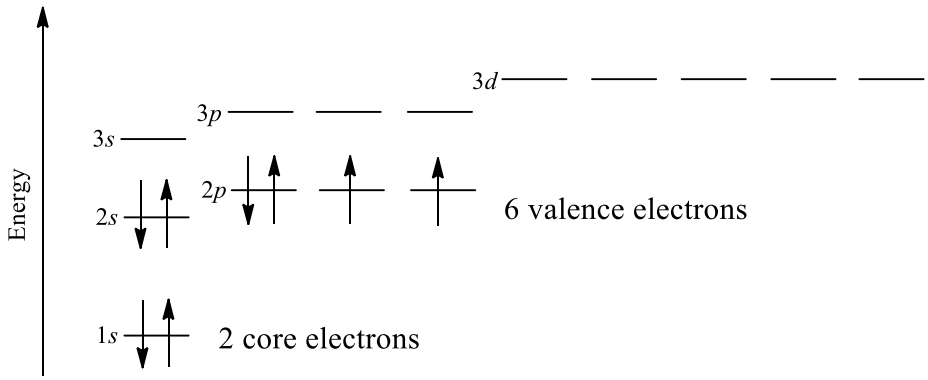
CHEM1405 (Vet. Science) - June 2012

2012-J-2

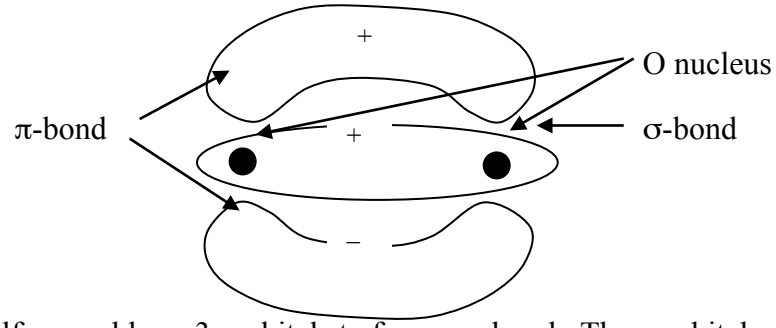
- $1s^2\ 2s^2\ 2p^4$



Pauli exclusion principle. There's a maximum of 2 electrons in each orbital with opposite spins, ensuring that no two electrons have the same set of quantum numbers.

Aufbau principle. Lowest energy orbitals fill first.

Hund's rule. Electrons in degenerate orbitals (*i.e.* orbitals with same energy) have the maximum number of parallel spins.



Sulfur would use 3*p* orbitals to form a π-bond. These orbitals are diffuse and overlap is poor and so it is more stable to use σ-bonds to 2 other atoms. Good overlap of the 2*p* orbitals in oxygen means that the π-bond is stable.

2012-J-3

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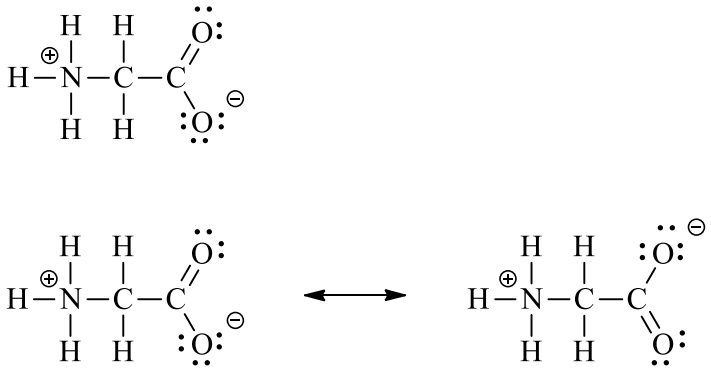

N: sp^3 hybridised; tetrahedral geometry

CH_2: sp^3 hybridised; tetrahedral geometry

CO_2^-: sp^2 hybridised; trigonal planar geometry

In its zwitterionic state, glycine has very strong electrostatic attractions (*i.e.* ionic bonds) between the NH_3^+ and CO_2^- groups giving it very high m.p.

Yes. It is ionic so dissolves in the very polar solvent water.

2012-J-4

• endothermic

The reaction will shift to the right (le Chatelier's principle)

89 kJ mol^{-1}

$\Delta G = \Delta H - T\Delta S$ Neither the entropy change for the reaction nor the temperature is 0, so $\Delta G \neq \Delta H$.

Neutral. Pure water is neutral at all temperatures as the $[H_3O^+(aq)] = [OH^-(aq)]$.

2012-J-5

• Half-life is the amount of time required for the amount (or activity) of a sample to decrease to half its initial value.

^{131}I: 0% ^{137}Cs: 56%

^{131}I would do more damage. It has the shorter half-life so undergoes more disintegrations and produces more radiation in a given time period.

2012-J-6

- 1.8×10^{-3} mol L^{-1}

  4.54

  The pH will increase as the equilibrium shifts to the left.

  $$CO_2(aq) + H_2O \rightleftharpoons H_2CO_3(aq) \rightleftharpoons HCO_3^-(aq) + H^+(aq)$$

  A buffer resists changes in pH. It contains substantial quantities of a weak acid and its conjugate base. In the H_2CO_3/HCO_3^- buffer, added acid is removed by the reaction:

  $HCO_3^-(aq) + H^+(aq) \rightarrow H_2CO_3(aq)$

  and added base is removed by: $H_2CO_3(aq) + OH^-(aq) \rightarrow HCO_3^-(aq) + H_2O$

2012-J-7

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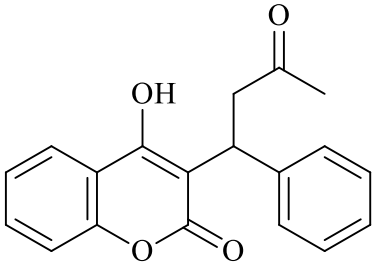

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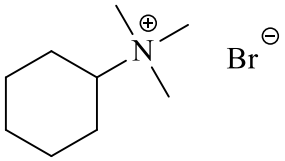
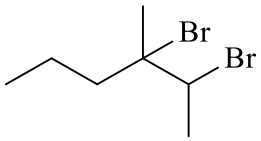
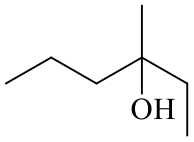
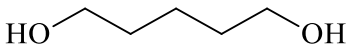
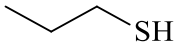








2 x 

2012-J-8

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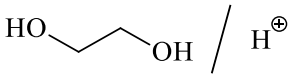
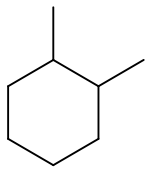
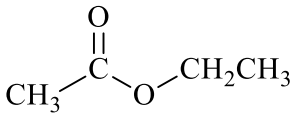
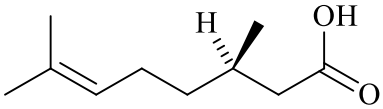
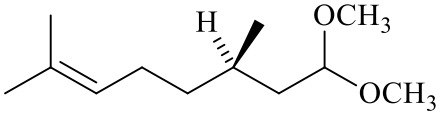
		
	$SOCl_2$	
		$CH_3CH_2CO_2^{\ominus}$ + CH_3CH_2OH
		
		

2012-J-9

• $C_{10}H_{18}O$

aldehyde, alkene





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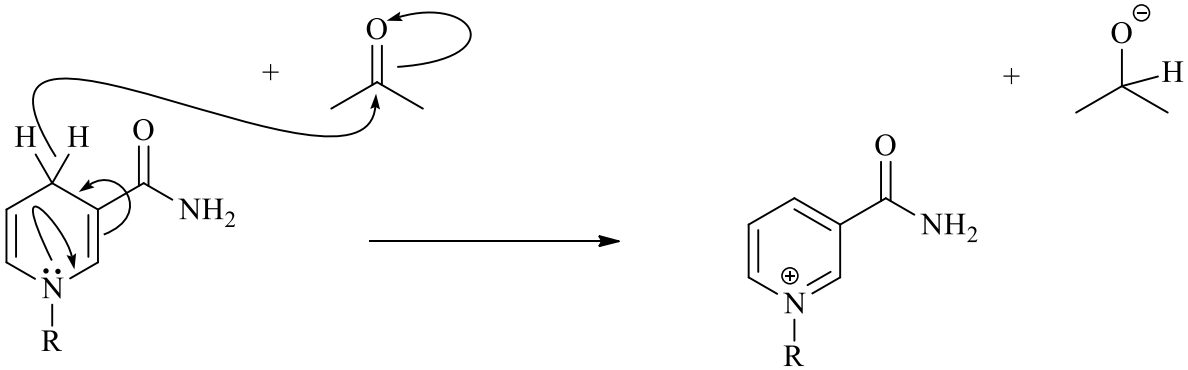

NADH NAD^+

2012-J-10

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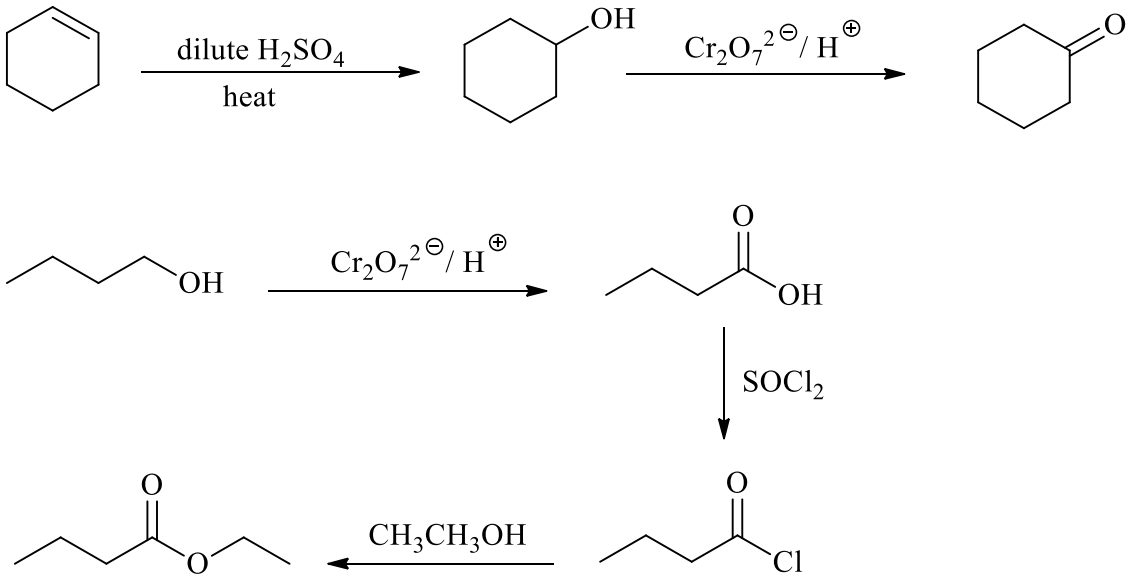

2012-J-11

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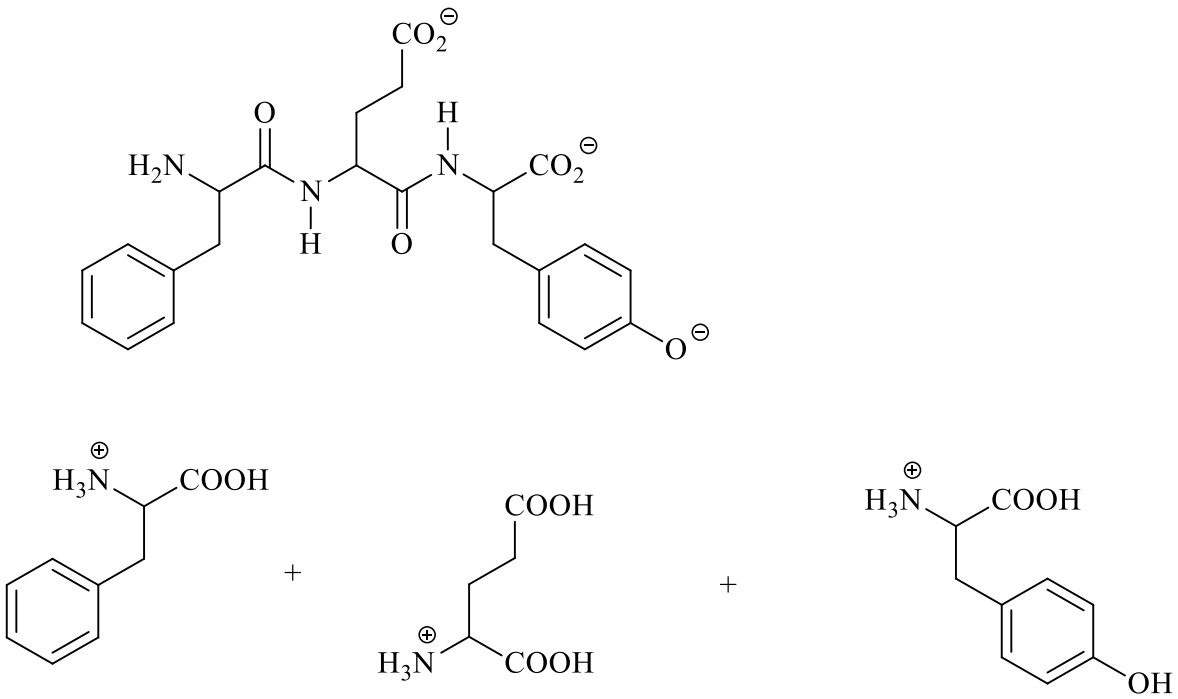
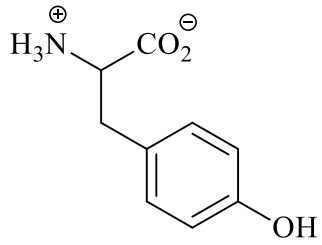
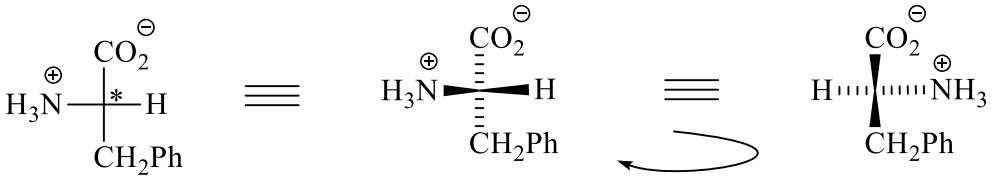


2012-J-12



5.66



Horizontal bonds in Fischer projections are out of the paper, vertical bonds are into the paper. Order of priority of substituents is $NH_3^+ > CO_2^- > CH_2Ph > H$. Reorient the molecule so that the lowest priority group (H) is at the back. Viewing down the C–H bond, the orientation of $NH_3^+ \rightarrow CO_2^- \rightarrow CH_2Ph$ is anticlockwise. Therefore (L)-phenylalanine has (*S*) configuration.

2012-J-13

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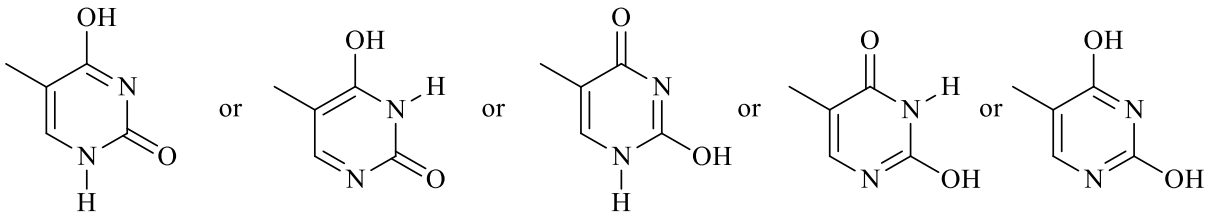
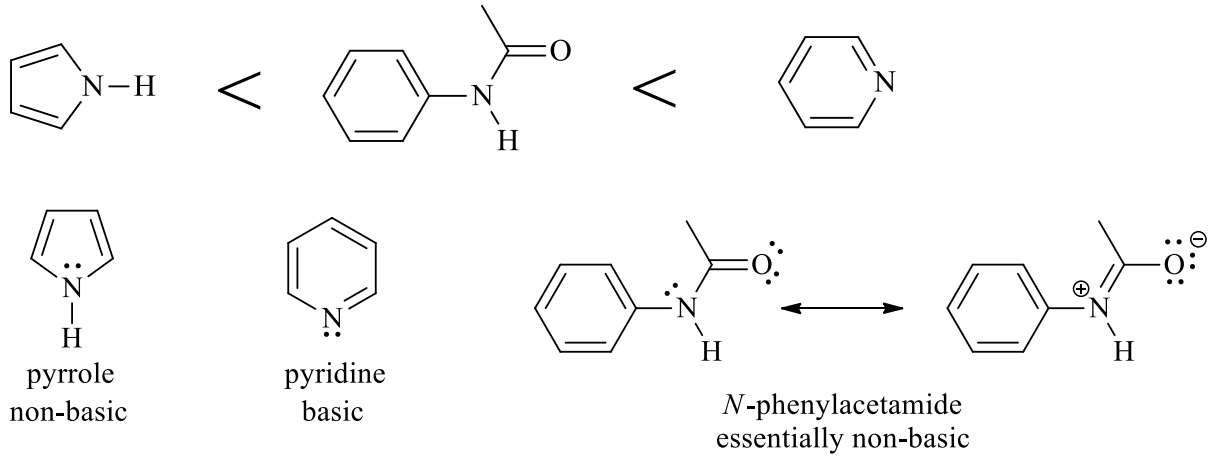


2012-J-13 (cont)

- Order of base strength is:



Pyridine is the most basic as the lone pair of electrons on nitrogen is available to bond with H^+.

Pyrrole is the least basic as the "lone pair" of electrons on nitrogen is part of the aromatic π-electron system and is delocalised around the ring. It is not available for bonding with H^+ ions.

N-Phenylacetamide is essentially non-basic as the lone pair of electrons is involved in resonance forms (including delocalisation of the positive charge into the aromatic ring, which is not shown).

2012-J-14

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