CHEM1405 (Vet. Science) - June 2008

2008-J-2
- (a) A biological catalyst.
  (b) A non-protein part of an enzyme (eg haem group in haemoglobin) that is required for the enzymic activity.
  (c) A sequence of amino acids linked by peptide bonds (amide functional group).
- The intermolecular forces in I\(_2\) and CH\(_4\) are weak dispersion forces. Iodine is a much larger atom than H or C and hence has more electrons and a much more polarisable electron cloud, so I\(_2\) has stronger dispersion forces and higher melting point. NaCl has relatively strong ionic bonds. SiO\(_2\) is a covalent network compound with very high melting point as covalent bonds need to be broken.

2008-J-3
- The NO\(_3\)\(^-\) ion is resonance stabilised as shown.

\[
\begin{align*}
\text{N} & \equiv \text{O} \\
\text{O} & \equiv \text{N} \\
\text{O} & \equiv \text{O}
\end{align*}
\]

The bond order is 4/3 = 1.33
- The molecule has two major resonance contributors as shown.

\[
\text{H} \quad \text{N} = \text{C} \quad \Theta \quad \text{H} \quad \Theta \quad \text{N} = \text{C}
\]

As a consequence of resonance, the CN bond has partial double bond character. This causes the peptide bond to be planar with restricted rotation.

2008-J-4
- 1\(s^2\) 2\(s^2\) 2\(p^6\) 3\(s^2\) 3\(p^1\)
  \(n = 3, \, l = 1, \, m_l = 1, \, m_s = +\frac{1}{2}\)
- 1.2 \times 10^3 \text{ g mol}^{-1}

2008-J-5
- 1.03 V
- 1.51 \times 10^{35}
- 201 \text{ kJ mol}^{-1}
  Reaction is spontaneous as \(\Delta G < 0\).
- Ni(s) \mid \text{Ni}^{2+} (aq) \mid \text{Ag}^{+} (aq) \mid \text{Ag(s)}
2008-J-6
- $-128.8 \text{ kJ mol}^{-1}$
  Reaction is spontaneous as $\Delta G < 0$.
  113.7 K

2008-J-7
- Cu does not dissolve in dilute HCl because of relevant electrode potentials.
  Cu(s) $\rightarrow$ Cu$^{2+}$(aq) + 2e$^-$  $E^{\circ}_{\text{ox}} = -0.34 \text{ V}$
  $2\text{H}^+$(aq) + 2e$^-$ $\rightarrow$ H$_2$(g)  $E^{\circ}_{\text{red}} = 0 \text{ V}$
  Cu dissolves in dilute HNO$_3$ because reduction of NO$_3^-$ ion occurs.
  Cu(s) $\rightarrow$ Cu$^{2+}$(aq) + 2e$^-$  $E^{\circ}_{\text{ox}} = -0.34 \text{ V}$
  NO$_3^-$ (aq) + $4\text{H}^+$(aq) + 3e$^-$ $\rightarrow$ NO(g) + $2\text{H}_2\text{O}$  $E^{\circ}_{\text{red}} = 0.96 \text{ V}$
- $+3.7 \times 10^{34}$
  Exothermic. Increasing the temperature reduces the $K_p$, ie pushes the reaction to the left. It is therefore exothermic (from Le Chatelier's principle).

2008-J-8
- Rate = $k[\text{CO}][\text{Cl}_2]$
  $1.3 \times 10^{-2}$ L mol$^{-1}$ s$^{-1}$
  $2.2 \times 10^{-2}$ mol L$^{-1}$ s$^{-1}$

2008-J-9
- 10.26
- 4.89
- 5.09
2008-J-10

- A: NaOH or Na or NaNH$_2$ or other strong base
  - B: I$_2$
  - C: Zn / H$^+$

- Tollens' reagent, [Ag(NH$_3$)$_2$]/OH$^-$
  The first compound will cause a silver precipitate to form. No reaction with the second compound as it does not contain hemi-acetal group.

- Cr$_2$O$_7^{2-}$/H$^+$
  Orange reagent will go green with first compound. No reaction with the second compound.

- Br$_2$ solution.
  First compound will decolourise the orange/brown Br$_2$ solution. No reaction with the second compound.

- $^1$H nmr will detect different numbers of H's attached to the ring. The first compound has 3 olefinic resonances (each 1H) and 1 aliphatic resonance (2H) whilst the second compound has 4 aromatic resonances (each 1H).

- IR. The first compound will give intense absorption at about 1740 cm$^{-1}$ due to the C=O group. The second compound will have no absorption in that region.
Aromatic compound must be cyclic, planar, conjugated, and have \(4n+2\) \(\pi\) electron. NAD\(^+\) is aromatic. NADH is not.

Only NADH will react.

NAD\(^+\) will not react as the amide N is not basic and the ring N has no lone pair of electrons.

2008-J-13

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Yes. Strong H-bonding and ion-dipole forces enable the peptide-water interactions to be more stable than interactions within either substance.

Basic. Due to the side chain on lysine, there is a greater number of basic groups than acidic groups overall.