CHEMISTRY 1B (CHEM1102) - November 2007

2007-N-2

- pH is a measure of the $H^+(aq)$ ion concentration in a solution,
  defined as $pH = -\log_{10}[H^+(aq)]$

  A strong acid dissociates completely in water *eg* $HCl(aq) \rightarrow H^+(aq) + Cl^-(aq)$

  A weak acid dissociated only slightly in water *eg* $HF(aq) \rightleftharpoons H^+(aq) + F^-(aq)$

  No. A solution of HCl could have a pH of 1.0 for 0.1 M solution or a pH of 6.0 for a 10^{-6} M solution. Similarly a solution of pH 2 could be a 10^{-2} M solution of a strong acid or a more concentrated solution of a weak acid.

2007-N-3

- $HF(aq) > H_2S(aq) > H_2O(l)$
  H–F bond is more polarised than H–O so is easier to break; hence HF is stronger acid than H_2O. S is much larger atom than O, so H–S bond is much longer and weaker than H–O; hence H_2O is weaker acid than H_2S. HF is stronger than H2S, but you can't be certain of this from first principles.
- Buffer systems resist changes in pH.
  They consist of a weak acid (HA) and its conjugate base (A^-) in high concentrations.

  Added H^+ is consumed by: $H^+(aq) + A^-(aq) \rightarrow HA(aq)$

  Added OH^- is consumed by: $OH^-(aq) + HA(aq) \rightarrow H_2O + A^-(aq)$

  $[CH_3COOH] : [CH_3CO_2^-] = 5.6 : 1$

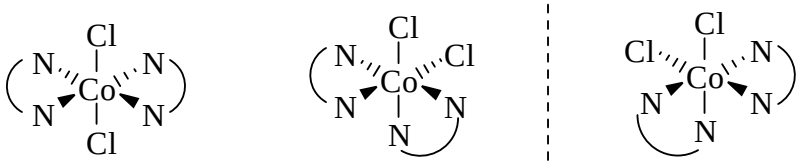
2007-N-4

- 1×10^{-20} M^2 (There was an error in the question as the true K_{sp} is 1×10^{-10} M^2.)

  The equilibrium $BaSO_4(s) \rightleftharpoons Ba^{2+}(aq) + SO_4^{2-}(aq)$ lies far to the left.
  Adding more $SO_4^{2-}(aq)$ ions pushes it further to the left. This would be advantageous as $Ba^{2+}(aq)$ ions are highly toxic.

2007-N-5

- A chelate is a ligand with more than one donor atom.



trans- *cis-* *cis-*

- The acidity is due to the charged Fe atom withdrawing electron density from the oxygen and leading to a more polarised O–H bond that is more easily broken. Fe^{3+} has higher charge than Fe^{2+} so does this more effectively and hence is the stronger acid.

2007-N-6

- Sublimation is a phase change from solid to gas without passing through the liquid phase.
  Melting is a phase change from solid to liquid.

  The triple point is the temperature and pressure at which all three phases (solid, liquid and gas) coexist in equilibrium.

  The triple point of CO_2 is above ambient pressure.
  The triple point of H_2O is below ambient pressure.

- The activation energy barrier that needs to be overcome is too high.

2007-N-7

- Rate = $k \times P(H_2) \times P^2(NO)$

  Rate constant = 1.61×10^{-6} kPa^{-2} s^{-1}

  Third order

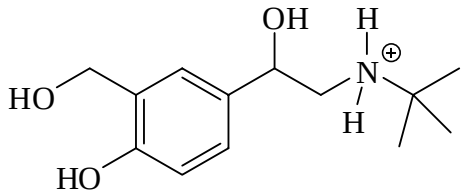
2007-N-8

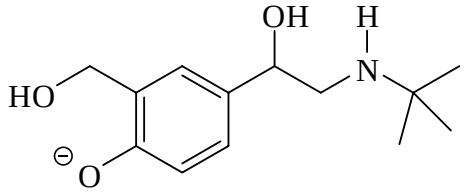
- The equilibrium associated with the solubility of Fe_2O_3 lies far to the left:
  $Fe_2O_3(s)$ + excess H_2O $\rightleftharpoons$ $2Fe^{3+}(aq)$ + $6OH^-(aq)$
  The equilibrium for the complexation of Fe^{3+} ions with Desferal lies far to the right (as K for this reaction is $10^{30.6}$).
  Desferal complexes all free $Fe^{3+}(aq)$ ions, so more Fe_2O_3 must dissolve to re-establish the first equilibrium (le Chatelier's principle). Eventually all the Fe_2O_3 will dissolve.

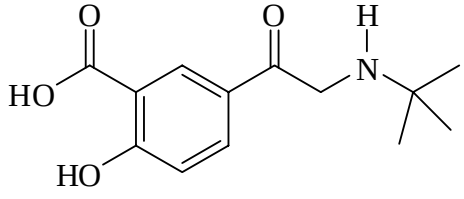
2007-N-9

- $C_{13}H_{21}O_3N$

  239.1516

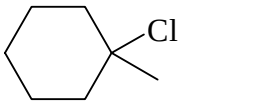


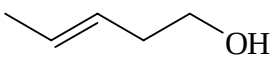


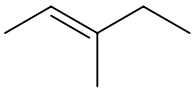


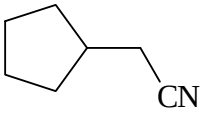
2007-N-10

- $SOCl_2$









2007-N-11

- electrophilic aromatic substitution
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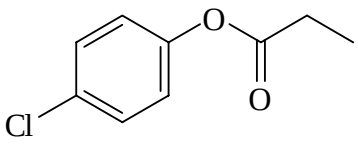

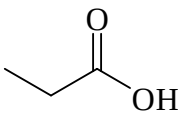

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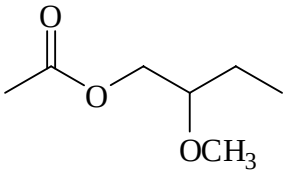

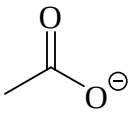

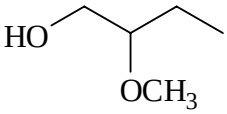

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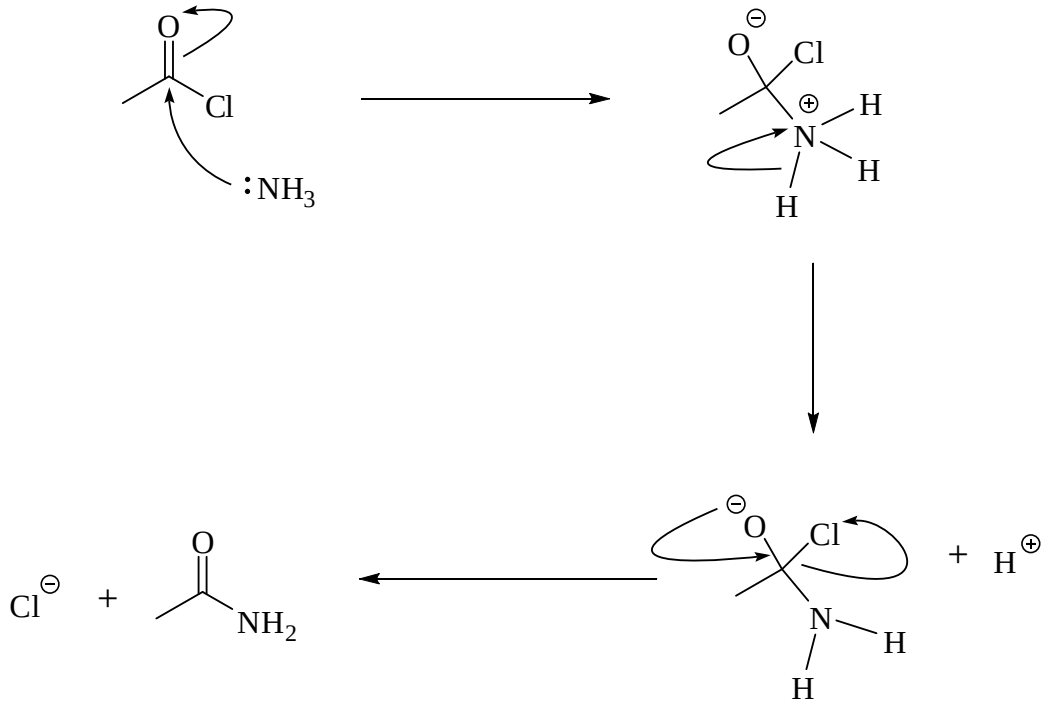

2007-N-13

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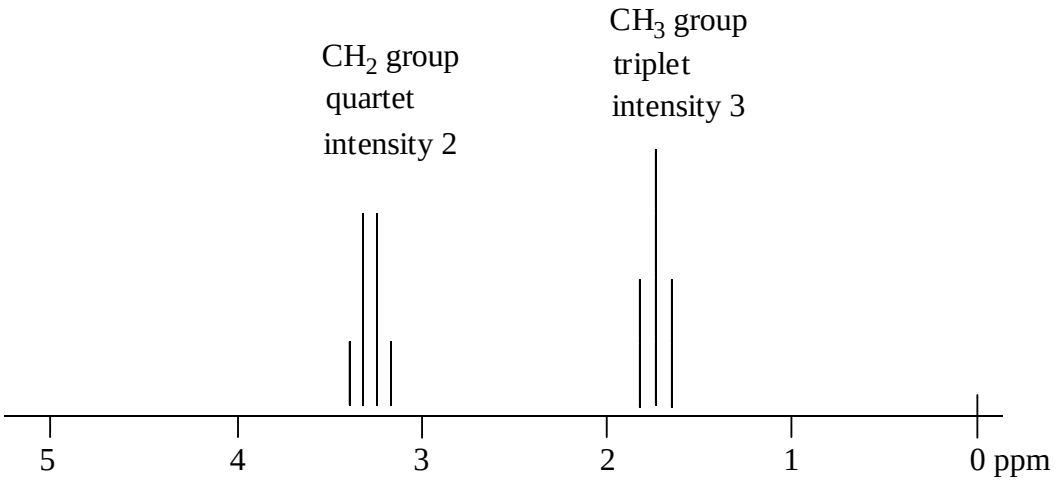

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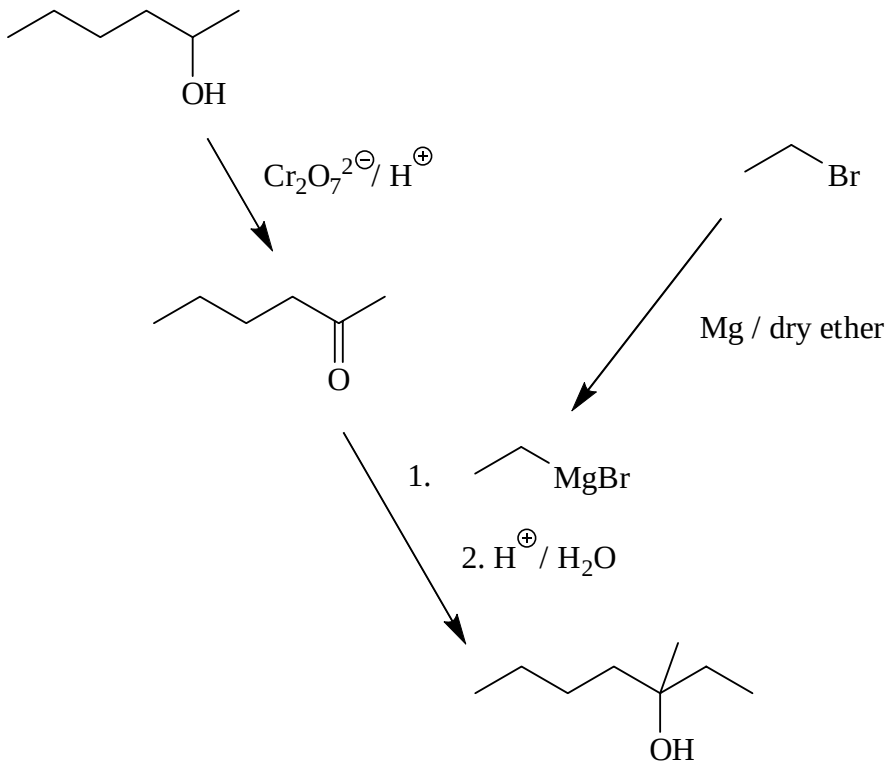
- 

racemic mixture