CHEMISTRY 1B (CHEM1102) - June 2004

2004-J-2

- Molecules must be oriented correctly for reaction to occur. Molecules must collide with sufficient energy to overcome the activation energy of reaction.

  From Arrhenius Equation $k = Ae^{-E_a/RT}$, the larger the activation energy (E_a), the smaller the rate constant (k). That is, higher activation energy results in slower reaction rate.

  218 kJ mol^{-1}

2004-J-3

- Buffers consist of a solution of a weak acid, HA, and its conjugate base, A^-, at high concentrations. They resist changes in pH because any added H^+ or OH^- is consumed as follows: $H^+ + A^- \rightarrow HA$ or $HA + OH^- \rightarrow A^- + H_2O$

  From Henderson-Hasselbalch equation pH= pK_a + log{[A^-]/[HA]}
  When pH= pK_a the concentrations of weak acid and conjugate base are equal. The change in value of log{[A^-]/[HA]} is smallest for the addition of any given amount of H^+ or OH^- when [A^-] = [HA] initially.

  Added H^+ is not consumed to form HA. Added OH^- reacts with H^+ present to form H_2O. Both result in large changes in [H^+] and hence large changes in pH.

  $CH_3COOH : CH_3CO_2^-$ = 0.58 (1:1.7)

2004-J-4

- $[CoCl_2(NH_3)_4]^+$

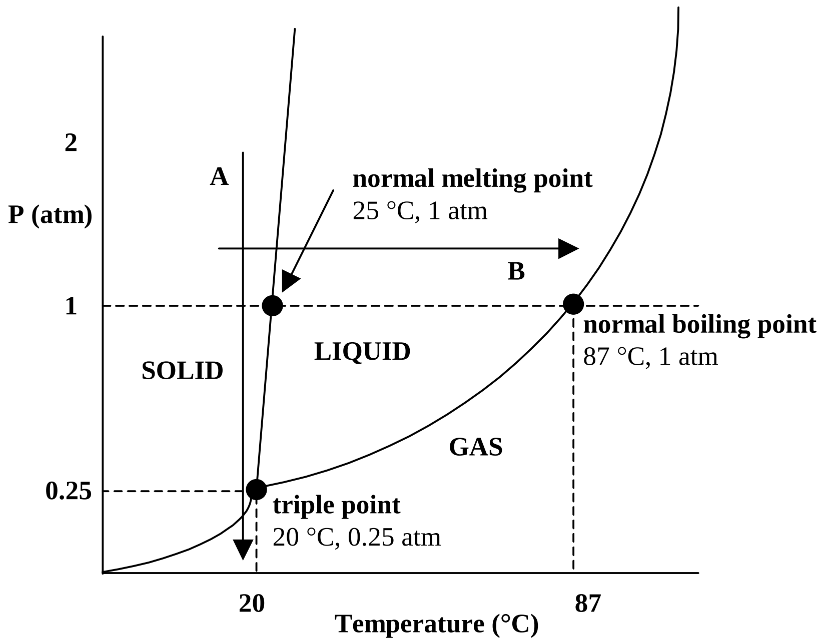
  N and Cl

  $3d^6$

- Limestone has a very low solubility in water, the following equilibrium lying very much to the left. $CaCO_3(s) \rightleftharpoons Ca^{2+}(aq) + CO_3^{2-}(aq)$
  However, limestone is much more soluble in water that contains dissolved carbon dioxide.
  $$CaCO_3(s) + CO_2(aq) + H_2O \rightleftharpoons Ca^{2+}(aq) + 2HCO_3^-(aq)$$
  Caves form where the limestone has dissolved away. When the water rich in Ca^{2+} and HCO_3^- ions percolates through the cave, the water evaporates and the $CO_2(g)$ escapes into the atmosphere. This pushes the equilibrium of the above reaction to the left and the $CaCO_3$ reprecipitates as limestone forming the stalagmites and stalactites.

2004-J-5

- The data allow the following phase diagram to be drawn.



The substance sublimes (goes directly from solid to gas) - Arrow A

The substance melts (goes from solid to liquid) - Arrow B

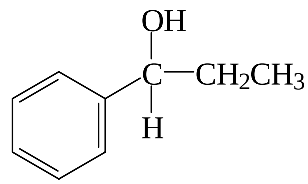
Solid is more dense. Consider any point on the solid/liquid equilibrium line. Increasing the pressure moves into the solid area of the diagram, so the solid is the more stable phase under increased pressure, i.e. the solid is more dense.

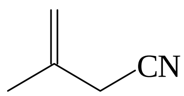
2004-J-6

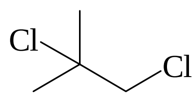
- 10.38

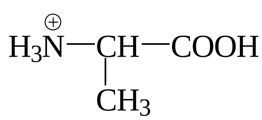
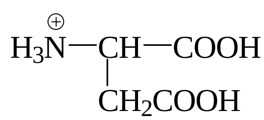
  Yes

2004-J-7

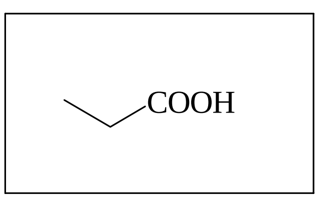
- 





2004-J-8

- 
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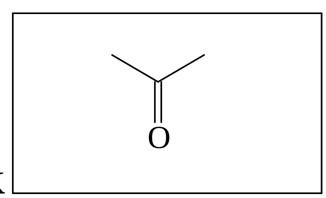
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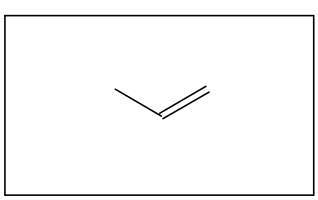
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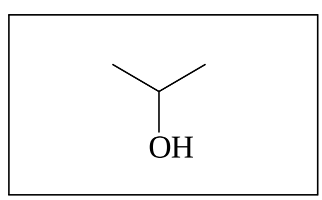
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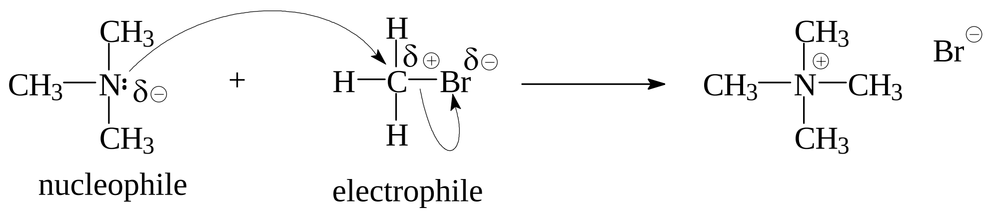
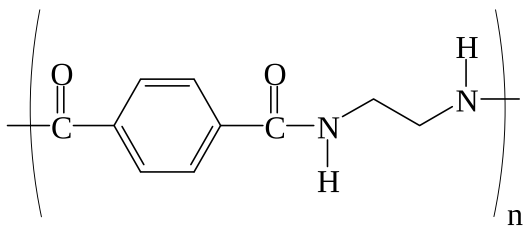
2004-J-9

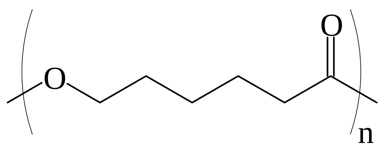
- CH_3COCl or $(CH_3CO)_2O$

  $NaHCO_3$

- 

2004-J-10

- 

  The polyamide is more stable as the ester functional group is more reactive than the amide functional group.

  The polyamide has the greater tensile strength as the benzene ring adds greater rigidity to the carbon chain back bone of the polymer and the amide group allows for the formation of hydrogen bonds between chains.

- The primary structure is the sequence of amino acids in the protein.

  The secondary structure is the formation of α-helices or β-pleated sheets due to intramolecular H-bonding.

  The tertiary structure is how the α-helices and β-pleated sheets fold together because of disulfide bridges, ionic forces, dispersion forces and hydrogen bonds to form the overall shape of the protein, eg globular.