Test 3

avg = 68.8
std dev = 13.9
All things are made of atoms – little particles that move around in perpetual motion, attracting each other when they are a little distance apart, but repelling upon being squeezed into one another.

R. Feynmann, R. Leighton, M. Sands
The Feynmann Lectures on Physics

Courtesy of California Institute of Technology. Used with permission.
<table>
<thead>
<tr>
<th>Name</th>
<th>Structure (at neutral pH)</th>
<th>Name</th>
<th>Structure (at neutral pH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glycine (Gly)</td>
<td>H₃N⁺−CH−CO₂⁻</td>
<td>Serine (Ser)</td>
<td>H₃N⁺−CH−CO₂⁻</td>
</tr>
<tr>
<td>Alanine (Ala)</td>
<td>H₃N⁺−CH−CO₂⁻</td>
<td>Threonine (Thr)</td>
<td>H₃N⁺−CH−CO₂⁻</td>
</tr>
<tr>
<td>Valine (Val)</td>
<td>H₃N⁺−CH−CO₂⁻</td>
<td>Leucine (Leu)</td>
<td>H₃N⁺−CH−CO₂⁻</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tyrosine (Tyr)</td>
<td>H₃N⁺−CH−CO₂⁻</td>
</tr>
<tr>
<td>Leucine (Leu)</td>
<td>H₃N⁺−CH−CO₂⁻</td>
<td>Cysteine (Cys)</td>
<td>H₃N⁺−CH−CO₂⁻</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Asparagine (Asn)</td>
<td>H₃N⁺−CH−CO₂⁻</td>
</tr>
<tr>
<td>Proline (Pro)</td>
<td></td>
<td>Glutamine (Gln)</td>
<td>H₃N⁺−CH−CO₂⁻</td>
</tr>
<tr>
<td>Methionine (Met)</td>
<td>H₃N⁺−CH−CO₂⁻</td>
<td>Phenylalanine (Phe)</td>
<td>H₃N⁺−CH−CO₂⁻</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aspartic acid (Asp)</td>
<td>H₃N⁺−CH−CO₂⁻</td>
</tr>
<tr>
<td>Tryptophan (Trp)</td>
<td>H₃N⁺−CH−CO₂⁻</td>
<td>Glutamic acid (Glu)</td>
<td>H₃N⁺−CH−CO₂⁻</td>
</tr>
</tbody>
</table>

(continued)
<table>
<thead>
<tr>
<th>Name</th>
<th>Structure (at neutral pH)</th>
<th>Name</th>
<th>Structure (at neutral pH)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Positively Charged R Groups</strong></td>
<td></td>
<td><strong>Positively Charged R Groups</strong></td>
<td></td>
</tr>
<tr>
<td>Arginine (Arg)</td>
<td>( \text{H}_3\text{N}^+-\text{CH}--\text{CO}_2^- )</td>
<td>Lysine (Lys)</td>
<td>( \text{H}_3\text{N}^+-\text{CH}--\text{CO}_2^- )</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Histidine (His)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Amino Acid</th>
<th>Side-Chain</th>
<th>pK(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alanine</td>
<td>Ala</td>
<td>A -</td>
</tr>
<tr>
<td>Cysteine</td>
<td>Cys</td>
<td>C 8.33</td>
</tr>
<tr>
<td>Aspartic Acid</td>
<td>Asp</td>
<td>D 3.90</td>
</tr>
<tr>
<td>Glutamic Acid</td>
<td>Glu</td>
<td>E 4.07</td>
</tr>
<tr>
<td>Phenylalanine</td>
<td>Phe</td>
<td>F -</td>
</tr>
<tr>
<td>Glycine</td>
<td>Gly</td>
<td>G -</td>
</tr>
<tr>
<td>Histidine</td>
<td>His</td>
<td>H 6.04</td>
</tr>
<tr>
<td>Isoleucine</td>
<td>Ile</td>
<td>I -</td>
</tr>
<tr>
<td>Lysine</td>
<td>Lys</td>
<td>K 10.79</td>
</tr>
<tr>
<td>Leucine</td>
<td>Leu</td>
<td>L -</td>
</tr>
<tr>
<td>Methionine</td>
<td>Met</td>
<td>M -</td>
</tr>
<tr>
<td>Asparagine</td>
<td>Asn</td>
<td>N -</td>
</tr>
<tr>
<td>Proline</td>
<td>Pro</td>
<td>P -</td>
</tr>
<tr>
<td>Glutamine</td>
<td>Gln</td>
<td>Q -</td>
</tr>
<tr>
<td>Arginine</td>
<td>Arg</td>
<td>R 12.48</td>
</tr>
<tr>
<td>Serine</td>
<td>Ser</td>
<td>S -</td>
</tr>
<tr>
<td>Threonine</td>
<td>Thr</td>
<td>T -</td>
</tr>
<tr>
<td>Valine</td>
<td>Val</td>
<td>V -</td>
</tr>
<tr>
<td>Tryptophan</td>
<td>Trp</td>
<td>W -</td>
</tr>
<tr>
<td>Tyrosine</td>
<td>Tyr</td>
<td>Y 10.13</td>
</tr>
</tbody>
</table>

Compiled by Andrew Magyar

Courtesy of Andrew Magyar. Used with permission.
Figure 24.4

(a) Chiral Objects

Mirror
Left hand Right hand

Cannot be Superimposed

(b) Achiral Objects

Mirror
Flask Flask

Can be Superimposed

Image by MIT OpenCourseWare.
Chiral and Achiral Molecules

Bromochlorofluoromethane: Cannot be Superimposed

Dichlorofluoromethane: Can be Superimposed
Figure 24.7

Stereoisomers

Geometric isomers
- cis isomer
- trans isomer

Optical isomers
- (+) enantiomer
- (-) enantiomer

Examples:
- cis-Dichloroethylene
- trans-Dichloroethylene
- (+)-Lactic acid
- (-)-Lactic acid

Four Categories of Stereoisomers

Image by MIT OpenCourseWare.
Figure 24.

1.0 g solute / 1 mL solvent / 10 cm path length

Detecting Chirality With Polarized Light

- Observer
- Movable analyzer
- Polarized light
- Polarizer
- Organic molecules in a sample tube
- Specific rotation 30°
- Unpolarized light
- Light source

Image by MIT OpenCourseWare.
Interaction of chiral molecules with biological receptors

Chiral Molecules

Receptor sites on protein

Fits receptor site, leading to a response.

Does not fit receptor site, no response.
extreme kinetics:  
 the Halifax Explosion

* Thursday, December 6, 1917

* *Imo*, Belgian, relief ship

* *Mont Blanc*, French, supply ship:  
  35 tons benzol  
  300 rounds ammunition  
  10 tons gun cotton  
  2,300 tons picric acid (used in explosives)  
  20,000 tons TNT

* at 8:45 a.m. *Imo* hits *Mont Blanc*,  
  missing TNT, striking picric acid  
  stored directly beneath drums of  
  benzol on deck, sparks

toluene = methyl benzene

trinitrotoluene = TNT
Trinitrotoluene

From Wikipedia, the free encyclopedia

Trinitrotoluene (pronounced /trə'nɪtrə'tʌləriən/; abbreviated TNT), or more specifically, 2,4,6-trinitrotoluene, is a chemical compound with the formula C₆H₆(NO₂)₃CH₃. This yellow-coloured solid is sometimes used as a reagent in chemical synthesis, but it is best known as a useful explosive material with convenient handling properties. The explosive yield of TNT is considered to be the standard measure of strength of bombs and other explosives. (Dynamite, though, has a more than 60% higher energy density than TNT, with roughly 7.5 MJ/kg compared to 4.6 MJ/kg for TNT.) In chemistry, TNT is used to generate charge transfer salts.

Contents

1 Preparation
2 Applications
3 Explosive character
4 Energy content
5 History
6 Safety and toxicity
7 See also
8 References
9 External links

Preparation
The Boston Christmas Tree

For more than 30 years, Nova Scotia has donated a giant evergreen each year to the people of Boston as a thank you for their assistance following the 1917 Halifax Explosion.

This year’s tree is a 40 foot white spruce located in New Ross, Lunenburg County. It is being provided by Mr. & Mrs. Alan Broome. The white spruce will serve as the focal point for the annual tree-lighting ceremony on Thursday Nov 30, 6:30 p.m. to 8 p.m. at the Boston Common.

Ross Pentz, Department of Natural Resource’s Christmas tree extension specialist for Western Nova Scotia, is co-ordinating activities on behalf of the province. Department of Transportation and Public Works staff are transporting the tree to Boston. Officials expect the tree will arrive in Boston on Friday, Nov. 17, at which time the tree will be set up on the Boston Common.

About the Boston Christmas Tree

The tree usually comes from a private land owner and is selected by the Nova Scotia Department of Natural Resources based upon the following specifications:

- Balsam fir, white spruce or red spruce
- Forty-five to fifty feet (45’-50’’) in height
- Healthy with good color
- Medium to heavy density
- Uniform and symmetrical
- Easy to access.
The Boston Christmas Tree, version 2007

14 m white spruce from the Annapolis Valley, Nova Scotia

Courtesy of the Province of Nova Scotia. Used with permission.
3.091SC Introduction to Solid State Chemistry
Fall 2009

For information about citing these materials or our Terms of Use, visit: http://ocw.mit.edu/terms.