK_a = -\log K_a$$

A stronger acid has a ________________ value of pK_a

A weaker acid has a ________________ value of pK_a

General Rule

All acid-base reactions favor formation of the   acid

$H\text{-}Cl \quad NaOH \rightleftharpoons H_2O + NaCl$

How to estimate relative acid strengths

$$H{-}A_1 + H_2O \rightleftharpoons A_1^{\ominus} + H_3O^{\oplus}$$

$$H{-}A_2 + H_2O \rightleftharpoons A_2^{\ominus} + H_3O^{\oplus}$$

→ Compare the relative stabilities of the anions produced upon deprotonation

2 important principles for predicting anion stability

1) Negative charge ($\ominus$) is

2) Delocalizing negative charge ($\ominus$)

Rules for anion stability —

The anion is more stable when the negative charge ($\ominus$) is:

a) On a more electronegative element (Principle 1)

b) On a larger atom (Principle 2)

c) On an atom with more "s" character to its hybridization

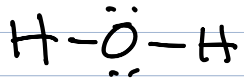
d) stabilized by resonance delocalization. (Principle 2)

e) Stabilized by the inductive effect (Principles 1 and 2)

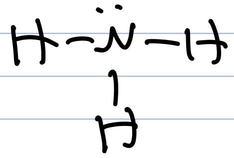
Examples

Rule a)

Ex.



$H-\ddot{\underset{\cdot\cdot}{O}}-H$



$H-\ddot{\underset{\underset{H}{|}}{N}}-H$

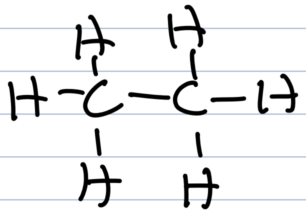
Rule b)

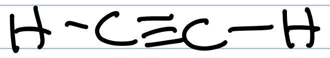
(Only compare atoms in same column of the Periodic Table)

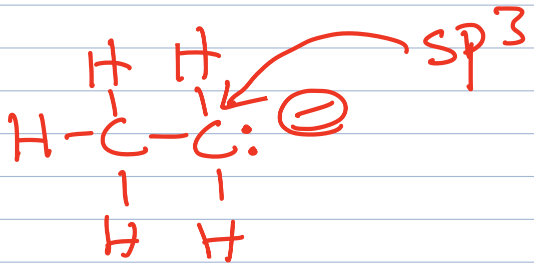
pKa

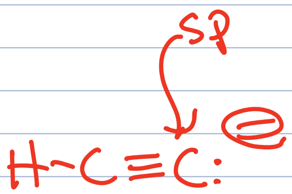
$H-F$ $H-Cl$ $H-Br$ $H-I$

Rule c)

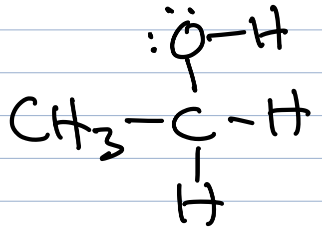


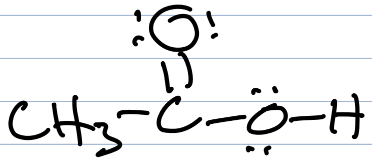


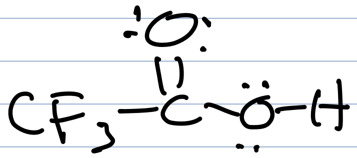




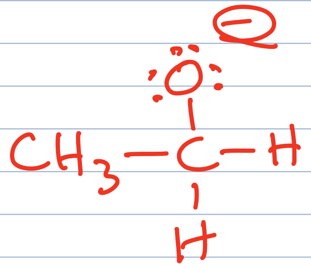
Ranks d) and e)

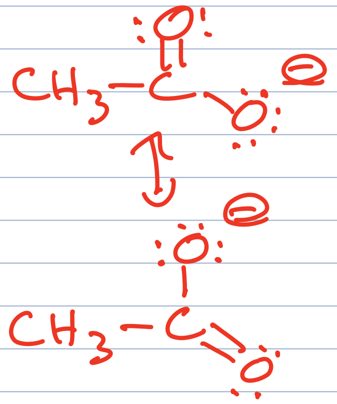


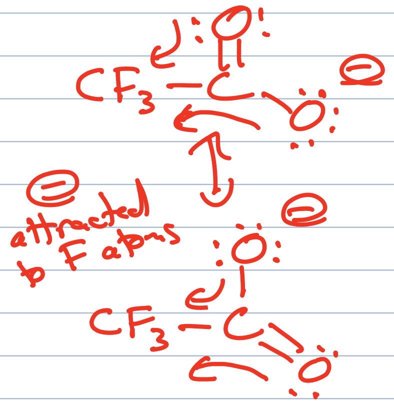




pKa

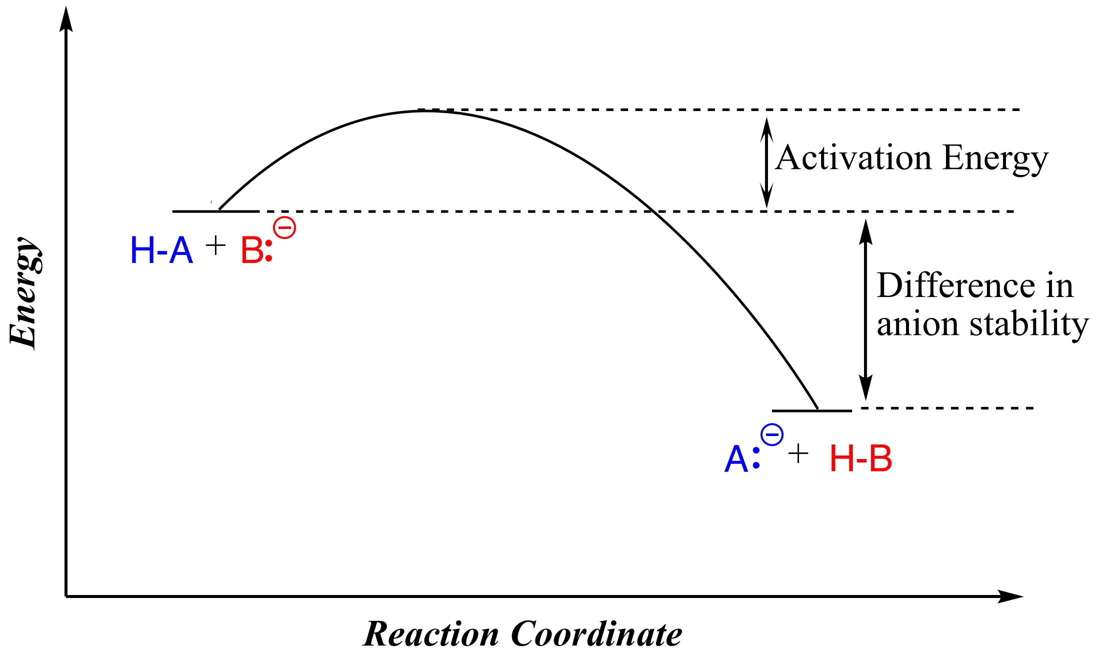






$$H\text{-}A + B:^{\ominus} \rightleftharpoons A:^{\ominus} + H\text{-}B$$

Assume $A:^{\ominus}$ is more stable than $B:^{\ominus}$



$$\boxed{K_{eq} = 10^{(pK_a\ H\text{-}B\ -\ pK_a\ H\text{-}A)}}$$

Example

$$CH_3S\text{-}H + HO^{\ominus} \rightleftharpoons CH_3S^{\ominus} + H_2O$$

$pK_a = 7$ $pK_a = 15.7$

$$K_{eq} = 10^{(\qquad - \qquad)} = 10^{(\qquad)}$$

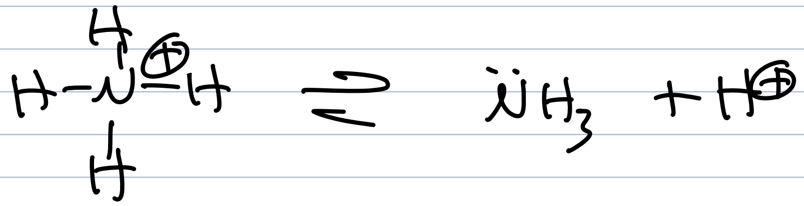
New idea: How do pKa and pH work together to determine predominant protonation states of acids?

An acid is mostly at a pH that is its pKa

An acid is mostly at a pH that is its pKa

Examples:

$CH_3CO_2H \rightleftharpoons CH_3CO_2^{\ominus} + H^{\oplus}$

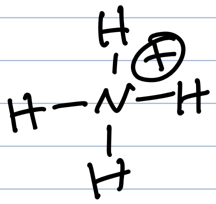


$NH_4^{\oplus} \rightleftharpoons \ddot{N}H_3 + H^{\oplus}$

Parent Acid →

CH_3CO_2H

$pK_a = 4.8$



$NH_4^{\oplus}$

$pK_a = 9.2$

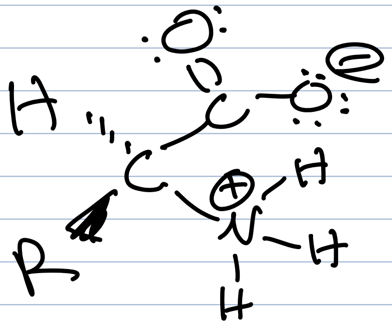
Forms Present at pH = 2.0

Forms Present at pH = 7.0

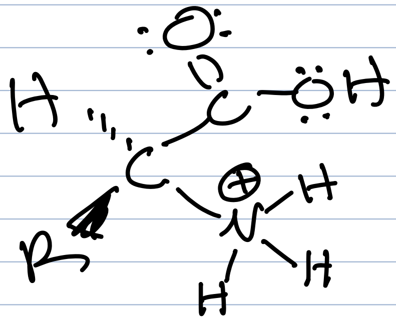
Forms Present at pH = 12.0

Application to important molecules → amino acids → same two groups we just saw

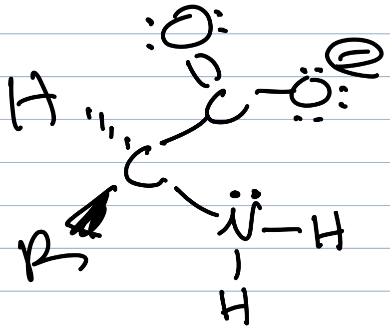
Form present at pH = ☐



Form present at pH = ☐

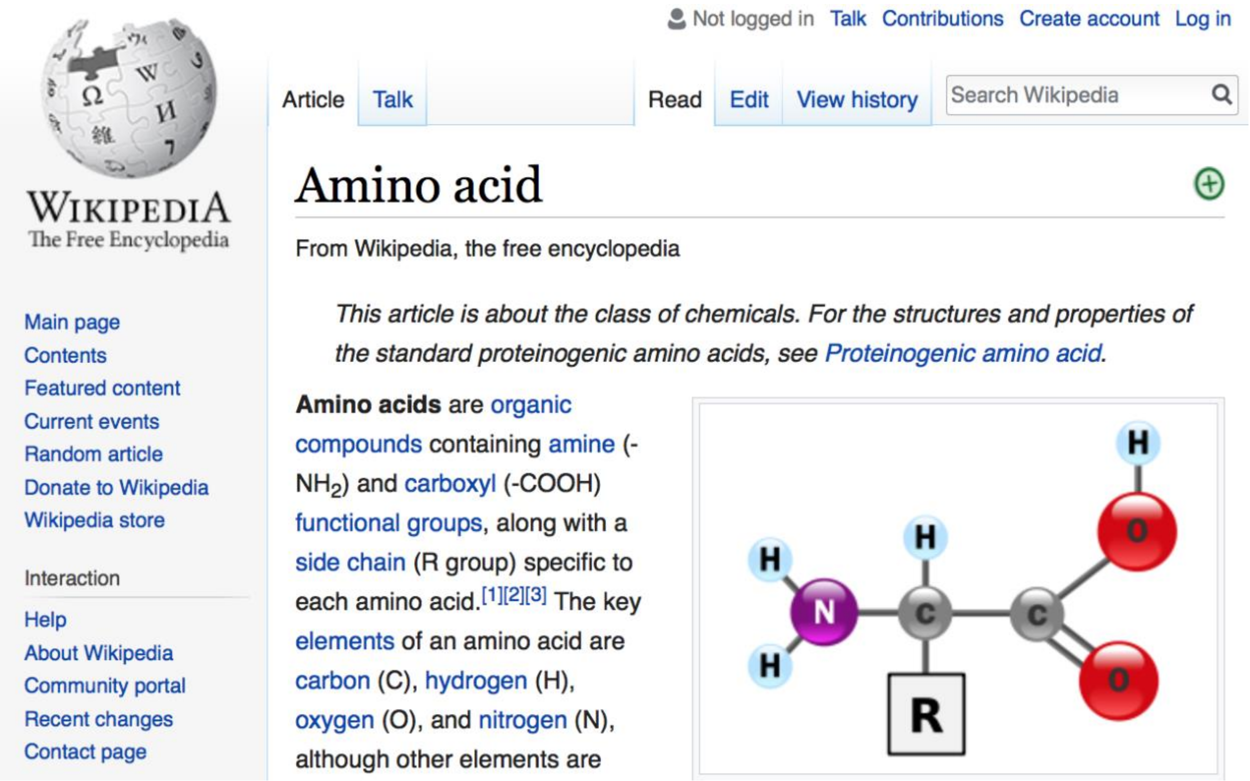


Form present at pH = ☐



⇒ The and
forms are NEVER both present
at any pH → Not possible!!

why doesn't anyone get this right?

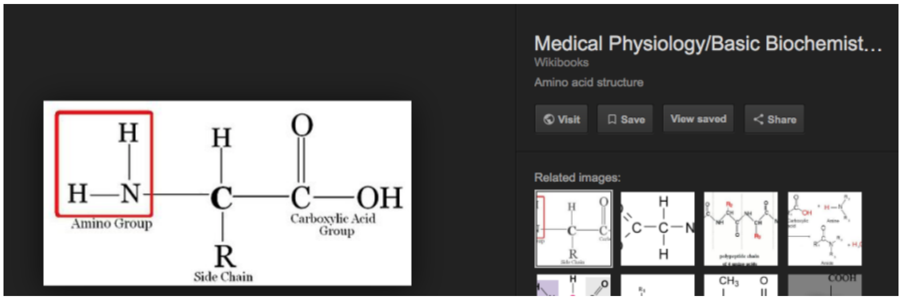


Amino acid

From Wikipedia, the free encyclopedia

This article is about the class of chemicals. For the structures and properties of the standard proteinogenic amino acids, see Proteinogenic amino acid.

Amino acids are organic compounds containing amine (-NH_2) and carboxyl (-COOH) functional groups, along with a side chain (R group) specific to each amino acid.[1][2][3] The key elements of an amino acid are carbon (C), hydrogen (H), oxygen (O), and nitrogen (N), although other elements are

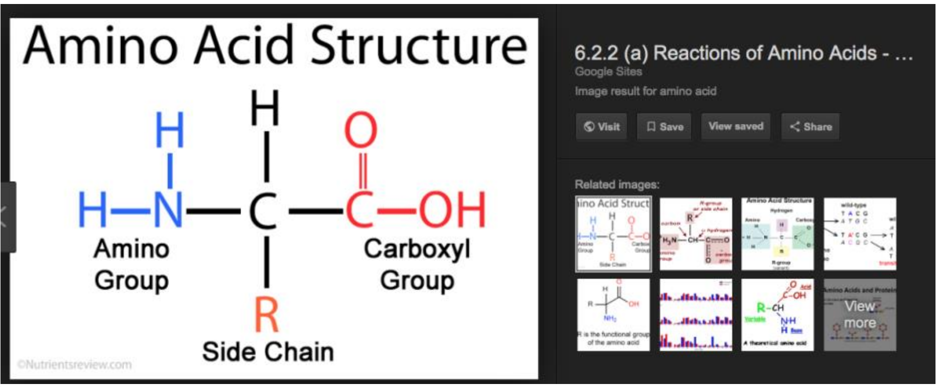


Medical Physiology/Basic Biochemist…

Wikibooks

Amino acid structure

Related images:



Amino Acid Structure

6.2.2 (a) Reactions of Amino Acids - …

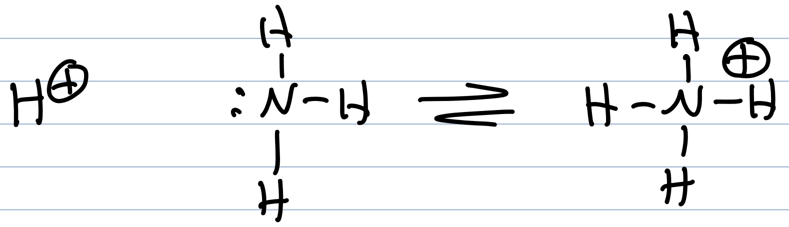
Google Sites

Image result for amino acid

Related images:

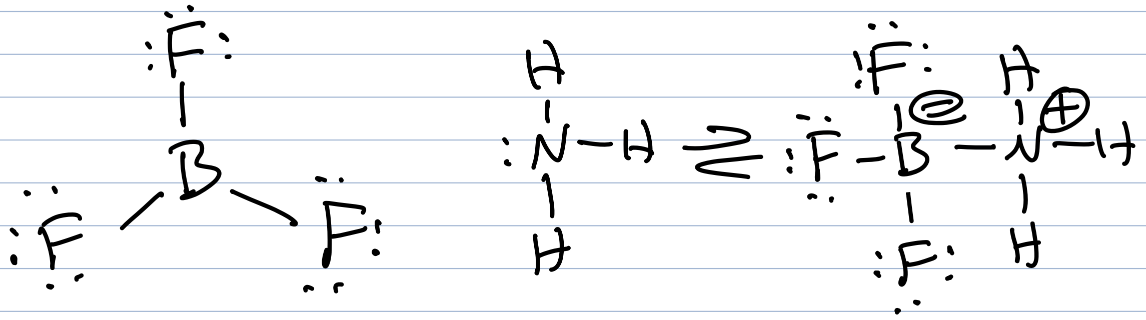
Lewis Acid →

Lewis Base →

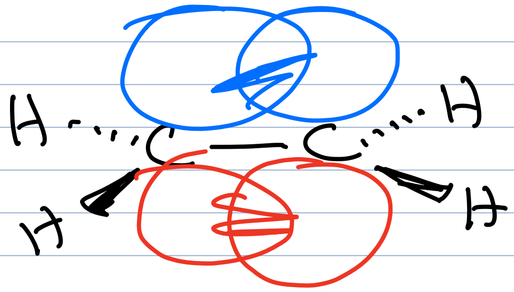


$H^{\oplus}$ can be thought of as a Lewis acid, →

but so can other species → atoms with an incomplete valence shell ⟹ B, Al, Zn, Fe



Electronic Structure of Alkenes



Consequences of π bonds

1) π bonds cannot rotate

2) Electron density is

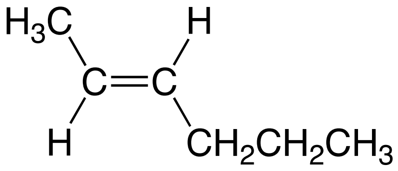
Naming Alkenes

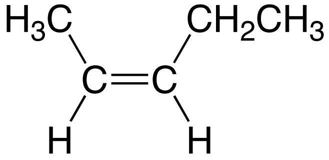
General Directions:

1. Locate longest continuous chain.
2. Number the chain so the double bond gets the lowest possible number.
3. For the parent chain name, use "-ene" not "-ane" as suffix and place a number to indicate the location of the double bond before the main chain name.
4. Make the suffix "-adiene" , "-atriene", etc. if multiple double bonds are present.

***cis/trans* nomenclature** – older chemical nomenclature, but still used commonly in biochemistry – most useful when each *sp*^{2} atom of the double bond has an H atom.

1. Track the longest chain through the double bond
    a. ***cis*** if whole main chain is on the same side of the double bond.
    b. ***trans*** if chain emerges on opposite sides of the double bond.





________________________________ ________________________________

Naming Alkenes

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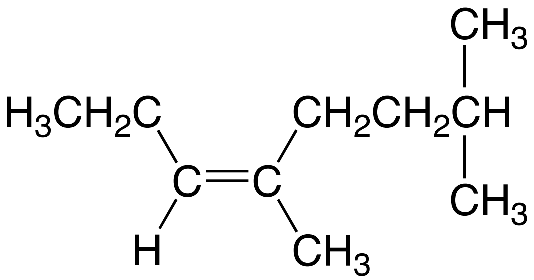
***E,Z* nomenclature** - A general IUPAC nomenclature to names alkenes.

Z (zusammen) = *z*ame *z*ide, *z*ame *z*ide, *z*ame *z*ide

E (entgegen) = opposite side

5. On each carbon of the double bond rank the two groups according to the Cahn, Ingold, Prelog priority rules (*R* vs. S rules).
6. If both of the highest-ranking groups are on the zame zide of the double bond it is ***Z***.
7. If both of the highest-ranking groups are on opposite sides of the double bond it is ***E***.



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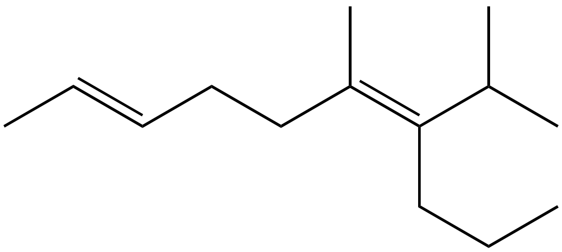

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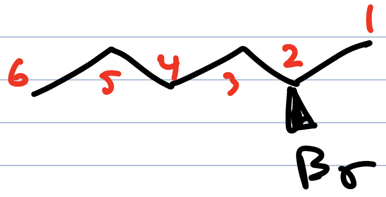
Today's Special Bonus Feature:
Halogen Nomenclature

$-\underset{\cdot\cdot}{\overset{\cdot\cdot}{F}}:$	$-\underset{\cdot\cdot}{\overset{\cdot\cdot}{Cl}}:$	$-\underset{\cdot\cdot}{\overset{\cdot\cdot}{Br}}:$	$-\underset{\cdot\cdot}{\overset{\cdot\cdot}{I}}:$
fluoro-	chloro-	bromo-	iodo-

$-CH_2F$

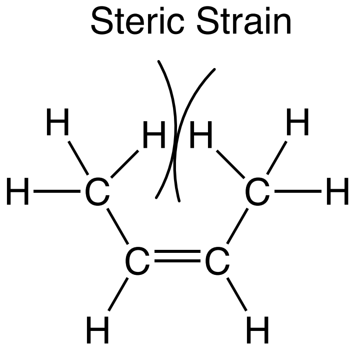
fluoromethyl group



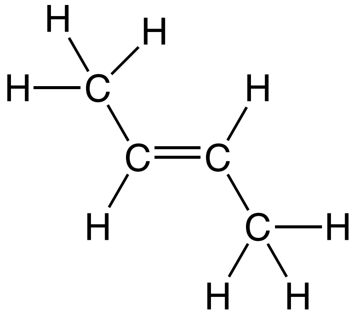
(R)-2-bromohexane

Special Alkene Bonus: Important material you will need to know!

Alkene stability part 1: Z (cis) groups larger than H atoms will crunch into each other causing steric strain.



Z

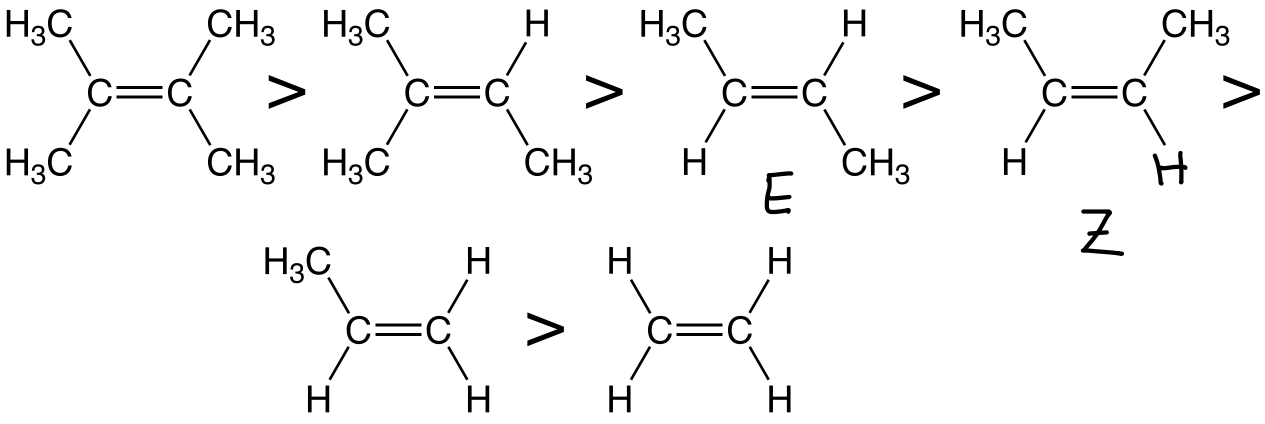


E

(no steric strain)

Alkene stability part 2: For reasons we are not able to tell you, more substituted alkenes have more stable (stronger) pi bonds than alkenes with more H atoms on their sp^2-hybridized C atoms (despite there being steric strain present in the most substituted alkenes).

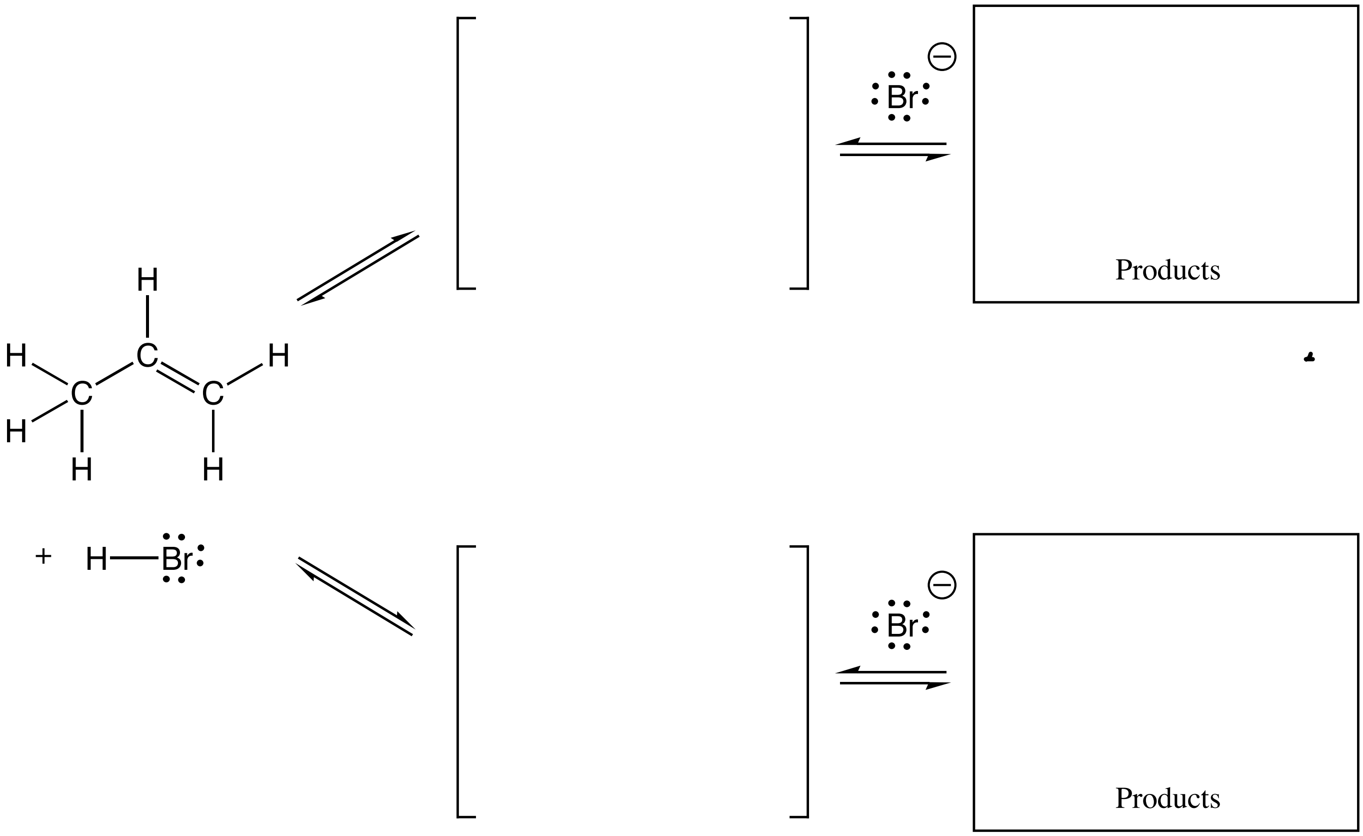
Strongest Pi Bond



Weakest Pi Bond

Time Capsule: Zaitsev's rule follows this trend!!

Addition of H-X to an Alkene

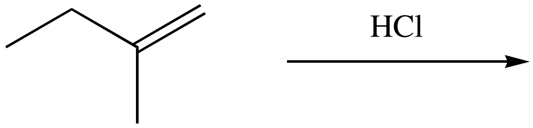


Summary:

Regiochemistry:

Stereochemistry:

Example:



For a reaction to take place, you need both:

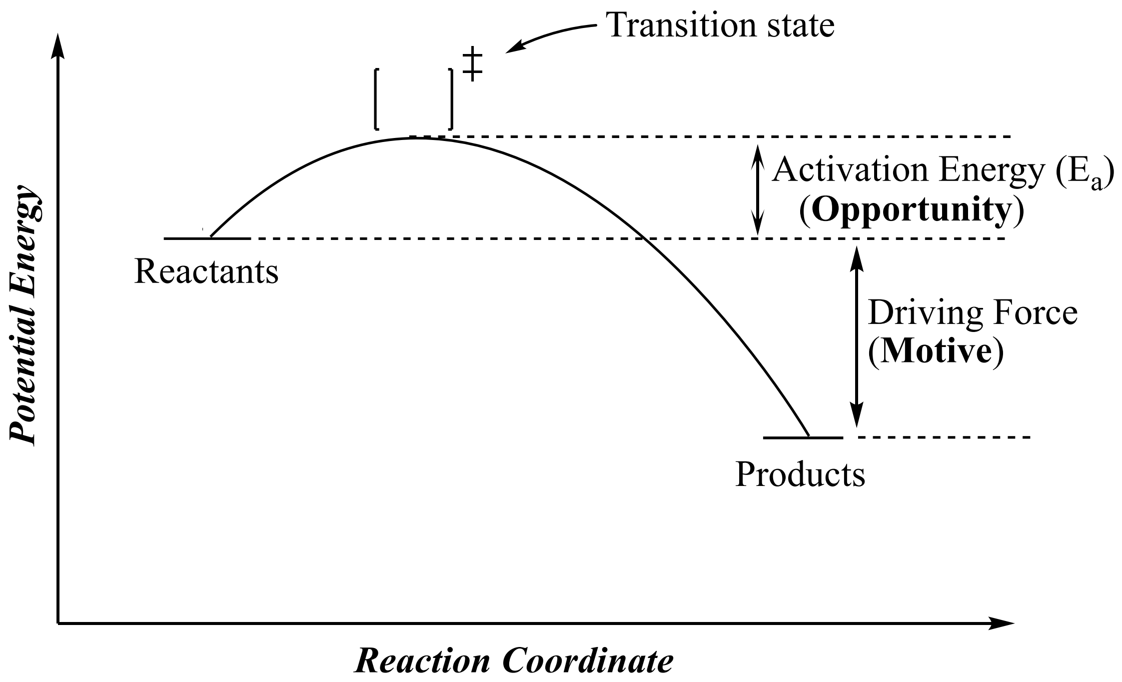
Motive → thermodynamic driving force

*1) Make stronger bonds

2) Formation of a

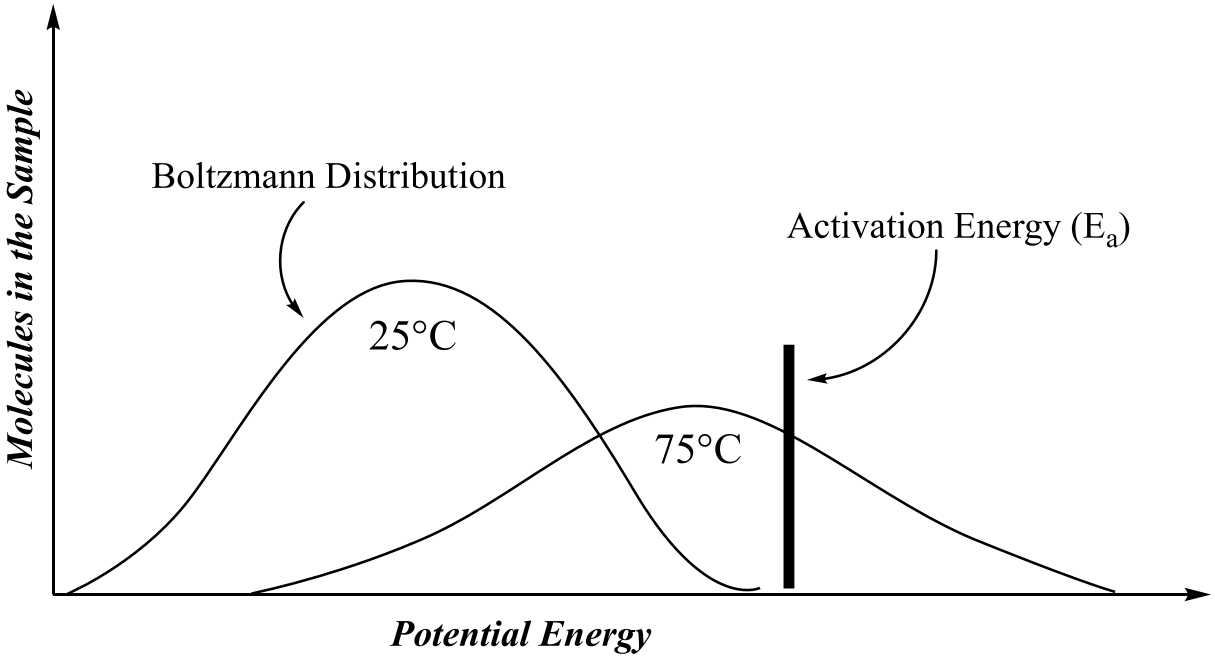
3) Entropy →

Opportunity → reasonable mechanism

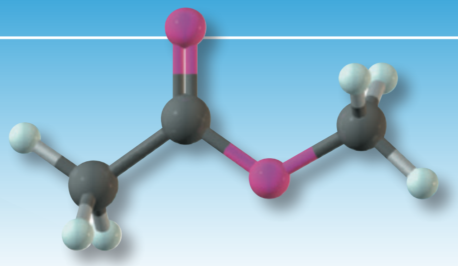


$$k = \text{reaction rate} = Ae^{-E_a/RT}$$

Increasing Temperature →



Appendix 3



Bond Dissociation Enthalpies

Bond dissociation enthalpy (BDE) is defined as the amount of energy required to break a bond homolytically into two radicals in the gas phase at 25°C.

$$A{-}B \rightarrow A\cdot + B\cdot \qquad \Delta H^0 \text{ [kJ (kcal)/mol]}$$

Bond	ΔH^0	Bond	ΔH^0	Bond	ΔH^0
H—H bonds		**C—C multiple bonds**		**C—Br bonds**	
$H{-}H$	435 (104)	$CH_2{=}CH_2$	727 (174)	$CH_3{-}Br$	301 (72)
$D{-}D$	444 (106)	$HC{\equiv}CH$	966 (231)	$C_2H_5{-}Br$	301 (72)
				$(CH_3)_2CH{-}Br$	309 (74)
X—X bonds		**C—H bonds**		$(CH_3)_3C{-}Br$	305 (73)
$F{-}F$	159 (38)	$CH_3{-}H$	439 (105)	$CH_2{=}CHCH_2{-}Br$	247 (59)
$Cl{-}Cl$	247 (59)	$C_2H_5{-}H$	422 (101)	$C_6H_5{-}Br$	351 (84)
$Br{-}Br$	192 (46)	$(CH_3)_2CH{-}H$	414 (99)	$C_6H_5CH_2{-}Br$	263 (63)
$I{-}I$	151 (36)	$(CH_3)_3C{-}H$	405 (97)		
		$CH_2{=}CH{-}H$	464 (111)	**C—I bonds**	
H—X bonds		$CH_2{=}CHCH_2{-}H$	372 (89)	$CH_3{-}I$	242 (58)
$H{-}F$	568 (136)	$C_6H_5{-}H$	472 (113)	$C_2H_5{-}I$	238 (57)
$H{-}Cl$	431 (103)	$C_6H_5CH_2{-}H$	376 (90)	$(CH_3)_2CH{-}I$	238 (57)
$H{-}Br$	368 (88)	$HC{\equiv}C{-}H$	556 (133)	$(CH_3)_3C{-}I$	234 (56)
$H{-}I$	297 (71)			$CH_2{=}CHCH_2{-}I$	192 (46)
		C—F bonds		$C_6H_5{-}I$	280 (67)
O—H bonds		$CH_3{-}F$	481 (115)	$C_6H_5CH_2{-}I$	213 (51)
$HO{-}H$	497 (119)	$C_2H_5{-}F$	472 (113)		
$CH_3O{-}H$	439 (105)	$(CH_3)_2CH{-}F$	464 (111)	**C—N single bonds**	
$C_6H_5O{-}H$	376 (90)	$C_6H_5{-}F$	531 (127)	$CH_3{-}NH_2$	355 (85)
				$C_6H_5{-}NH_2$	435 (104)
O—O bonds		**C—Cl bonds**			
$HO{-}OH$	213 (51)	$CH_3{-}Cl$	351 (84)	**C—O single bonds**	
$CH_3O{-}OCH_3$	159 (38)	$C_2H_5{-}Cl$	355 (85)	$CH_3{-}OH$	385 (92)
$(CH_3)_3CO{-}OC(CH_3)_3$	159 (38)	$(CH_3)_2CH{-}Cl$	355 (85)	$C_6H_5{-}OH$	468 (112)
		$(CH_3)_3C{-}Cl$	355 (85)		
C—C single bonds		$CH_2{=}CHCH_2{-}Cl$	288 (69)		
$CH_3{-}CH_3$	378 (90)	$C_6H_5{-}Cl$	405 (97)		
$C_2H_5{-}CH_3$	372 (89)	$C_6H_5CH_2{-}Cl$	309 (74)		
$CH_2{=}CH{-}CH_3$	422 (101)				
$CH_2{=}CHCH_2{-}CH_3$	322 (77)				
$C_6H_5{-}CH_3$	435 (104)				
$C_6H_5CH_2{-}CH_3$	326 (78)				

<u>Organic Chemistry</u> is the study of carbon-containing molecules.

This class has two points.

The first point of the class is to understand the organic chemistry of living systems. We will teach you how to think about and understand the most amazing things on the planet!!

Water is essential for life, you will learn why water has such special properties. 8/27/25

You will learn the secret structural reason proteins, the most important molecular machines in our bodies, can support the chemistry of life. 9/10/25

You will learn why when you take Advil for pain, exactly half of what you take works, and the other half does nothing. 9/24/25

You will learn how toothpaste works.

You will learn how a single chlorofluorocarbon refrigerant molecule released into the atmosphere can destroy many, many ozone molecules, leading to an enlargement of the ozone hole.

You will learn how medicines like Benadryl, Seldane, and Lipitor work.

You will learn how Naloxone is an antidote for an opioid overdose.

You will learn why Magic Johnson is still alive, decades after contracting HIV.

You will learn how MRI scans work.

The second point of organic chemistry is the synthesis of complex molecules from simpler ones by making and breaking specific bonds.

You will learn how to understand movies of reaction mechanisms like alkene hydration.

You will learn reactions that once begun, will continue reacting such that each product molecule created starts a new reaction until all the starting material is used up.

You will learn reactions that can make antifreeze from vodka.

You will learn a reaction that can make nail polish remover from rubbing alcohol.

You will learn how to look at a molecule and accurately predict which atoms will react to make new bonds, and which bonds will break during reactions.

You will learn how to analyze a complex molecule's structure so that you can predict ways to make it via multiple reactions starting with less complex starting molecules.