## CHEM1612 (Pharmacy) - November 2010

### 2010-N-2

- A Lewis base is a species that donates an electron pair.

  When a chemical system in a state of equilibrium is disturbed, it reattains equilibrium by undergoing a net reaction that reduces the effect of the disturbance.

  The acceleration of a reaction by the addition of a substance (the catalyst) which is in a different phase state from the reactants. Typically the catalyst is a solid which interacts with liquid or gaseous reactants and products. The solid's surface provides a different reaction pathway and increases the rate at which the reaction attains equilibrium.
- 28.83 °C

### 2010-N-3

0.16 kJ $\text{mol}^{-1}$

–136 J $\text{K}^{-1}$ $\text{mol}^{-1}$

### 2010-N-4

- 20. L

  1500 J
- 101 J $\text{K}^{-1}$ $\text{mol}^{-1}$

### 2010-N-5

- $[SO_2(g)] = 4.60 \times 10^{-3}$ M $[NO_2(g)] = 5.97 \times 10^{-4}$ M

  $[SO_3(g)] = 0.0174$ M $[NO(g)] = 0.0134$ M

### 2010-N-6

- 530
- The $K_{sp}$ of $Fe(OH)_3$ is so low, that even at pH 7.4 there are sufficient $OH^-$ ions present to precipitate the $Fe^{3+}$ ions as $Fe(OH)_3$. To avoid precipitation and to allow a higher concentration of $Fe^{3+}$ to be circulated, $Fe^{3+}$ is complexed by *transferrin* in the bloodstream and iron is stored within *ferritin* within the cell.

**2010-N-7**

- The most important buffer system in the blood is the hydrogencarbonate / carbonic acid system:

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

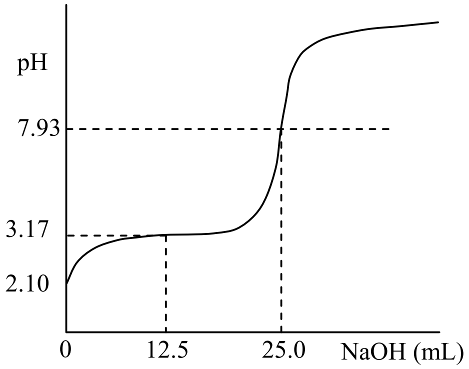
  If the amount of $H^+$ exceeds the capacity of the buffering system (*e.g.* during vigorous exercise), the lungs can help by removing $CO_2(g)$. $CO_2$ is linked to the buffer system via $H_2CO_3(aq) \rightleftharpoons H_2O + CO_2(g)$
  Thus removal of $CO_2(g)$ will shift the $HCO_3^-/H_2CO_3$ equilibrium to the right, reducing $H^+$.

  If the blood becomes too basic, the kidneys can help by excreting $HCO_3^-$. This will shift the buffer equilibrium to the left, producing more $H^+$.

- $1.7 \times 10^4$ g mol$^{-1}$

**2010-N-8**

- (i) 2.10 (2.09 if approximation used) (ii) 3.17 (iii) 7.93 (iv) 12.30



**2010-N-9**

- 31,000 years

  The very low activities of very old objects means that errors in measurement are proportionally more significant.

  Small amounts of contamination from modern organic material may have a larger proportional effect on the activity of older samples.

  Atmospheric and biosphere $^{14}C$ content may have changed slightly since very old samples were formed as the rate of production of $^{14}C$ is dependent on solar activity.

- Positrons immediately annihilate when they collide with their antiparticles (electrons) and produce 2 gamma rays that propagate in opposite directions. These are easily detected and, with the aid of computers, allow determination of the line along which the source must have been. Statistical repetition allows a 3-dimensional image to be generated.

**2010-N-10**

- A 2-dimensional self-assembled structure consisting of two layers of lipids with their non-polar (hydrophobic) tails pointing inwards and their polar (hydrophilic) heads at the interface with the solution.

  The charge an atom would have if all the electrons involved in covalent bonds were allocated to the more electronegative of the 2 atoms they are shared between.

  The process of forcing a non-spontaneous redox reaction to occur by providing sufficient energy in the form of an applied electromotive force.

- 470 minutes

- ${}^{66}_{28}\mathrm{Ni} \rightarrow {}^{66}_{29}\mathrm{Cu} + {}^{0}_{-1}\mathrm{e}$

  ${}^{72}_{34}\mathrm{Se} + {}^{0}_{-1}\mathrm{e} \rightarrow {}^{72}_{33}\mathrm{As} + \text{X-rays}$

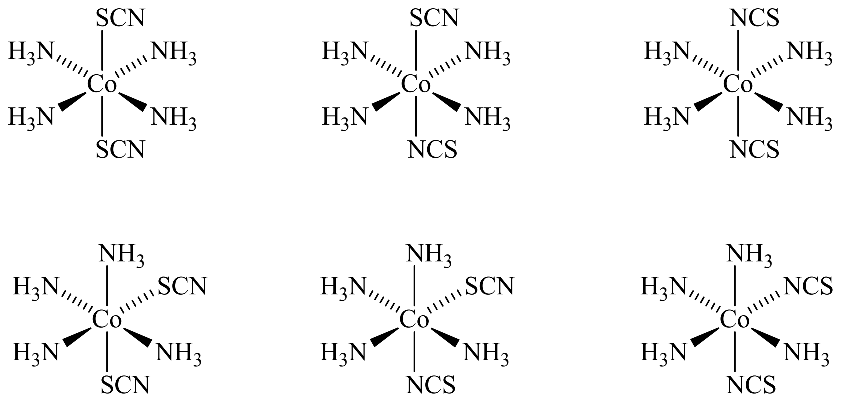
**2010-N-11**

- 368 kJ mol$^{-1}$

  No. $\Delta G°$ is positive.

**2010-N-12**

- tetraamminedithiocyanatocobalt(III) chloride



*trans*-isomers

*cis*-isomers

2 thiocyanato ligands

1 thiocyanato ligand &
1 isothiocyanato ligand

2 isothiocyanato ligands

N–H bonds are covalent in $NH_3$. These bonds are relatively short, strong and highly directional.

Co–:$NH_3$ coordination bonds are due to the donation of the lone pair of electrons on N to the $Co^{3+}$. These bonds are weaker, longer and less directional than covalent bonds.

$[Co(NH_3)_4(SCN)_2]^+$ and $Cl^-$ are ionically bonded in the solid state due to coulombic attraction between the oppositely charged ions. These bonds are strong but not directional.

**2010-N-13**

- ~ $2.0 \times 10^{-3}$ mmol $L^{-1}$ $s^{-1}$

  ~ $1.0 \times 10^{-3}$ mmol $L^{-1}$ $s^{-1}$

**2010-N-14**

first order

~2300 s

- The insoluble precipitate is actually in equilibrium with its ions, but the equilibrium lies heavily to the left.

  *e.g.* $AgCl(s) \rightleftharpoons Ag^{+}(aq) + Cl^{-}(aq)$

  When a ligand is added, the $Ag^{+}(aq)$ ions form a complex and are removed from the above equilibrium.

  *e.g.* $Ag^{+}(aq) + 2CN^{-}(aq) \rightarrow [Ag(CN)_2]^{-}(aq)$

  Due to Le Chatelier’s principle, more AgCl(s) must dissolve to try and re-establish the equilibrium and eventually all the “insoluble“ precipitate will dissolve.